Country Report

Indonesia

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 Indonesia [1), 2), 3)]

National Flag	**Country Name**	Long form : Short form :	Republic of Indonesia Indonesia
	Capital	Jakarta	
	Area (km²)	Total: Land: Inland Water:	1,910,930 1,811,570 99,360
Population			249,865,631
Population density(people/ km² of land area)			138
Population growth (annual %)			1.2
Urban population (% of total)			52
Languages		Indonesian	
Ethnic Groups		Mostly Malays (there are about 300 ethnic groups including Java and Sunda)	
Religions		Islam 88.1%, Christianity 9.3%(Protestant 6.1%, Catholic 3.2%), Hinduism 1.8%, Buddhism 0.6%, Confucianism 0.1%, Others 0.1%	
GDP (current US$) (billion)			868
GNI per capita, PPP (current international $)			9,260
GDP growth (annual %)			5.8
Agriculture, value added (% of GDP)			14
Industry, value added (% of GDP)			46
Services, etc., value added (% of GDP)			40

Brief Description

Indonesia is the largest archipelago in the world comprised of 18,110 islands, extending 5,110 km from east to west. In Indonesia and the surrounding region, several ocean plates collide with each other, and form part of the Circum-Pacific orogenic belts. For that reason, Indonesia has many volcanoes, including Krakatoa. Indonesia is the fourth most populous nation, with the world's largest Muslim population.

Indonesia is one of the founding members of ASEAN (founded on August 8, 1967), and the Headquarters of ASEAN is located in Jakarta, the capital of Indonesia. It is the most populous country in ASEAN, with approximately 40 percent of the total population of ASEAN living in the country.

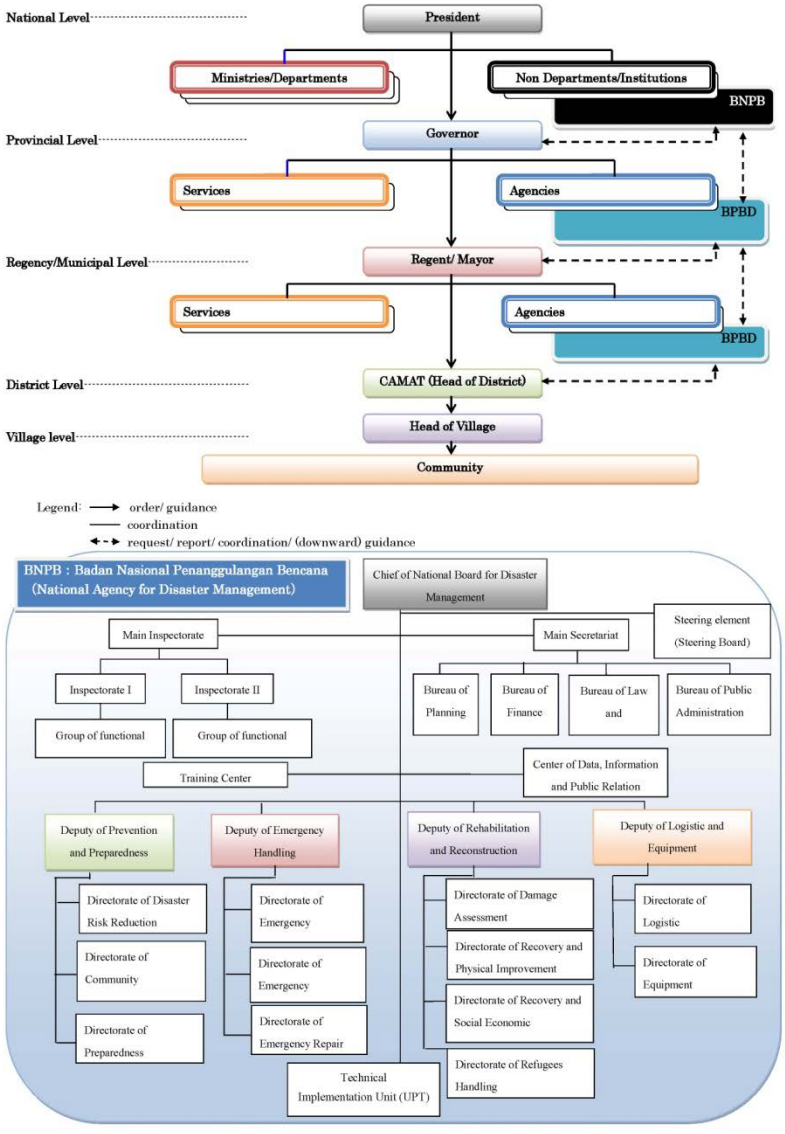
The country adopts a presidential system, and the government is classified as a republican government. The current president of Indonesia is Susilo Bamban Yudhoyono. The Yudhoyono administration identified economic development, use of natural resources, and improvement of

human resources as the country's highest priority areas. It is expected that the country will continue to promote mining and processing of resources, and the manufacturing of industrial products.

Natural Hazards

The various types of disasters such as flooding, earthquake, mass movement-wet, and volcanic eruption occurred in Indonesia. Earthquake and flood disrupted 88% of the total number of affected people. On the other hand, earthquake caused the highest number of death and significant economic losses. This is mainly due to the Sumatra Earthquake in 2004 and Java Earthquake in 2006. Flooding and earthquake will be the two major disasters that have great impact in Indonesia.

Disaster Management System [4), 5)]



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) Dr. Syamsul Maarif, Msi (date unknown): *Disaster Management in Indonesia* (Presentation Slide), p.11.
5) BNPB Website: http://www.bnpb.go.id/website/asp/content.asp?id=4 (Accessed: October 15, 2014) (BNPB's organogram was provisionally translated in English by the JICA Study Tea)

Contents

Overview of the Country

1. Introduction

This report is the first version of the Country Report for Indonesia, 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 Indonesia, 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 Kits, Version 2.
2. AHA Centre and JICA (2015): The Country Reports; Brunei, Cambodia, Laos, Malaysia, Myanmar, the Philippines, Thailand, 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] AHA Centre and JICA (2015), Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region, , 2013 to 2015.

2. Natural Disaster Risks

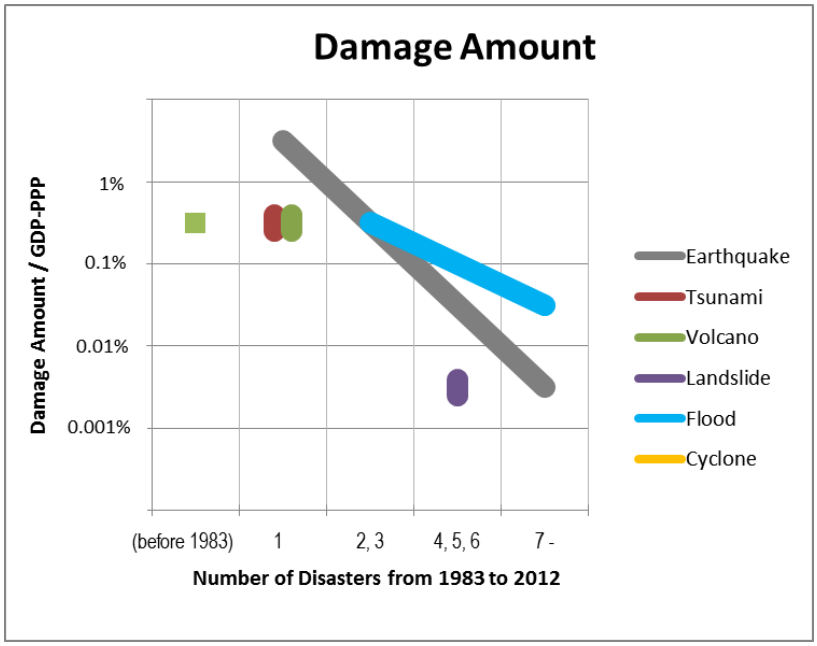
2.1 Predominant Hazards

Major natural hazards, namely floods, earthquakes, tsunamis, volcanoes, cyclones and landslides have been recorded in Indonesia. Tsunamis caused the largest impact in terms of the number of deaths. The largest amount of damage was caused by the 2004 Indian Ocean Tsunami. In addition, a further 7 tsunamis have caused more than 1000 deaths since the 17th century. The number of deaths caused by the earthquakes is less than that of tsunamis however they occur frequently. 7 earthquakes caused more than 1000 deaths since the beginning of the 19th century. The number of deaths from a single flood is less than that of tsunamis or earthquakes, however they occur more frequently. The amount of damage caused by floods is larger than that of earthquakes as these events occur every several years. The impacts of volcanoes and cyclones have been small in the last 30 years but events with more than 1000 deaths were recorded before 1983.

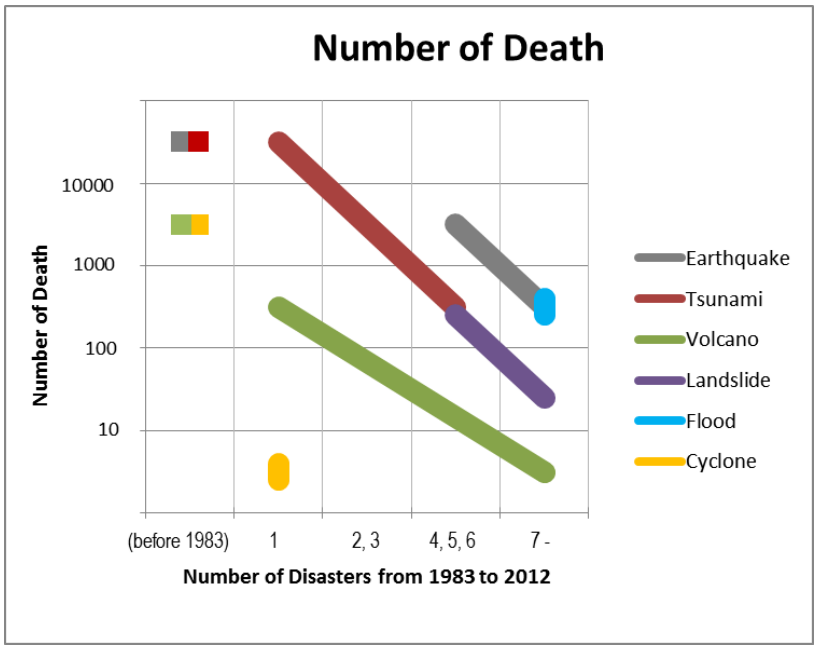
The records of natural disasters that have affected Indonesia are classified based on the impact and frequency of occurrence in Figure 2.1. Both "damage amount" and "number of deaths" are used to express the impact, and "number of disasters occurred between 1983 and 2012" is used to represent the frequency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

Figure 2.1 can be used to see the relative level of risk of natural hazards in Indonesia 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 Indonesia 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 Indonesia

2.2 Flood

Risks

Locations of flood disasters in Indonesia are shown in Figure 2.2. Size of circles represents the scale of the disasters in terms of human losses and economic losses.

There is a high frequency of floods in Indonesia. Java Island has the highest frequency, followed by Sumatra Island and Sulawesi Island, but Kalimantan Island has a low frequency.

Hot spots are of flood disasters include:

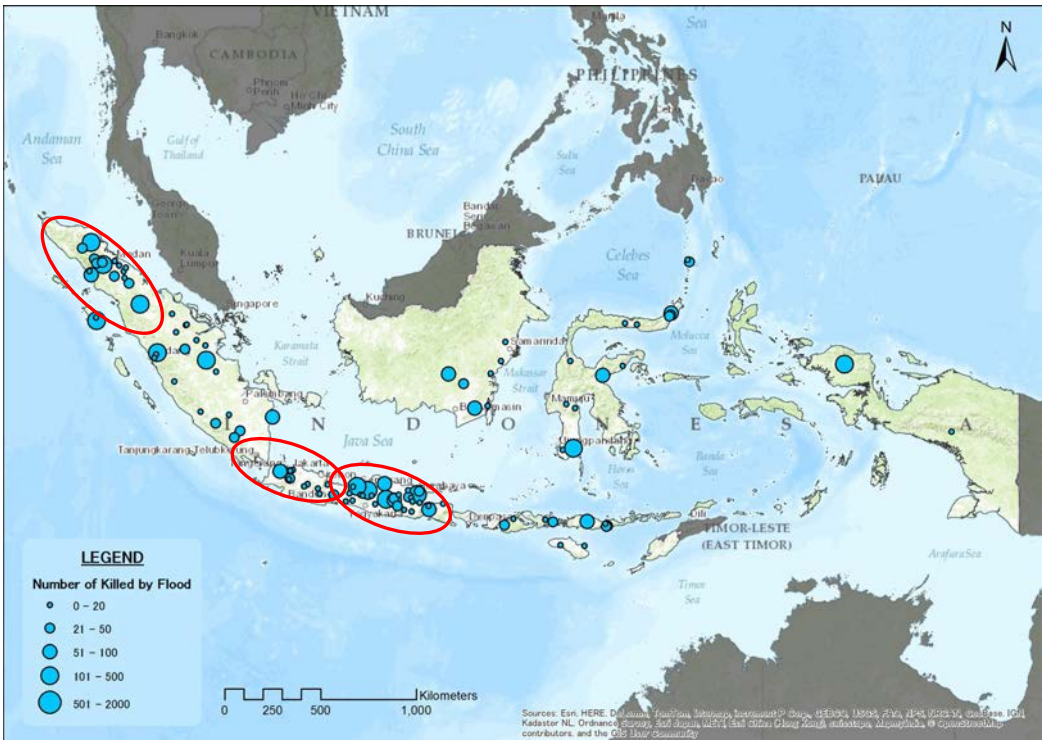
- Java Island: Banten Province, Jakarta Special Capital Region, West Java Province, Central Java Province, East Java Province
- Sumatra island: Ache Province, North Sumatra Province

Recent flood disasters are:

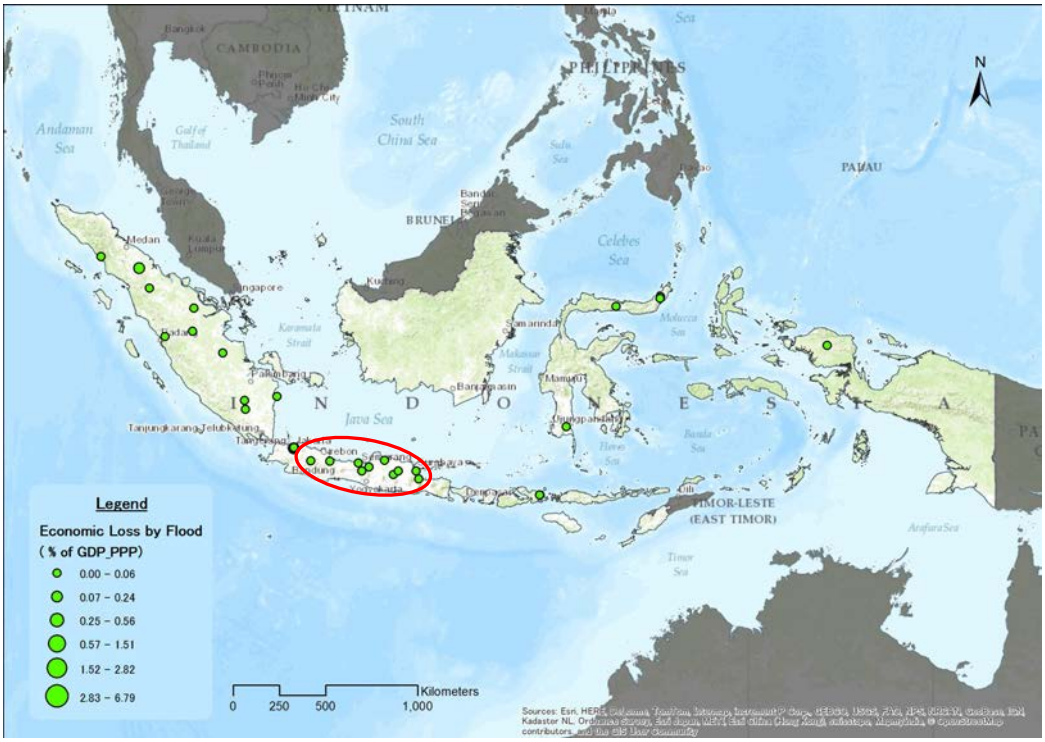
- The flood on February 5, 2007 caused by rainfall in the amount of over 150 mm beginning January 23 in the southern part of Jakarta caused damages including 60 fatalities. Approximately 220,000 people in Jakarta, Tangeran, and Bekasi were affected. It also caused damage to Japanese-owned businesses in Jakarta.
- The flash flood on March 27, 2009 was caused by the collapse of the Situ Gintung Dam, where the water level was raised by prolonged rainfalls. A flash flood occurred before dawn on March 27, causing severe damages in the settlements of Cirendeu and Ciputat downstream, leaving 100 people dead or missing.

The flood on January 15, 2013 was caused by storm rainfalls and lasted until January 25 due to intermittent storm rainfalls, causing damage in Jakarta and its surrounding area. The flood waters were deeper than 2 meters in the coastal area, which paralyzed transportation, blocked infrastructure, and greatly impacted the livelihood of citizens. The damages included 40 fatalities, and 40,000 people affected. The Jakarta Industrial Estate Pulogadung in east Jakarta was submerged, with operations stopped due to the stoppage of the electric power supply. At the industrial estate in

west Java, some auto industries suspended operations as the disruption of the supply chain stopped the supply of parts.



(a) Human Losses



(b)Economic Losses (% of GDP)

: 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 Indonesia

Background

In Indonesia floods are caused by storm rainfalls occurred in the rainy season from January to February. Heavy rainfalls in the mountain area cause floods in the plains downstream. Many floods have occurred due to the east-west monsoons in the rainy season (January to February). Heavy rainfalls in the mountainous region cause floods in the plain and extensive damage in swamps and coastal low-lying areas. Urban areas become inundated because of an insufficient drainage system and poor maintenance work. Land subsidence is common in coastal towns due to groundwater use by industries, etc., and due to an increase in ponding.

Sources of Hazard and Risk Information

Table 2.1 Sources of Hazard and Risk Information: Flood

Badan Nasional Penanggulangan Bencana, National Disaster Management Agency (BNPB)
http://www.bnpb.go.id/
Regional Disaster Management Agency(BPBD) DKI Jakarta
http://bpbd.jakarta.go.id/
Regional Disaster Management Agency (BPBD) Java Tengah
http://bpbdjateng.info/
Regional Disaster Management Agency (BPBD) Java Barat
http://bpbd.jabarprov.go.id/
Badan Meteorologi, Klimatologi, dan Geofisika (BMKG)
http://www.bmkg.go.id/BMKG_Pusat/Depan.bmkg
Lembaga Ilmu Pengetahuan Indonesia Indonesian Institute of Sciences (LIPI)
http://www.lipi.go.id/www.cgi?depan&&&&&eng
Institut Teknologi Bandung (ITB)
http://www.itb.ac.id/en/
ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management(AHA Centre)
http://www.ahacentre.org/

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 2.3. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.2.

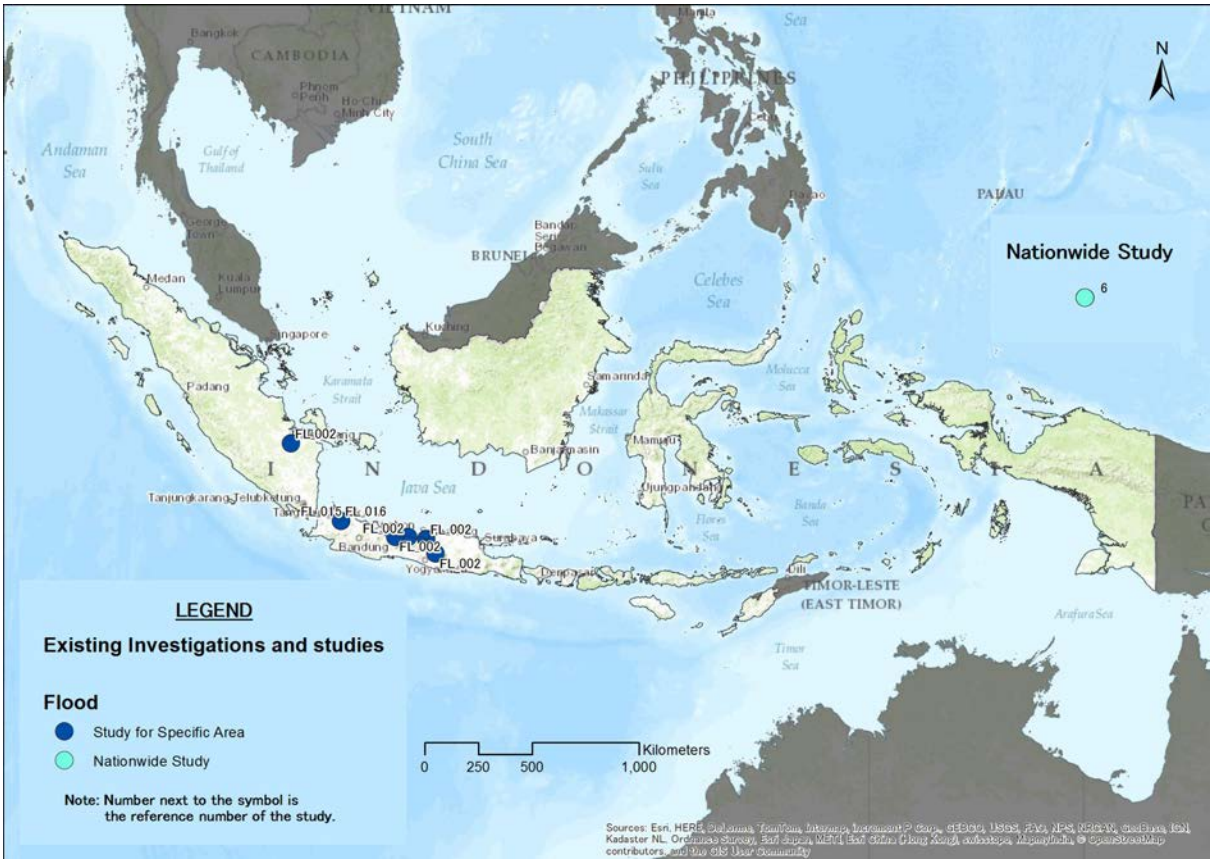


Figure 2.3 Locations of Existing Investigations and Studies: Flood

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.
Indonesia	The analytical work for Indonesia leans toward the Jakarta region. Both highly technical analysis using hydrologic models as well as community interview methods have been used to assess hazards and risks.

References for Data and Further Reading

1) Ministry of Foreign Affairs of Japan (2013): "Information on Indonesia in Japanese", 06 2013
2) Asian Disaster Preparedness Center (2011) Program for Hydro-Meteorological Disaster Mitigation in Secondary Cities in Asia (PROMISE) 2005 to 2010: Bangkok
3) ADRC: "Countries: Indonesia", Information on Disaster Risk Reduction of the Member
4) ADRC: "Indonesia, Flood, 2007/02/03"
5) ADRC: "Indonesia, Flash Flood, 2009/03/27". Details of Disaster Information
6) ADRC(2009):"Indonesian Flood, 2013/01/15," Details Disaster Information.
7) Arief Anshory Yusuf & Herminia Francisco (2009). Climate Change Vulnerability Mapping for Southeast Asia, Singapore: EEPSEA
8) BBC NEWS (2007b): "Disease fears amid Jakarta floods," 5 February 2007
9) BBC NEWS (2007a): "Jakarta floods death toll rises", 4 February 2007
10) BBC NEWS (2007): "In pictures: Jakarta flooding," Sunday, 4 February 2007
11) Brinkman, JanJaap et al (2009) Jakarta Flood Hazard Mapping Framework: Jakarta
12) CNN NEWS (2009): "Suburban 'tsunami' kills 98 in Jakarta," March 29, 2009
13) Global Voices: Indonesia: ""Mini-Tsunami" hits village as dam collapses Posted," 30 March 2009
14) Relief Web, OCHA (2007d): "ACT Rapid Response for floods in Jakarta, Indonesia," Rapid Response Payment No.03/2007,09 Feb 2007
15) Relief Web, OCHA (2007e): "Indonesia: Jakarta flood victims could face more rain, illness," Report from Caritas, 16 Feb 2007

16) Relief Web, OCHA (2007f): "Major Natural Disaster in Indonesia During 2007," Map from UN Office for the Coordination of Humanitarian Affairs, 31 Dec 2007.
17) Relief Web, OCHA (2007c): "Jakarta, Indonesia, Area affected by Flooding," Map from UN Office for the Coordination of Humanitarian Affairs, as of 13 Feb 2007
18) Relief Web, OCHA (2007a): "DKI Jakarta Province, Indonesia, Location of Persons Displaced by Flooding," Map from UN Office for the Coordination of Humanitarian Affairs, as of 7 Feb 2007
19) Relief Web, OCHA (2007b): "Indonesia, Flood Information Product - Jakarta Overview Derived from Radarsat-1," Map from MDA Geospatial Services, 7 Feb 2007
20) Relief Web, OCHA (2013c): Report from UN Office for the Coordination of Humanitarian Affairs, 22 Jan 2013
21) Relief Web, OCHA (2013b): "Assistance to Jakarta flood victims delayed floods in Jakarta and its greater area - Situation Report No. 03," Report from IRIN, 21 Jan 2013
22) Relief Web, OCHA (2013d): "Indonesia, Floods in Jakarta and its greater area," Situation Report No. 04/2013, as of 25 January 2013
23) Relief Web, OCHA (2013a): "Indonesia: Jakarta Flood," Map from UN Office for the Coordination of Humanitarian Affairs, 17 Jan 2013
24) Velasquez, Jerry et al (ed.) (2012). Reducing vulnerability and exposure to disasters: Asia-Pacific disaster report 2012, ESCAP/UNISDR AP
25) 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
26) World Bank, UNISDR (2010). Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment

2.3 Earthquake

Risks

Locations of earthquake disasters in Indonesia are shown in Figure 2.4. Size of circles represents the scale of the disasters in terms of human losses and economic losses.

Since 1797, 24 earthquakes with magnitude of 8 or more have been recorded in and around Indonesia. The 2004 Indian Ocean Earthquake (M9.1) was the largest.

More than 1,000 people were killed in 7 of those earthquakes. Additionally, 10,000 people were killed by the earthquakes that occurred in 1815 and 1917 in Bali.

The earthquakes that greatly impacted the Indonesian economy were the 2004 Indian Ocean Earthquake (M9.1), the 2006 Central Java Earthquake, and the 2009 Sumatra Earthquake (M7.5).

Total losses caused by the 2004 Indian Ocean Earthquake (M9.1) were USD 10 billion (1.5% of GDP). The 2006 Central Java Earthquake (M6.3) was not so large in magnitude, but more than 5 thousand people were killed, with loss totaling USD 3.1 billion (0.40% of GDP). The 2009 Sumatra Earthquake (M7.5) caused the deaths of more than 1,000 people and USD2.2 billion in losses (0.23% of GDP).

Background

The south end of the Eurasian Plate where the Indonesian Archipelago is located forms complex plate boundaries with the subducting Indo-Australian Plate and the surging Pacific Plate and Philippine Sea Plate (See Figure 2.5). This causes many earthquakes around the area.

Many large earthquakes occur along the Sunda (Java) Trench where the Indo-Australian Plate subducts under the Indonesian Archipelago, as seen in the 2004 Indian Ocean Earthquake (M9.1) (See Figure 2.4).

Figure 2.6 is the Earthquake Risk Map developed by the insurance company, PT. Asuransi MAIPARK Indonesia. The map illustrates that the Sunda Trench sides of Sumatra and Java and the Pacific Ocean sides of New Guinea and Sulawesi have a high earthquake risk. On the other hand, the Java Sea and the Banda Sea sides have

a low earthquake risk. The earthquake risk of Kalimantan is especially lower than other areas.

Responses by Indonesia

Disaster Management Information

The Geology Research Development Centre (GRDC) has developed active fault maps for Mt. Merapi and Mt. Krakatoa, and a seismotectonic map of Manado.

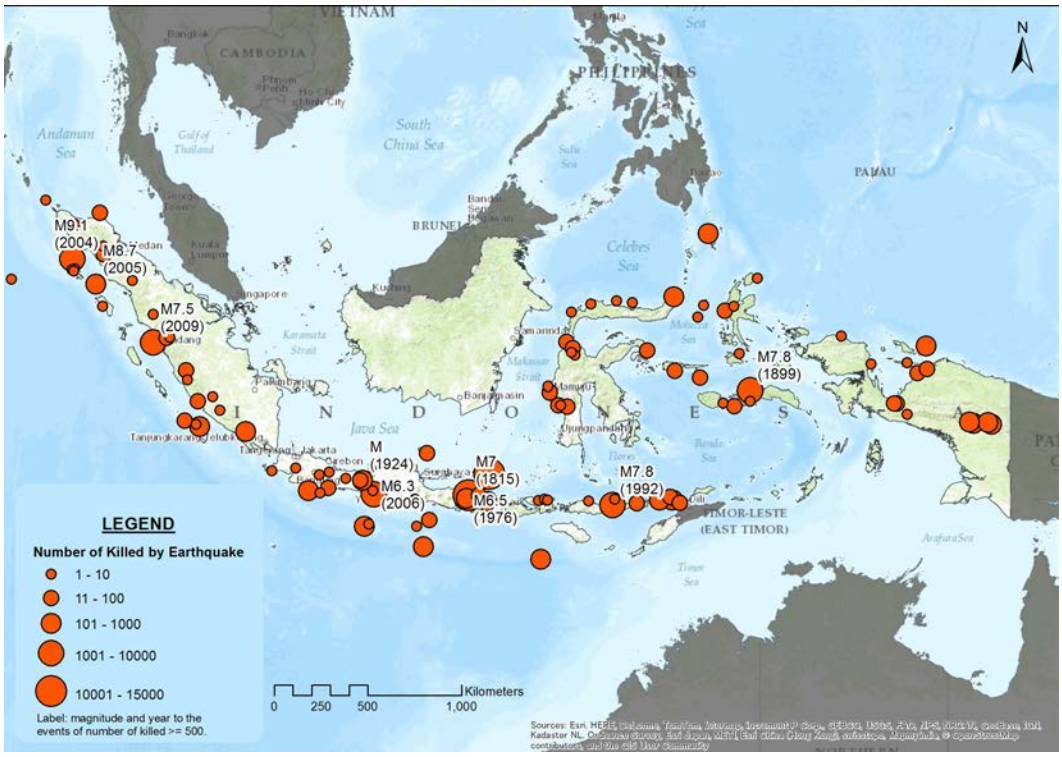
For Aceh Province, TDMRC (Tsunami & Disaster Mitigation Research Center, Syiah Kuala University) has developed risk maps.

The National Agency for Disaster Management (BNPB) has developed two databases called GEOSPASIAL and DIBI (Data dan Informasi Bencana Indonesia), which are posted on their website. GEOSPASIAL is a Web-GIS database system that displays: (1) disaster/damage information caused by disasters occurring within 30 days, (2) various types of hazard maps, and (3) administrative boundaries on maps. DIBI is a database that stores information on historical disaster events in Indonesia. After a disaster has occurred, BNPB collects disaster information from the national government, local governments, NGOs, universities, etc., and enters the information into the database. The DIBI has accumulated data on disasters since 1815.

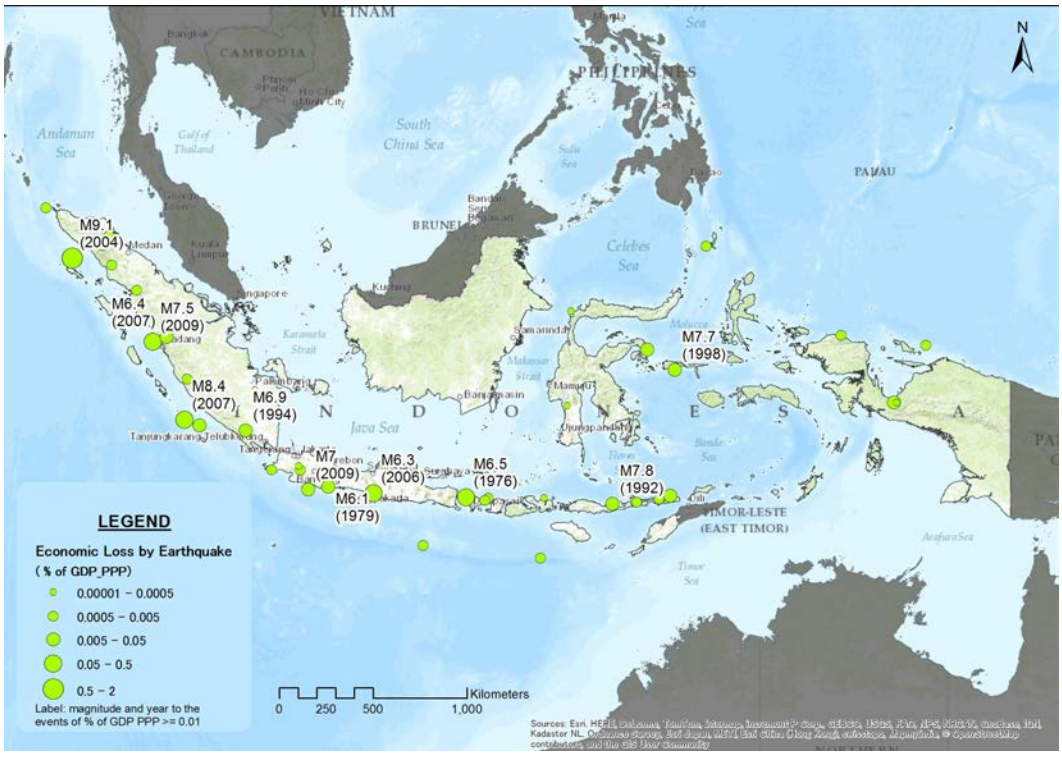
Early Warning and Information Transmission

The Meteorological, Climatological and Geophysical Agency (BMKG) prepares Seismic Intensity Maps in measured in Modified Mercalli Intensity after earthquakes and posts them on their website.

