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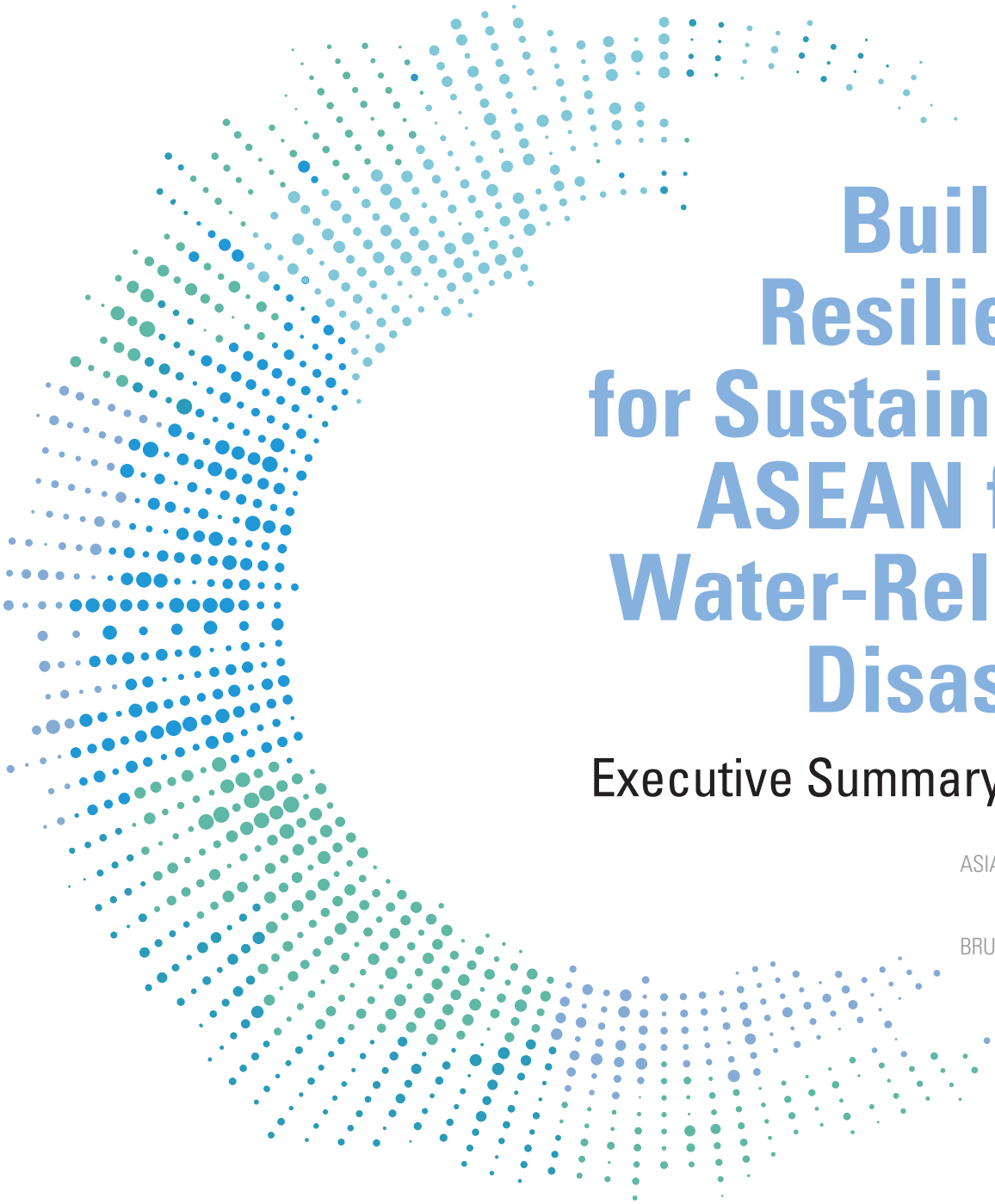

Building Resilience for Sustainable ASEAN from Water-Related Disasters

Executive Summary Report

ASIA AND THE PACIFIC
ASEAN
BRUNEI DARUSSALAM
CAMBODIA
LAOS
MALAYSIA
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CGWF 춘천국제물포럼 CHUNCHEON GLOBAL WATER FORUM

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ROK-ASEAN Cooperation Projecton

" Building Resilience for Sustainable ASEAN from Water-related Disasters"

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- Director CHIN, Jang Chul / HONG, Ilpyo
- Coordinator Jihyeon PARK (Irene)
- Administration KWON, Yongbum / OH, Yeonok

Published in April 2017

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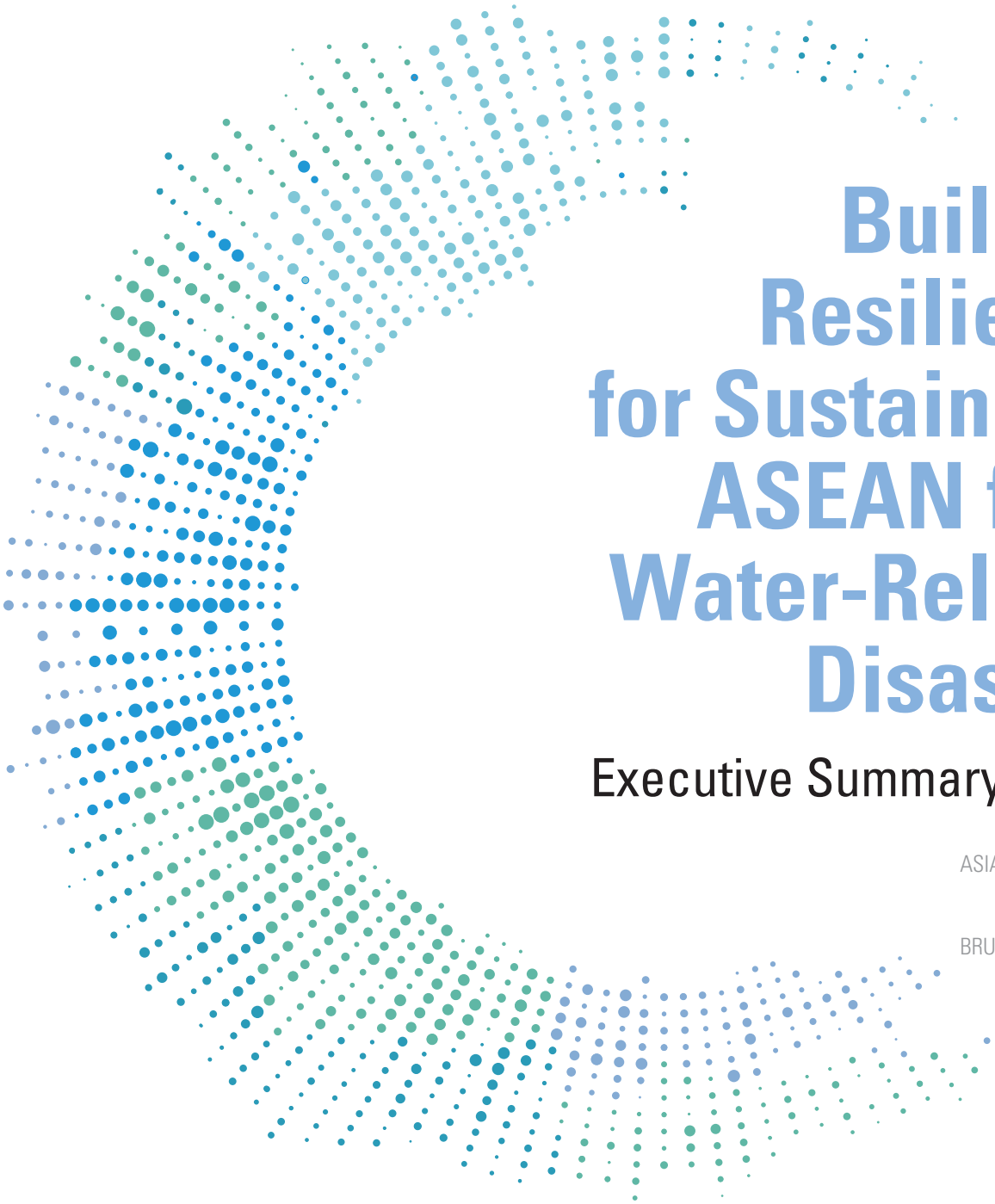

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Message from the Secretary-General of ASEAN

As in other regions, water in ASEAN is an essential resource for sustaining life, ecosystems and socio-economic development in the ASEAN Member States. With 80 percent of the ASEAN region surrounded by water, the ASEAN region is prone to water-related disasters such as floods, cyclones and storm waters. Collaborative actions across the relevant sectors in ASEAN need to be strengthened so as to address the issues of water-related disasters in a holistic manner and to build a resilient region.

I wish to commend the completion of the project "Building Resilience for Sustainable ASEAN from Water Related Disasters" and the publication of the project results. The project is in line with and contributes to the implementation of the ASEAN Socio-Cultural Community Blueprint 2025 striving for an ASEAN Community with equitable access to sustainable environment that can support its social development and its capacity to work towards sustainable development.

The publication of the project results will be a useful reference on the ASEAN Member States' responses to water-related disasters including institutional framework setup, experiences and best practices. The publication also features experiences and best practices from ASEAN Plus Three partners, namely the People's Republic of China, Japan, and the Republic of Korea.

My appreciation goes to the Chuncheon Global Water Forum for its effective implementation of the project. I would also like to convey sincere appreciation to the Republic of Korea for their continuous support to ASEAN in promoting environmental cooperation.

Thank you.

LE LUONG MINH

Secretary-General of ASEAN

Message by the Chair of High-level Experts and Leaders Panel on Water and Disasters (HELP)

Water is life. But water is also a threat to life. Issues of water and disaster resilience are so intimately related that it is impossible to think of one without the other. During the past decade, water-related disasters have not only struck more frequently but have also been more severe, hampering sustainable development by causing political, social, and economic upheaval in many countries.