BMKG also operates the InaTEWS (Indonesia Tsunami Early Warning System), which manages the observation, analysis, evaluation, and transmission of information for earthquakes and tsunamis. Data is transmitted to the InaTEWS from more than 300 BMKG seismographs, GPS and tide-gauges from the Geospatial Information Agency (BIG), and tsunami buoys of Agency for the Assessment and Application of Technology (BPPT).



(a) Human Losses



(b) Economic Losses (% of GDP)

Data Sources:

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

National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA): http://ngdc.noaa.gov/hazard/hazards.shtml

Figure 2.4 Locations of Earthquake Disasters in Indonesia

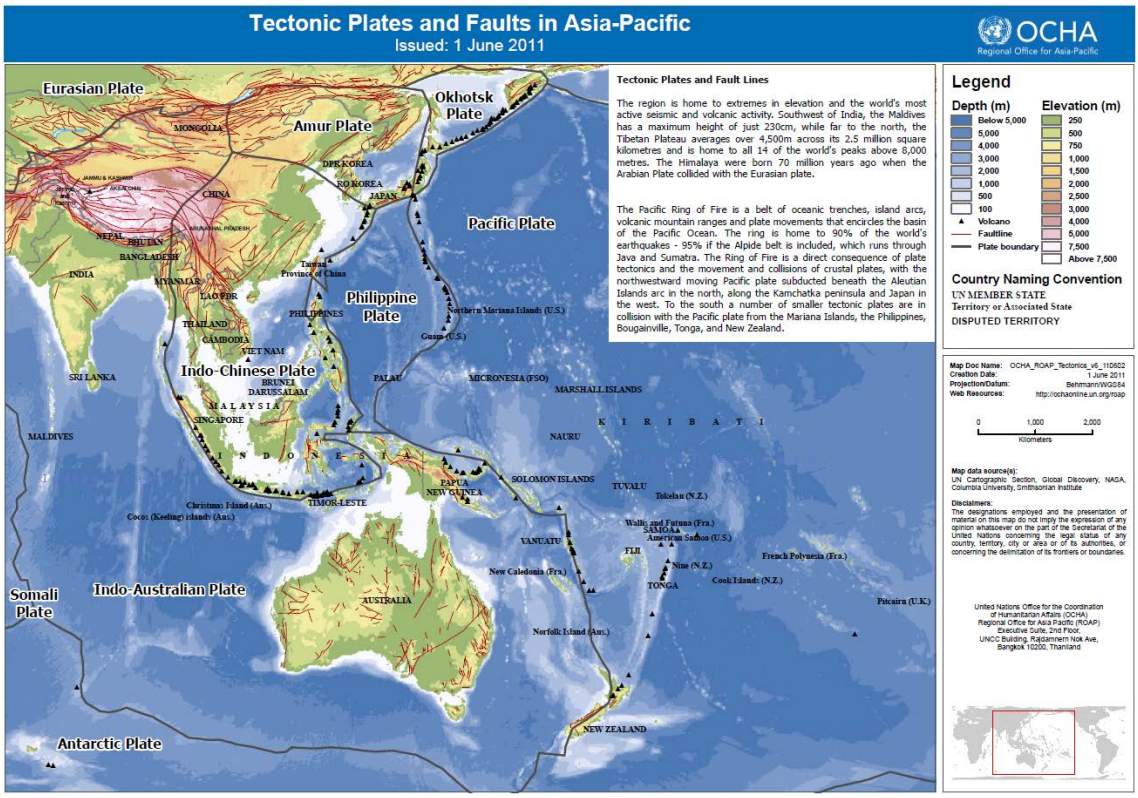
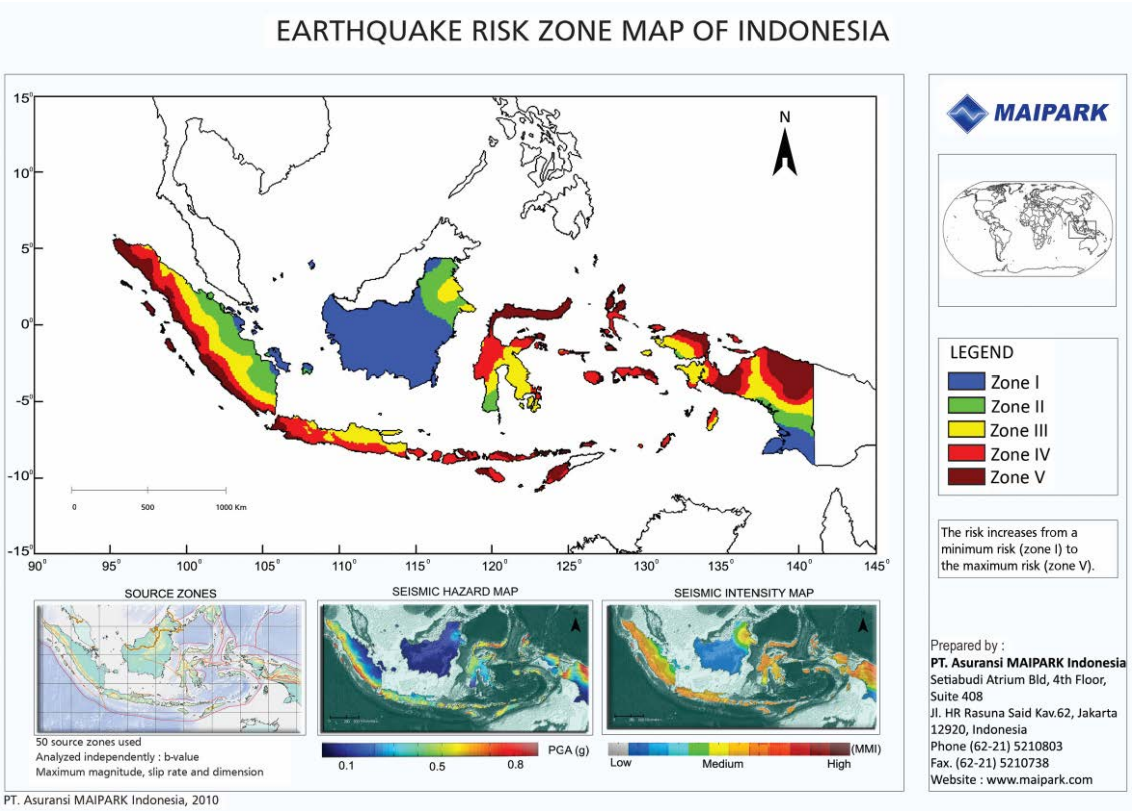


Figure 2.5 Tectonic Plates and Faults in Asia-Pacific



Source:http://www.maipark.com/download/File/other/MAIPARK%20EQ%20Zone%202010.pdf

Figure 2.6 Earthquake Risk Zone Map of Indonesia (MAIPARK 2010)

Sources of Hazard and Risk Information

Table 2.3 Sources of Hazard and Risk Information: Earthquake

Badan Nasional Penanggulangan Bencana (BNPB) **National Agency for Disaster Management**
http://www.bnpb.go.id/
GEOSPASIAL
http://geospasial.bnpb.go.id/
Data dan Informasi Bencana Indonesia (DIBI) **Indonesian Disaster Information and Data**
http://dibi.bnpb.go.id/DesInventar/dashboard.jsp?lang=ID
Badan Meteorologi, Klimatologi, dan Geofisika (BMKG) **Meteorological, Climatological and Geophysical Agency**
http://www.bmkg.go.id/BMKG_Pusat/Depan.bmkg
Indonesia Tsunami Early Warning System (InaTEWS)
http://inatews.bmkg.go.id/new/
Badan Informasi Geospasial (BIG) **Geospatial Information Agency**
http://www.bakosurtanal.go.id/
Badan Penanggulangan Bencana Aceh (BPBA) **Aceh Disaster Management Agency**
http://bpba.acehprov.go.id/
Tsunami and Disaster Mitigation Research Center (TDMRC), Syiah Kuala University
http://www.tdmrc.org/en/
Badan Geologi
http://www.bgl.esdm.go.id/
Pusat Vulkanologi dan Mitigasi Bencana Geologi (PVMBG) **Center for Volcanology and Geological Hazard Mitigation**
http://www.vsi.esdm.go.id/static_content.php?id_kategori=1

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 earthquakes 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.

Figure 2.7 Locations of Existing Investigations and Studies: Earthquake

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.

Indonesia	Many organizations executed earthquake hazard-related investigations and studies for Indonesia. There is a zoning map for earthquake insurance in this country. BNPB publishes seismic intensity maps and related damage information for the earthquakes that have occurred since 2009. However, descriptions are written in Indonesian, limiting users.

References for Data and Further Reading

1) BAPPENAS, the Provincial and Local Governments of D.I. Yogyakarta, the Provincial and Local Governments of Central Java, and international partners, (2006). Preliminary Damage and Loss Assessment: Yogyakarta and Central Java Natural Disaster: The 15th Meeting of The Consultative Group on Indonesia Jakarta, June 14, 2006
2) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
3) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"
4) Mark Petersen et al. (2007). , Documentation for the Southeast Asia Seismic Hazard Maps, USGS
5) OCHA-ROAP (2011). Indonesia: Natural Hazard Risks
6) PT. Asuransi MAIPARK (2010). Earthquake Risk Zone Map of Indonesia
7) United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Regional Office for Asia Pacific (ROAP) (2011): "Tectonic Plates and Faults in Asia-Pacific", Downloaded from http://reliefweb.int/sites/reliefweb.int/files/resources/OCHA_ROAP_Tectonics_v6_110602.pdf
8) USGS (2009). Seismic Hazard of Western Indonesia

2.4 Tsunami

Risks

Locations of earthquake disasters in Indonesia are shown in Figure 2.8. Size of circles represents the scale of the disasters in terms of human losses and economic losses.

The 2004 Indian Ocean Earthquake (M9.1) and its tsunami affected 500,000 people, with 170,000 dead or missing, and USD 4.45 billion in losses (0.68% of GDP). The 2006 Java Earthquake (M7.7) caused 800 deaths and USD 55 million in losses (0.007% of GDP).

More than 1,000 people were also killed by the 1674 Seram Earthquake (M6.8), the 1815 Bali Earthquake (M7.0), the 1861 Sumatra Earthquake (M8.5), the 1899 Seram Earthquake (M7.8), and the 1992 Flores Earthquake (M7.8). Moreover, the volcanic eruption of Mt. Krakatoa in 1883 caused a tsunami that killed more 30,000 people.

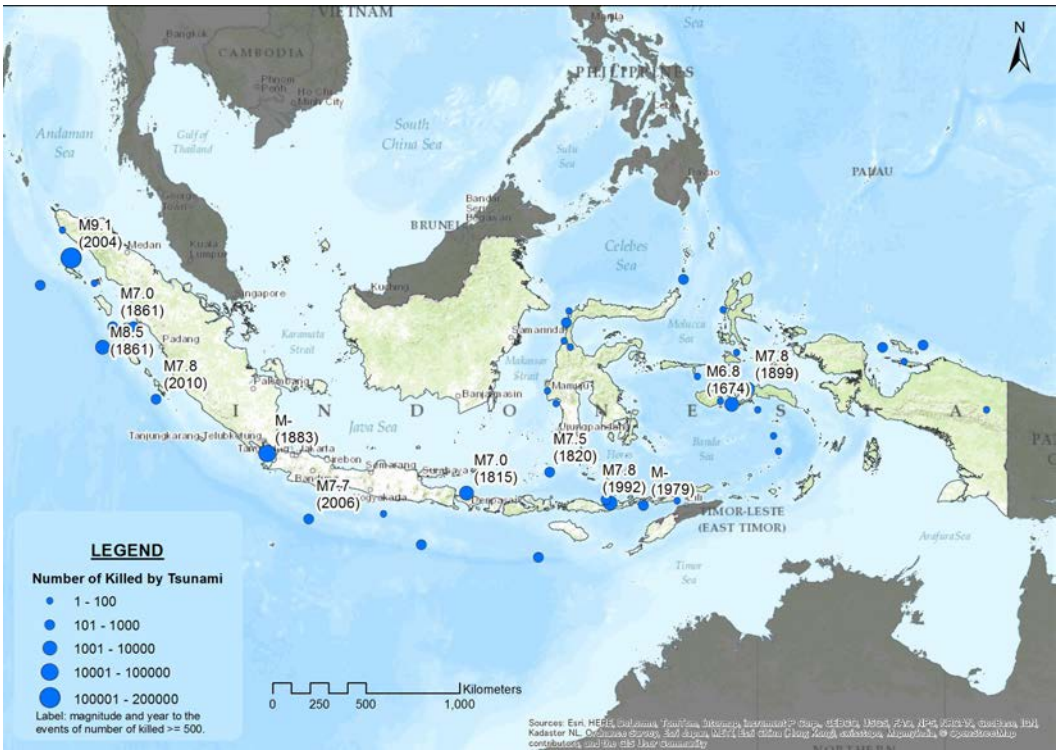
In Indonesia, which is surrounded by ocean and experiences many earthquakes, tsunami is one of the most catastrophic risks and attention should be paid to it.

Background

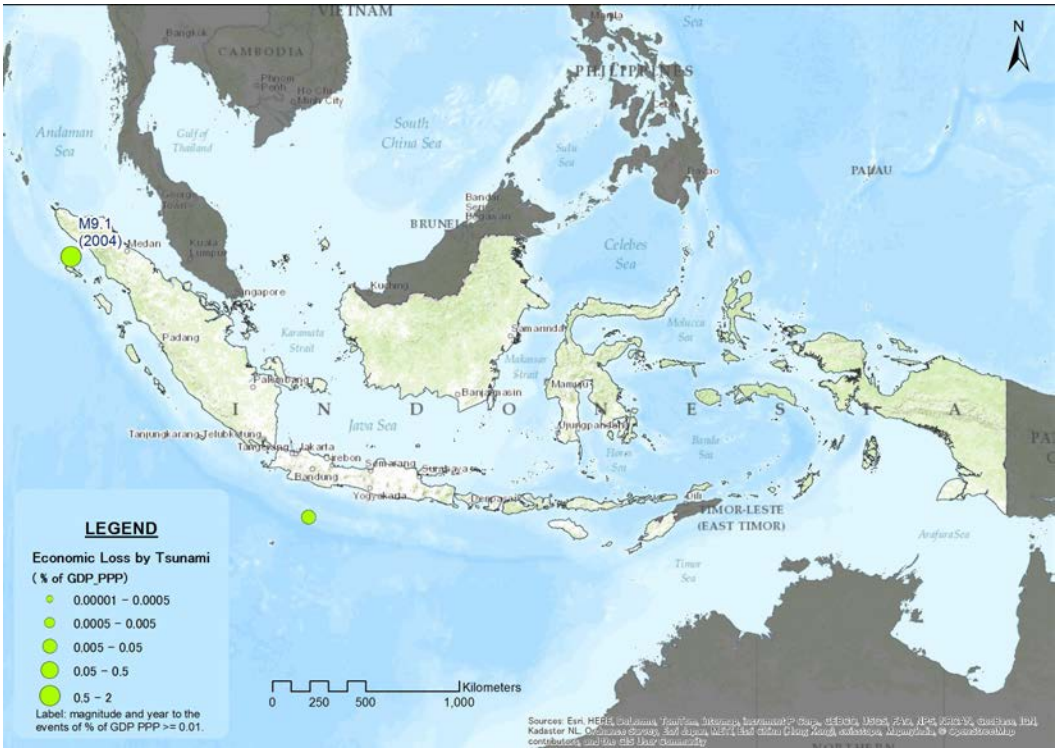
It is well known that tsunamis are generated by sea floor earthquakes. However, an undersea volcanic eruption, an undersea landslide, or other disturbances above or below water can also generate a tsunami.

Figure 2.9 is the Tsunami Disaster Risk Map of Indonesia developed by the National Agency for Disaster Management (BNPB). It illustrates that the coasts of Sumatra and Java along the Sunda Trench, the coasts of Lesser Sunda, Sulawesi, and Moluccas, and the east coast of Kalimantan have tsunami risk.

Moreover, the Tsunami Hazard Map, developed by the Volcanic Tsunami Working Group (called “Firewaves”), shows that the coast of Sumatra along the Sunda Trench, the coast along the Cenderawasih Bay of New Guinea and the coast of Seram along the Banda Sea have especially high tsunami risk. (See Figure 2.10)



(a) Human Losses



(b) Economic Losses (% of GDP)

Data Sources:

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

National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA): http://ngdc.noaa.gov/hazard/hazards.shtml

Figure 2.8 Locations of Tsunami Disaster in Indonesia

Figure 2.9 Threat of Tsunami Disaster in Indonesia by BNPB

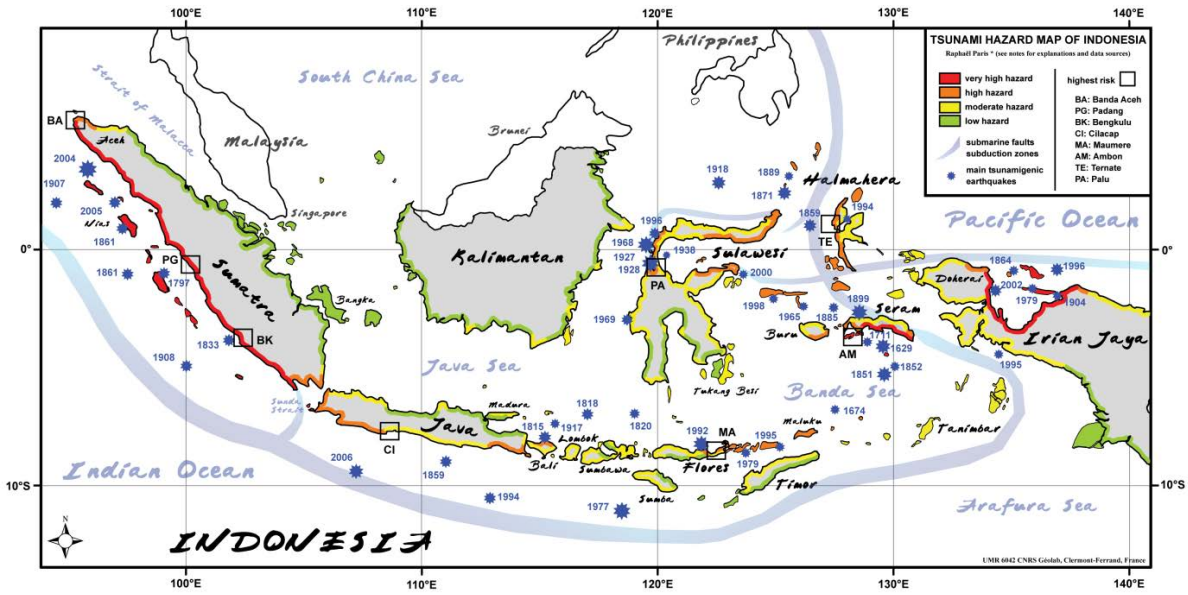


Figure 2.10 Tsunami Hazard Map of Indonesia

Responses by Indonesia

Disaster Management Information

Geospatial Information Agency (BIG) developed multi-hazard maps for flooding and tsunami, which are posted on their website.

Geology Research Development Centre (GRDC) developed tsunami hazard maps of Sulawesi, Barat, Gorontalo, and Aceh in 2012, and is currently developing tsunami hazard maps of Sulawesi Utara and Sulawesi Selatan.

The National Agency for Disaster Management (BNPB) has set up two database systems named "GEOSPASIAL" and "DIBI," which are posted on their website. GEOSPASIAL is a Web-GIS database system that displays: (1) disaster/damage information caused by disasters occurring within 30 days, (2) various types of hazard maps, and (3) administrative boundaries on maps. DIBI is a database that stores information on historical disasters in Indonesia after 1815 collected by the national government, local governments, NGOs, universities, etc.

Early Warning and Transmitting Information

The Meteorological, Climatological and Geophysical Agency (BMKG) operates the InaTEWS (Indonesia Tsunami Early Warning System), which is an integrated system composed of seismic and tsunami observations, analysis, evaluation, and dissemination. All data recoded by more than 300 seismometers managed by BMKG, GPS and tide gauges managed by BIG, and tsunami buoys managed by Agency for the Assessment and Application of Technology (BPPT) are transmitted to InaTEWS.

The tsunami early warning consists of the following 3 ranks, "Red (Major Warning): Tsunami height > 3 meters", "Orange (Warning): Tsunami height 0.5-3 meters", and "Yellow (Advisory): Tsunami height < 0.5 meters." The InaTEWS provides early warning on tsunami that may impact Indonesia to disaster management agencies, local governments, mass media, etc. within 5 minutes after an earthquake occurs.

Early warning to the public is disseminated through sirens, television, radio, SMS, FM Radio Data System (FMRDS) alerts receiver, speakers, police sirens, social media (Facebook, Twitter), etc. Twenty-four (24) tsunami sirens are installed in six provinces.

Preparedness and Education

For Aceh Province, the Tsunami & Disaster Mitigation Research Center (TDMRC) of Syiah Kuala University has developed many kinds of risk maps. TDMRC has also published educational materials on tsunami disaster prevention. The database, called DIBA (Data dan Informasi Bencana Aceh), includes all of the disasters that have occurred in Aceh Province and is posted on their website. The Aceh Tsunami Museum can be used as a tsunami evacuation building. The four evacuation buildings constructed by a grant aid project in Aceh Province can accommodate 6,000 people.

The Ministry of National Education of Indonesia has established a curriculum for primary and secondary school students regarding disaster management for six major hazards: earthquake, tsunami, volcano, flood, landslide and typhoon/cyclone.

Sources of Hazard and Risk Information

Table 2.5 Sources of Hazard and Risk Information: Tsunami

Badan Nasional Penanggulangan Bencana (BNPB) **National Agency for Disaster Management**
http://www.bnpb.go.id/
GEOSPASIAL
http://geospasial.bnpb.go.id/
Data dan Informasi Bencana Indonesia (DIBI) **Indonesian Disaster Information and Data**
http://dibi.bnpb.go.id/DesInventar/dashboard.jsp?lang=ID
Badan Meteorologi, Klimatologi, dan Geofisika (BMKG) **Meteorological, Climatological and Geophysical Agency**
http://www.bmkg.go.id/BMKG_Pusat/Depan.bmkg
Indonesia Tsunami Early Warning System (InaTEWS)
http://inatews.bmkg.go.id/new/
Badan Informasi Geospasial (BIG) **Geospatial Information Agency**
http://www.bakosurtanal.go.id/
Badan Penanggulangan Bencana Aceh (BPBA) **Aceh Disaster Management Agency**
http://bpba.acehprov.go.id/
Tsunami and Disaster Mitigation Research Center (TDMRC), Syiah Kuala University

http://www.tdmrc.org/en/
Badan Geologi
http://www.bgl.esdm.go.id/
Pusat Vulkanologi dan Mitigasi Bencana Geologi (PVMBG) **Center for Volcanology and Geological Hazard Mitigation**
http://www.vsi.esdm.go.id/static_content.php?id_kategori=1

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 2.11. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.6.

Figure 2.11 Locations of Existing Investigations and Studies: Tsunami

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.
Indonesia	There are some materials summarizing tsunami hazards. There is a report of tsunami disaster on May 27, 2006 that affected Jogjakarta and the surrounding area. BNPB publishes damage information for tsunamis caused by earthquakes that have occurred since 2010. However, descriptions are made in Indonesian, limiting users.

References for Data and Further Reading

1) ADB (2005). From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami
2) BAPPENAS, the Provincial and Local Governments of D.I. Yogyakarta, the Provincial and Local Governments of Central Java, and international partners, (2006). Preliminary Damage and Loss Assessment: Yogyakarta and Central Java Natural Disaster: The 15th Meeting of The Consultative Group on Indonesia Jakarta, June 14, 2006
3) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"
4) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
5) Volcanic Tsunami Working Group, Firewaves:
"Tsunami Hazard map of Indonesia", Downloaded from
"http://raphael.paris.pagesperso-orange.fr/database/indonesia_tsunami.jpg"

2.5 Volcanoes

Risks

Locations of earthquake disasters in Indonesia are shown in Figure 2.12. Size of triangle symbols represents the scale of the disasters in terms of human losses and economic losses.

The volcanic eruption of Mt. Tambora in 1815 was the largest eruption in the history of Indonesia caused more than 10,000 deaths. The eruption of Mt. Krakatoa in 1883 was the second largest eruption in history inducing a large landslide, which in turn caused a devastating tsunami.

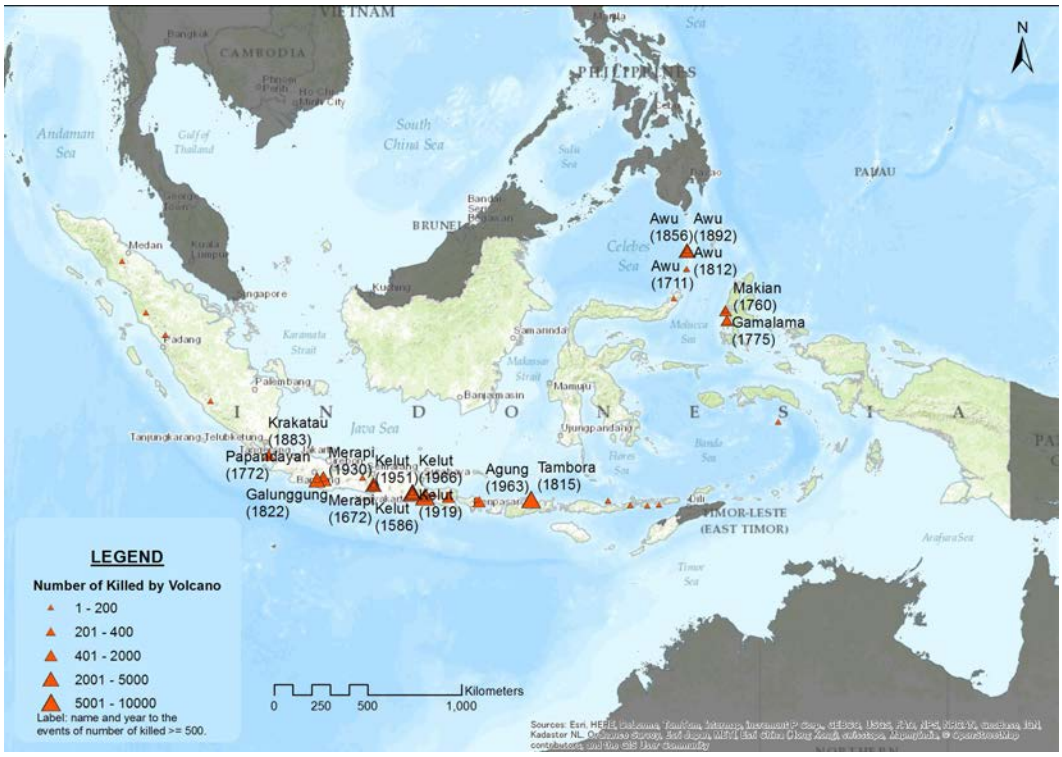
There are many volcanoes including Mt. Merapi, Mt. Kelute, Mt. Awe and Mt. Sumeru, which had erupted many times in throughout history and are still active. Mt. Merapi is especially active and has erupted five times in the past 20 years (1994, 1997, 1998, 2006, and 2010). 322 people were killed by the eruption in 2010. The eruptions of Mt. Kelute in 1586, 1909, 1919, and 1966 caused several thousands of deaths and the latest eruption in 1990 also caused 10~20 deaths.

In terms of economic impact, the following losses caused by the eruptions were recorded: USD 160 million (0.12% of GDP) with the eruption of Mt. Galunggung in 1982, USD 150 million (0.10% of GDP) with the eruption of Mt. Gamalama in 1983, and USD 25 million (0.02% of GDP) with the eruption of Mt. Colo in 1983.

Background

There are about 150 volcanoes in Indonesia and 80 of them are active volcanoes. Historical records show up to 1,200 eruptions. Figure 2.13 shows volcanoes that erupted after 1900 A.D. Most of the volcanoes are located in Sumatra, Java, Lesser Sunda, the north part of Sulawesi and Moluccas.

Figure 2.14 shows the volcanoes in Asia-Pacific region that have erupted during the Holocene. The Holocene is a geological epoch from 10,000 years ago to the present. The map indicates that Indonesia is one of the areas where volcanoes have erupted most actively.



(a) Human Losses

(b) Economic Losses (% of GDP)

Data Sources:

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

National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA): http://ngdc.noaa.gov/hazard/hazards.shtml

Figure 2.12 Locations of Volcanic Disasters in Indonesia

Figure 2.13 Major Volcanoes of Indonesia

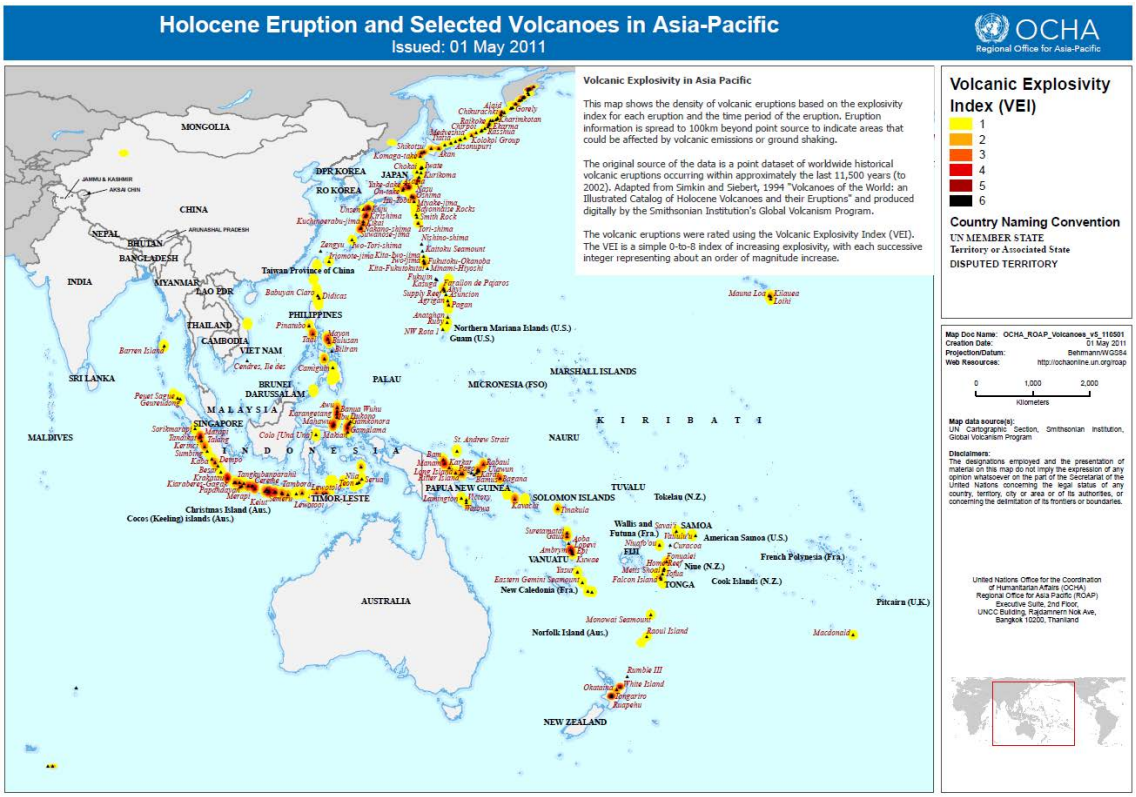


Figure 2.14 Holocene Eruption and Selected Volcanoes in Asia-Pacific

Responses by Indonesia

Disaster Management Information

The National Agency for Disaster Management (BNPB) has set up two database systems named "GEOSPASIAL" and "DIBI," which are posted on their website. GEOSPASIAL is a Web-GIS database system that displays: (1) disaster/damage information caused by disasters occurring within 30 days, (2) various types of hazard maps, and (3) administrative boundaries on maps. DIBI is a database that stores information on historical disasters in Indonesia after 1815 collected by the national government, local governments, NGOs, universities, etc.