The ASEAN region, with population of over 628 million people, is one of the most prone to natural disasters. More than half of global disaster mortality occurred in ASEAN region between 2004 and 2014. From 2000 to 2015, total economic loss from disasters in the region was US$91 billion. Climate change is projected to exacerbate the extremes in these disasters.

It comes as no surprise that disaster risk reduction and climate change adaptation are part of key agendas being considered in all recent global agreement. These include global goals emanating from the Sustainable Development Goals, the Sendai Framework for Disaster Reduction, and Paris Agreement on Climate Change. To address this issue, internationally there has been ongoing initiatives to elevate water and disaster to the highest level – through initiatives including United Nations Secretary-General's Advisory Board on Water and Sanitation (UNSGAB), High-level Experts and Leaders Panel on Water and Disasters (HELP), and most recently the High Level Panel on Water (HLPW), which commits itself to take action on water, and calls upon Heads of State and Government, and all people, to do the same.

This agenda is so important, that the UN General Assembly adopted a resolution in January 2017 to proclaim the period from 2018 to 2028 the International Decade for Action, "Water for Sustainable Development". UN General Assembly also expressed in the resolution that it is deeply concerned about water-related disasters will be further exacerbated by urbanization, population growth, desertification, drought and other extreme weather events and climate change, as well as lack of capacity to ensure integrated water resource management.

By sharing the experience and know-how of ASEAN Plus Three countries to cope with water-related hazards and disasters to build regional cooperation in tackling water and water-related disaster issues from a policy-making perspective.

HAN Seung-soo

Chair of the High-level Experts and Leaders Panel on Water and Disasters
UN Secretary-General's Special Envoy for Disaster Risk Reduction & Water
Special Advisor to the High-level Panel on Water
Former Prime Minister of the Republic of Korea

Acknowledgements

The Executive Summary Report is the product from ROK-ASEAN Cooperation Project on "Building Resilience for Sustainable ASEAN from Water-related Disasters". The findings, analysis and proposals for ASEAN regional cooperation derived from each focal ministry of ASEAN Working Group on Water Resources Management (AWGWRM) and a consultant who was selected by the ministry and made a contract with an implementing agency, Chuncheon Global Water Forum of the Republic of Korea. Dr. Keizrul bin Abdullah as the eminent water expert and who is the member of High-level Experts and Leaders Panel on Water and Disaster (HELP), led inspirational guidance and intellectual advice to draw out concrete outcome with close collaboration with ASEAN Member States and played pivotal role as a lead author. We are especially thankful to Jihyeon Irene Park as the coordinator for her support and contributions that led to the successful completion of the Report.

Appreciation is also extended for contributions from the following Ministries and authors: Ministry of Development of Brunei and Othman & Associates Consulting Engineer, Ministry of Environment of Cambodia and Chan Mony, Ministry of Natural Resources and Environment of Lao PDR and Khemngeun Pongmala, Ministry of Public Works and Housing of Indonesia and Hendarti, Department of Irrigation and Drainage of Malaysia and Dato' Ir. Hj. Hanapi bin Mohamad Noor, Ministry of Natural Resources and Environmental Conservation of Myanmar and U Chit Kyaw, Public Utilities Board of Singapore, in particular Mr. Han Loong Fong, National Water Resources Board of the Philippines and Yolanda Gomez, Ministry of Natural Resources and Environment of Thailand and Pongsak Suttinon, Ministry of Natural Resources and Environment of Vietnam and Dang Thi Lan Huong, UNESCAP and Mr. Kim, Sung-Eun.

Project inception meeting and formal consultations were held between June 2016 and February 2017 in Luang Prabang, Chuncheon, Jakarta and Seoul. We are grateful to the ASEAN Secretariat, institutions in host country and individuals to support in particular Mardiah Hayati, Natalia Derodofa, Lan Phousavanh, Daophaphone Bounphakhom, Hendarti and Indra Kurniawan, former ASEAN Secretariat colleagues Saroj Srisai and Riena Prashiddha for organizing these consultations.

Thanks also go again to Jihyeon Irene Park in planning, organizing and facilitating all the activities and the Chuncheon Global Water Forum Secretariat for their dedication in assisting this project and initial consultation.

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Executive Summary Report

Asia and the Pacific

Water-Related Disasters in Asia and the Pacific

Written by UNESCAP

Asia-Pacific is the most disaster-prone region in the world. Each year, countries in the region report large number of natural disasters including floods, storms, droughts, landslides, earthquakes and tsunamis. These affect millions of people, cause thousands of casualties and result in vast economic losses. Asia-Pacific countries also reported many disasters in 2016. Some of notable disasters are the winter-associated drought ('dzud') in Mongolia in January; floods and landslides in Sri Lanka, Indonesia, Myanmar and India in May and June; and floods and landslides triggered by heavy rainfall during monsoon season in Nepal, Bangladesh, Democratic Republic of Korea, Lao PDR and the Philippines in July and August.[1]

Among the disasters reported in the region, hydro-meteorological disasters such as floods and storms were the most frequent and had the widest impact on people. They often caused extensive devastation to infrastructure, buildings and roads which accounted for approximately $180 billion worth of economic damage over the period 2005-2014.[2] During the period, Southeast Asia suffered the most from water-related disasters.