Early Warning and Transmitting Information

Survey and monitoring activities of active volcanoes, such as creating geological maps, seismic observations, ground deformations, magnetic and gravity surveys, and geochemical surveys, etc., are conducted by the Center for Volcanology and Geological Hazard Mitigation (CVGHM).

The CVGHM has developed 80 hazard maps for volcanoes. On the maps, the volcanic hazardous areas are classified into the following 3 categories: "Region I: Affected by secondary risk from eruption (lahars, ash clouds)", "Region II: Affected by material eruption by climatic condition," and "Region III: Directly affected by material eruption (pyroclastic flow, debris, gasses)."

The early warning system for volcanic eruption is by the CVGHM. The warning levels for volcanic eruption are classified into the following 4 categories: "Level I: Normal, Volcanic activity stays in normal without any difference from its background levels", "Level II: Alert, Volcanic activity begins to increase and has passed over its background levels", "Level III: Stand by, Volcanic activity shows its precursor before eruption," and "Level IV: Danger, Started with volcanic ash eruption, and then approaching the main eruption."

Preparedness and Education

Relocation of communities from hazardous areas has been conducted in the rehabilitation and reconstruction program of Merapi.

Sources of Hazard and Risk Information

Table 2.7 Sources of Hazard and Risk Information: Volcano

Badan Nasional Penanggulangan Bencana (BNPB) **National Agency for Disaster Management**
http://www.bnpb.go.id/
GEOSPASIAL
http://geospasial.bnpb.go.id/
Data dan Informasi Bencana Indonesia (DIBI) **Indonesian Disaster Information and Data**
http://dibi.bnpb.go.id/DesInventar/dashboard.jsp?lang=ID
Pusat Vulkanologi dan Mitigasi Bencana Geologi (PVMBG) **Center for Volcanology and Geological Hazard Mitigation**
http://www.vsi.esdm.go.id/static_content.php?id_kategori=1
Badan Informasi Geospasial (BIG) **Geospatial Information Agency**
http://www.bakosurtanal.go.id/
Badan Geologi
http://www.bgl.esdm.go.id/
Badan Penanggulangan Bencana Aceh (BPBA) **Aceh Disaster Management Agency**
http://bpba.acehprov.go.id/
Tsunami and Disaster Mitigation Research Center (TDMRC), Syiah Kuala University
http://www.tdmrc.org/en/

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 volcanic hazards are shown in Figure 2.15. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.8.

Figure 2.15 Locations of Existing Investigations and Studies: Volcano

Table 2.8 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).
Indonesia	The governmental organization BNPB publishes volcanic hazard maps on its website. Some maps use satellite images.

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
6) USGS/CVO (2001), "Map, Major Volcanoes of Indonesia with eruptions since 1900 A.D.", Downloaded from http://vulcan.wr.usgs.gov/Volcanoes/Indonesia/Maps/map_indonesia_volcanoes.html

2.6 Cyclone and Meteorological Hazards

Risks

Indonesia is located between latitudes 6° to the north and 11° to the south and longitudes 95° and 141° to the east. As it is located near the equator, it has a tropical climate characterized by high temperatures, heavy rainfall, and high humidity.

The southeastern part of Sumatra Island, Java Island, and the Lesser Sunda Islands located in the southern hemisphere away from the equator have two seasons. There is much rain during the rainy season (summer in the southern hemisphere) from October to March and less rain during the dry season (winter in the southern hemisphere) from April to September in these regions. On the other hand, there are two maximum occurrences of rain in a year in the Moluccas Malay Peninsula close to the equator, Sumatra, Borneo, and Celebes, as the rainfall increases during the alternation of monsoon winds there. Annual rainfall in most areas of the country exceeds 2,000 mm. Rainfall is less than 1,000 mm in parts of the Lesser Sunda Islands and the eastern part of Java.

As Indonesia is located in the subtropical region on the equator, it is not usually affected by tropical cyclones. Five storm disasters due to tropical cyclones have occurred in the country according to 1980 - 2012 records.

Table 2.9 Tropical Cyclone (Storm) Disasters in Indonesia (1980 - 2012)

Date	Cause	Killed	Total Affected
February 1980	Tropical Cyclone	-	800
January 1982	Tropical Cyclone	2	123
February 1985	Storm	-	10000
February 2004	Storm	4	2400
March 2004	Tropical Cyclone	-	1315

The major meteorological disaster which occurs in Indonesia is flood. In addition to flood hazards, Indonesia is also affected by landslides, forest fires, droughts, and storm disasters. Extreme weather phenomena such as droughts and heavy rains related to El Niño may result to significant impacts on agriculture. Serious damage brought about by droughts and heavy rains due to El Niño have been reported in 1982, 1991, 1997 and 1998. The most severe of these occurrences was the drought of 1997, which resulted in the death of 672 people and affected over one (1) million others. The Indonesian regions most prone to drought are the western Sumatra and Java Islands.

Table 2.10 Meteorological Disasters in Indonesia (EMDAT: 1984 ~ 2013)

Disaster	No. of Events	Killed	Total Affected	Damage (millions US$)
Drought	5	986	1,083,000	89
Flood (including Flash Flood)	125	4,789	6,818,901	5,749
Landslide	42	1,558	381,873	122
Storm	5	25	24,265	1
Forest Fire	9	300	3,034,478	9,329

Background

As Indonesia is located on the equator, the country's climate is heavily influenced by the ITCZ (Intertropical Convergence Zone) and monsoons. While the ITCZ lies near the equator, the easterly wind blows into the convergence zones in both the northern and southern hemispheres. Then, when the convergence zone is displaced to higher latitudes along with the movement of the sun, a narrow westerly region appears between the equator and the ITCZ called the equatorial westerlies. Therefore, in areas where the position of the convergence zone is displaced significantly from summer to winter as is in Southeast Asia, the direction of the prevailing wind moves to the opposite side, depending on the season, and, as such, monsoon phenomenon occurs. As Indonesia is located in the subtropical region on the equator, it is not usually affected by tropical cyclones. However, East Java and the Lesser Sunda Islands are located in the southern hemisphere and may be subject to indirect effects of tropical cyclones.

The most deaths due to natural disasters are caused by floods. Severe thunderstorms often bring sudden floods, which bring more damage by causing landslides including volcanic and mud flows. In addition, droughts and storms have also been experienced by the country. Forest fires may occur due to severe thunderstorms during the inter-monsoon period.

Torrential rain hit northern Sumatra in December of 2006. 360,000 people evacuated from Aceh province. The tropical convergence zone usually stagnates near Central Sumatra in December. As a result of the northeastern wind which blows into northern Sumatra, rainfall in the area increases. When cold air flows there from the mid-latitudes during this period, the northeastern wind is intensified and convective activity becomes more active in Southeast Asia.

Droughts, floods, and many more extreme weather events are likely to occur because Indonesia is impacted by El Niño. Areas with a high risk of flooding are spread all throughout Indonesia, especially on the east coast of the northern part of Sumatra, the northern coasts of the western part of Java Island, the western and southern parts of Kalimantan Island, the southern part of Sulawesi Island, and the southern parts of Papua. Direct damage of tropical cyclones is not that significant, but cyclones (tropical depressions) may affect Java and the Lesser Sunda Islands, which are located in the eastern part of Indonesia located in the southern hemisphere. Tidal waves, tornadoes, and storm surges in the area may also cause damage. In addition, the northern states of Sulawesi and the coastal areas of Marc Islands in the northern hemisphere may be subject to damage due to storm surges and high waves, which may have resulted from the effects of typhoons in Philippine waters. Additionally, many tornadoes that occurred in Java and Bali were due to the cumulonimbus clouds associated with Cyclone Iggy in January of 2012.

Climate change vulnerability and impact on Indonesia are follows.

- For tropical cyclone frequency, more models suggest a decreasing trend in tropical storm frequency over the 21st century than an increasing trend in the western North Pacific.
- For tropical cyclone intensity, most of the studies projected an increase in tropical cyclone intensity over the western North Pacific.
- The annual mean temperature in Indonesia has been increasing by around 0.3 °C since 1990, occurring in all seasons of the year. This is relatively consistent with, if not slightly lower than the expectation of the warming trend due to climate change.
- It has been projected that mean temperature will increase over 20 years from somewhere between 0.36 to 0.47 °C by 2020 with the highest temperatures potentially occurring in the islands of Kalimantan and the southeastern part of the Moluccas (DFID, 2007).
- An increase in annual precipitation is predicted across the majority of the Indonesian islands, except in southern Indonesia, where it is projected to decline by up to 15%.

- There could also be change in the seasonality of precipitation. Parts of Sumatra and Borneo may become 10 to 30% wetter by the 2080s during December-February. Jakarta is projected to become 5 to 15% drier during June-August.

Indonesia is sensitive to climate change. The country may experience prolonged droughts, increased flooding, and more frequent and severe storms as a consequence of climate change. Indonesia is currently experiencing a sea level increase of 1-3 mm/year in coastal areas, and this is projected to increase at a rate of about 5 mm per year over the next century. In addition, the impact of the increased frequency and severity of El Niño events may cause several coastal regions to become susceptible to damage.

Responses by Indonesia

As part of the implementation of Law Number 24 Year 2007 on Disaster Management, particularly Article 36, the government and local governments are required to prepare a Disaster Management Plan in line with their authority. These preparations will be coordinated by the Agency.

Meteorological Service in Indonesia is under the responsibility of the BMKG (Badan Meteorologi, Klimatologi, Dan Geofisika). It consists of four technical sections: meteorology, climatology, geophysical, and instrument/calibration/network.

The Indonesian region is not directly affected by tropical cyclones. However, the occurrence of tropical cyclones in nearby regions influences Indonesian weather, resulting in extreme weather disasters, floods, and landslides.

Indonesia has been a member of the RA-V Tropical Cyclone Committee since it was established by RA V-IX in 1986. BMG (BMKG) operates the Jakarta TCWC (Tropical Cyclone Warning Centre) covering the sea area of latitudes from the equator to 10° to the south and longitudes 90° and 125° to the east. The BKMG monitors the tendencies of tropical cyclones and conducts forecasts in its area of responsibility. The Jakarta TCWC issues TC outlooks, extreme weather warnings, high wave warnings, coastal zone warnings, and aviation advisories.

The BKMG has been authorized to perform the following tasks:

- To prepare for national policy, public policy, and technical policy;

- To do maintenance work for observation instruments, data and information processing;
- To provide information related to climate change to stakeholders and relevant institutions;
- To issue early warning information to the public and relevant agencies;
- To promote research, assessment, and development;
- To implement and educate with regards to the calibration of observation equipment and the communication network; and
- To implement of projects in cooperation with international actors.

Sources of Hazard and Risk Information

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

Indonesia Weather, Climate, Geophysical Agency (BMKG) (Badan Meteorologi, Klimatologi, Dan Geofisika)
http://www.bmkg.go.id/BMKG_Pusat/Depan.bmkg / Tel : +62-21-4246321

Table 2.12 Other Sources of Information: Cyclone and Other Meteorological Hazards

Institution	Literature name
UNDP (2007)	Climate Variability and Climate Changes, and Their Implication Government http://www.undp.or.id/pubs/docs/Final% 20Country% 20Report% 20 -% 20Climate% 20Change.pdf
UNISDR (2010)	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment http://www.unisdr.org/files/18872_asean.pdf
OCHA Regional Office for Asia Pacific (2011)	Indonesia: Natural Hazard Risks http://reliefweb.int/sites/reliefweb.int/files/resources/map_1297.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 2.13 indicates the responsible territory allocated to ASEAN members and its leading country.

Table 2.13 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 other meteorological hazards are shown in Figure 2.16. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.14.

Figure 2.16 Locations of Existing Investigations and Studies: Cyclone and Other Meteorological Hazards

Table 2.14 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.
Indonesia	There is no indication of tropical cyclones/typhoons as Indonesia is located on the equator. Heavy rain can continue for several days due to El Nino. A down-scaling forecast experiment in tropical meteorology using a high resolution regional NWP model has been implemented.

References for Data and Further Reading

1) BMKG (Website): http://www.bmkg.go.id/BMKG_Pusat/Depan.bmkg
2) ESCAP/WMO Typhoon Committee. (http://www.typhooncommittee.org/)
3) IPCC Fourth Assessment Report: Climate Change 2007
4) JMA/WMO Workshop on Quality Management in Surface, Climate and Upper-air Observations in RA II (Asia) 2011
5) National Disaster Management Plan 2010-2014
6) UNDP (2007): Climate Variability and Climate Changes, and Their Implication Government
7) WMO National Meteorological or Hydrometeorological Services of Members (http://www.wmo.int/pages/members/members_en.html)
8) 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 earthquake disasters in Indonesia are shown in Figure 2.17. Circle size represents the scale of the disaster in terms of human losses and economic losses.

There is a record of the tragic mudflow from the eruption of Kelut Volcano in 1911. The disaster killed more than 5,000 people. 144 landslides have been recorded since 1950. There are 7 landslides on record (3 of them are after 2000) that killed more than 100 people.

Thus, the country frequently suffers from landslides, most of which occur around Java and Sumatra Islands. Relatively fewer landslides are recorded in the islands of Sulawesi and Irian Jaya.

Landslides in the country are deeply related to the distribution of volcanoes. Vulnerable and steep geological formations from volcanic activity form predisposing factors, while heavy rain and earthquakes form contributing factors.

Most types of landslides are caused by land collapse and flash floods. In particular, flash floods called “Banjir-Bandang” are being studied as a combination disaster of flooding and debris flow.

Background

The landslides that occurred in Central and West Java such as Cipinas (2001), Bandung (2005), and Sijeruk (2006) recorded more than 100 fatalities. In those disasters, slopes collapsed during heavy rains and flowed down along valley topography, hitting settlements in the basin and causing serious damage.

Landslides in the country feared as "Banjir-Bandang" are so called flash flood caused due to landslide dam failure. They have recently occurred at Langkat (North Sumatra), Sinjai (South Sulawesi), and Jember (East Java) on a massive scale.

These landslides occur mainly on slopes in volcanic mountain areas, especially on Sumatra and Java, which are densely populated regions, increasing the amount of damage. Since volcanoes are distributed on every island of the country, flash floods should be expected in the lower reaches of these volcanoes.

Landslide exposure related to climate change has been widely confirmed at mountain slopes in Sulawesi Island and Irian Jaya Island, in addition to Sumatra and the volcanic area of Java.

Some areas of large cities such as Jakarta, Bandung, and Semarang are experiencing rapid land subsidence.

Responses by Indonesia

Early Warning and Transmitting Information

An early warning system for landslides is not operated in the country.

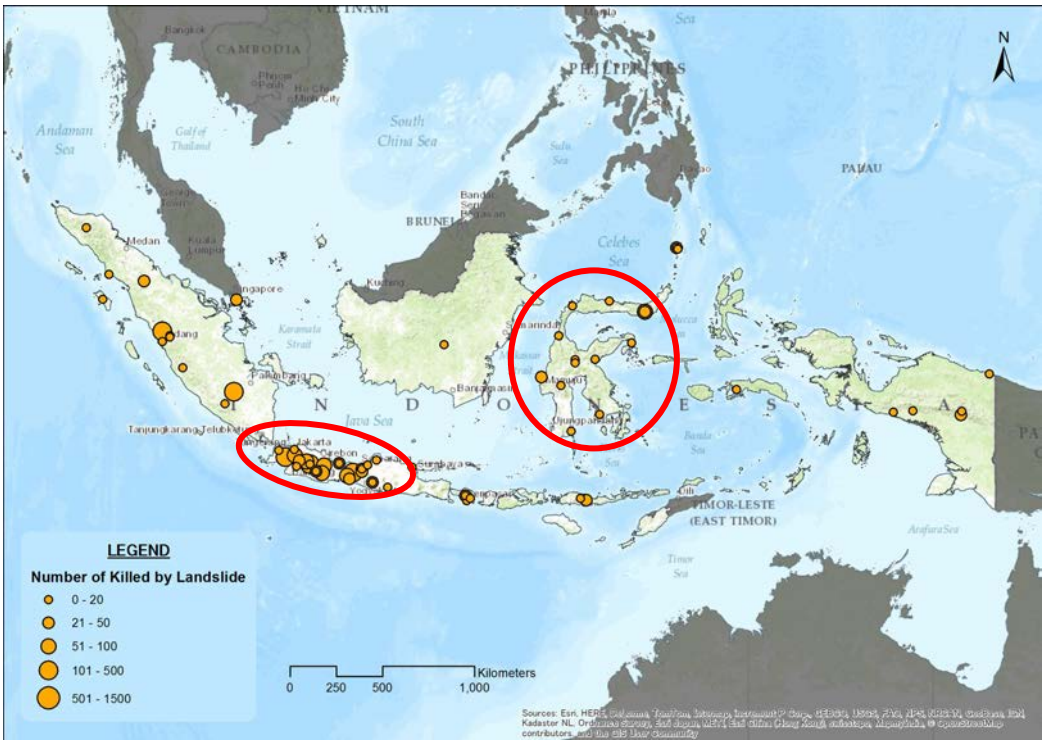
Observation of landslides by GPS, hyetometer, and extensometer are conducted by the Center of Volcanology and Geological Hazard Mitigation (CVGHM), which issues alerts for landslides.

Sources of Hazard and Risk Information

CVGHM publishes hazard maps of landslides on 33 states and small scale provincial hazard maps.

Reports on Hazard and/or Risk Assessment

Locations of existing investigations and studies on landslides are shown in Figure 2.18. Outlines of those investigations and studies are shown in Appendix 2 and their summary is given in Table 2.15.



(a) Human Losses

(b) Economic Losses (% of GDP)

: 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 2.17 Location of Landslide Disasters in Indonesia

Figure 2.18 Locations of Existing Investigations and Studies; Landslide

Table 2.15 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.
Indonesia	High levels of hazard are distributed near volcanic areas, which are concentrated on the Indian Ocean side of the archipelago, and some parts of Celebes and West Papua New Guinea. There is no hazard on the Java Sea side where the metropolis is located. Exposure distribution is similar to hazard, with the number of landslides per year and deaths per year being the highest in ASEAN. The vulnerability index shows the country is ranked second in terms of deaths per year per million people, and its average annual economic loss is ranked first. Statistics from 2003-2005 indicated in LS-004 show the amount of events, number of deaths, amount of damaged farmlands, and roads that are most vulnerable in the east Java region. The second highest number of landslides occurs in the central Java region and the number of deaths is the highest in the north Sumatra region. There have been many landslide disasters in the past, and some disaster studies and risk assessment projects were conducted by Japan, Australia and the World Bank. LS-016 reports a study on flash floods (Bansir-Pandang), which contains assessment methodology using the relationship with landslides and the hazard map of some areas. Improvement projects for landslides are conducted mainly by BNPB. Hazard maps are prepared

	for the entire country, even though some areas are not of a large enough scale. SATLAKPB has been organized as the main body for disaster emergency command. The conditions for which have been reported in terms of framework, responsibility, and their role in some pilot provinces (LS-017). Significant subsidence of the ground in metropolises (such as Jakarta, Bandon, Semarang) shall be assessed as a disaster of soils.

References for Data and Further Reading

3. Industrial Parks

3.1 Distribution of Industrial Parks in Indonesia

67 industrial parks were identified by the study, and as shown in Figure 3.1, most of them are distributed in Java. The rest are located in Sumatera, Sulawesi and Kalimantan.

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

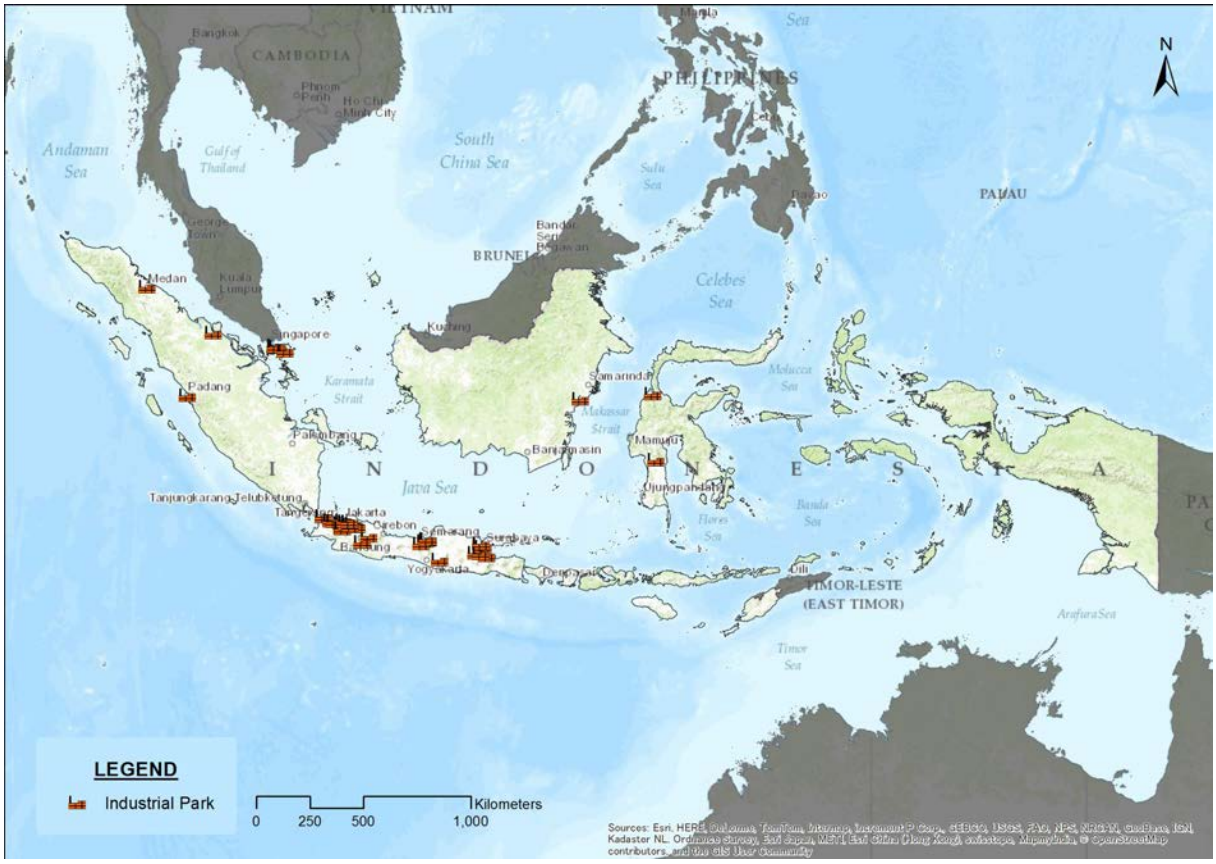


Figure 3.1 Distribution of Industrial Parks in Indonesia

While the level of development of industrial estates in Indonesia varies, most are relatively well managed, and maintain their own websites and marketing teams. Estates in Java and Riau are generally equipped to communicate with and support foreign investors, given their significant experience with foreign tenants. Most websites have English language content. Marketing teams generally have English-speaking staff that are helpful and responsive to inquiries, though specific kinds of information,

[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.

such as details on tenant firms, is often considered confidential and not publicly available.

3.2 Historical Evolution of Industrial Parks

Industrial estates in Indonesia started to develop in the early 1970s as part of government effort to promote inbound FDI. Initially, most industrial estates were established and owned by the government. In 1973, the government established the country's first industrial estate, Pulo Gadung Industrial Estate. This was followed by the establishment of Surabaya Rungkut Industrial Estate in 1974. Several industrial estates were subsequently developed. In 1986, the government established the Nusantara Bonded Zone, which increased the facilities available to exporters, in a further effort to attract FDI.

In 1989, the government issued Presidential Decree 53/1989, which opened the industrial estate development business to private companies. The decree also established the legal and technical requirements for the development and operation of estates. The decree was replaced in 1996 by Presidential Decree 41/1996, which set new guidelines for industrial estates in Indonesia. The decree defines an industrial estate as "a center for industrial activities with provisions of infrastructure and supporting facilities, which is developed and operated by a licensed industrial estate company". Since then, industrial estates run by private sector firms have shown significant growth.

During the 1990s, the strong development of manufacturing industries in Indonesia further contributed to the development of industrial estates, until the 1997 Asian Financial Crisis. The Crisis saw many investors leave industrial estates, resulting in low occupancy rates and multiple estate closures. The development of new estates also slowed significantly. Indeed, several areas set aside for estates prior to 1997 have yet to be developed. As Indonesia's economic growth has recovered, industrial estate development has improved, but generally remains slower than in the early 1990s. Estate development slowed in 2005 and 2006 due to the fuel price increases, but has increased since 2007. Part of this improvement was due to a law passed in 2006 requiring new manufacturing companies to locate their operations in industrial estates, driving estate development. (Existing factories outside industrial estates are required to move into industrial estates when their land use right end.)

According to Industrial Park Association (HKI) data, as of June 2012, the total industrial land in Indonesia reached 27,320.6 ha. Industrial estates are concentrated on Java Island, where the vast majority of commercial businesses are based and the best infrastructure is located.

3.3 Recent Trends and Japanese Investment

Japanese investors have been present in Indonesian industrial estates since the 1970s, attracted by relatively low costs. However, Japanese investment increased significantly in the late 1980s, following the appreciation of the Yen and the opening of industrial estate development to private firms. Since then, Japanese companies have established various industrial estates in the area between Jakarta and Cikampek in West Java Province. The growth of Japanese-affiliated industrial estates attracted further Japanese investment, especially in West Java province or the nearby Jakarta Special Area. Until 2003, 75% of Japanese investment was concentrated in these two provinces, with 8% located in Riau province. While some Japanese firms have extended into other areas, this general pattern of Japanese investment is still present today.

3.4 Risks of Natural Hazards

For the first glance of risks of natural hazards to industrial parks and individual enterprises, it is useful superimpose your location on the distribution maps of natural disasters given in Chapter 2. Figures 3.2 and 3.3 are enlarged maps of Banten, Jakarta and West Java showing relationships of locations of Industrial parks, and flood and earthquake disasters, 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 Indonesia is attached in Appendix 4.

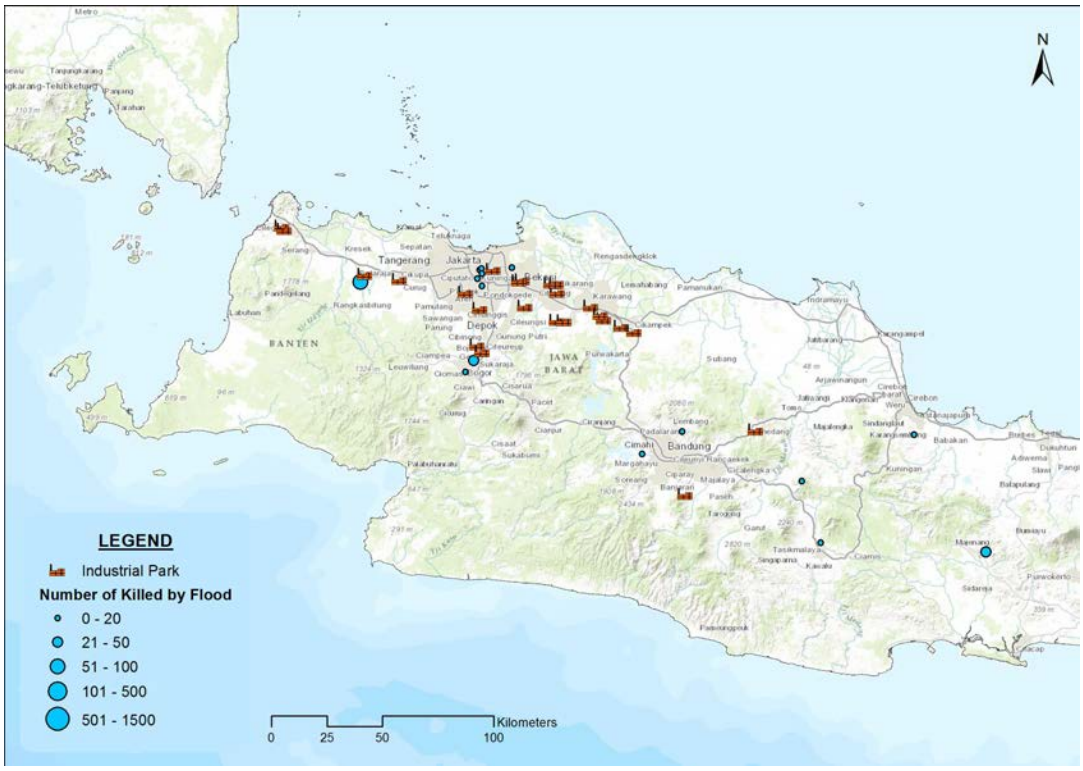


Figure 3.2 Industrial Parks and Flood Disasters: Banten, Jakarta, West Java

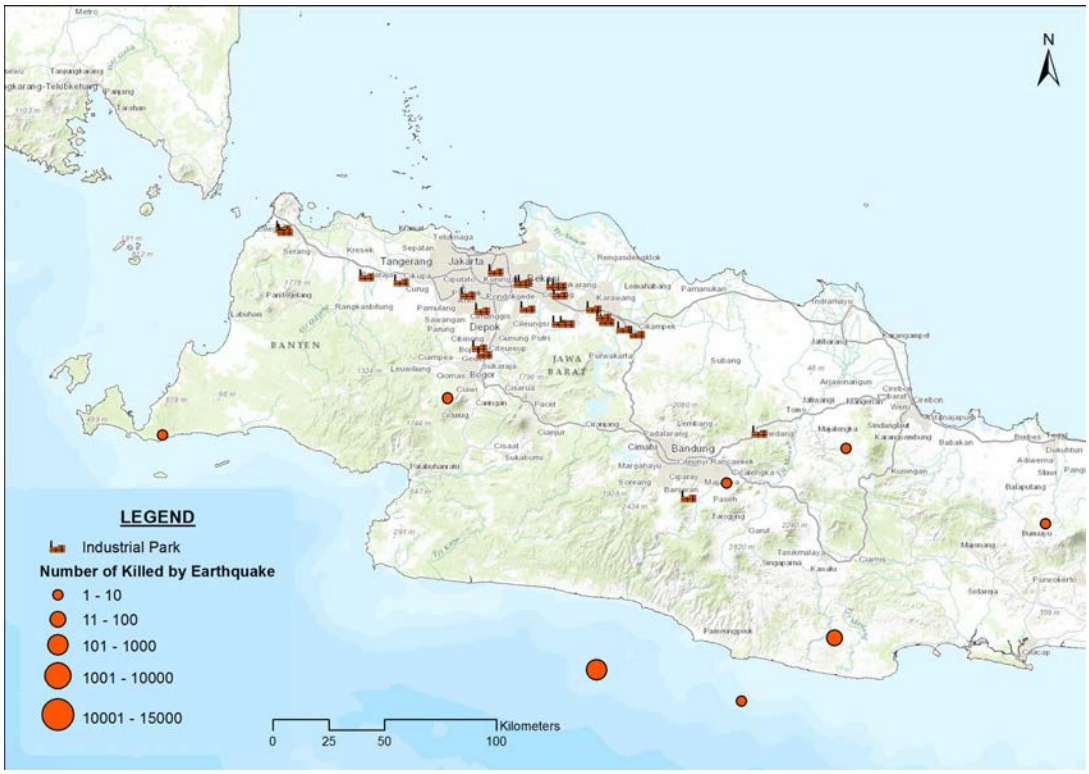


Figure 3.3 Industrial Parks and Earthquake Disasters: Banten, Jakarta, West Java

4. Transport Infrastructure and Lifeline Utilities

4.1 Overview of Transport Infrastructure

Road

The total length of road in Indonesia is about 497,000 km: 39,000 km of national road, 54,000 km of provincial road, and 404,000 km of regency road. Not all of the national roads are paved, and there are more unpaved roads in other categories. It can also be said that the pavement maintenance is insufficient. In Indonesia, there are two (2) Asian Highways: one is the road (AH25) which travels north-south through Sumatra, and the other is the road (AH2) which travels west-east through Java.

Major road networks of Indonesia are shown in Figure 4.1.

Railway

Although Indonesia has a 6,720-km train line, the length of route actually used is 4,600 km. The railroad has not been connected in many areas. There are three routes in Java, with one route in Sumatra. The length of the train line is 3,300 km in Java and 1,300 km in Sumatra.

- The gauge of the track is 1,067 mm, which is the same narrow gauge used Japan.
- The railroad of Indonesia is managed by PT Kereta Api (PTKA).

There have been 200 million railway passengers, 98% of whom are from within Java and 93% of whom are from the Jakarta metropolitan area. The rail freight tonnage is 20 million tons per year.

Major railway networks are shown in Figure 4.1.