According to the World Risk Report 2014, 9 of the 15 countries in the world with the highest exposure and risk are in Asia and the Pacific, including 3 countries from Southeast Asia, Brunei Darussalam, Cambodia, and the Philippines.[3] The high exposure to natural hazards and disaster risk of countries in Asia-Pacific are likely to increase considering growing population, expanding urban areas, as well as changing climate.

Noting the challenges from natural disasters for sustainable development, recent global agreements, namely the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015-2030, and the Paris Agreement on Climate Change, acknowledge disaster risk reduction as an integral component in achieving sustainability. Countries in the Asia-Pacific region have also recognized the high disaster risk, and made efforts to address disaster risk and build resilience.

To further promote the efforts for disaster risk reduction and resilience in the region, understanding the existing disaster risk is a critical step, as it will provide the basis for developing appropriate strategies and policies for risk management customized to natural and socio-economic characteristics of the region and respective countries. Moreover, it contributes to raising awareness on disaster risk facing at all levels, maintain political momentum and promote multi-stakeholder action to reduce the disaster risk where vulnerability and danger to such disasters have become dominant.

In this context, this chapter/section provides an overview of disaster risk in the Asia-Pacific region, while the most recurrent water-related disasters are given more emphasis. This is followed by an analysis of water-related disasters in the region with specific focus on South-East Asia, and by a brief discussion on the estimated annual average loss from natural disasters. The final section briefly introduces current regional cooperation mechanisms for addressing natural disasters and summarizes the chapter/section.

[1] OCHA Relief Web. Available from: http://reliefweb.int/disasters (Accessed on 7 October 2016).
[2] ESCAP (2015) Asia-Pacific Disaster Report 2015
[3] Alliance Development Network and UNU-EHS (2014) World Risk Report 2014

OVERVIEW OF NATURAL DISASTERS IN ASIA-PACIFIC

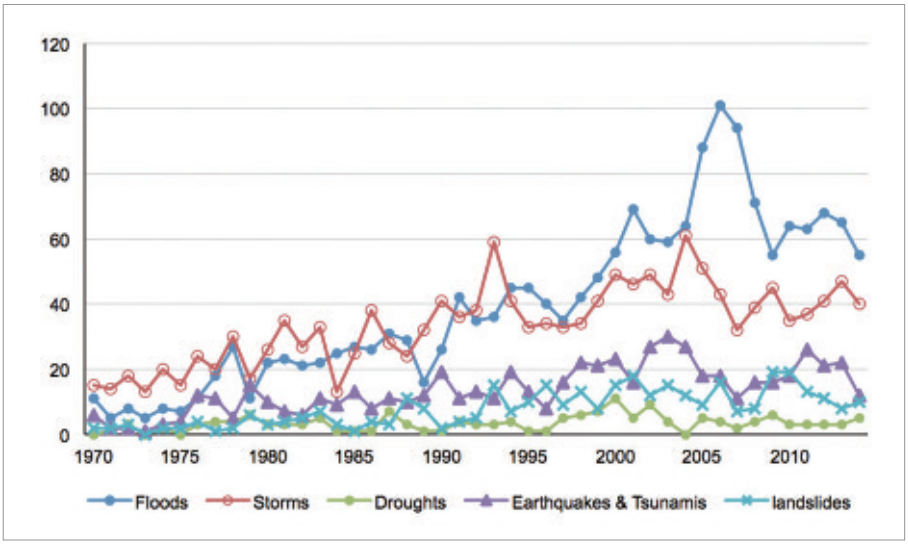
Between 1970 and 2014, Asia and the Pacific had 5,139 reported disasters including floods, storms, droughts, landslides, earthquakes and tsunami.[4] Of the disasters that occurred during the period, approximately 6 billion people affected and over 2 million people lost their lives in the Asia-Pacific region alone (Table 1).[5]

(Table 1) Occurrence and impacts of natural disasters by type of hazards in Asia-Pacific, 1970-2014

	Occurrence	Fatalities	Affected (Millions)	Damage, 1970-2013 (Billions, 2005 US dollars)
Flood	1,779 (34.6%)	199,733 (9.9%)	3,351 (55.7%)	369.7 (32.1%)
Storms	1,515(29.5%)	742,770 (36.8%)	871 (14.5%)	214.2 (18.6%)
Drought	153 (3.0%)	5,697 (0.3%)	1,625 (27.0%)	53.4 (4.6%)
Landslides	353 (6.9%)	20,696 (1.0%)	8.3 (0.1%)	3.1 (0.3%)
Earthquakes &Tsunamis	612 (11.9%)	916,876 (45.5%)	141 (2.3%)	472.2 (41.0%)
Others	727 (14.1%)	130,078 (6.5%)	24 (0.4%)	39.1 (3.4%)
Total	**5,139**	**2,015,850**	**6,019**	**1,151.9**

Source : EM-DAT : The OFDA/CRED International Disaster Database

Floods and storms were the two most frequent types of the disasters reported in the region. From 1970 to 2014, floods and storms combined accounted for 64.1 per cent of the total number of disasters and close to half of total lives lost. This indicates that Asia-Pacific region is more susceptible to recurring water-related disasters which makes the population constantly vulnerable and cause extensive damage. Moreover, reported numbers of water-related disasters have substantially increased during the past four decades (Fig.1).