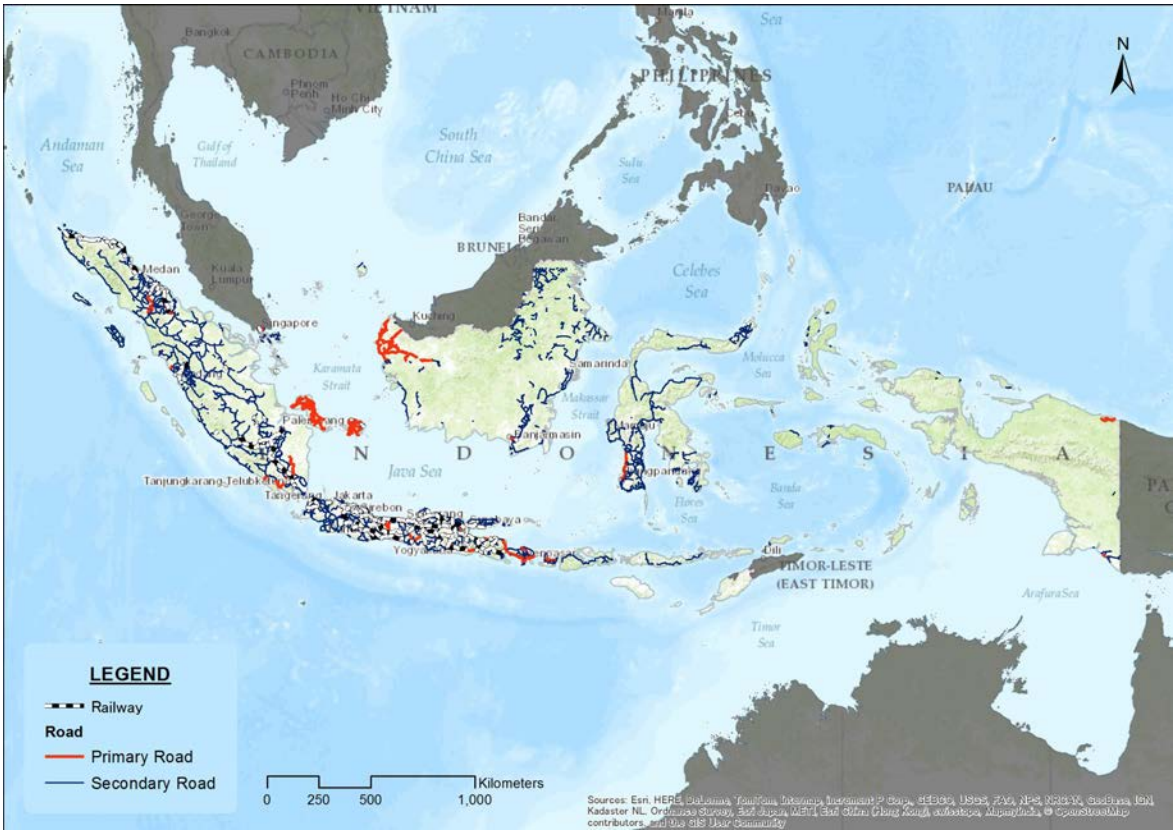


Figure 4.1 Major Road and Railway Networks of Indonesia

Port

Indonesia consists of approximately 17,000 islands. Therefore, the maritime transport that connects these islands plays an important role. The management and operation of ports are conducted by the four (4) national port companies (PT. Pelabuhan Indonesia I~IV: PELINDO).

In Indonesia there are 300 public ports, of which 43 are international ports and 14 are designated ports of ASEAN (Table 4.1). There are four (4) major ports (Tanjung Priok, Tanjung Perak, Belawan, and Makassar), of which the largest is Tanjung Priok. This port is located in northern Jakarta and handles half of the entire container throughput of Indonesia.

Locations of major ports are shown in Figure 4.2.

Table 4.1 14 Designated Ports by ASEAN in Indonesia

Island	Port
Sumatra	Belawan, Dumai, Tanjung Pelapas, Palembang, Pajang
Java	Tanjung Priok, Tanjung Emas, Tanjung Perak
Kalimantan	Pontianak, Bajarmashin, Balikpapan
Sulawesi	Makassar, Bitung
New Guinea	Sorong, Jayapura

Source: ERIA, ASEAN Strategic Transport Plan 2011-2015

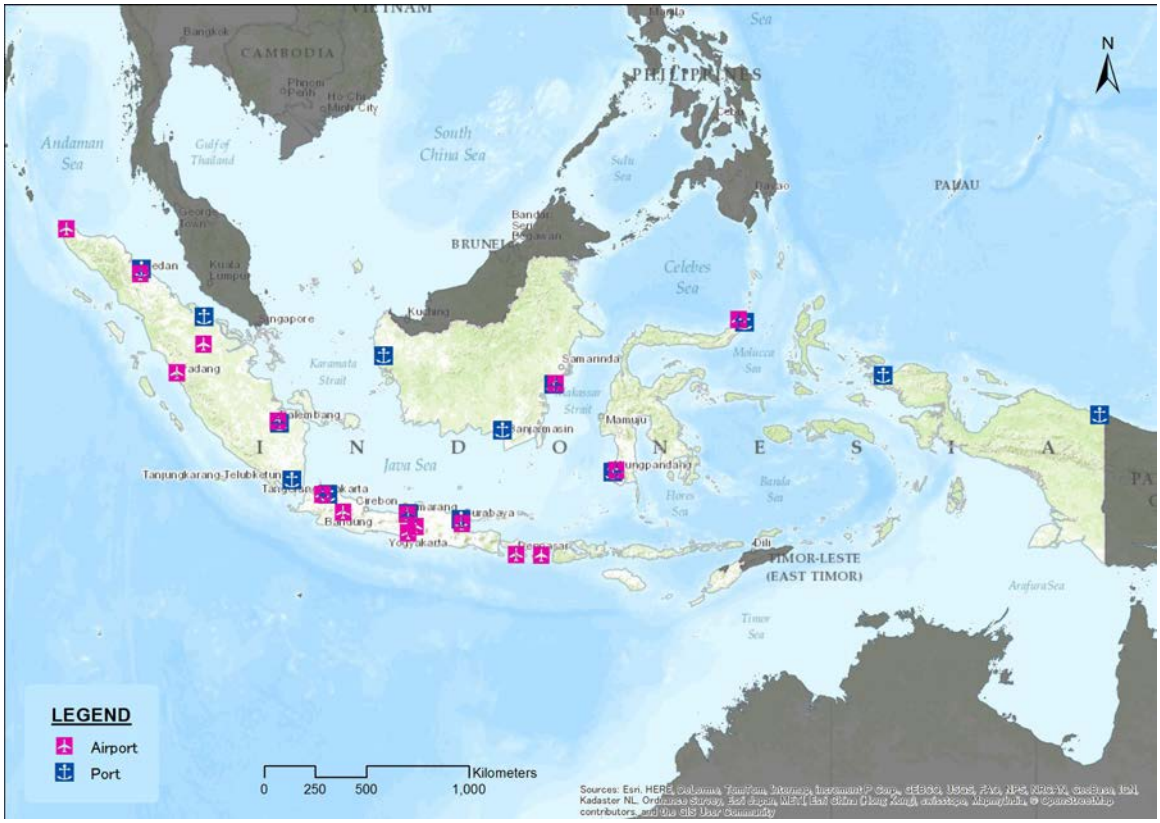


Figure 4.2 Major Ports and Airports of Indonesia

Airport

There are 187 airports for civil aviation use in Indonesia, of which 16 are international airports. These airports are mostly only equipped with short runways less than 1,000 m. There are only seven airports that have runways over 3,000 m.

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

4.2 Overview of Lifeline Utilities

Electricity

In Indonesia, Perusahaan Listrik Negara (PLN) is engaged in electric power generation and power transmission. Although PLN is the only entity conducting power transmission, an Independent Power Producer (IPP) may enter the electric power generation business.

The total power generation in 2011 was about 183,400 million kWh, and the electric power generating capacity was 29,268 MW. In addition, the national electrification rate was 72.95% as of 2011, although the electrification rates were low in Sulawesi, New Guinea, and especially Pulau Timor.

The sources of energy are largely dependent on fossil fuels such as coal, natural gas, and oil produced at home.

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

Table 4.2 Rate of Produced Energy Source of Indonesia 2010

Source of Power Generation Energy	Produced Electricity (1 million kWh)	Share (%)
Coal	68,040.5	41.1
Natural Gas	51,977.8	31.4
Oil / Diesel	19,104.4	11.5
Hydro	17,031.9	10.3
Geo Thermal	9,305.2	5.6
Biomass	87.5	0.1
Sunlight / Wind	0.5	0.0
Gross Total	165,547.9	100.0

Source: JBIC, Indonesia Investment Environment 2012.4

Water Supply

In Indonesia, BPPSPAM and Cipta Karya, which are under the Ministry of Public Works, have jurisdiction over the national water supply. Under this, PDAMs, which are wholly

financed by local governments, perform operation and maintenance work for the water supply system.

- The number of PDMAs is not clear because of different numbers in statistical data.
- The water supply system should be reviewed because the rate of non-revenue water is as high as 30%. The access rate to safe water is 82% for the whole country.

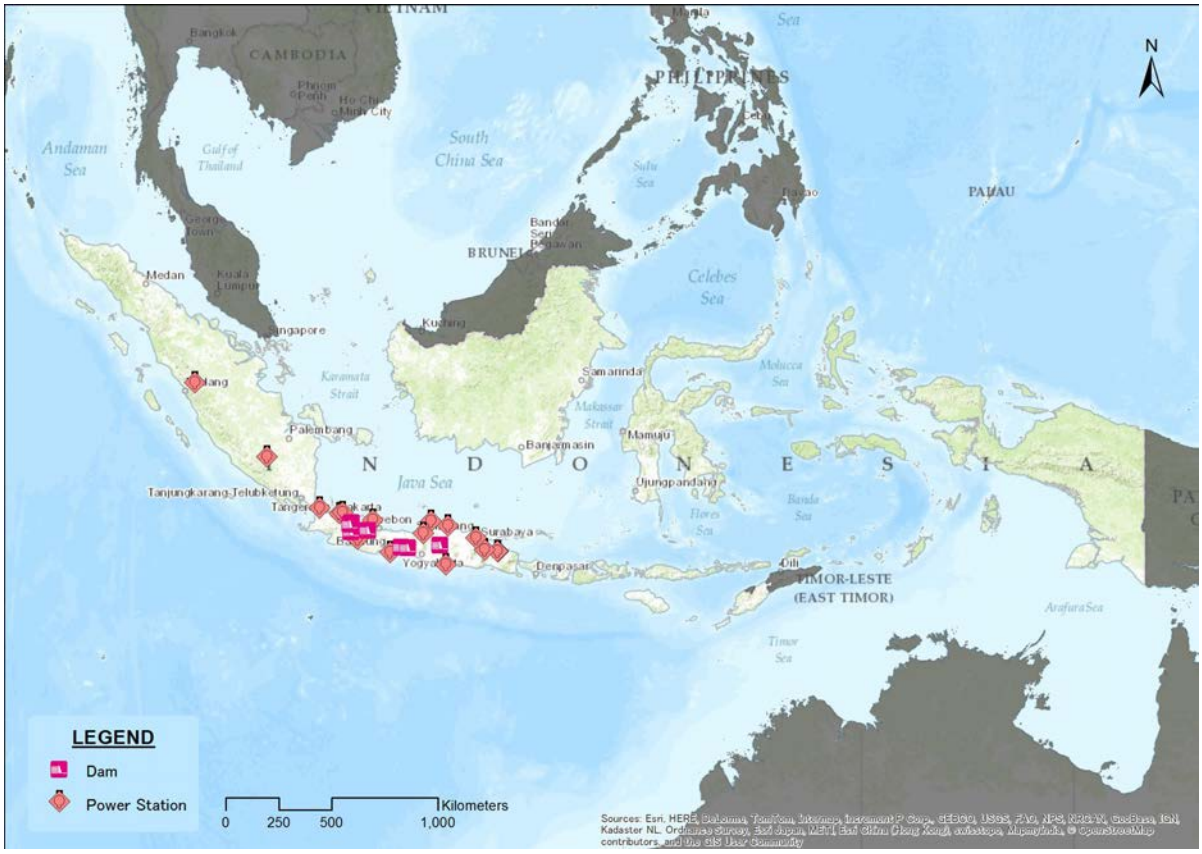


Figure 4.3 Major Power Stations and Dams of Indonesia

Sewerage

In Indonesia, the sewerage coverage ratio is about 1%, which is remarkably low, even compared with the neighboring countries. Generally, septic tanks are popularly used (62%) in urban areas, but discharging into rivers without treatment is a cause of river water pollution. Only 4% of septic tanks discharge their waste water after treatment. The industrial estates in east Jakarta have installed sewerage treatment plants within their lots in order to avoid discharging polluted waters.

The waste water treatment technologies applied by the industrial estates are widely varied from the most simple aerated lagoon process to oxidation treatment with long aeration, membrane separation and filtration methods.

Communications

Internet and Broadband

204 companies have obtained licenses to provide internet access service as of 2011. Moreover, there are 2.74 million broadband subscribers with a yearly upward trend.

Mobile Phone

The main companies in the mobile phone business are Telkomset, Indosat, and XL Axiata. This market also shows rapid growth and a one mobile phone per person distribution.

Fixed-line Phone

Six (6) companies provide local telephone service. Indonesia holds a satellite and provides satellite communications services.

Radio Broadcasting

There are about 800 broadcasting stations in the country including RRI (public broadcasting), commercial broadcasting, university broadcast, army broadcast, and community broadcasting.

Broadcasting

After TVRI started broadcasting in 1962, commercial broadcasting was started from 1989 with 11 companies performing broader-based broadcasting. The satellite broadcasting company Indovision started broadcasting in 1994, and about 650,000 people have now subscribed. For cable TV, there are two main companies, but the number of subscriber remains low at about 160,000, with only people in the metropolitan area being able access the channels. The government is aiming to convert to digital broadcasting completely by 2018.

Waste

In Indonesia, waste is defined as "invaluable organic and/or inorganic solid or semi-solid residue from a business and/or other activities" by the Environment Management Act, etc. Waste is divided into the two (2) categories: domestic waste and dangerous/harmful waste, officially called B3 waste.

The amount of waste production is estimated to be about 2 - 3 liters per person per day or 440 million liters per day in the country. This calculates to 80.3 million tons or 154 billion liters per year. The average composition rate of waste is estimated based on the composition of waste of each urban area.

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 to 4.6 are examples focusing on Java. Following description of natural disasters may be useful to interpret the figures. 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.

Indonesia is an archipelago state which consists of about 17,000 islands. There are 5,500 or more rivers in the whole country and since most rivers have not been improved, several big floods occur during the monsoon every year.

There is a high frequency of floods in this country. Java Island has the highest frequency, followed by Sumatra Island and Sulawesi Island, but Kalimantan Island has a low frequency. Many floods have occurred due to the east-west monsoons in the rainy season (November to March). Heavy rainfalls in the mountainous region cause floods in the plain and extensive damage in swamps and coastal low-lying areas. Urban areas become inundated because of an insufficient drainage system and poor maintenance work.

Sumatra, Java, Bali, Nusa Tenggara, Irian Jaya, and Sulawesi, etc. have earthquake belts running through all the places throughout the country, and many earthquakes exceeding M5.0 have occurred.

The earthquake of Sumatra that occurred in 2004 was of a huge scale at M9.1. The Java Trench was generated by a gap between plate boundaries and in its vicinity, earthquakes exceeding M7.0 occur frequently.

There are 129 active volcanoes in Indonesia and it is thought that 70 of them are dangerous. Because of the eruptions of Mount Merapi in 2006 and 2010, there is a suspected correlation with the Great Sumatra Earthquake. Since the north side of Java is far from the Java Trench, the impact of an earthquake is quite small. However, it is an area prone to flooding due to its heavy rains.

Since Indonesia is near the equator, it is not affected by trade winds. Therefore, cyclones and typhoons affect only a portion of the country. However, the heavy rain

in the rainy season caused by the monsoon is intense, causing floods and landslides. Even though the industrial estates are built on high ground, the impact for these disasters on roads, railroads, power lines, lifelines, etc. cannot be avoided. Attention should also be paid to ash fall from volcanic eruptions in central Java.

Although the seashore zone needs to be protected from tsunamis caused earthquakes in the southern areas of Sumatra or Java, it can be said that the north side is not greatly affected by tsunami. However, the generation of high tides by low pressure is possible.

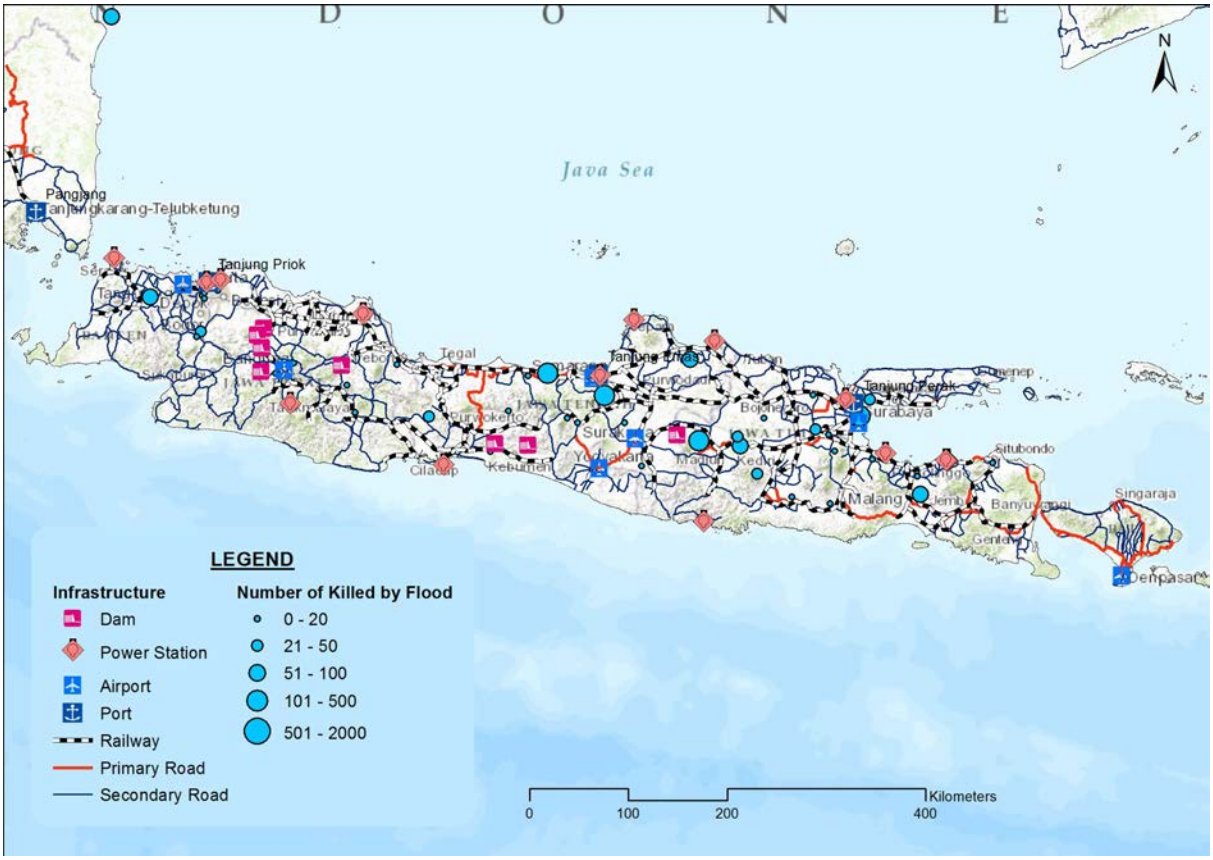


Figure 4.4 Flood Disasters and Major Road and Railway Networks: Java

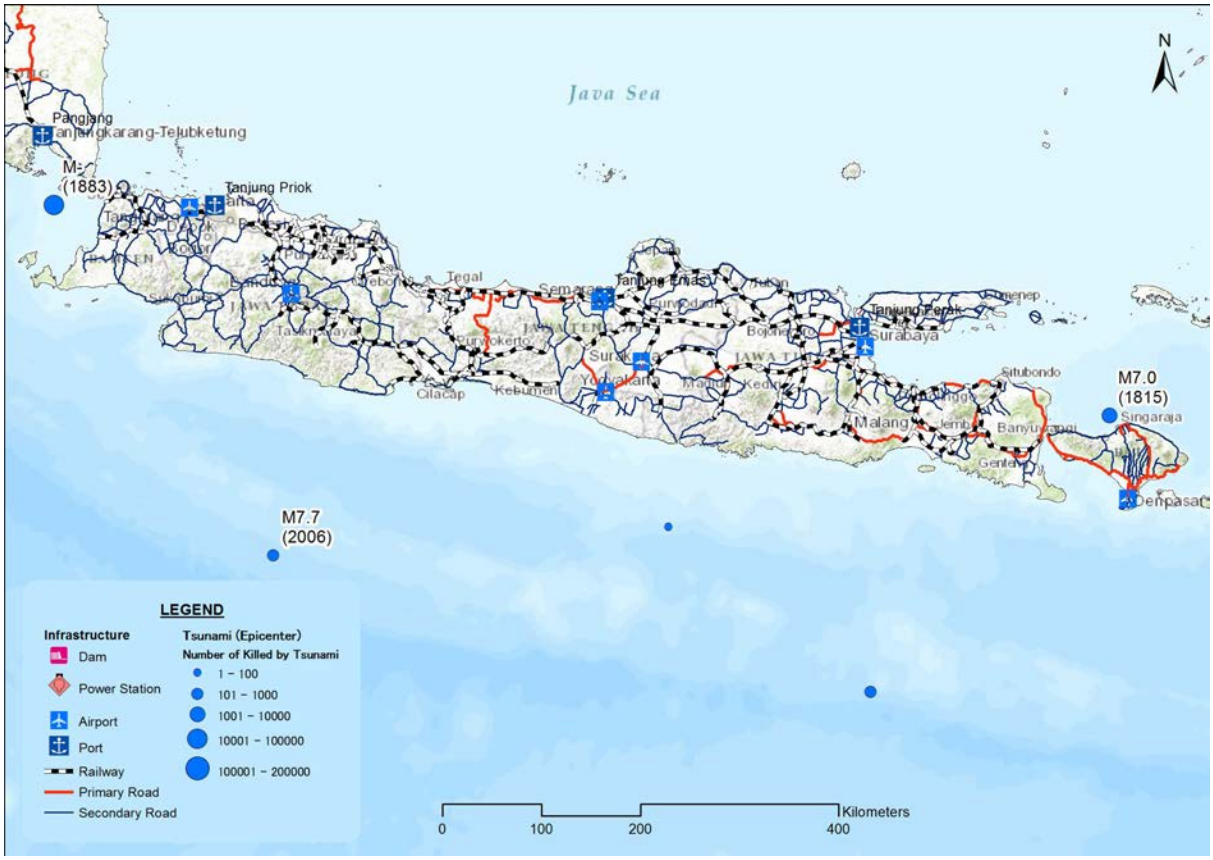


Figure 4.5 Tsunami Disasters, and Major Ports and Airports: Java

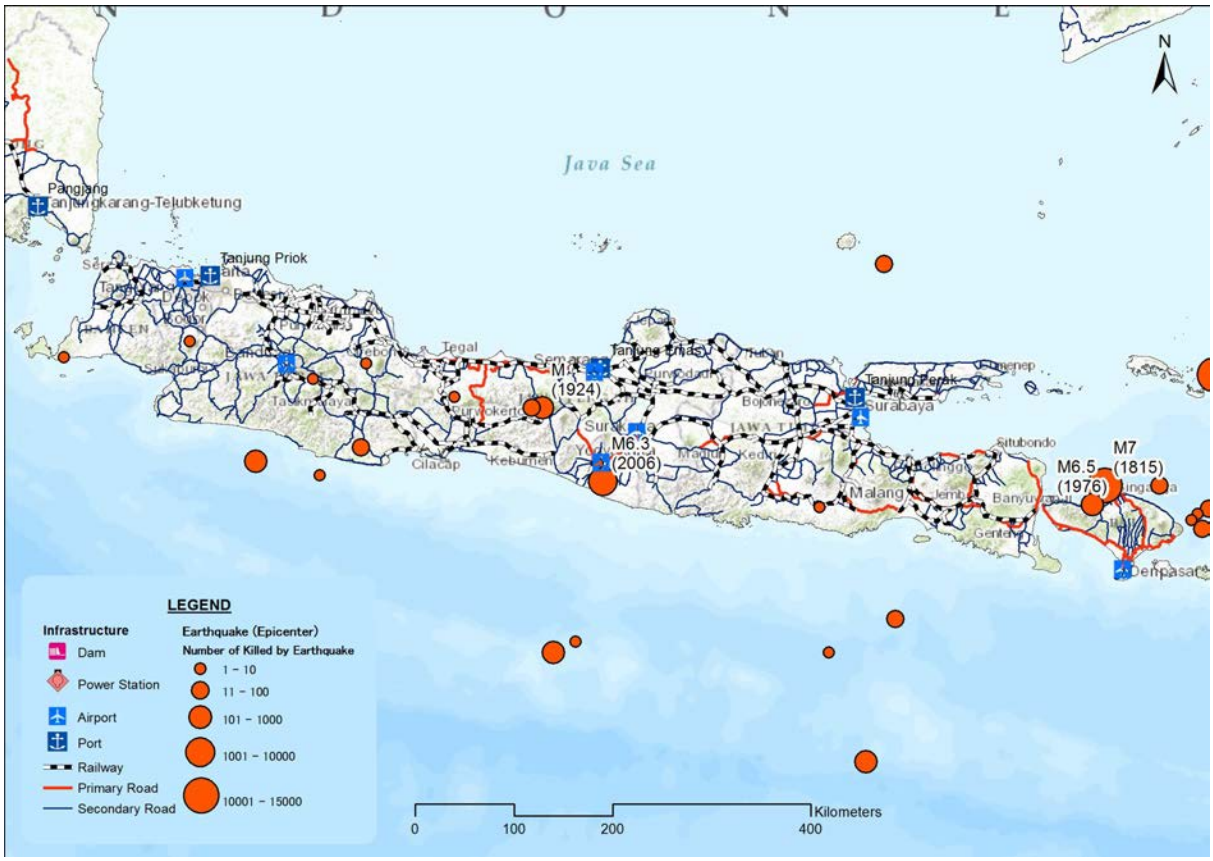


Figure 4.6 Earthquake Disasters, and Power Stations and Dams: Java

5. Legislative Systems

5.1 Legislative Systems for Disaster Management

Disaster Management Laws

Table 5.1 Laws and Regulations of Disaster Management in Indonesia

	Laws / Regulations	Supervisory Authority	Matter
Law	Law of the Republic of Indonesia concerning disaster management, (Law No.24), 2007	National Disaster Management Agency (BNPB)	Disaster Management

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

Disaster Management Strategies and Plans

Table 5.2 Strategies and Plan for Disaster Management in Indonesia

	Laws / Regulations	Supervisory Authority	Matter
Plan	National Disaster Management Plan 2010-2014	BNPB	General Disasters
Plan	National Action Plan for Disaster Risk Reduction 2010-2012	BNPB	General Disasters
Plan	Regional governments' action plans	BPBD	General Disasters

As stipulated by the Disaster Management Law (No.24), the "National Action Plan for Disaster Risk Reduction 2010-2012" was formulated as an action plan for the implementation of disaster management in Indonesia in 2010. The annual action plan of each ministry and local governments' action plans are formulated based on this action plan. As of March 2012, maintenance of an action plan has been completed in all the 33 states. In regencies and cities where BPBD is established, the same action plan is to be formulated.

5.2 Regulations and Standards for Business Continuity Management

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

	Laws / Regulations	Supervisory Authority	Matter
Regulation	Regulation No. 9/15/PBI/2007	Bank of Indonesia	BCM
Regulation	Regulation No. 6/8/PBI/2004	Bank of Indonesia	BCM
Regulation	Indonesia BCP	Bank Indonesia (Central Bank)	BCM
Guideline	Manual: business continuity planning, 2011	International Labour Organization	BCM

Regulation No. 9/15/PBI/2007 prescribes the regulations for implementing risk management using IT systems in banking. In this regulation, data recovery centers are defined as back-up facilities that will function in time of disaster.

In Regulation No. 6/8/PBI/2004, the establishment of BCP and disaster recovery plans for banking is described.

The Manual on Business Continuity Planning indicates the importance of business continuity planning efforts and its guideline for development have been published. However, this document is only available in the Indonesian language.

5.3 Legislative Systems for the Environment and Pollution Control

Environmental Laws and Regulations

Table 5.4 Laws and Regulations regarding the Environment in Indonesia

	Law / Regulations	Supervisory Authority	Matter
Law	Environmental Basic Law, No.04, 1982	Ministry of Environment	Environment
Law	Environmental Management Act, No.23, 1997	Ministry of Environment	Environment
Law	Environmental Protection and Management Act, No.32, 2009	Ministry of Environment	Environmental Assessment

The legal system for managing the environment in Indonesia is stipulated in the Environmental Basic Law, No.04 and the Environmental Management Act, No.23. In addition, the environmental assessment is regulated in the Environmental Protection and Management Act, No.32.

Pollution Control Laws and Regulations

Table 5.5 Laws and Regulations for Environmental Pollution Control in Indonesia

	Laws / Regulations	Supervisory Authority	Matter
Law	Law on Water Resources, No.7, 2004	Ministry of Environment	Water Pollution
Regulation	Government Regulation No.82/2001 (Water Quality Management and Waste Water Control)	Ministry of Environment	Water Pollution
Decree	Ministerial Decree No.51/MENLH/10/1995 (Effluent Standard for Industry)	Ministry of Environment	Industrial Effluent
Regulation	Government Regulation No.41, 1999 (Air Pollution Management)	Ministry of Environment	Air Pollution
Decree	Ministerial Decree No.48/MENLH/11/1996 (Noise Standards)	Ministry of Environment	Noise
Decree	Ministerial Decree No.49/MENLH/11/1996 (Vibration Standards)	Ministry of Environment	Vibration
Regulation	Government Regulation No.74/2001	Ministry of Environment	Hazardous Waste
Decree	Government Regulation No.18 and No.85 (Hazardous Waste Management)	Ministry of Environment	Hazardous Waste
Regulation	Government Regulation No.27, 1999 (Environmental Impact Assessment (EIA))	Ministry of Environment	Environmental Assessment
Decree	Ministry of Environment Decree No.11, 2006	Ministry of Environment	Environmental Assessment

Legal rules for environmental pollution control in Indonesia are defined by several decrees and regulations. The decrees and regulations related to industrial activities are listed above. These regulations cover water, industrial effluent, air pollution, noise, vibration, hazardous waste, and environmental assessments.

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

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

	Laws / Regulations	Supervisory Authority	Matter
Law	Law No.5, 1960 concerning Basic Agrarian Law	under survey	Land Use
Decree	Presidential Decree No.36, 2005	under survey	Land Acquisition
Decree	Presidential Decree No.65, 2006	under survey	Land Acquisition
Law	Forestry Act, 1999	under survey	Forestry

Law	River Act, 1991	under survey	River

Law No.5, 1960 concerning Basic Agrarian Law pertains to the use of land in Indonesia. Moreover, acquisition of land is prescribed by the Presidential Decree No.36, 2005 and the Presidential Decree No.65, 2006.

In addition, although regulations about the fundamental use and development of forests and rivers are defined by the Forestry Act and River Act, a direct statement about urgent disaster response measures and disaster recovery/restoration cannot be found.

Moreover, no regulations on construction standards could be confirmed in this investigation.

6. Implementation of BCP

6.1 Major Natural Disasters and Awareness Disaster Management

Earthquakes, volcanic disaster, floods, and storms are regarded as probable natural disasters for which preparations should be made in Java, Indonesia. Although risk management for these natural disasters has already been considered by private enterprises and civil organizations, disaster management plans are not yet well prepared. Moreover, most business people are not very familiar with the concept of BCP, nor the necessity of BCP for corporate disaster risk management is commonly recognized.

Through private institutes such as the Chamber of Commerce and Industry (KADIN), enterprises seem to put more weight on developing business activities than the management of disaster risk reduction, and most SMEs in Indonesia are not very concerned about corporate disaster risk.

6.2 Current State of BCP Implementation

Implementation of BCP in Enterprises

Private or public companies dealing with any hazardous material such as oil or gas are obligated by laws on public safety and environmental conservation to establish a risk management system for the environment or crisis situations. The implementation of disaster risk management should be also furthered by general enterprises.

As electric utility companies are also required to prepare for crisis management, they develop Standard Operating Procedures. Although response during emergencies is also defined in this procedure, disaster management and contingency plans have not been established. Furthermore, at water utility agencies, there is no well-structured disaster risk management currently being conducted.

At other utility companies or agencies such as water resources, telecommunications, and road networks, no instance of developed BCP could be found. Most company

have not even established plans or manuals such as contingency or disaster recovery plans, nor have they considered the risks of a large-scale disaster.

Implementation of BCP in Foreign Capital Companies and Japanese Companies

It is assumed that some foreign capital companies including major manufacturers and commercial firms have prepared a BCP. In industrial parks accommodating the main factories of foreign capital companies, utility redundancy is ensured since water distribution systems and electric transmission systems are basically independent from the surrounding area. In addition, some individual companies and industrial parks have electric power facilities for emergencies. Thus, preparedness in terms of utilities has been established.

Enterprises consider labor demonstrations, accidents, and traffic congestion as business risks more important than the risks from natural disasters. Because foreign capital companies commonly devote their resources to these problems, the implementation of disaster risk management seems to have a relatively low priority.

6.3 Efforts on Promoting BCP Implementation

Regulations and Guidelines for BCP Implementation

National strategies for disaster risk management and action plans have been developed. Enterprises are required to implement risk management in accordance with these strategies and master plans developed at the regional level.

At the central and local level, governmental authorities related to disaster risk management such as the National Disaster Management Agency (BNPB) and Regional Disaster Management Agency (BPBD) are in charge of the establishment and coordination of disaster management schemes. However, no laws that compel enterprises to develop disaster management plans are currently established. The implementation of contingency plans or BCP has not advanced sufficiently at either private or government-owned enterprises.

Efforts on Disseminating and Increasing Awareness of BCP by the Private Sector

Efforts for the implementation of BCP by enterprises attempted by the private sector have been determined. For efforts on improving corporate management for disaster risk, no actions to support enterprises in the establishment of disaster risk management systems or in conducting disaster risk assessments have been verified.

However a function of KADIN is to support business growth in SMEs. This is done through periodic business seminars and symposiums. However, the issues of business continuity and disaster management have never been covered as a main topic. KADIN also believes interest in implementing BCP will increase in the near future.

6.4 Problems Facing for Implementation of BCP

To implement the BCP, it is essential to improve utility infrastructure. The failure to construct infrastructure in Indonesia is one problem for BCP diffusion. Road network problems seem to be the main bottleneck, with the continuous traffic congestion around Jakarta causing a severe impact on logistics. In addition, the improvement of infrastructure such as roads and drain facilities is an urgent issue considering flood vulnerability. Private enterprises including foreign capital companies are concerned by these weaknesses in social infrastructure.

The lack of knowledge and know-how in developing BCM/BCP is also regarded as a reason for not proceeding with implementation of BCP in the private sector.

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 A1,
2) The number of disaster events for each country is added by type of hazard and disaster rank, and then classified into Table A2,
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
1	- 0.001%	- 10

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

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

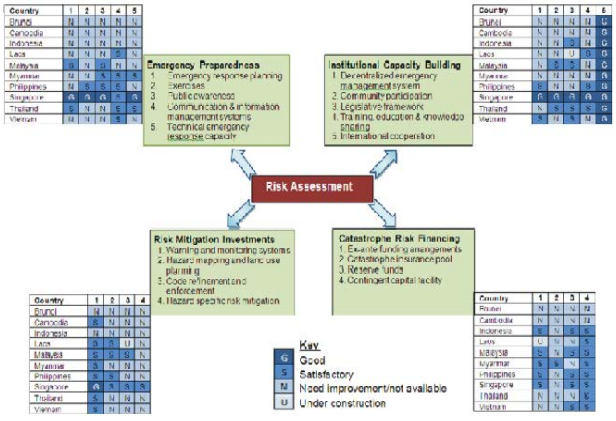
Method: the number of disaster events, deaths, affected population and economic losses are plotted against hazard types for 5 year intervals.

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:

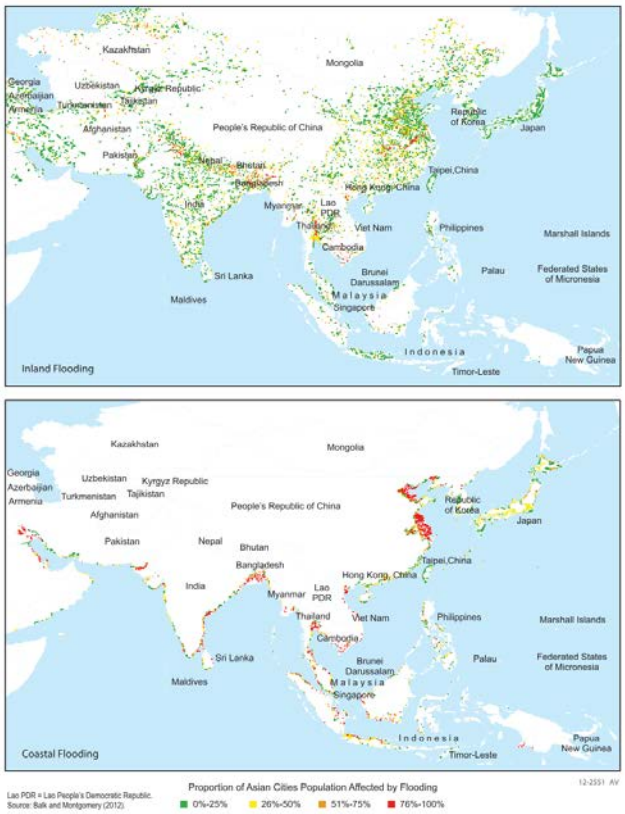
This report summarizes vulnerability of urban cities to flood in Asian and Pacific counties including the ASEAN region. The floods are classified as coastal flood and inland flood that may affect urban cities. Vulnerabilities are estimated by population and areas % at risk of flooding. Top 40 cities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

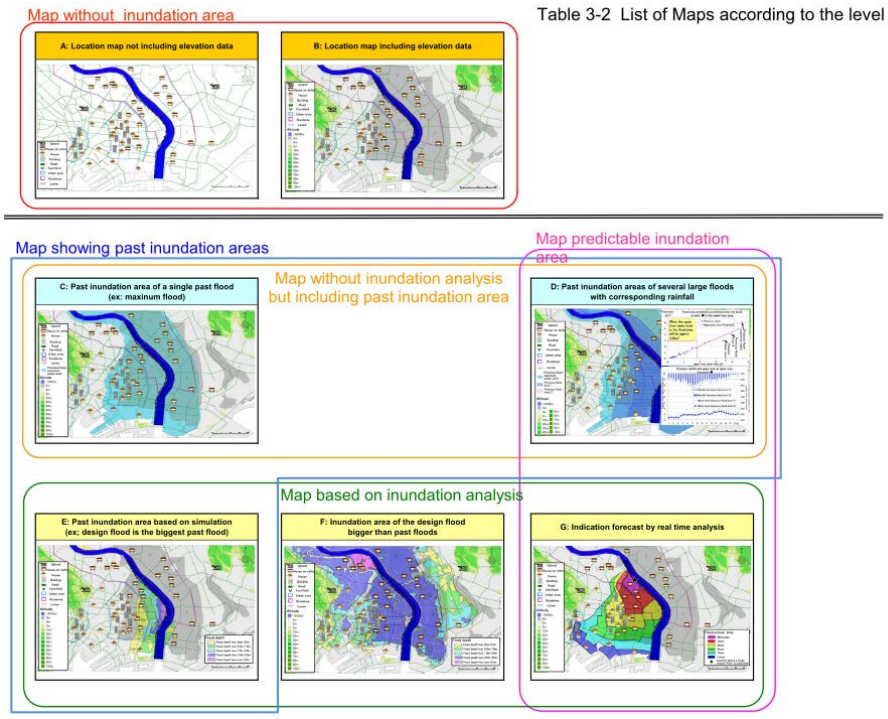
1) Overview

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.



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

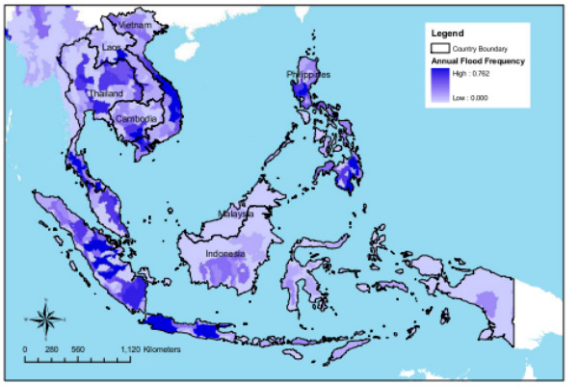
This study assesses vulnerability of Southeast Asian countries (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines) of climate change including flooding. Vulnerability is defined as a function of exposure (potential loss due to a hazard), sensitivity (the potential gravity of losses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

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.



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

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-015	Published Year:	2011
Study/ Report Name:	Program for Hydro-Meteorological Disaster Mitigation in Secondary Cities in Asia (PROMISE) 2005 to 2010		
Access to Information:	http://www.adpc.net/v2007/programs/udrm/Downloads/ PROMISE/MNE/PROMISE_FinalReport.pdf		
Research Organization:	Asian Disaster Preparedness Center (ADPC)		
Study Area (Country):	Indonesia/ Vietnam		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Area		
Main Data Sources:			

Summary of the Study:

1) Overview

Mitigation of flood risks, activities conducted 2005-2010

2) Jakarta urban risk context

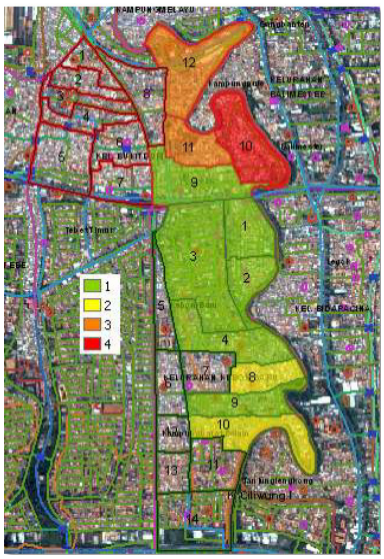
Jakarta is highly prone to flooding for 27 water systems are comprised of 13 rivers, drains and canals that collect surface run-off exits into Jakarta Bay through Jakarta's 35-km coast.

3) Cause of flooding: excessive rainfall, flash floods along these systems

4) Size of hazard: swells of about 2 to 4 meters, land subsidence, high tide, the conversion of swamps into residential areas in South and East Jakarta

5) The areas with flood risk: red most risky areas

A hazard map was produced using DUFLOW software with hydrology data of 2007 flood event and topography map and calibrated and verified with field data. Vulnerability was assessed and mapped using socio-demographic data. Capacity was mapped based on the assessed draining capacity of pumps and levees.



6) Community program for flood preparedness

Hazard mapping, risk identification, flood risk assessment, flood mitigation, flood disaster management planning, town watching, community-based action plan.

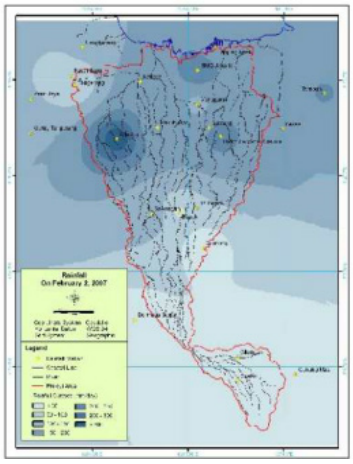
No.:	FL-016	Published Year:	2009
Study/ Report Name:	Jakarta Flood Hazard Mapping Framework		
Access to Information:	http://www.hkv.nl/documenten/jakarta_flood_ hazard_mapping_framework_mh.pdf		
Research Organization:	World Bank		
Study Area (Country):	Indonesia, Jakarta		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Flood Hazard Map (FHM)		
Main Data Sources:			

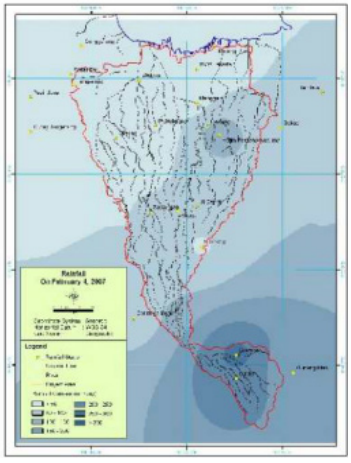
Summary of the Study:

This paper describes the Flood Hazard Mapping (FHM) to analyze the flood causes and hazard in Jakarta. The FHM framework consists of rainfall-runoff (RR), for hydraulics (1D) and inundation calculation (2D).

Data used for RR: area-elevation curves, population numbers, subsidence data, land-use characteristics and discharge methods (pump or gravity) in ArcGIS. Its analysis concluded 40 % reduction in flood risk could be reached in case maintenance was carried out regularly to keep cross sections in accordance with the design.

Hydrological Units: 450
The runoff calculation model: Sacramento model
Rainfall measurement stations: 23 stations
Data used for 1D hydraulics Model: SOBEK Model
Analysis area: 13 Rivers, nearly 600 km long
Geometry description: 2300 cross-sections
Data used for 2D inundation modelCalculation model: 2D module of SOBEK
Below is the rainfall events in February 2007

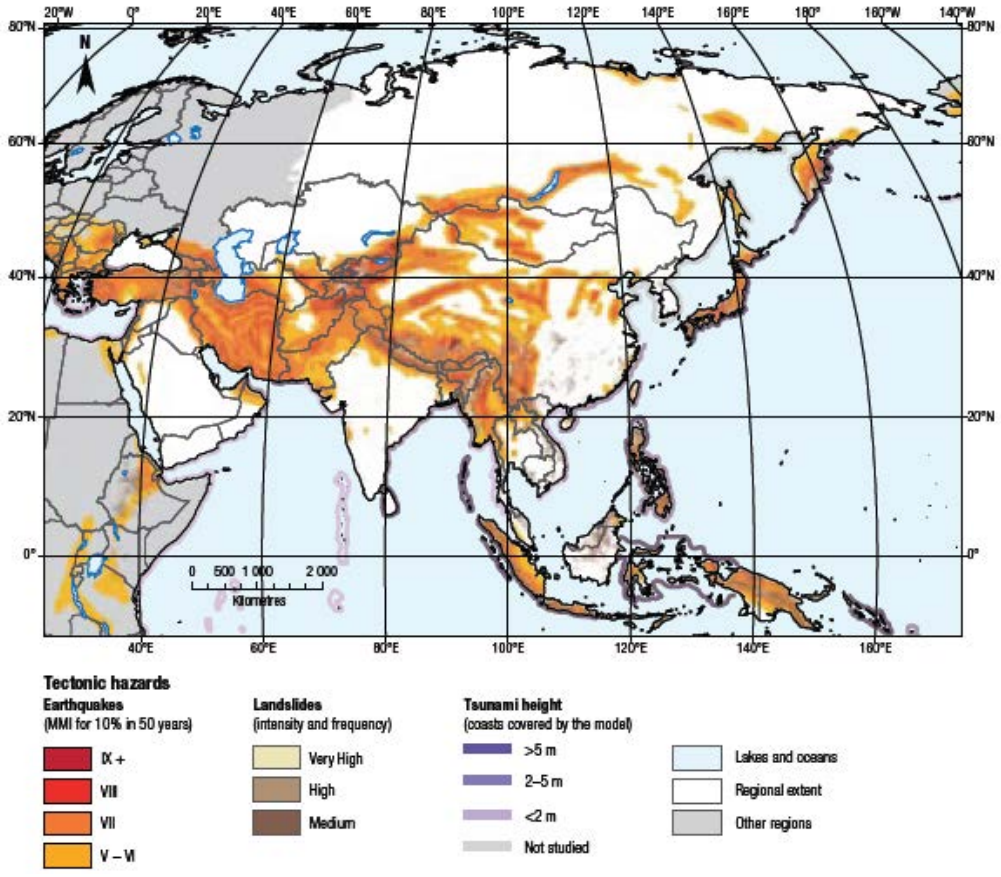




No.:	EQ_001	Published Year:	2009
Study/ Report Name:	Global assessment report on disaster risk reduction (2009) Risk and poverty in a changing climate		
Access to Information:	http://www.unisdr.org/we/inform/publications/9413		
Research Organization:	United Nations International Strategy for Disaster 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:			

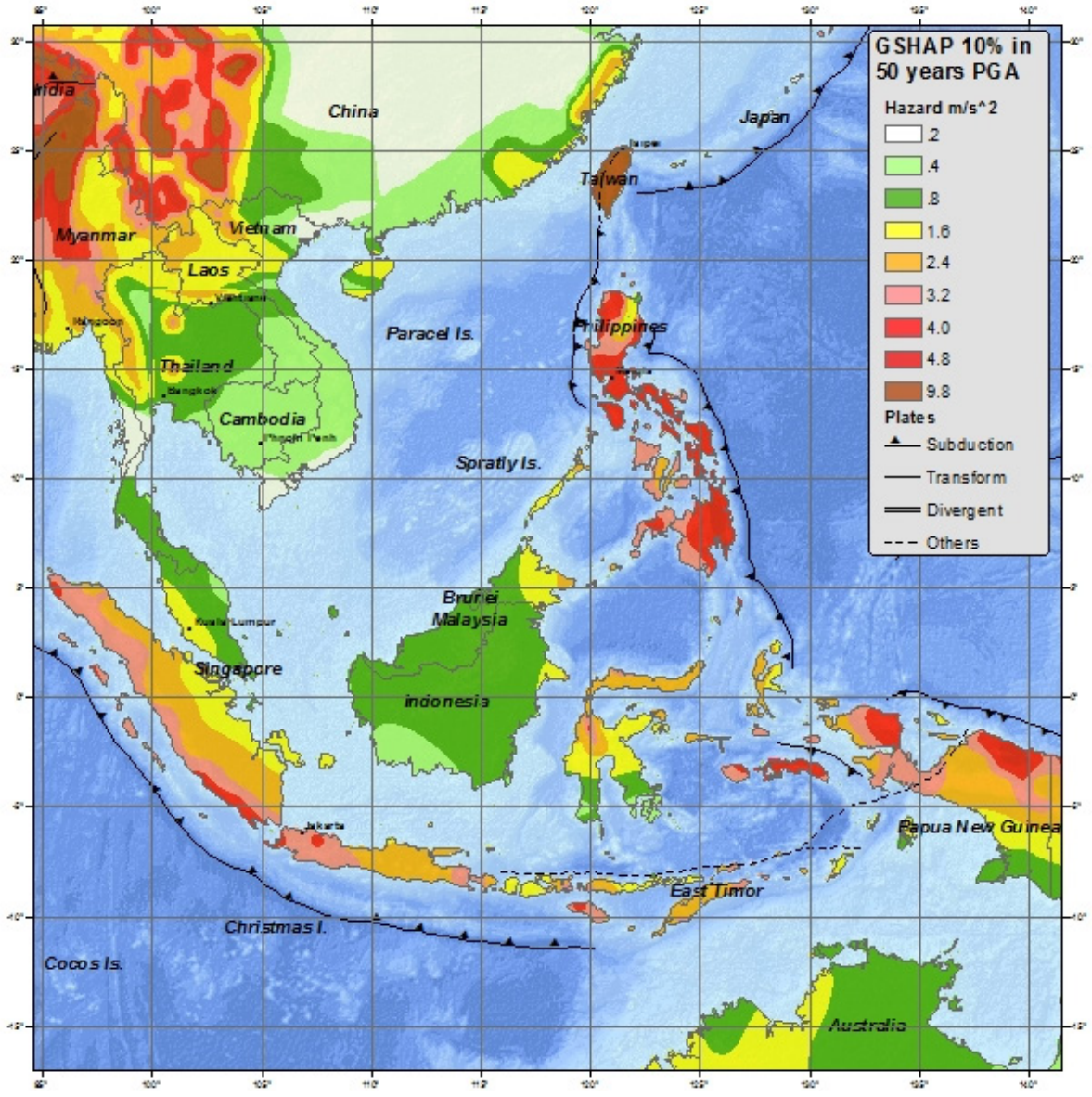
Summary of the Study:

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:			

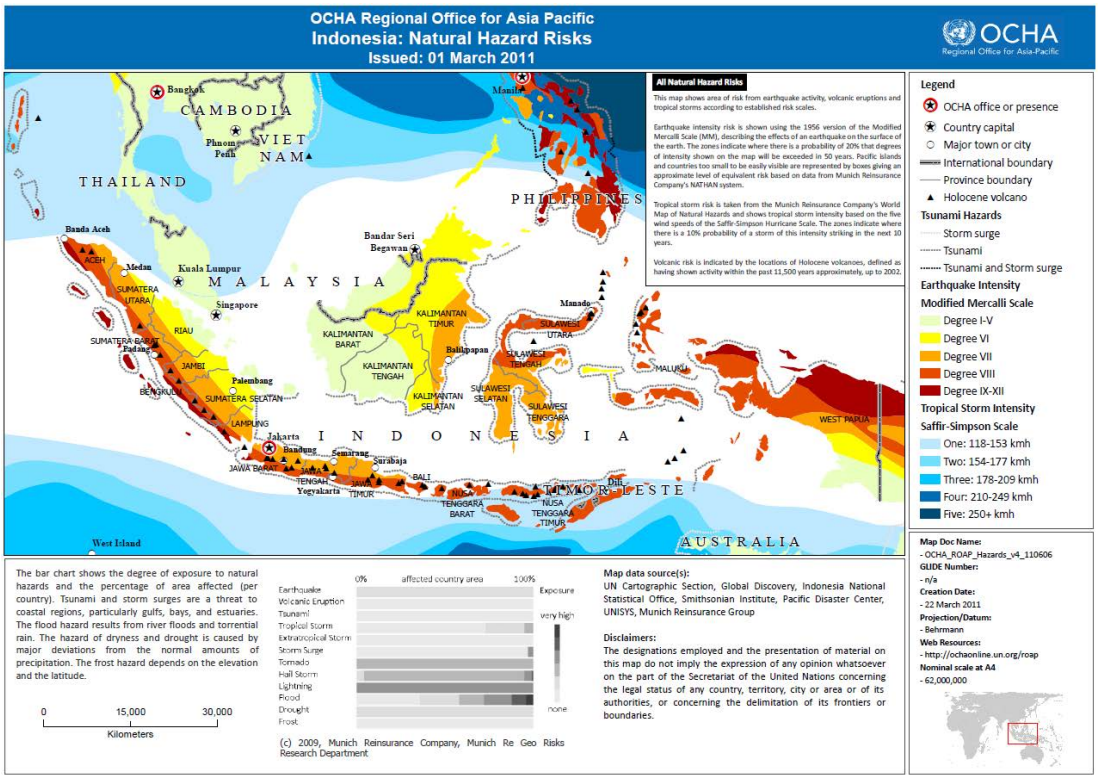
Summary of the Study:



No.:	EQ_003	Published Year:	2011
Study/ Report Name:	Indonesia: Natural Hazard Risks		
Access to Information:	http://reliefweb.int/sites/reliefweb.int/files/resources/map_1297.pdf		
Research Organization:	United Nations Office for the Coordination of Humanitarian Affairs Regional Office for Asia and the Pacific (OCHA-ROAP)		
Study Area (Country):	Indonesia		
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:

This map illustrates Indonesia's exposure to seismic, volcanic and tropical storm hazard. Earthquake intensity zones indicate where there is a 20% probability that degrees of intensity indicated 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.

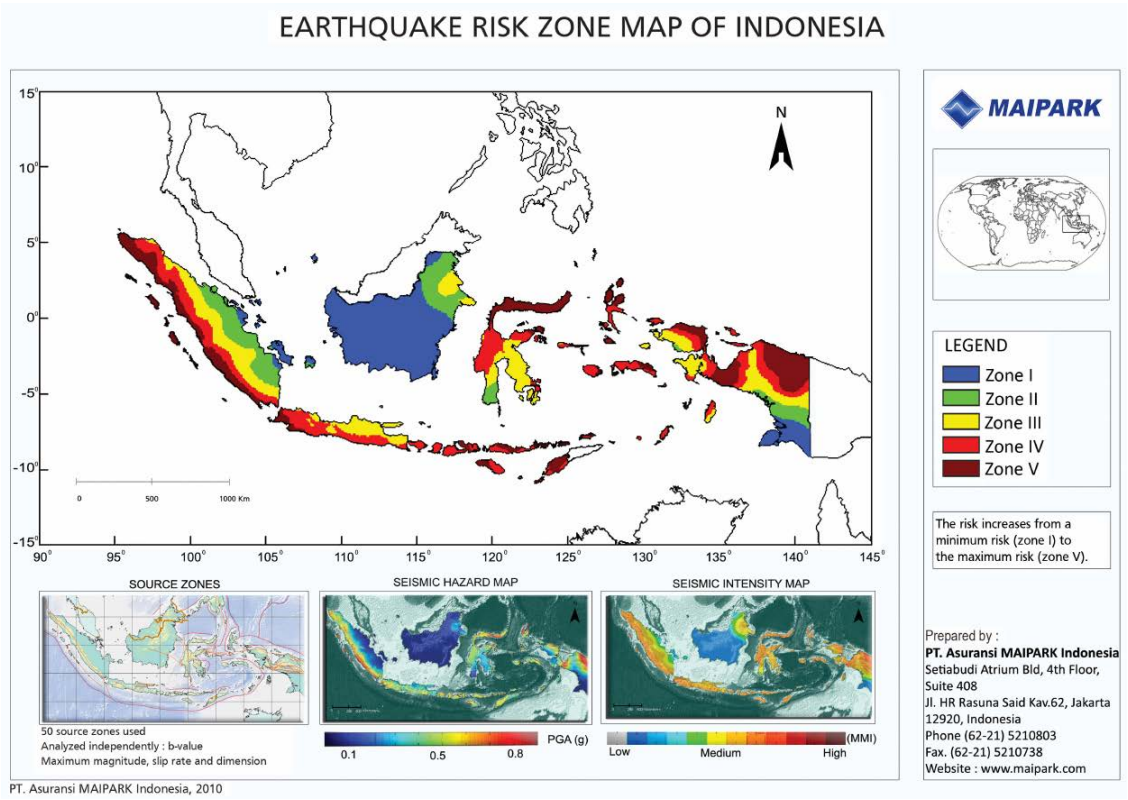


No.:	EQ_004	Published Year:	2010
Study/ Report Name:	Earthquake Risk Zone Map of Indonesia		
Access to Information:	http://www.maipark.com/download/File/other/MAIPARK%20EQ%20Zone%202010.pdf		
Research Organization:	PT. Asuransi MAIPARK		
Study Area (Country):	Indonesia		
Studied Hazard:	Earthquake Risk Zone for insurance		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

Maipark's primary mission, as established by the Ministry of Finance, is to develop a national database on catastrophe insurance in order to provide affordable insurance premiums in line with the government regulation 73/1992, which stipulates business conduct and adequacy of premium practices.

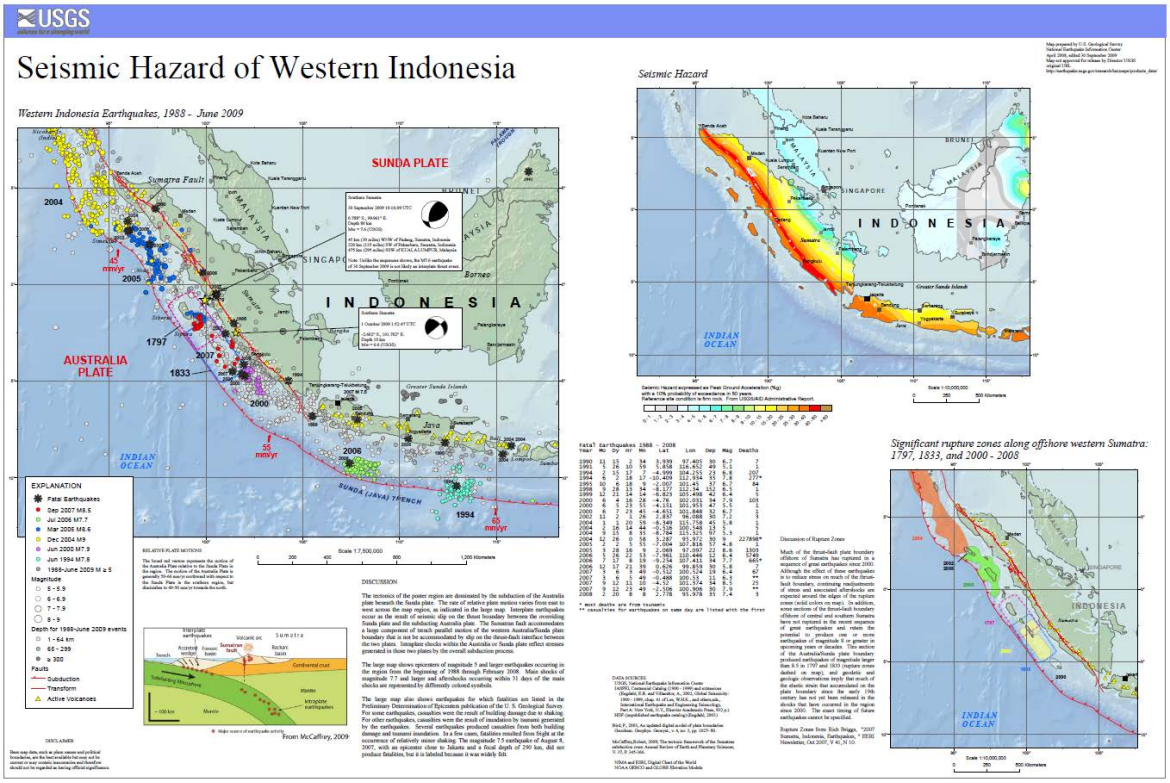
In order to establish premium prices, it has divided the country into five earthquake zones, with the highest premiums being charged in the most dangerous zone (Zone 5). Furthermore, it is currently developing a comprehensive earthquake hazard map through a research and development project to identify all geological hazards in the country.



No.:	EQ_005	Published Year:	2009
Study/ Report Name:	Seismic Hazard of Western Indonesia		
Access to Information:	http://earthquake.usgs.gov/earthquakes/eqarchives/poster/2009/20090930b.php		
Research Organization:	USGS		
Study Area (Country):	Indonesia		
Studied Hazard:	Earthquake / 10% in 50 years PGA		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

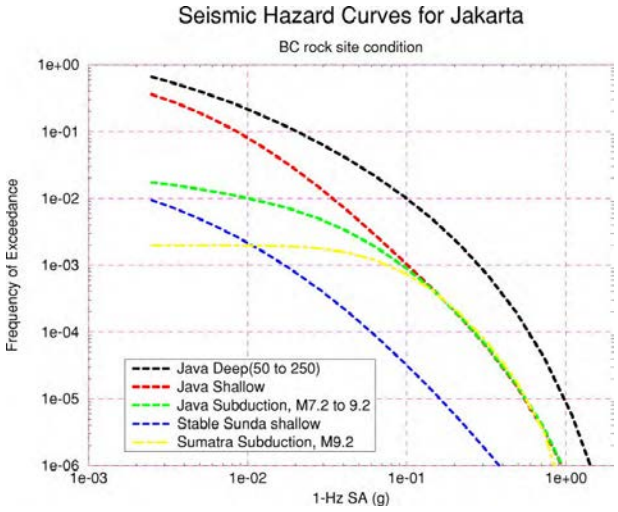
The tectonics of Western Indonesia is summarized as Western Indonesia Earthquakes (1988 - June 2009), Seismic Hazard, Significant rupture zones along offshore western Sumatra (1797, 1833, and 2000 – 2008), and Fatal Earthquakes (1988 – 2008) are summarized.



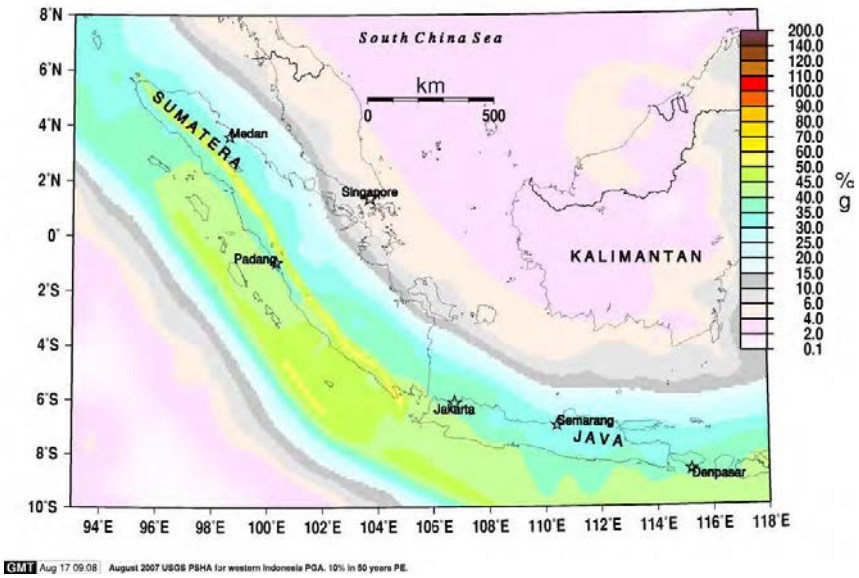
No.:	EQ_006	Published Year:	2007
Study/ Report Name:	Documentation for the Southeast Asia Seismic Hazard Maps		
Access to Information:	http://earthquake.usgs.gov/hazards/products/foreign/		
Research Organization:	USGS		
Study Area (Country):	**Indonesia**, Thailand, Malaysia / Jakarta, Bangkok		
Studied 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_007	Published Year:	2006
Study/ Report Name:	Preliminary Damage and Loss Assessment: Yogyakarta and Central Java Natural Disaster		
Access to Information:	http://www.adb.org/publications/preliminary-damage-and-loss-assessment-yogyakarta-and-central-java-natural-disaster		
Research Organization:	Asian Development Bank		
Study Area (Country):	Indonesia, Yogyakarta and Central Java		
Studied Hazard:	Earthquake, Tsunami		
Studied Damage/ Risk:	Mortality risk, GDP		
Main Data Sources:			

Summary of the Study:

This report presents a preliminary assessment of the damage and losses caused by the earthquake. The assessment used the international standard methodology for measuring disasters, and draws upon some of the best experts in the world. The report provides the Government and the international community a clearer understanding of the impact of the disaster, and a basis for designing reconstruction and recovery programs. The report was prepared under the leadership of BAPPENAS, supported by a strong team of Indonesian and international specialists.