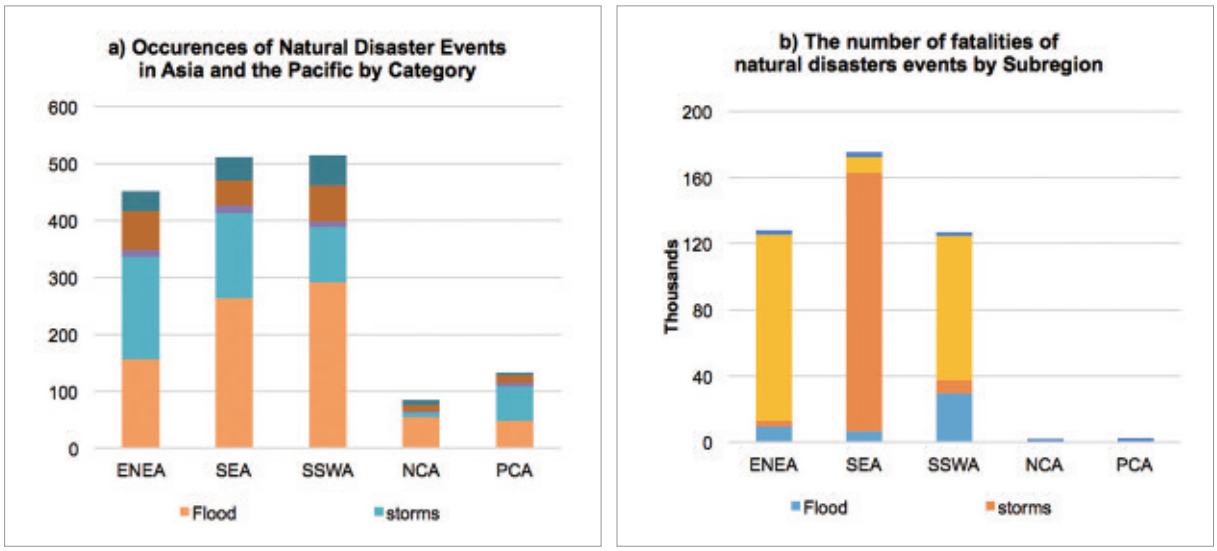
(Fig.1) Natural disasters recorded in Asia and the Pacific (1970-2014)
Source : EM-DAT : The OFDA/CRED International Disaster Database

[4] ESCAP (2015) Overview of natural disasters and their impacts in Asia and the Pacific 1970-2014
[5] ESCAP (2015) Overview of natural disasters and their impacts in Asia and the Pacific 1970-2014

Geophysical disasters such as earthquakes and tsunami were not as frequent as floods and storms, but earthquakes and tsunamis were deadliest disasters resulting in more than 900,000 fatalities. In 2011, Japan was hit by a tsunami caused by a magnitude 9.0 earthquake, and this was recorded as the world's costliest natural disaster with estimated economic damage of $165 billion.[6] The earthquake in Sichuan province in China in 2008 also lost 87,000 lives with economic damage of $60 billion.

Water-related disasters

Floods and storms are the most prevalent hazards in this region and there are compelling evidences of the destructive power of such disasters, while the fatalities from water-related disasters were mostly pronounced in South-East Asia (Fig.2). Some of the disasters of recent times in the region are: Cyclone Nargis in 2008 in Myanmar which resulted in 138,000 fatalities, displacement of around 800,000 people and 2.4 million people severely affected, Cyclone Ketsana in September 2009 in Philippines, catastrophic flood of October 2008 and January 2007 flood in Viet Nam and many others.[7&8]