Figure 3: Disaster Risk Hotspots for Indonesia: Mortality risk

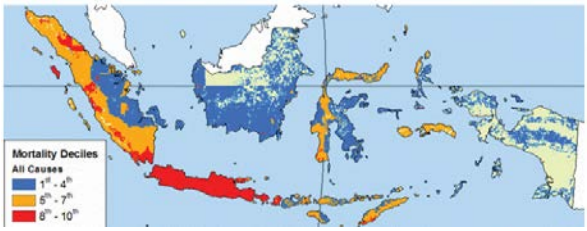
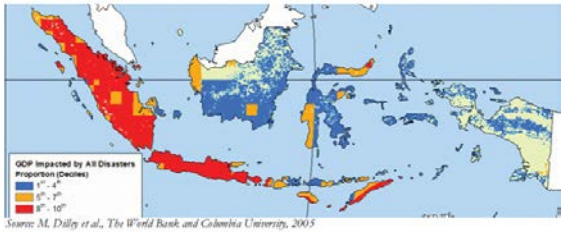


Figure 4: Disaster Risk Hotspots for Indonesia: GDP



Source: M. Dilley et al., The World Bank and Columbia University, 2005

Table 8: Summary of Damage and Losses (Rp Billion)

	Disaster Effects			Ownership	
	Damage	Losses	Total	Private	Public
Housing	13,915	1,382	15,296	15,296	0
Infrastructure	397	154	551	76	476
Transport and Communications	90	0	90	0	90
Energy	225	150	375	0	375
Water and Sanitation	82	4	86	76	10
Social Sectors	3,906	77	3,982	2,112	1,870
Education	1683	56	1739	584	1154
Health and Social Protection	1569	21	1590	1030	560
Culture and Religion	654	0	654	498	156
Productive Sectors	4,348	4,676	9,025	8,854	170
Agriculture	66	640	705	700	5
Trade	184	120	303	138	165
Industry	4063	3899	7962	7962	0
Tourism	36	18	54	54	0
Cross-Sectoral	185	110	295	48	247
Government	137	0	137	0	137
Banking and Finance	48	0	48	48	0
Environment	0	110	110	0	110
Total	22,751	6,398	29,149	26,386	2,763
Total, million US$	2,446	688	3,134	2,837	297

Source: Estimates by Joint Assessment Team

No.:	EQ_008	Published Year:	unknown
Study/ Report Name:	Indonesia Earthquake Information		
Access to Information:	http://earthquake.usgs.gov/earthquakes/world/?region=Indonesia		
Research Organization:	USGS, GSHAP		
Study Area (Country):	Indonesia (Southeast Asia)		
Studied Hazard:	Earthquake / seismic hazard, earthquake density etc.		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

Historic Information

Institutions

- •Badan Meteorologi dan Geofisika - BMG
- •ASEAN Earthquake Information Center
- •Volcanological Survey of Indonesia

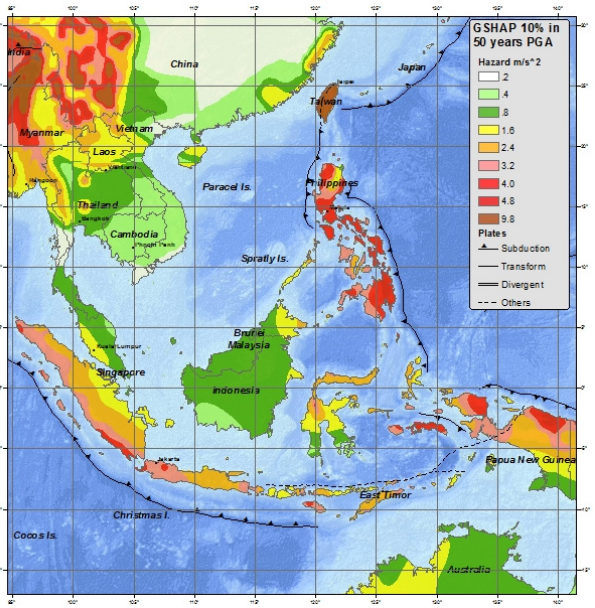
Maps

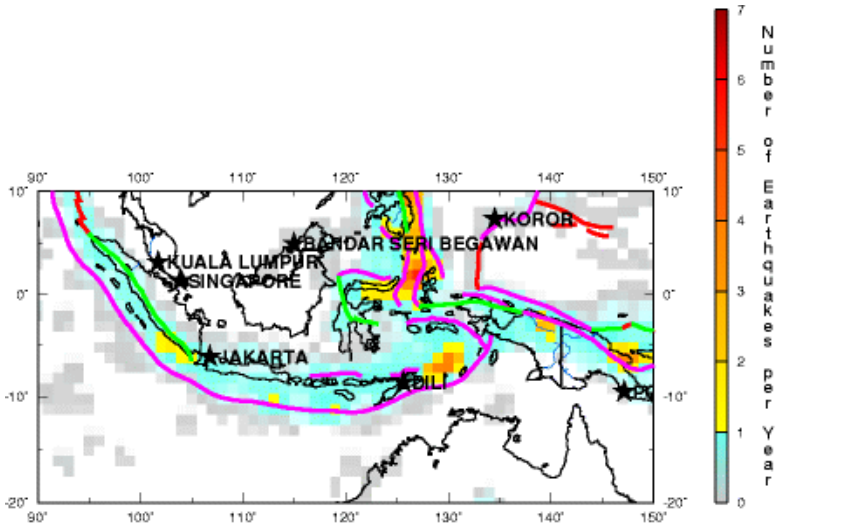
- •Seismic Hazard Map of Indonesia
- •Earthquake Density Map
- •Seismicity Map of Indonesia

Notable Earthquakes

Recent Earthquakes

Tectonic Information





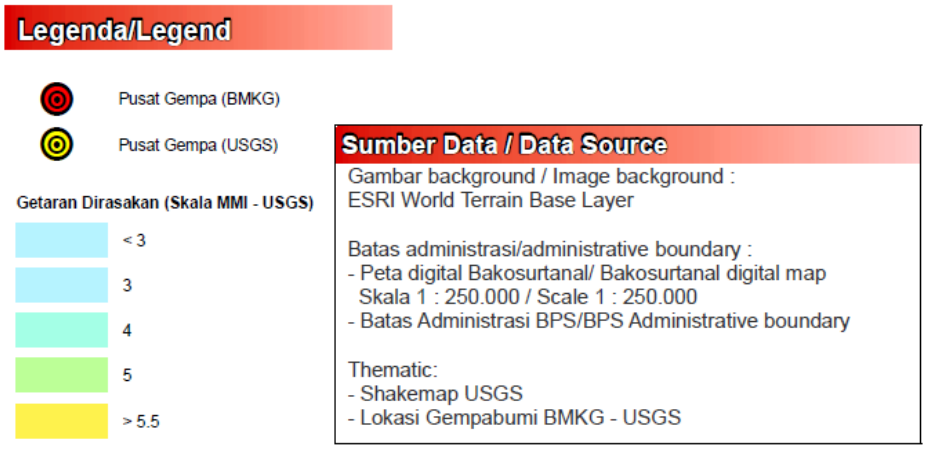
Number of Earthquakes per Year, Magnitude 5 and Greater, All Depths

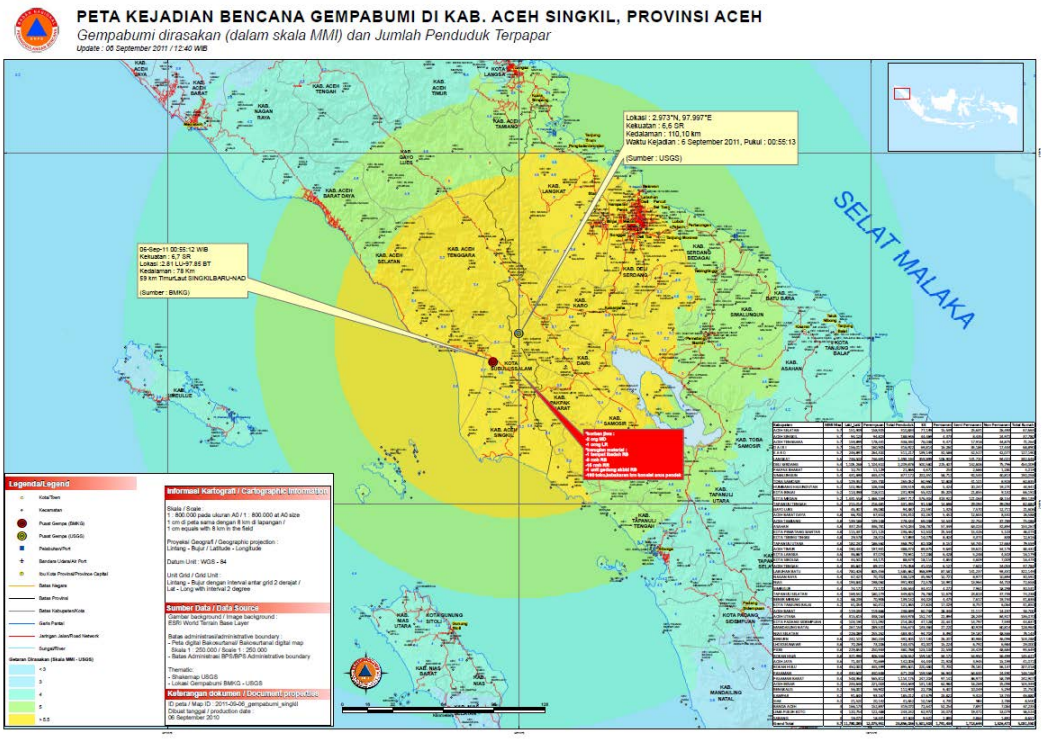
Major Tectonic Boundaries: Subduction Zones -purple, Ridges -red and Transform Faults -green

No.:	EQ_009	Published Year:	continuously-updated
Study/ Report Name:	Peta Tematik (Thematic Map), Gempa (Earthquake)		
Access to Information:	http://geospasial.bnpb.go.id/category/peta-tematik/gempa/		
Research Organization:	Bandan Nasional Penanggulangan Bencana (BNPB) National Agency for Disaster Management		
Study Area (Country):	Indonesia		
Studied Hazard:	Shake map (MMI), 2009 - present		
Studied Damage/ Risk:			
Main Data Sources:	MMI (USGS)		

Summary of the Study:

Maps are open on the web site of BNPB

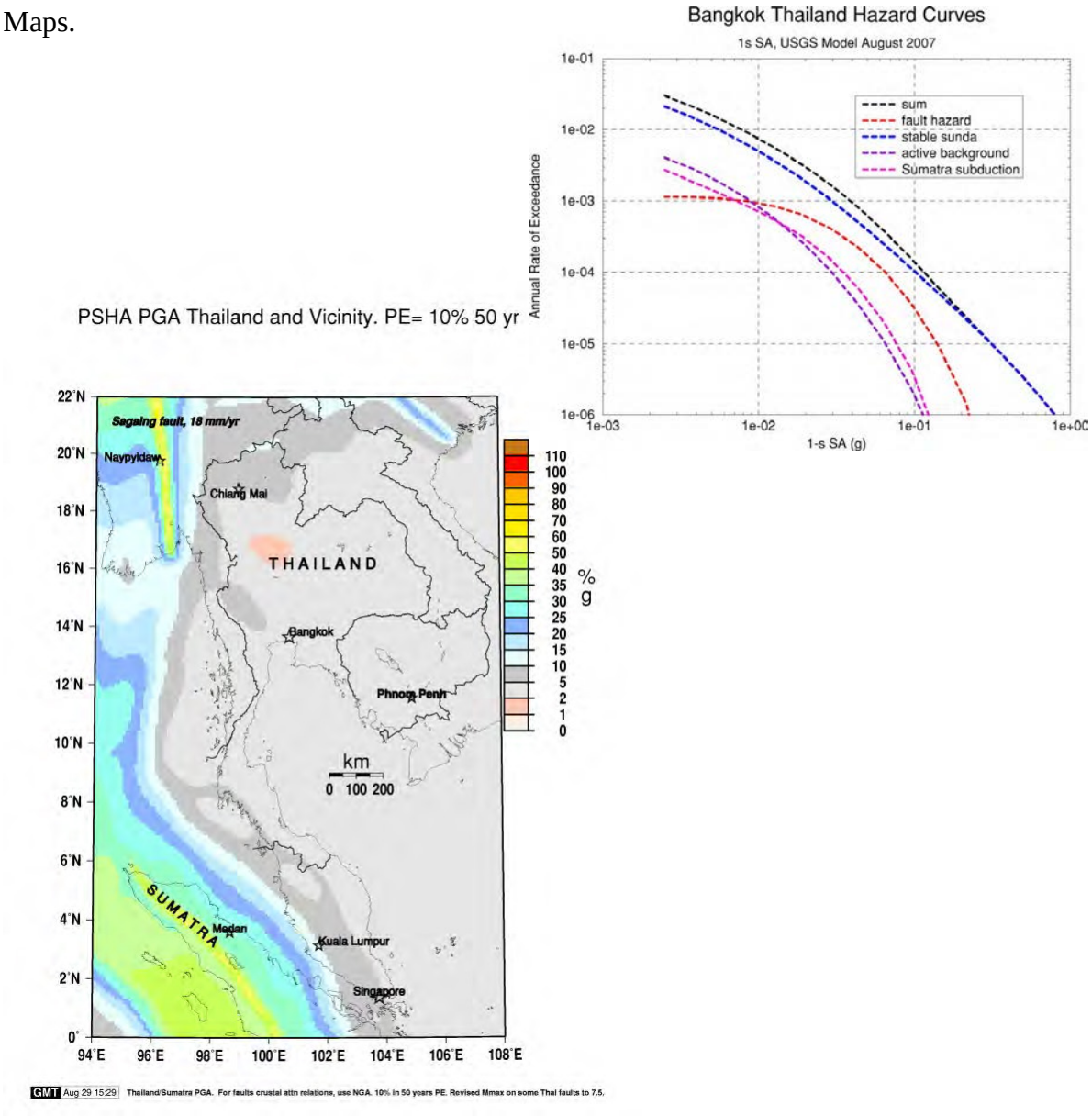




No.:	EQ_024	Published Year:	2007
Study/ Report Name:	Documentation for the Southeast Asia Seismic Hazard Maps		
Access to Information:	http://earthquake.usgs.gov/hazards/products/foreign/		
Research Organization:	USGS		
Study Area (Country):	Jakarta of Indonesia, Bangkok of Thailand, Malaysia		
Studied 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.

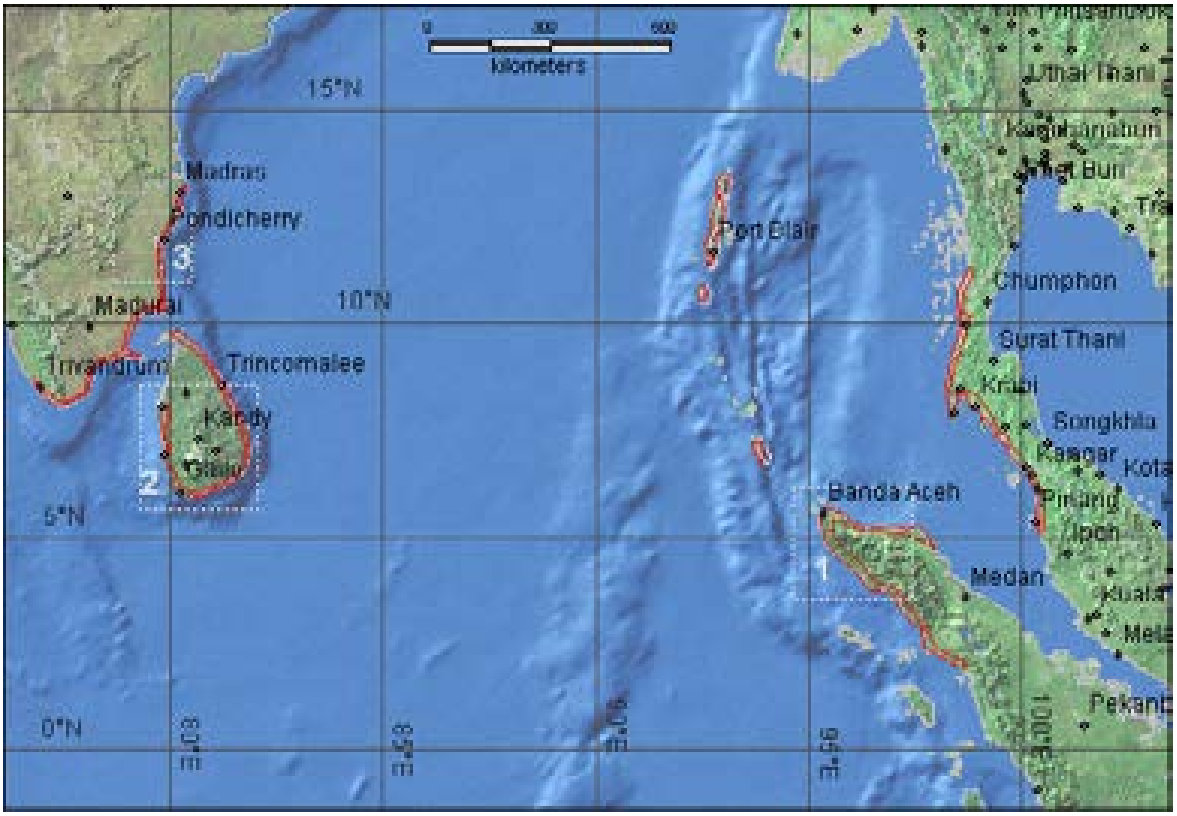


No.:	TN_001	Published Year:	2004
Study/ Report Name:	Southern Asia - Earthquake and Tsunami - Indonesia, Sri Lanka and India (The Sumatra Earthquake of 26 December 2004)		
Access to Information:	http://www.dartmouth.edu/~floods/2004193.html		
Research Organization:	Dartmouth Flood Observatory		
Study Area (Country):	Indonesia, Sri Lanka and India		
Studied Hazard:	Tsunami (Inundation)		
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.:	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:			

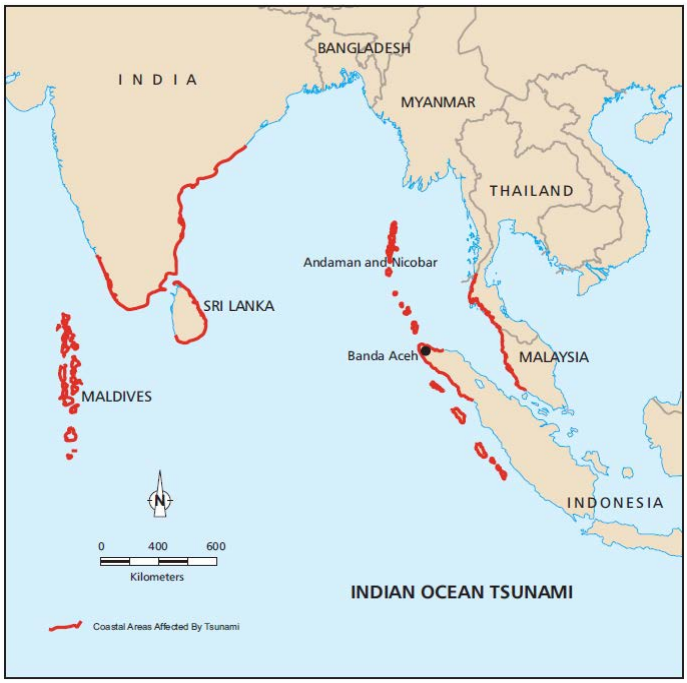
Summary of the Study:

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.

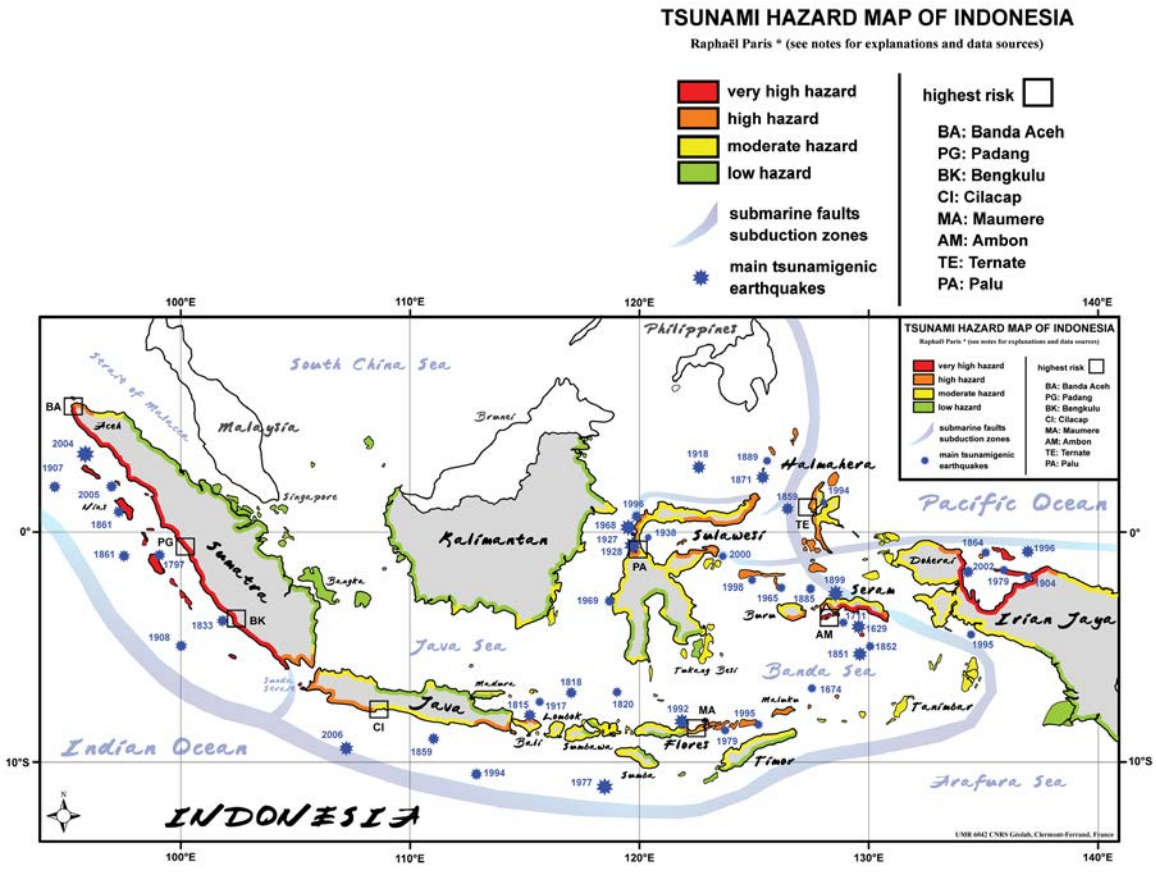


No.:	TN_003	Published Year:	2007
Study/ Report Name:	Tsunami Hazard map of Indonesia		
Access to Information:	http://raphael.paris.pagesperso-orange.fr/database/indonesia_tsunami.jpg		
Research Organization:	Firewaves: Volcanic Tsunami Working Group, UMR6042 Geolab		
Study Area (Country):	Indonesia		
Studied Hazard:	Tsunami hazard		
Studied Damage/ Risk:			
Main Data Sources:	NGDC (National Geophysical Data Center, NOAA) HTDB database (Tsunami Laboratory in Novosibirsk, Russia)		

Summary of the Study:

All the events listed in the database were integrated in a GIS environment and the Indonesian coasts were divided in 39 main areas. The main tectonic lineaments and a map of the cities and population densities provided by the ESRI network were added to the GIS earthquake databases (NGDC, USGS and Smithsonian Institution). The legend presents four levels of hazard: very high (more than 10 attested events since 400 years), high (5-10 events), moderate (4-2 events) and low (< 2 events).

http://firewaves.over-blog.com/article-a-tsunami-hazard-map-for-indonesia-80685148.html



No.:	TN_004	Published Year:	2006
Study/ Report Name:	Preliminary Damage and Loss Assessment: Yogyakarta and Central Java Natural Disaster		
Access to Information:	http://www.adb.org/publications/preliminary-damage-and-loss-assessment-yogyakarta-and-central-java-natural-disaster		
Research Organization:	Asian Development Bank (ADB)		
Study Area (Country):	Indonesia, Yogyakarta and Central Java		
Studied Hazard:	Earthquake, **Tsunami**		
Studied Damage/ Risk:	Mortality risk, GDP		
Main Data Sources:			

Summary of the Study:

This report presents a preliminary assessment of the damage and losses caused by the earthquake. The assessment used the international standard methodology for measuring disasters, and draws upon some of the best experts in the world. The report provides the government and the international community a clearer understanding of the impact of the disaster, and a basis for designing reconstruction and recovery programs. The report was prepared under the leadership of BAPPENAS, supported by a strong team of Indonesian and international specialists.

Figure 3: Disaster Risk Hotspots for Indonesia: Mortality risk

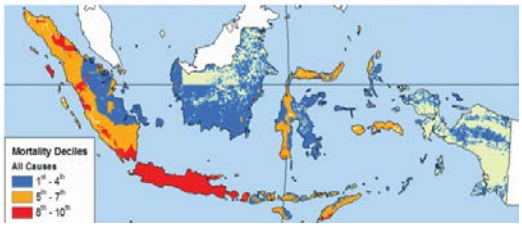
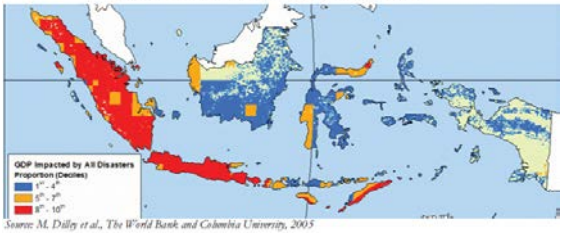


Figure 4: Disaster Risk Hotspots for Indonesia: GDP



Source: M. Dilley et al., The World Bank and Columbia University, 2005

Table 8: Summary of Damage and Losses (Rp Billion)

	Disaster Effects			Ownership	
	Damage	Losses	Total	Private	Public
Housing	13,915	1,382	15,296	15,296	0
Infrastructure	397	154	551	76	476
Transport and Communications	90	0	90	0	90
Energy	225	150	375	0	375
Water and Sanitation	82	4	86	76	10
Social Sectors	3,906	77	3,982	2,112	1,870
Education	1683	56	1739	584	1154
Health and Social Protection	1569	21	1590	1030	560
Culture and Religion	654	0	654	498	156
Productive Sectors	4,348	4,676	9,025	8,854	170
Agriculture	66	640	705	700	5
Trade	184	120	303	138	165
Industry	4063	3899	7962	7962	0
Tourism	36	18	54	54	0
Cross-Sectoral	185	110	295	48	247
Government	137	0	137	0	137
Banking and Finance	48	0	48	48	0
Environment	0	110	110	0	110
Total	22,751	6,398	29,149	26,386	2,763
Total, million US$	2,446	688	3,134	2,837	297

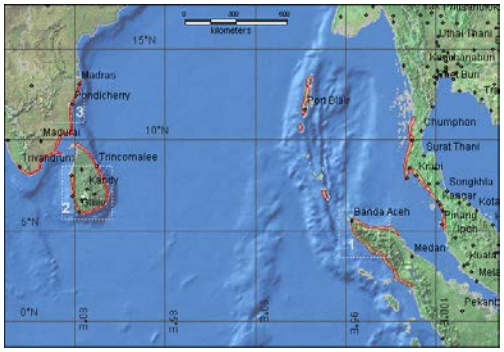
Source: Estimates by Joint Assessment Team

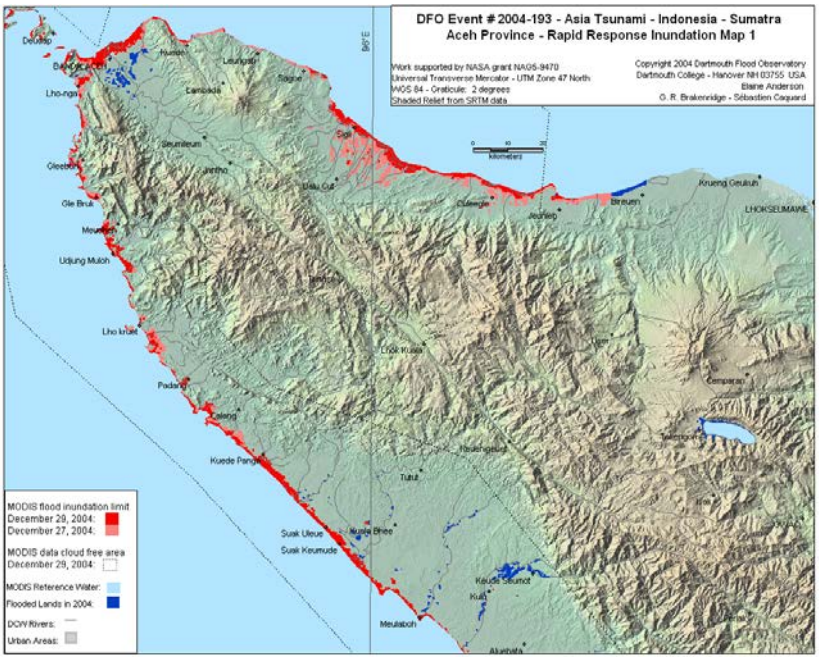
No.:	TN_005	Published Year:	2004
Study/ Report Name:	Rapid Response Inundation Map Southern Asia - Earthquake and Tsunami - Indonesia, Sri Lanka and India (The Sumatra Earthquake of 26 December 2004)		
Access to Information:	http://www.dartmouth.edu/~floods/2004193.html		
Research Organization:	Dartmouth Flood Observatory (DFO)		
Study Area (Country):	Indonesia - Sumatra – Aceh Province		
Studied Hazard:	Tsunami (Inundation)		
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.:	TN_006	Published Year:	continuously updated
Study/ Report Name:	Thematic Map of Tsunami (Peta Tematik / Tsunami)		
Access to Information:	http://geospasial.bnpb.go.id/category/peta-tematik/tsunami-peta-tematik/		
Research Organization:	Bandan Nasional Penanggulangan Bencana (BNPB) National Agency for Disaster Management		
Study Area (Country):	Indonesia		
Studied Hazard:	inundation area and casualties by Tsunami		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

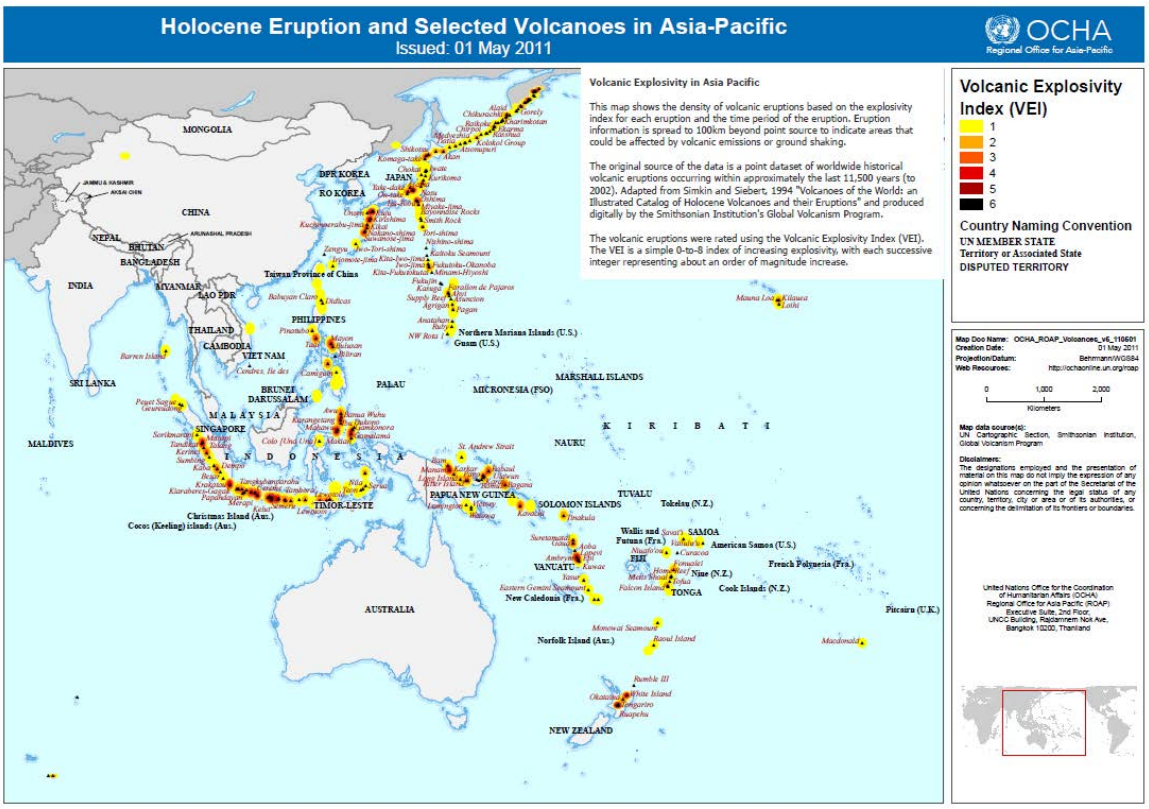
Maps are open on the web site of BNPB

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.

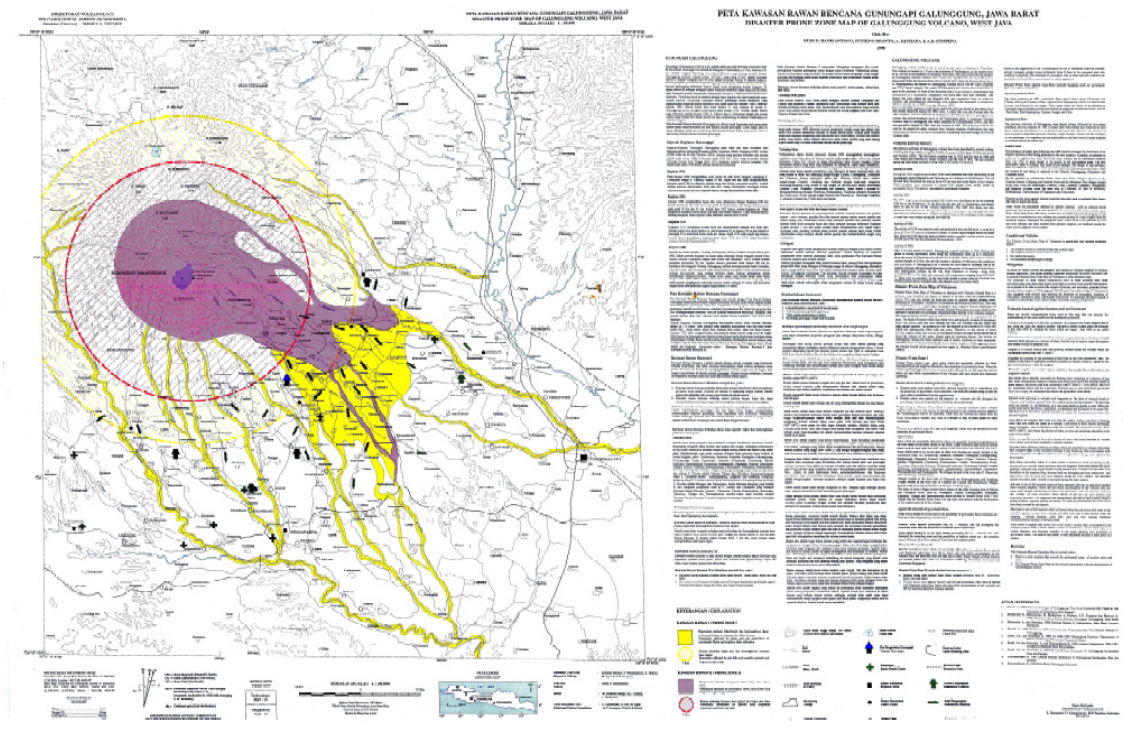
The volcanic eruptions were rated using the Volcanic Explosivity Index (VEI). The VEI is a simple 0 to 8 index of increasing explosivity, with each successive integer representing about an order of magnitude increase.



No.:	VE_002	Published Year:	continuously updated
Study/ Report Name:	Thematic Map of Volcano (PETA TEMATIK / GUNUNGAPI)		
Access to Information:	http://geospasial.bnpb.go.id/category/peta-tematik/gunungapi-peta-tematik/		
Research Organization:	Bandan Nasional Penanggulangan Bencana (BNPB) National Agency for Disaster Management		
Study Area (Country):	Volcanos		
Studied Hazard:	Banjir (Flood), Gempa (Earthquake), **Gunungapi (Volcano)**, Kebakaran (Fire), Kekeringan (Drought), Longsor (Landslide), Tsunami Peta Kawasan Rawan Bencana (KRB): Disaster Prone Area Map etc.		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

Volcanic hazard zone is shown as the following ranks, for example.
zone III: Frequently affected by pyroclastic flow, lava flow, ejected rock fragments
zone II: Potentially affected by pyroclastic flow, lava flow, glowing rock fragments and lahar
zone I: Potentially affected by lahar and the possibility of pyroclastic flow and lava flows.



No.:	CM-001	Published Year:	2002
Study/ Report Name:	Overview of Early Warning in Cambodia, Indonesia, Lao PDR, Philippines and Vietnam		
Access to Information:	http://www.adpc.net/pdr-sea/publications/OEWS.pdf		
Research Organization:	Asian Disaster Preparedness Center		
Study Area (Country):	Indonesia, Vietnam, Philippines, Lao PDR, Cambodia		
Studied Hazard:	Storm(heavy rain)		
Studied Damage/ Risk:	Hazard		
Main Data Sources:			

Summary of the Study:

Globally, the incidence of hydro-meteorological disasters has doubled since 1996. In the past decade, more than 90% of the people killed by natural hazards and lost their lives due to droughts, windstorms and floods, of which 85% of the total deaths were reported from Asia (WDR, 2001). Strengthening disaster reduction strategies throughout the region is an important step towards ensuring that natural hazards do not result in social and economic disasters.

The UN International Decade on Natural Disaster Reduction (IDNDR) Conference on Early Warning Systems for Reduction of Natural Disasters (held in Potsdam, Germany in September 1998) declared that the successful application of early warning is the most practical and effective measure for disaster prevention. Ultimately, the declaration continues, early warning systems must be comprehended by and motivate communities at greatest risk, including those disenfranchised and particularly disadvantaged people who must take appropriate protective actions. One of IDNDR's original program targets was for all countries to have in place, by the year 2000, ready access to global, regional, national and local warning systems as part of their national plans. Many governments and related disaster management organizations throughout Asia have already initiated Early Warning Systems; though, the resulting systems vary widely in their capacity to produce and communicate effective warnings. This report summarizes the findings of a study of Early Warning Systems in Cambodia, Indonesia, Lao PDR, Philippines and Vietnam, the countries targeted by the Disaster Preparedness Program of the European Commission Humanitarian Aid Office (DIPECHO). The study, conducted in accordance with the IDNDR objectives, was undertaken by Asian Disaster Preparedness Center's Partnerships for Disaster Reduction-South East Asia (PDR-SEA) project, which emphasizes the need to address disaster related issues within the context of sustainable development, with communities targeted as major beneficiaries1. Most broadly, the project aims to develop the capacities of communities to prevent or mitigate the impact of disasters.

This report attempts to raise awareness of the early warning systems in the respective countries and to provide a basis for further enhancing institutional mechanisms, technical capacities and community response options for reducing vulnerability to extreme climate events. The study has the following objectives:

• Review the international initiatives on early warning system

• Conduct a rapid appraisal of existing early warning system for hydro-meteorological hazards in DIPECHO target countries, and

• Undertake short case studies to assess community-level vulnerability and response to hydro-meteorological hazards.

Huge populations in the selected countries are highly vulnerable to hydro-meteorological hazards as large numbers of communities are settled in risk prone marginal areas. Fertile flood valleys, plains and deltas, such as the Lower Mekong River basin, are attractive to farmers as they provide access to livelihoods; but they are also most vulnerable to floods.

In urban areas, burgeoning populations are in many instances located in areas vulnerable to hazards such as tropical storms. This study is limited to the EWS for hydrometeorological hazards focusing on tropical cyclone and floods as recommended in the proposal approved by the European Commission Humanitarian Aid Office (ECHO).

No.:	CM-02	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-003	Published Year:	2011
Study/ Report Name:	CLIMATE VARIABILITY AND CLIMATE CHANGES, AND THEIR IMPLICATION		
Access to Information:	http://www.undp.or.id/pubs/docs/Final%20Country%20Report%20-%20Climate%20Change.pdf		
Research Organization:	UNDP		
Study Area (Country):	Indonesia		
Studied Hazard:			
Studied Damage/ Risk:	Hazard		
Main Data Sources:			

Summary of the Study:

In the past four decades, climate related hazards such as floods, droughts, storms, landslides and wild fires have caused major loss of human lives and livelihoods, the destruction of economic and social infrastructures as well as environmental damages. Within the period of 2003-2005 alone, there were about 1,429 disaster incidences in Indonesia. About 53.3% were hydro-meteorological disasters (Bappenas and Bakornas PB, 2006). Of this figure, floods occur most often (34%), followed by landslides at 16%. A report from UN-OCHA (2006) indicates that Indonesia is one of the vulnerable countries to climate related hazards (Figure 1). In the future, a changing climate brought about by global warming is expected to create new patterns of risk, and higher risks generally. Sea level rise due to melting glaciers and polar ice and thermal expansion will contribute to the increase of coastal flooding. Increasing intensity of tropical cyclones observed in recent decades may be tied to increasing sea surface temperatures. By impacting the hydrologic cycle, global warming is expected to alter climatic ranges, shift regional climatic averages, resulting in shifting of climate zones, and lead to a higher frequency and amplitude of weather events. Climate variability and change occurring against a backdrop of increasing global population and globalization of economic processes may be expected to lead to increased competition over resources and new vulnerabilities. With the increase of climate risk, many countries, particularly least developed and developing countries, may have difficulties to achieve the Millennium Development Goals related to poverty, hunger and human health.

This country report describes briefly the type of climate hazards in Indonesia and their impact on various sectors, trends of climate change in the past and climate change scenarios in the future as well as their implication on the sectors. Views from sectors on how to address this climate change impact are summarized in the last chapter. The country report was developed based on data and information provided by sectors, reviewed journal articles and project reports. Scientific explanations are not discussed in detail, however, where

relevant, short notes on the methodology used for data analysis are provided as foot notes.

No.:	LS-003	Published Year:	2006~
Study/ Report Name:	National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL)		
Access to Information:	www.bakosurtanal.go.id/multihazard/		
Research Organization:	National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL)		
Study Area (Country):	Indonesia		
Studied Hazard:	Mass movement, Flood		
Studied Damage/ Risk:	Disaster Risk		
Main Data Sources:	PU,ESDM,BMG		

Summary of the Study:

1)overview

In the middle of 2006 was declared cooperation four government institutions there are; National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL), Department of Public Works (PU), Department of Mineral Resources and Energy (ESDM), and Geophysics and Meteorology Agency (BMG). The scope of this project was build disaster map on national and local scale especially focused on flood and mass movement disaster with the same used of based (topographic) map which prepared by BAKOSURTANAL then disaster spatial data supported by ESDM for mass movement disaster, PU supported for flood hazard data, while BMG giving for next 2 months rainfall prediction.

2)Disaster risk map

The actual output from this collaboration are disaster maps (flood and mass movement) , called one of the thematic maps, overlaying with rainfall prediction for 2 next months both on national or local level divide by provincial or regency administration boundary. The spatial disaster data is shown with the same based map and same map parameters as well as standard datum and reference of map projection.

The thematic map of Disaster risk cannot obtain from the web site. The explanation of this study is described by On Integrating of Multi-Hazard Mapping in Indonesia (Habib Subagio2009). http://www.gisdevelopment.net/application/natural_hazards/overview/mma09_habib.htm

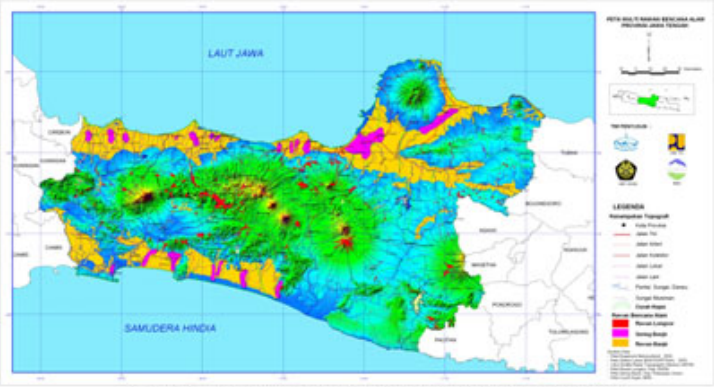


Fig.3: Map of Natural Multi Hazard in Center of Java Province

The sample of disaster risk map can see on that web site shown as blow.

No.:	LS-004	Published Year:	2006~
Study/ Report Name:	Pengenalan Gerakan Tanah (Introduction to Soil Movement) and Geology Hazard Vulnerability Mapping		
Access to Information:	http://www.esdm.go.id/publikasi/lainlain.html		
Research Organization:	Ministry of Energy and Mining Resouce(MEMR)		
Study Area (Country):	Indonesia		
Studied Hazard:	Landslide Tsunami Volcano Earthquake		
Studied Damage/ Risk:	Hazard area		
Main Data Sources:	Not clear		

Summary of the Study:

1)overview

This site explains general nature of landslide disaster in Indonesia, approximate amount of event and victim in 2003-2005 and hazard area of that country. The data of those are not so detailed but there are at local (province and regency) scale maps, which this agency developed with spatial analysis process from some parameters using GIS except on Map of Volcanic Hazard Areas due to already mapping in each volcanic area. This product is called Geology Hazard Vulnerability Mapping which contains of; Tsunami Inundation Area, Mass Movement Area, Land Stability Index, Earthquake Hazard Area, and other thematic maps which supported of these products Map of Earthquake Hazard Areas in Indonesia.

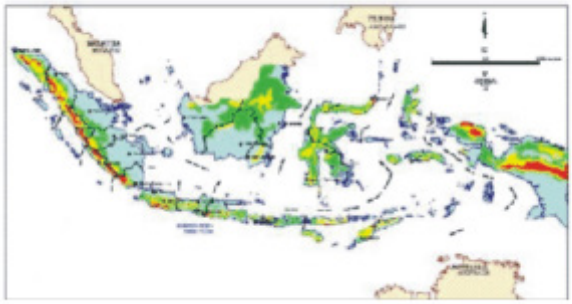
The detailed maps are not shown in the web-site.

Events and Victim of Landslide 2003-2005

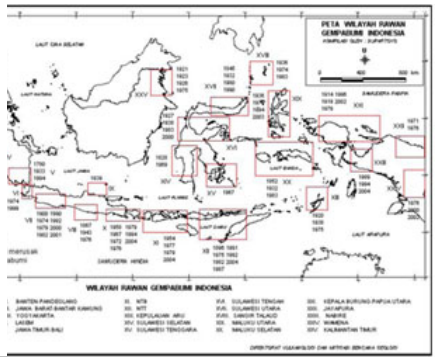
DAFTAR KEJADIAN DAN KORBAN BENCANA TANAH LONGSOR 2003-2005

No.	Propinsi	Jumlah Kejadian	Korban Jiwa		RH	RR	RT	LPR (ha)	JL (m)
			MD	LL					
1.	Jawa Barat	77	166	108	198	1751	2290	140	705
2.	Jawa Tenah	15	17	9	31	22	200	1	75
3.	Jawa Timur	1	3	-	-	27	-	70	-
4.	Sumatera Barat	5	63	25	16	14	-	540	60
5.	Sumatera Utara	3	126	-	1	40	8	-	80
6.	Sulawesi Selatan	1	33	2	10	-	-	-	-
7.	Papua	1	3	5	-	-	-	-	-
	Jumlah	103	411	149	256	1854	2498	751	920

PETA ZONA KERENTANAN TANAH LONGSOR INDONESIA



(Landslide Vulnerability Zone Map IN.)



(Index map of detailed landslide vulnerability zone)

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

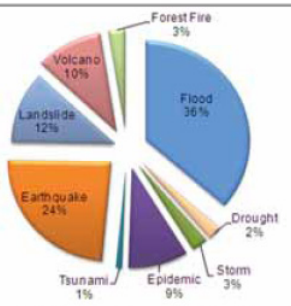


Figure 8: Percentage distribution of reported disasters in Indonesia

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, Earthquakes, Storms, Volcanoes		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

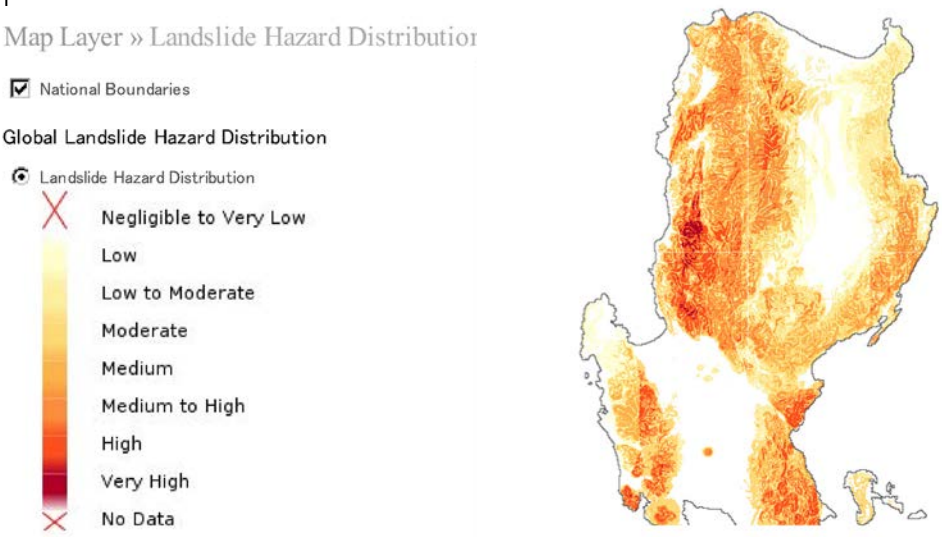
1)overview

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 Distribution Map indicating Northern Philippines



No.:	LS-008	Published Year:	2011
Study/ Report Name:	Disaster risk management programs for priority countries - 2nd edition		
Access to Information:	http://www.unisdr.org/we/inform/publications/20049		
Research Organization:	UNISDR(united nations office for disaster risk reduction)		
Study Area (Country):	Indonesia, Vietnam, Philippines, Lao PDR, Cambodia,		
Studied Hazard:	All natural hazards		
Studied Damage/ Risk:	Profile, management framework, activities about disaster risk		
Main Data Sources:	The world bank, EN-DAT		

Summary of the Study:

1)overview

This report is studying several aspects about disaster risk reduction, such as risk profile, management framework, activities and organization, concerning donor engagement and global facility to prepare comprehensive programs for disaster risk management and climate change adaptation for the next three to five years in each of the priority and donor earmarked countries by GFDRR (global facilities for disaster risk reduction). The following steps are undertaken to develop the country programs.

1. Investigation of a) the underlying risk factors and b) the progress in the five priority areas of the Hyogo Framework for Action;
2. stocktaking of ongoing risk reduction and climate change adaptation programs by key stakeholders, including UN agencies, multilateral and bilateral donors, and other partners;
3. identification of key gaps at national, sector, and local levels;
4. solicitation of proposals from different government and non-government entities and concerned donor agencies;
5. analysis of the solicited proposals and consensus building in a consultative process involving a range of stakeholders, including relevant government ministries, UN organizations, multilateral and bilateral donors, INGOs and civil society actors;
6. development of strategic comprehensive programs of support based on the gathered information.

2)Framework and assessment of present condition

In the report, those assessments are described as each countries separately.

1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation

2: Identify, assess and monitor disaster risks and enhance early warning

3: Use of knowledge, innovation, and education to build a culture of safety andresilience at all levels

4: Reduction of the underlying risk factors (reduction of exposure and vulnerability and

increase of resilience)

5: Disaster preparedness, recovery and reconstruction at national, regional, and local levels

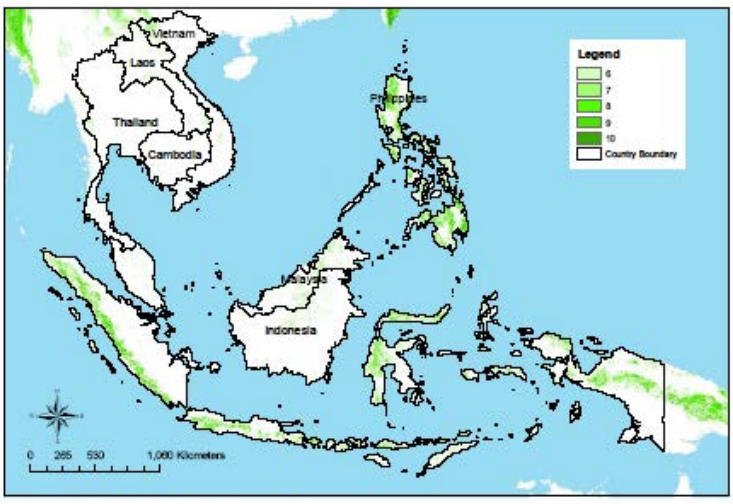
No.:	LS-013	Published Year:	2009
Study/ Report Name:	Climate Change Vulnerability Mapping for Southeast Asia		
Access to Information:	http://web.idrc.ca/uploads/user-S/12324196651Mapping_Report.pdf		
Research Organization:	Economy and Environment Program for Southeast Asia (EEPSEA)		
Study Area (Country):	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.



Appendix 2D. Landslide exposure (2005)

The map shows Landslide exposure changing rate caused by Climate change

No.:	LS-14	Published Year:	2010
Study/ Report Name:	THE PREPARATORY STUDY ON DISASTER MANAGEMENT PROGRAM FOR INDONESIA		
Access to Information:	http://libopac.jica.go.jp/search/detail.do?rowIndex=0&method=detail&bibId=0000252755		
Research Organization:	JICA		
Study Area (Country):	INDONESIA		
Studied Hazard:	earthquake, flood, landslide, destructive wind, tsunami, volcano		
Studied Damage/ Risk:	The GOI policy, their achievements, current situation and critical issue on disaster management sector		
Main Data Sources:	EM-DAT,		

Summary of the Study:

1)overview

The target of the program is set to contribute to peace and prosperity in Indonesia through strengthening the comprehensive disaster risk management framework, which will increase the country's ability to cope with disasters at any stage of disaster risk management cycle (Preparedness, Mitigation, Emergency Response, Rehabilitation/Reconstruction).

2)outputs

Areal distribution of natural disasters is investigated using the EM-DAT. Highly disaster-prone areas of each natural disaster are summarized as follows.

- Landslide: North-western part of Sumatra, Java, Sulawesi and Nusa Tenggara

Identified issue of Disaster Management Cycle (HFA) and Disaster Type analysis (as shown in blow) are those.

- Many of donors cover HFA Priority 1, 2, and 3, and all types of disasters (not disaster specific)
- Response is different from types of disasters, therefore, disaster specific projects need to be implemented or considered
- Earthquake disaster especially in HFA Priority 4 on Risk Reduction is lacking
- Also, Tsunami, Volcanic disaster in HFA Priority 4 is lacking

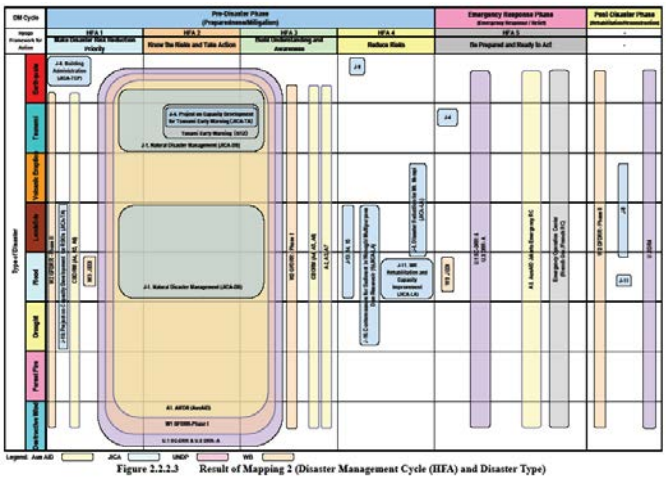


Figure 2.2.2.3 Result of Mapping 2 (Disaster Management Cycle (HFA) and Disaster Type)

No.:	LS-15	Published Year:	On going
Study/ Report Name:	Indonesia Scenario Assessment for Emergencies (InaSAFE)		
Access to Information:	http://inasafe.org/index.html		
Research Organization:	BNPB/AIFDR/GFDRR		
Study Area (Country):	Indonesia		
Studied Hazard:	Flood, Earthquake, Tsunami		
Studied Damage/ Risk:	Real-time Hazard simulation		
Main Data Sources:	BNPB/AIFDR/GFDRR.		

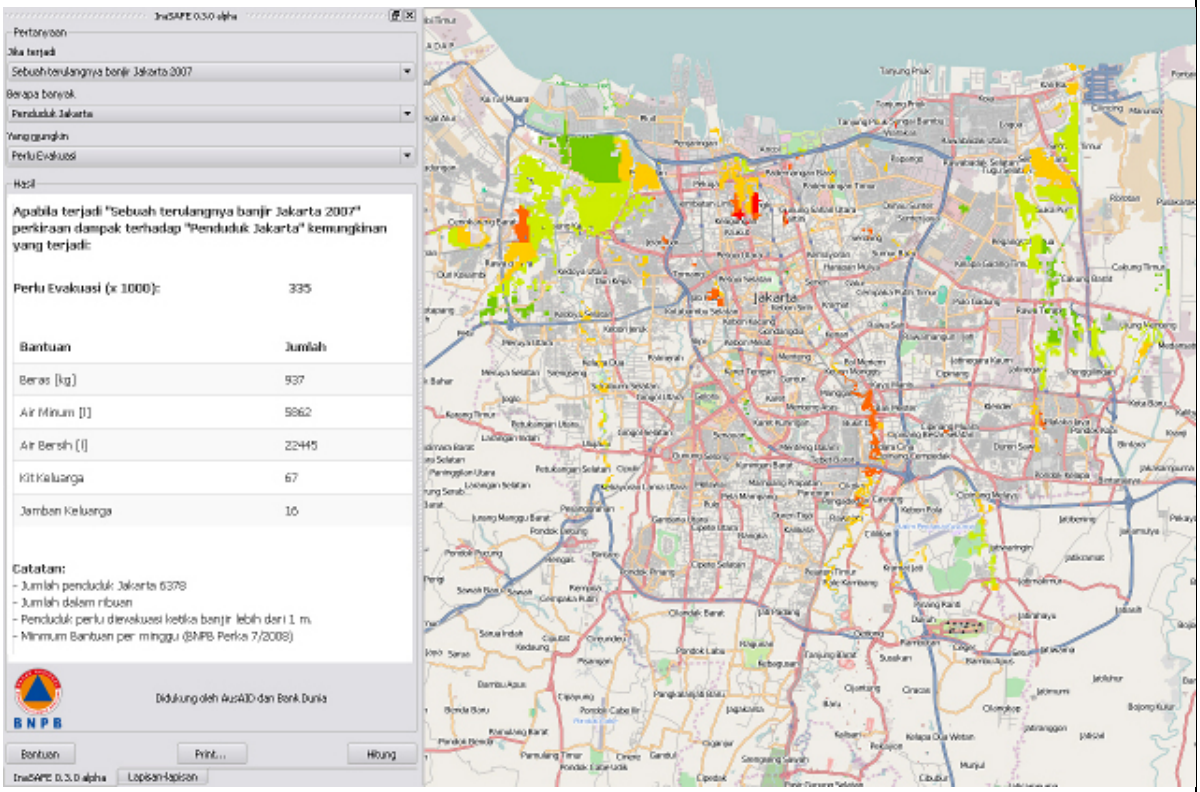
Summary of the Study:

1)overview

Indonesia Scenario Assessment for Emergencies (InaSAFE) is free software that produces realistic natural hazard (Tsunami, Flood, Tephra) impact scenarios for better planning, preparedness and response activities.

Effectively preparing for a disaster requires people from a wide range of sectors and backgrounds to effectively work together and share their experience, expertise, and resources.

A sample of out put (Jakarta flood simulation)



No.:	LS-16	Published Year:	2008
Study/ Report Name:	Preparatory Study of the Countermeasure Project for “Banjir Bandang” (in Japanese)		
Access to Information:	http://libopac.jica.go.jp/search/detail.do?rowIndex=41&method=detail&bibId=0000245004		
Research Organization:	JICA		
Study Area (Country):	Indonesia		
Studied Hazard:	Landslide, Flash flood		
Studied Damage/ Risk:	Disaster record,		
Main Data Sources:	BNPB		

Summary of the Study:

1)overview

Indonesia has experienced a major disaster by the tsunami and accompanying earthquake off the coast of Sumatra in December 2004. On this occasion, in relation to disaster management coordination of activities, the Presidential Decree (No.83-2005) will be issued in 2005, the central government BAKORNAS (National Disaster Management Coordination Committee), on the state level disaster management SATKORLAK(State disaster management coordinating committee), on the prefecture level disaster management SATLAK(Prefecture disaster Management coordination Committee)to adjust to disaster management activities across the organization at each level. Coupled with the promotion of decentralization of administrative functions, some organizational changes related to disaster management are implemented at the level of each country, state, prefecture. It is a on-going step of disaster management. BAKORNAS was reorganized and renamed BNPB (Advisory Board for Natural Disaster) in October 2007.

2)result and collected data

The result of this project is summarized in that web-site.

http://www.jica.go.jp/project/indonesia/0800040/materials/index.html

a sample of collected data are show as below ,in which disaster of flash flood is described.

表 3.2　インドネシアにおける過去 6 年間の災害発生件数と犠牲者数（2002 年から 2007 年）

災害の種類	発生件数	犠牲者数(人)	年間平均		1 件当犠牲者
			件/年	人/年	
地震(Gempa Bumi)	68	7,061	11	1,177	104
地震＋津波(Gempa Bumi dan Tsunami)	2	166,628	0	27,771	83,314
火山噴火(Letusan Gn. Api)	23	6	4	1	0
地すべり(Tanah Longsor)	357	914	60	152	3
洪水＋地すべり(Banjir dan Tanah Longsor)	154	1,280	26	213	8
洪水(Banjir)	1,227	1,114	205	186	1
台風(Angin Topan)	323	56	54	9	0
大波/侵食(Gelombang Pasang/Abrasi)	63	3	11	1	0
技術的破壊(Kegagalan Teknologi)	56	1,425	9	238	25
山火事と野火(Kebakaran Hutan dan Lahan)	37	8	6	1	0
火災(Kebakaran)	286	88	48	15	0
社会騒乱(Konflik/Kerusuhan)	37	2,244	6	374	61
テロ/破壊行為(Aksi Teror/Sabotase)	25	309	4	52	12
気候変動(Perubahan Cuaca)	1	95	0	16	95

No.:	LS-17	Published Year:	2009
Study/ Report Name:	The Study on Natural Disaster Management Plan		
Access to Information:	http://libopac.jica.go.jp/search/detail.do?rowIndex=7&method=detail&bibId=0000246685		
Research Organization:	JICA		
Study Area (Country):	Indonesia(Junburu prefektur, provinsi dan Padang Ammann Paris,Kota Pariaman)		
Studied Hazard:	Flood, Landslide, Earthquake, Tsunami		
Studied Damage/ Risk:	Hazard and Risk		
Main Data Sources:	-		

Summary of the Study:

1)overview

The hazard assessment of natural disasters in the studying area and implementation and its evaluation about the status of disaster prevention in the level of each community and the local government at the national government have been studied.

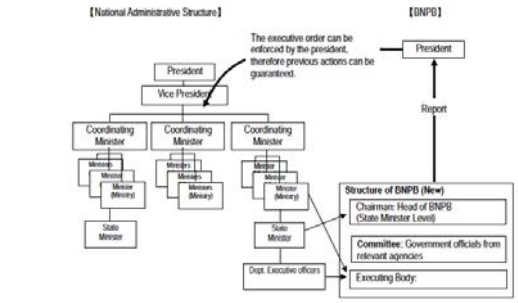
The project recommended the plan for construct a comprehensive disaster prevention management at the level of both the countries and regions of Indonesia.