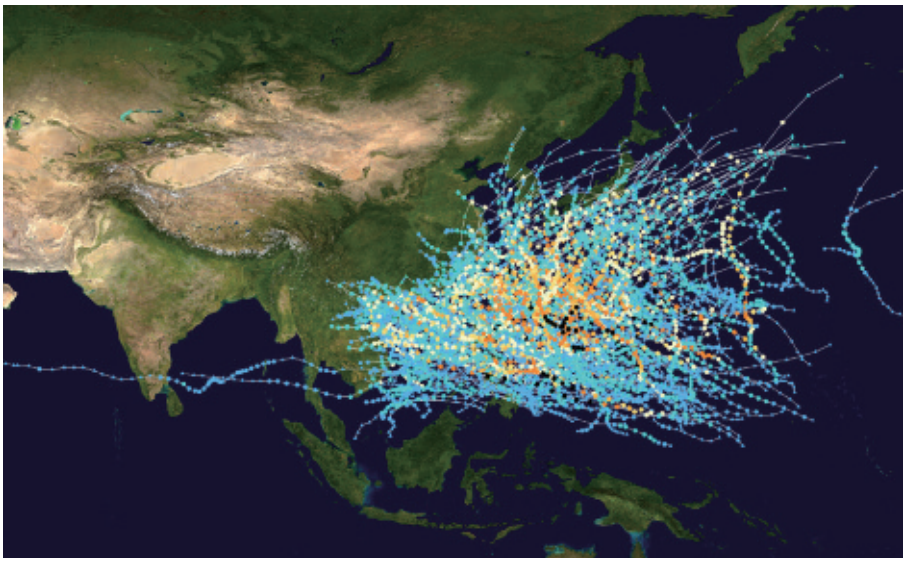
(Fig.2) Occurrences of natural disaster events in Asia and the Pacific by category
Source : EM-DAT : The OFDA/CRED International Disaster Database

Large-scale floods frequently transcend national borders and they often go beyond the capacities of individual countries to manage them. Large river systems and water bodies in Southeast Asia including the Mekong, Ayeyarwardy, Tonle Sap and Lake Toba have been supporting livelihoods, and riverine plains have been home to a large number of people, especially the poor, in the region. They are potentially exposed to recurrent water-related hazards that require coordination and cooperation at both subregional and regional level.

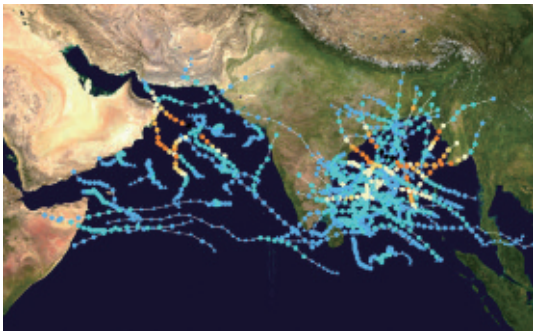
Among subregions in Asia and the Pacific, the most disaster-prone subregion was Southeast Asia, which witnessed the largest number of events (489 cases reported), of which 393 were water-related disasters.[9] South-East Asia is more susceptible to water-related disaster in particular because many of them are located along major typhoon tracks. On average, there are 86

[6] ESCAP (2015) Asia-Pacific Disaster Report 2015
[7] UNISDR (2010) Synthesis report on Ten ASEAN Countries Disaster Risks
[8] ESCAP (2015) Asia-Pacific Disaster Report 2015
[9] Data source : EM-DAT: The OFDA/CRED International Disaster Database.

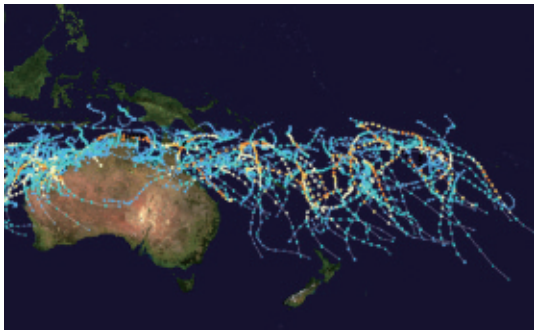
tropical cyclones reported globally each year, while around 50 to 60 arise in three ocean basins of Asia-Pacific.[10] In particular, countries in South-East Asia as well as East and Northeast Asia witness the largest number of tropical cyclones (Fig.3-a).



a) Western North Pacific Ocean and South China Sea



b) Bay of Bengal and the Arabian Sea



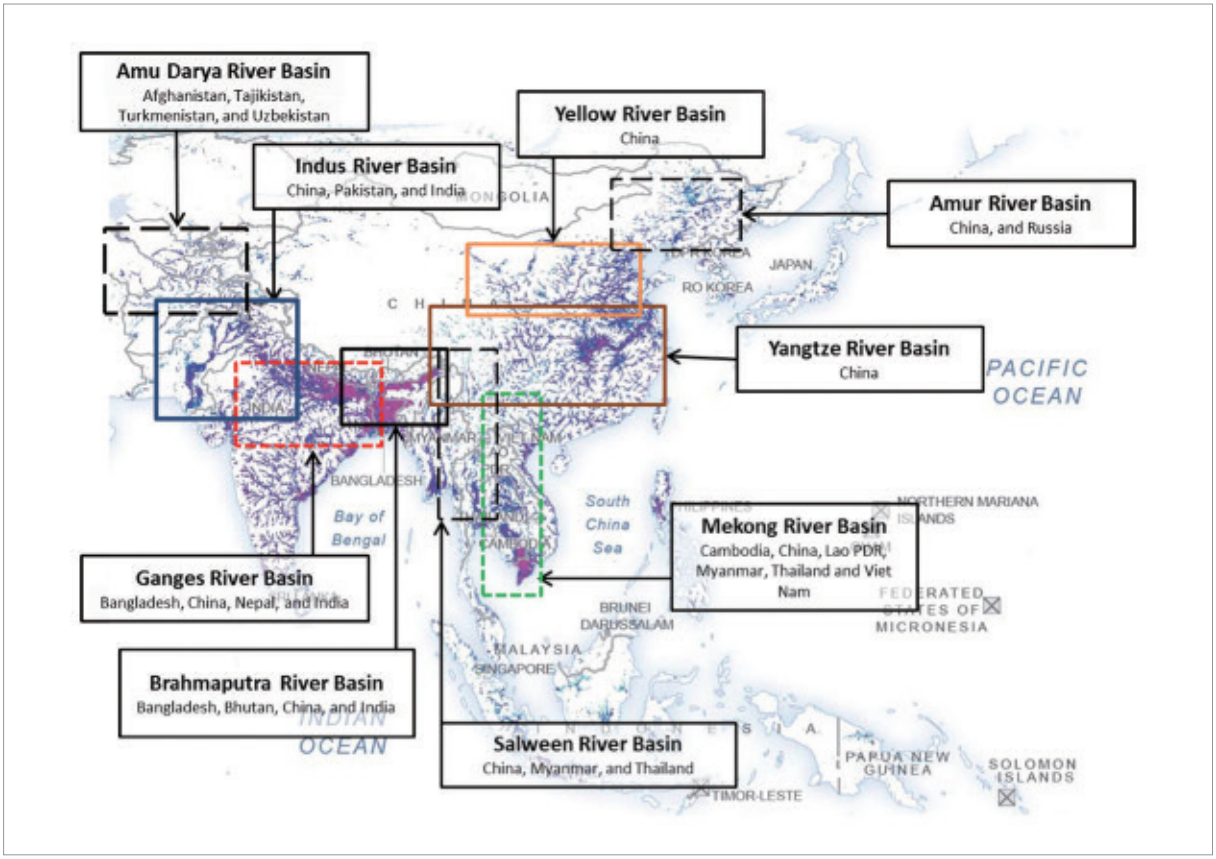
c) South-West Pacific Ocean

(Fig.3) Asia-Pacific ocean basins, and the tracks of tropical cyclones 2005-2014

Source : ESCAP (2015) Asia-Pacific Disaster Report 2015, Figure I-9, which is based on data from the Joint Typhoon Warning Center (US). Available from http://www.usno.navy.mil/JTWC/.

Flood risk was also very high in many parts of the region including the Mekong River Basin in Southeast Asia; Indus River Basin, Ganges and Grahamputra-Meghna River Basin in South and Southeast Asia; and domestic river basins in China (Fig.4). As such, each year countries in Asia-Pacific experience large numbers of floods, sometimes transboundary. During the last decade, major floods were reported from China, India, Pakistan and Thailand.

[10] 3 ocean basins of Asia-Pacific refer to 1) Western North Pacific Ocean and South China Sea, 2) Bay of Bengal and the Arabian Sea, and 3) Southeast Pacific Ocean.



(Fig.4) Flood risk in Asia and the Pacific
Source : ESCAP (2015) Asia-Pacific Disaster Report 2015, Figure I-10.

Box 1

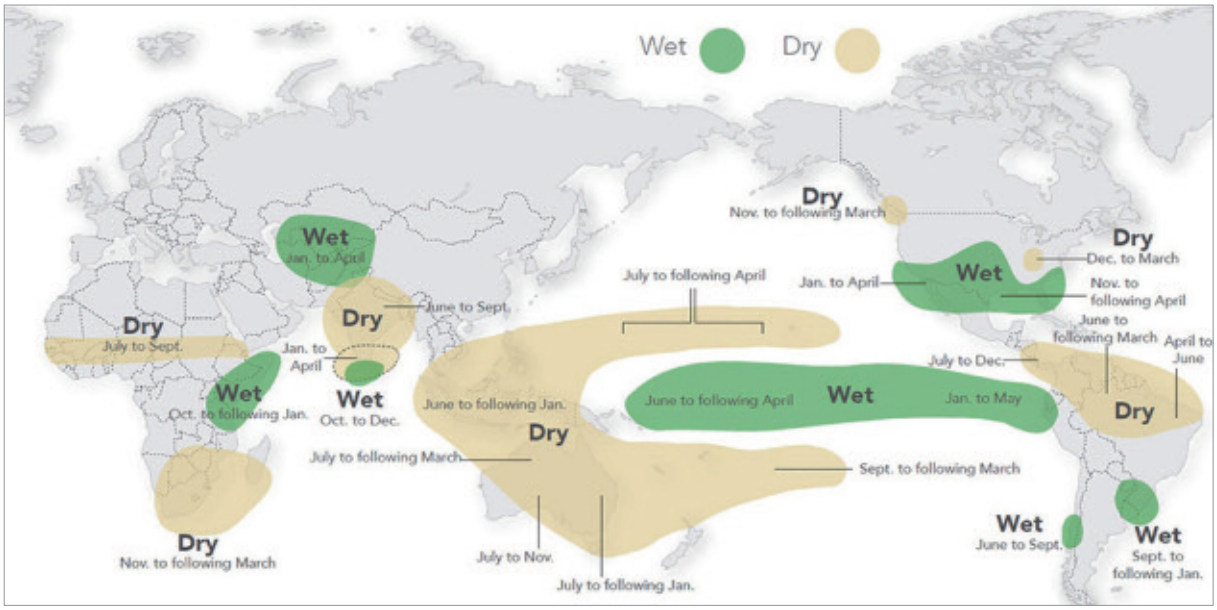
The impacts of recent El-Nino event in Asia-Pacific including ASEAN countries