2)output

The disaster prevention level of Indonesia have been studied and present systems, such disaster records and administration structures are summarized in selected areas (Jember kabupaten, Pariaman kabupaten and Preaman City) as shown in below.

As a test-case, a hazard map and risk map of that areas is created from the collected data.

Preparedness system and emergency measures in each country and provincial levels are recommended.



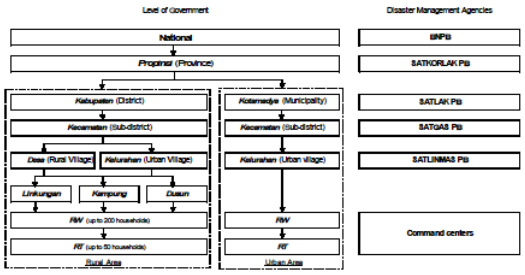
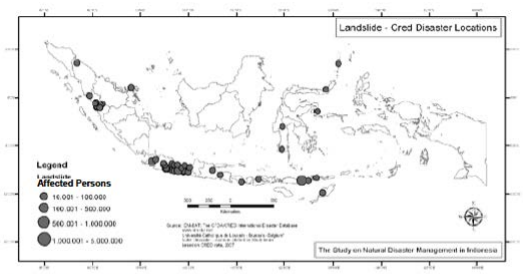
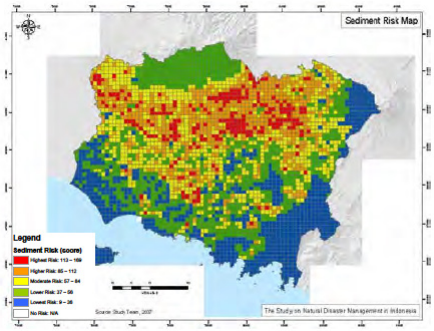


図 3.1.3 インドネシアの地域行政及び防災体制



出典: EM-DAT: OFDA/CRED 国際災害データベース

図 2.2.6 土砂災害発生位置と被災者数



Appendix 3:
List of Industrial Parks in Indonesia

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
ID0001			Indonesia	North Sumatera	Medan Industrial Area	Jalan Perdana Kota Medan 20231
ID0002			Indonesia	North Sumatera	Medanstar Industrial Estate	NO ADRESS
ID0003			Indonesia	North Sumatera	Pulahan Seruai Industrial Estate	NO ADRESS
ID0004			Indonesia	West Sumatera	Padang Industrial Park	Jalan Mohammad Yamin Sh,Kota Padang
ID0005			Indonesia	Riau	industrial park Dumai	Jendral Sudirman Kota Dumai 28826
ID0006			Indonesia	Riau	industrial park Tanjung Buton	NO ADRESS（Sumatera）
ID0007		**XXID01**	Indonesia	Batam	Batamindo Industrial Park	Jalan Gaharu-Batamindo Indurty Park Kota Batam 29433
ID0008		**XXID04**	Indonesia	Batam	Bintang Industrial Park	Near Harris resort (Julan Brigien Katamso Tanjang Vncang Batang)
ID0009		**XXID08**	Indonesia	Batam	Kabil Integrated Industrial Estate	Jalan Pattimura Kota Batam 29467
ID0010		**XXID19**	Indonesia	Batam	Panbil Industrial Estate	Jalan Ahmad Yani-Komplek Panbil Industri Kota Batam 29433
ID0011			Indonesia	Batam	Puri Industrial Park 2000	Jalan Raya Puri 61363
ID0012		**XXID25**	Indonesia	Batam	Tunas Industrial Park	Jalan Mekar Sari 3 Kota Bekasi 17112
ID0013			Indonesia	Batam	Union Industrial Park	Unnamed Rd Kota Batam 29444
ID0014			Indonesia	Batam	West Point Maritime Industrial Park	Jalan Jend. A. Yani Kota Batam 29433
ID0015		**XXID03**	Indonesia	Bintan	Bintan Industrial Estate	Bintan Island Riau Archipelago, Indonesia
ID0016			Indonesia	Jakarta	CilandakCommercial Estate	Jalan Sekolah Duta 5 22 Kota Jakarta Selatan 12310
ID0017			Indonesia	Jakarta	Pulogadung IndustrialArea	Pulo Asem Utara 10 11 Kota Jakarta Timur 13220
ID0018		**XXID18**	Indonesia	Jakarta	Nusantara Bonded Zone	Nusantara Kota Depok 16451
ID0019			Indonesia	Banten - Cilegon	Cilegon IndustrialArea	Jalan Kyai Haji Tubagus Ismail Kota Cilegon 42418
ID0020			Indonesia	Banten - Cilegon	Jababeka Industrial Estate	Jalan Kh. Ahmad Dahlan 23 Kota Cilegon 42441
ID0021			Indonesia	Banten - Cilegon	MGM Cikande Integrated IndustrialPark	Jalan Kh. Ahmad Dahlan 23 Kota Cilegon 42441
ID0022		**XXID17**	Indonesia	Banten - Cilegon	Modern Cikande Industrial Estate	KM. 68 Bakung Cikande Banten, Indonesia
ID0023			Indonesia	Banten - Tangerang	Cikupamas Industrial Area & Warehousing	Jalan Ki Samaun 28 Kota Tangerang 15118
ID0024		**XXID14**	Indonesia	Banten - Tangerang	MilleniumIndustrial Estate	Jalan Millenium Raya III, Blok H1, Millenium Industrial Estate, Desa Peusar,, Panongan, Banten 15710
ID0025			Indonesia	Banten - Tangerang	Bumi Serpong Damai Techno Park	Jalan Ki Samaun 28 Kota Tangerang 15118
ID0026			Indonesia	West Java - Bogor	Cibinong CenterIndustrial Estate	Jalan Kampung Cikempong 2 Cibinong 16915
ID0027			Indonesia	West Java - Bogor	Sentul IndustrialArea	Jalan Lan Bau 25 16810
ID0028			Indonesia	West Java – Sumedang	Rancaekek IndustrialArea	Cibalong Satu 45355
ID0029			Indonesia	West Java – Karawang	BukitIndah Industrial Park	Jalan Benda Sari I 147 Karawang Timur 41371
ID0030	**XXID11**	**XXID11**	Indonesia	West Java – Karawang	Kujang IndustrialArea	Near Jalan Teluk Jambe Indonesia

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
ID0031			Indonesia	West Java – Karawang	International Industrial City Area	Jalan Benda Sari I 147 Karawang Timur 41371
ID0032	**XXID15**	**XXID15**	Indonesia	West Java – Karawang	Mitrakarawang IndustrialArea	Jalan Ms Al-Koriah, Setu, Bekasi, Jawa Barat 17320
ID0033	**XXID21**	**XXID21**	Indonesia	West Java – Karawang	Suryacipta City ofIndustry	Jalan Peruri, Ciampel, Karawang 41363
ID0034			Indonesia	West Java – Karawang	Daya Kencanasia Industrial Park	Pair Huni 40379
ID0035			Indonesia	Central Java	Candi Industrial Area	Jalan Satria Utara 2 Kota Semarang 50257
ID0036			Indonesia	Central Java	TuguWijaya Kusuma IndustrialArea	Kandangan Rowo Senen 56281
ID0037		**XXID23**	Indonesia	Central Java	Terboyo Semarang IndustrialArea	Semarang, Central Jawa, Indonesia
ID0038			Indonesia	Central Java	Wonogiri IndustrialArea	Parkit Wonogiri 57611
ID0039			Indonesia	Central Java	Bugangan Baru Semarang Small Industry Community	Jalan Musi Kota Semarang 50126
ID0040			Indonesia	Central Java	Bukit Semarang Baru Industrial Park	Kandangan Rowo Senen 56281
ID0041			Indonesia	Central Java	Tanjung Emas Export Processing Zone	Jalan Pemuda Rembang 59217
ID0042			Indonesia	West Java - Purwakarta	Lion Industrial Area	Cimaung Purwakarta 41116
ID0043	**XXID27**	**XXID27**	Indonesia	West Java - Purwakarta	Kawasan Industrial Indotaisei Kota Bukit Indah	Purwakarta, West Jawa
ID0044	**XXID09**	**XXID09**	Indonesia	West Java - Purwakarta	Kota BukitIndah Industrial City	Near Kota Bukit Indah Plaza Hotel Blok L, Kota Bukit Indah, Purwakarta, Jawa Barat 41181, Indonesia
ID0045	**XXID02**	**XXID02**	Indonesia	West Java Bekasi	Bekasi International Industrial Estate	Stasiun Bekasi Kota Bekasi 17143
ID0046	**XXID05**	**XXID05**	Indonesia	West Java Bekasi	EastJakarta Industrial Estate	Kompl Industry Ejip Plot 7L Lemhbng Cikrang Barat Kabupaten Bekasi Jawa Barat, Indonesia
ID0047	**XXID06**	**XXID06**	Indonesia	West Java Bekasi	Greenland International Industrial Centre	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0048	**XXID07**	**XXID07**	Indonesia	West Java Bekasi	Jababeka Industrial Estate	Jalan Industry Pasir Gonbong, Indonesia
ID0049			Indonesia	West Java Bekasi	Gobel IndustrialArea	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0050			Indonesia	West Java Bekasi	Indonesia China Integrated Industrial Area	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0051	**XXID12**	**XXID12**	Indonesia	West Java Bekasi	Lippo Cikarang Industrial Park	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0052			Indonesia	West Java Bekasi	MarundaCenter	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0053			Indonesia	West Java Bekasi	MM2100 Industrial Town – BFIE	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0054	**XXID16**	**XXID16**	Indonesia	West Java Bekasi	MM2100 Industrial Town – MMID	Jalan Kampung Rawa Lele Timur No.45, Cibitung, Bekasi, Jawa Barat 17520
ID0055			Indonesia	West Java Bekasi	PatriaManunggal Industrial Estate	Jalan Perjuangan Raya 15 Kota Bekasi 17143
ID0056			Indonesia	East Java	Gresik Industrial Area	Jalan Harun Tohir Jalan Harun Tohir Gresik 61113
ID0057			Indonesia	East Java	Ngoro Industrial Park	Jalur Gempol - Mojokerto Ngoro 61385
ID0058			Indonesia	East Java	Surabaya Industrial Estate Rungkut	Siak Kota Surabaya 60241
ID0059			Indonesia	East Kalimantan	KaltimIndustrial Estate	NO ADRESS（Kalimatan Timur）
ID0060			Indonesia	East Kalimantan	Kariangau IndustrialArea	Jalan Soekarno Hatta Kota Balikpapan 76127
ID0061		**XXID13**	Indonesia	South Sulawesi	MakasarIndustrial Area	Jalan Gamba Puang 91712
ID0062			Indonesia	Central Sulawesi	Palu Industrial Area	Jalan Mangga Kota Palu 94111

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
ID0063		**XXID22**	Indonesia	Batam	Taiwan International Industrial Estate	Jalan Jend. A. Yani Kota Batam 29433
ID0064		**XXID10**	Indonesia	Banten - Cilegon	Krakatau Industrial Estate	Jalan Kh. Ahmad Dahlan 23 Kota Cilegon 42441
ID0065		**XXID20**	Indonesia	East Java	Pasuruan Industrial Estate Rembang	Jalan Kyai Haji Wachid Hasyim Kota Pasuruan 67116
ID0066		**XXID24**	Indonesia	East Java	Tuban Industrial Estate	PT Kawasan Industri Gresik, Jl. Tridharma 03 Gresik, East Java,Indonesia
ID0067	**XXID26**	**XXID26**	Indonesia	West Java - Karawang	Karawang International Industrial City	Industri KIIC Karawang 41361, West Java, Indonesia

Appendix 4:
General Investment Risk of Indonesia

(1) Political Risk

Indonesia is a republic headed by a president who is both head of state and commander-in-chief of the armed forces. President Susilo Bambang Yudhoyono, a former Army general, was re-elected for his second and final five-year term in July 2009. Yudhoyono heads the Partai Demokrat (PD), which has the most seats - 148 out of 560 - in the legislature, the People's Representative Council. The PD is in coalition with four of the largest Islamic political parties. The other main parties are Golkar, which has 106 seats and is in the coalition, and the Indonesian Democratic Party-Struggle (PDI-P) with 94 seats. Golkar was the dominant political party under President Suharto, while former President Megawati Sukarnoputri heads the PDI-P. These three main parties do not differ substantially in their political platforms and will tend to favor populist policies ahead of elections, including raising subsidies.

President Yudhoyono relies heavily on businessman-turned-politician Abu Rizal Bakrie, who is the head of Golkar, to push through politically sensitive laws. His support was instrumental in pushing through the partial removal of oil subsidies earlier this year as well as encouraging lower barriers for foreign investment. This is likely to continue despite Bakrie's falling public popularity because of financial irregularities in his family business as he retains the support of his party.

The military played a prominent role in politics under President Suharto. Since 1999, its role in governing the country has decreased, formally ending in 2004. The military's marginal political role makes a military coup unlikely.

The next presidential and parliamentary elections are scheduled for 2014. The ruling PD has done poorly in opinion polls; due partly to President Yudhoyono's declining popularity and multiple corruption scandals. The current president Yudhoyono is constitutionally banned from seeking a third consecutive term and will therefore stand aside ahead of the 2014 poll. There is no clear successor for Yudhoyono within his party and the prospects of the ruling party are marginal at best. Meanwhile, the PD's coalition partners, Golkar and the Indonesian Democratic Party of Struggle (Partai Demokrasi Indonesia Perjuangan: PDI-P), have seen their support levels rising in tandem with the reigning party's downfall. It is likely that one of these big secular

parties, which have the required wealth and regional connections, will be forming the next coalition government. Golkar has particular advantages in terms of wealth and political networks. Gerindra, the largest newcomer to Indonesia's political scene, is also a potential player in the making.

As a result of popular fear that domestic firms and workers will lose out to foreign competition, Indonesian politicians have passed multiple populist indigenization policies as elections have drawn near. These policies narrow the operating space for foreign firms and increase local ownership requirements. Since 2011, such policies have been passed in the retail, banking, mining and oil and gas sectors. If Golkar comes to power in 2014, the enforcement of such policies is likely to be softened, and new indigenization measures are less likely. Should PDI-P or Gerindra come to power, this trend is likely to continue, if not accelerate.

(2) Economic Risk

Domestic demand propelled Indonesia to 15-year growth peak in 2011 and will remain the key driver of the economy in the near term. On the back of strong consumer and business confidence, household spending and investment should continue to grow at a brisk pace despite persistent global headwinds. Thanks to robust domestic demand, Indonesia's economy should clock in growth of 6.1% in 2013, following last year's 6.2% expansion. Both private consumption and investment continue to grow at a fast clip owing to rising incomes and inflows of foreign direct investment as foreign firms seek to capitalize on the country's favorable demographics and natural resources. Domestic demand is at some risk from the government’s implementation of fuel subsidy cuts from 22 June 2013 on, although we do not currently expect this to dramatically weaken demand it will certainly limit upside surprises.

The Indonesian rupiah (IDR) has been the worst performing emerging market Asian currency in 2012. To help bolster the rupiah's value, the central bank (BI), in August 2012, reduced terms for foreign exchange hedging contracts to one month from three months and raised the floor for money market rates to 4% from 3.75% to absorb excess rupiah liquidity. These measures combined with the extra liquidity from the US Federal Reserve's quantitative easing that began in September 2012, helped the IDR to appreciate slightly against the dollar. Despite this, by December 2012, the IDR had depreciated to around 9,650 to the dollar, or by about 6.5% for 2012. However, a

currency crisis is unlikely in the next year largely because foreign exchange reserves totaled USD 110 billion in November 2012, covering around seven months of imports. Moreover, at end-2011 domestic and external debt combined stood at 25% of GDP. These favorable figures are probably underlying BI's tolerance of a declining rupiah. For 2013, the government projects growth of around 6.6%, accounting for weaker demand from European and the US.

BI has not introduced any capital controls recently, having put several measures in place between 2008 and 2010. However, further capital controls would be likely if external economic conditions were to again deteriorate. In late 2008, BI reacted to possible currency speculation by requiring Indonesian nationals or firms purchasing over USD 100,000 in foreign currency to provide evidence of the transactions underlying the exchange. Foreign nationals and firms were limited to making currency purchases over USD 100,000 only through spot transactions. In June 2010, the government introduced further measures to make investors commit funds for longer durations, stipulating that investors in the bank's debt paper must hold the bills for at least 28 days. Bank Indonesia also widened spreads on its overnight deposit and lending rates and began selling longer-dated SBIs.

Financing investment initiatives has become easier and less costly in the wake of Indonesia's return to investment-grade sovereign credit rating status. Direct investment inflows have been hitting record highs in 2011–2012, bearing witness to Indonesia's growing appeal as an investment destination. These positive trends reflect progress made in the past decade in improving the business environment and reducing debt. The government has lowered corporate tax rates, modestly reduced rampant tax evasion, eased red tape, introduced critical new legislation, and taken concrete steps to clarify the regulatory environment. As a result, Indonesia has been improving its standing in global competitiveness rankings. However, prevalent corruption and infrastructure limitations remain key restrictions on foreign investment. Foreign investors are often compelled to pay bribes or risk facing delays and other impediments to their investments on both a national and a local level.

(3) Legal Risk

Indonesia's regulatory and legal environment can be opaque, incoherent, and time-consuming. Laws are subject to inconsistent interpretation and enforcement,

and many foreign investors see the unreliable legal environment as the main challenge to starting a business in Indonesia.

The legal system is based on a combination of Roman-Dutch law, indigenous customary law, and Islamic law. Since the country's independence in 1945, government rhetoric has long promoted the continuing rationalization and modernization of laws and regulations. Following the restoration of political stability and the accession to power of Indonesia's first democratically elected government in 2004, there have been moves to revise significant portions of the legal framework. These attempts are highlighted by four major amendments to Indonesia's Constitution every year from 1999 to 2002, dealing with issues such as the decentralization of authority from the central government to provincial and regional governments, human rights provisions, and the creation of additional constitutional bodies such as the House of Regional Representatives and the Constitutional Court.

Despite promises of legal reform, the judiciary remains weak and corrupt, and the introduction of deregulation under the 2001 Autonomy Law has added further layers of complicated rules and regulations for foreign investors to deal with. Provinces have taken over responsibility for various regional-level legislation, including tax and the handling of revenue from the extraction of natural resources. The central government remains in charge of legislation in such areas as foreign policy, security, defense, justice, and monetary/fiscal matters. The current government of President Yudhoyono has prioritized the modernization of the legal system. It will, however, take some time before the ramifications of these enhancements are felt and the complex legal system is turned into a more efficient one. Entrenched corrupt business practices and deficiencies in law enforcement are also likely to be much harder to remedy than weaknesses in the legal system.

(4) Tax Risk

The Indonesian tax system is in the process of continuous reform, but progress has been slow. The main sources of revenue, besides oil and gas, are income taxes – personal and corporate. Indonesia has a high personal income tax rate and a moderate corporate tax rate by regional standards. The corporate income-tax reduction was concluded in January 2010. The system relies heavily on withholding taxes, reflecting the difficulties in revenue collection. Tax evasion is a major problem in Indonesia where the tax system works on a self-assessment basis and taxpayers are

trusted to register, calculate their income generated and the tax payable, and report to the tax office. The government therefore urgently needs to widen the tax base. The decentralization process that commenced in 2001, allowing for more regional autonomy, has resulted in a greater risk that additional taxes are levied at provincial level. Improved budget allocation along with better public financial management systems would lead to substantial efficiency gains on a regional level, while, on the national level, efforts to improve tax administration and spending efficiency are a priority. Currently, there is, however, little supervision of the tax office's activities and corruption is perceived as rife in the Indonesian tax system.

(5) War Risk

Indonesia and Malaysia have a number of disputed maritime borders. The most significant of these is the Ambalat maritime dispute. This surfaced in 2005 after oil reserves were found in Ambalat, and both countries deployed naval forces to guard the area. In 2008, Indonesia's Parliament lodged a protest against alleged territorial violations by Malaysian troops in the area. Malaysia refers to oil blocks in the area as ND6 and ND7, which are both partially within the disputed territory. Both countries have awarded exploration rights to companies there. Malaysia awarded Shell Oil and PETRONAS Carigali Sdn Bhd joint exploration rights in 2005, while Indonesia awarded the Italian energy company ENI similar rights.

Despite this, military conflict between Indonesia and Malaysia over the Ambalat dispute is unlikely, as economic and diplomatic relations have improved. In 2002, a previous maritime dispute between the two countries concerning the Sipadan and Ligitan Islands was resolved by the International Court of Justice in Malaysia's favor. It is likely that the dispute will also be diplomatically resolved. Until then, protests by the respective navies over encroachment by their counterparts across the disputed boundary are probable. In 2010, Indonesia was considering the possibility of managing the territory with Malaysia, with joint naval patrols. But this has not been acted upon since. There is a moderate risk of naval skirmishes involving ramming, but commercial vessels in the area are unlikely to be harassed.

Interstate conflict with East Timor is unlikely. Relations between Indonesia and East Timor have improved significantly since the latter won independence, despite accusations by East Timor that East Timorese rebels had crossed into Indonesia to seek refuge in 2006. While Indonesia has admitted that a lack of military capacity means it

is unable to monitor rebel movements across the common border effectively, it has initiated joint patrols with East Timorese troops, particularly around East Nusa Tenggara. Indonesia investment is also increasing in East Timor. In December 2012, Indonesian state-owned PT Waskita Karya said that it will expand its operations in East Timor in 2013.

(6) Terrorism Risk

There have been multiple large-scale Islamist militant attacks in Indonesia against commercial properties that have resulted in significant property damage and loss of life. Several of these attacks have targeted Western assets, including the 2002 and 2005 Bali bombings. There have been subsequent attacks on Western targets including the 2009 Ritz-Carlton and Marriott attacks in Jakarta. Counterterrorist police have since succeeded in disrupting various cells and killing or capturing key militants. Further, we assess the new generation of militants will probably change this pattern.

Cells are now more dominated by new recruits that are less experienced and more locally focused. These recruits have backgrounds in vigilante groups and are unlikely to have trained in Afghanistan or the Philippines, reducing their capability to crude IEDs. As they are less connected to the global jihadist movement, they are less likely to follow the traditional jihadist target pattern, i.e. Western diplomatic and commercial interests. Rather, target sets will probably include 'un-Islamic' assets (including alcohol and music stores, bars and nightclubs), security forces, local government assets and central and local government officials perceived to be opposed to an Islamic state. Overall, this reduces the risk to commercial assets such as hotels and shopping malls, which fall outside the target set of most cells. Areas likely to be targeted include Cirebon, Poso, Ambon, Makassar and the urban areas of Java. Groups which do target Western diplomatic assets lack the capability, unity and organization to successfully carry out attacks.

Separately, in Papua, there is a low-intensity separatist conflict headed by the Free Papua Movement (OPM) which is likely to target the US-based mining firm Freeport-McMoRan's Grasberg mine. OPM militants are likely to mount road ambushes targeting migrant workers. In September 2012, suspected OPM militants fired at Freeport Indonesia buses carrying mine employees on two occasions, but injured no one. Since February 2012, the military has been providing support in securing the Grasberg mine area, mitigating the risk posed by separatists slightly.

(7) Civil Unrest Risk

Protests in Indonesia occur frequently and are driven by a wide range of issues. Land-related protests are likely to increase after President Yudhoyono implemented regulations forcing landowners to sell for infrastructure construction in August 2012. Infrastructure projects have stalled over land disputes and experience protests once they are completed. In December 2012, a few dozen farmers protested against the government in Pahlawan, Central Java, after they were forced to leave their land to make way for the Logung dam in kudus Regency. Palm oil and biofuel cultivation are a probable source of land-related protests. Biofuel production increased to 1.52 billion from 781 million liters in 2011 year-on-year. This is expected to reach 2.2 billion liters in 2013. Thousands in East Kalimantan in June 2012 protested against a palm oil company's plans to clear their land to make way for a plantation.

Mining-related protests are likely to increase and become more violent as a surge in illegal mining and mining permits awarded without the consent of locals becomes politicized in the 122 local elections taking place in 2013. In December 2012, the police identified 900 likely hotspots for conflict between miners and locals across the country. Mine protests are likely in Sumbawa, Papua, Sulawesi and North Sumatra.

Protests against perceived insults to Islam are also probable. Although these are normally peaceful, they become violent occasionally and pose an elevated risk of property damage. In September 2012 protesters in Jakarta threw bricks and Molotov cocktails at the US embassy after the release of an US-made anti-Islamic video. In Medan, protesters forcibly closed McDonalds and KFC branches. There is also an elevated risk of communal unrest based on religious differences. Such events are exacerbated by the Blasphemy Laws that protesters perceive validate their actions. In August 2012, 1,000 people attacked homes belonging to members of a minority Muslim sect in Sukabumi. Such unrest is unlikely to affect commercial assets.

Volatility in the price of commodities is likely to trigger protests. The police, in March 2012, deployed around 14,000 personnel to control thousands of protesters marching on the Presidential Palace in Jakarta after a fuel price increase was announced. Protesters also occupied Polonia International Airport for five hours, disrupting flights. The protests remained peaceful throughout, but further protests over fuel prices have the potential to turn violent.

Generally, national level, industry-wide strikes are unlikely, but reform to labor laws, likely after 2014 elections, is likely to lead to protests lasting a day or two in multiple cities. More often, there are day-to-day contract negotiations, strikes and protests at the factory or work-site level. These normally involve local grievances ranging from the availability of free cigarettes to workers to unpaid wages. The number of strikes has gradually increased since the end of the Suharto era in 1998, but the right under the law to fire striking workers gives employers an advantage during industrial action. Further, while the number of employees in some sectors is large (e.g. 200,000 employed in the timber sector in Kalimantan alone), the low-skilled nature of their occupations leaves them little bargaining power. And so although strikes may be more frequent, wide-scale industrial action is rare due to workers' dependence on daily wages and their weaker bargaining position, reducing business disruption risks.

(8) Infrastructure Risk

A lack of investment in infrastructure since the Asian Financial Crisis means that infrastructure limitations are increasingly undermining Indonesia's competitiveness and ability to attract foreign investment. Despite strong recent economic growth, there are significant factors that will hinder a sector-wide turnaround in the infrastructure sector in the next five years. Public opposition to hikes in fares is likely to constrain the government's options for privatizing key rail, marine and aviation facilities and utilities operators ahead of elections in 2014. Further, allowing utilities providers to set their own tariffs would be a major indicator of political will to reform the power sector; however, the decision not to raise electricity rates in 2011 suggests that this is also unlikely prior to 2014.

Another factor contributing regulatory uncertainty is that while new legislation, such as the Railway Law and Electricity Law, is aimed at dismantling underperforming state infrastructure monopolies, this has yet to be accompanied by clear implementing regulations and procedures which facilitate the entry of private investors. The government intends to draw USD 47.3 billion from public private partnerships up to 2014, but the formula is still largely untested. In the last decade, only USD 2 billion has been realized in new investments from these projects. The outlook for change is therefore likely to be characterized by sustained but gradual improvements in infrastructural performance and national/international connectivity, as poorly-managed and inadequately funded state-owned enterprises dominate the

infrastructure sector up to 2014. Other key issues that are likely to derail or at least slow down the implementation of projects include land acquisition disputes and delays caused by communal protests.

Roads: The existing road infrastructure compares unfavorably with neighboring countries, particularly in rural areas. Travel by road is the primary means of passenger and cargo transportation in Indonesia, but Indonesia's road density is lower than its regional peers, including the Philippines, Malaysia, Thailand and Vietnam, at just over 0.2 km per km². Furthermore, of the country's 437,759 km of roads, just under 60% are paved (against 99% in Thailand and 81% in Malaysia). Road development has been outstripped by vehicle sales, which numbered roughly 1 million cars and 3.5 million motorcycles per year over the last decade. This has led to increasing stress on the quality of roads and bottlenecks across the country. Costs to business are significant due to additional maintenance, accidents and time constraints incurred. As a result, goods transportation is on the whole inefficient and costly when compared to other Asian countries. Given that approximately 70% of freight is transported by trucks, Indonesia's road infrastructure is an impediment to trade and investment, with implications for a number of sectors. Local disputes over land rights constrain efforts to improve road infrastructure.

Rail: Indonesia's rail network is among the worst performing networks in the region. Indonesia has 5,824 km of railway tracks, making it the longest network in Southeast Asia. With only 4,337 km in operation, however, the sector has been severely neglected. Annual growth of rail has been only 4% for the last 25 years. As a result, performance is low due to poor and dated facilities. Tracks, signals and telecommunications systems are old and in bad shape, which also contribute to a high accident rate. Delays are frequent due to the poor quality of infrastructure, which needs continual attention. Locomotive upgrades and repairs take 30 days on average to complete, in comparison to modern standards which take 7-10 days. As such, rail shoulders only a modest part of the burden placed on overland transport, accounting for 17% and just 0.6% of passenger and freight transport respectively. By far the greatest application of rail passenger transport is in Java, where two long-distance routes link Jakarta with Surabaya and Yogyakarta and shorter routes link the capital with Bandung and Cirebon.

Ports: Indonesia has some 111 commercial ports (with 25 major commercial ports), 614 non-commercial ports and about 1,000 private ports that deal with specialized cargo such as specific commodities. The commercial ports are managed by the state-owned port operator PT Pelabuhan Indonesia (Pelindo), which is divided into four separate jurisdictions across the country. These Indonesian Port Corporations (IPCs) have long maintained a national monopoly over port authority and the provision of services. Private management is limited to a handful of foreign companies involved in joint-ventures with the regional state-run operators (known as Pelindos). Privatization is a slow process, and any major restructuring of port operations will likely increase the risk of strikes and protests by port unions. Despite their importance, Indonesia's public ports suffer from a significant shortfall in capacity, and are slow and expensive to use compared to other Asian economies. Congestion is a major concern, with ships running through Indonesia's main ports facing long waiting times, spending less than half of their turnaround time actually working. Also, the cost of shipping a 40 foot container from Padang (West Sumatra) to Jakarta is estimated at USD 600, whereas the cost of transporting the same container over the greater distance between Jakarta and Singapore costs USD 185. These expenses are compounded by poor transport logistics around ports and limited dry port infrastructure which inhibit the movement of cargo in and out of ports. Logistically, a major constraint is the centralization of shipping around a small number of container ports, meaning that cargo in and out of remote islands has to be transshipped through a central hub, typically a port in Java.

Airports: Despite public private partnership initiatives, most airports have not seen major investments in decades and are struggling to keep up with increasing demand. There are presently 210 airports in Indonesia, of which some are overseen by state-owned PT Angkasa Pura. Some smaller airports are operated separately through local governments or the Ministry of Transportation. There are some PPPs underway, but overall private uptake in airport projects has been limited. Freight transportation by air is relatively underdeveloped, and consists mostly of the shipment of perishable goods, much of which is trans-shipped via Singapore. On the other hand, between 2002 and 2006, passenger transport increased five-fold.

Power: Indonesia has an installed electricity generation capacity of around 44.5 GW. Some 57% of this is owned by the state-owned provider Perusahaan Listrik Negara (PLN), which, until the government passed its electricity law in 2009, was the sole

provider of power in the country. The remaining share is accounted for by the 10,000 or so industrial and manufacturing units that see to their own power supply. Electricity production is heavily dependent on non-renewable feedstock, which is vulnerable to external price shocks (as in the case of diesel fuel) or entails an opportunity cost in terms of the non-export of domestic resources (as with natural gas). Indonesia's electricity sector is beset by inadequate capacity and inefficient transmission and distribution infrastructure. Electrification rates are lower than elsewhere in Southeast Asia, with large disparities by province. Having not seen substantial investment in decades, most power plants, the majority of which are located in Java, are inefficient, meaning that actual production falls far short of PLN's generating capacity. However, in areas where electricity is more readily available (e.g. Jakarta), subsidization encourages increased consumption by domestic and industrial consumers, and electricity demand has increased by roughly 7% annually over the last few years. Many businesses already regard poor electricity supply as a major hindrance to their operations.

Water: Water supply is increasingly compromised by pollution, poor management and the low level of state and private investment in the sector. The use of water in the agricultural sector accounts for 58.5% of consumption, and this, along with rising industrial and domestic consumption is putting significant pressure on supply. Water use was calculated at 591 billion liters/day in 2005 and is forecast to rise to 1,131 billion liters by 2015. Demand in Jakarta is growing, with the city needing an additional 13% supply by 2012. Piped water is available to just 24% of the population, but even in Jakarta some 35% of residents are reliant on other sources such as ground water, which may be contaminated, or bottled water, which comes at a considerable cost. The outlook for supply is deteriorating, as rising sea levels threaten coastlines and pose the risk of fresh water salinization. Similarly, water degradation is an increasingly acute problem as industry and the population expand, resulting in rivers effectively ending up as disposal grounds for industrial and household waste.