The 2015-2016 El Nino event was reported to be one of the strongest since 1997-1998 and several countries in the Asia-Pacific region, including Cambodia, Indonesia, the Philippines, Timor-Leste and Thailand, were severely hit.

Cambodia experienced both drier and wetter rainfall conditions during El Nino years.[11] Due to extended periods of drought, 115,129 ha (approximately 5 per cent of cultivated land in Cambodia) were affected. South and southeast regions of Indonesia were also affected by drought conditions by the El Nino, resulting in severe forest fires which affected 2 million hectares of the land and 45 million people. 250,000 ha of crop area were also affected, especially in Java where 55 percent of rice is grown. In the Philippines, especially in the second quarter of 2015, paddy crops were down by 7 percent in upland areas and the overall crop production level significantly dropped. The Philippines Government has planned to import 800,000 tons of rice to ensure food security in the country.[12] In Thailand, summer season rainfall was significantly reduced in 2014, and this resulted in insufficient replenishment of key reservoirs. The decreased rainfall conditions were also observed in Timor-Leste, and this led to reduced groundwater availability with damaging impact on agricultural sector.

Historical El Nino rainfall patterns in the Asia-Pacific

[11] ESCAP (2015) El Nino 2015/2016 Impact Outlook and Policy Implication
[12] Personal communication and research undertaken by RIMES, reported in ESCAP (2015) El Nino 2015/2016 Impact Outlook and Policy Implication

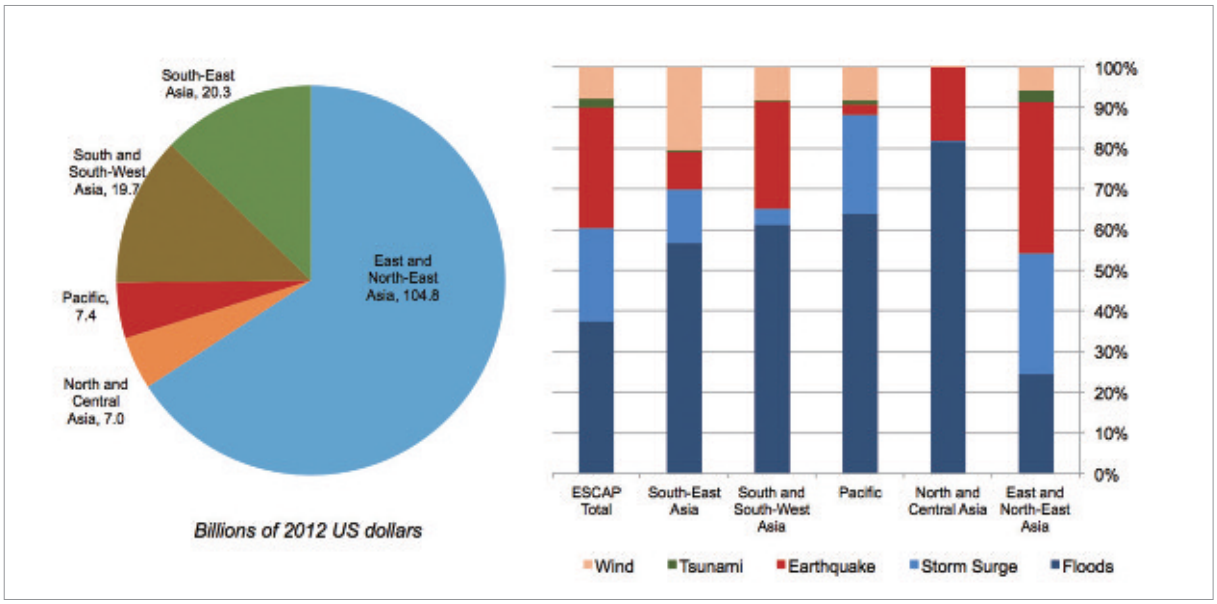


(Fig.5) 2015-2016 El Nino, early action and response for agriculture, food security and nutrition

Source : FAO (2015), Working draft (30th of October, 2015)

Estimating Future Losses

Moreover, it is reported that the high impacts of natural disasters in the region continues in the future. By the year 2030, Annual Average Loss (AAL) from 5 types of hazards – floods, storm surge, earthquakes, tsunamis and wind – is estimated to be around 160 billion dollars per year on average in the Asia-Pacific region alone (Fig.6).[13]



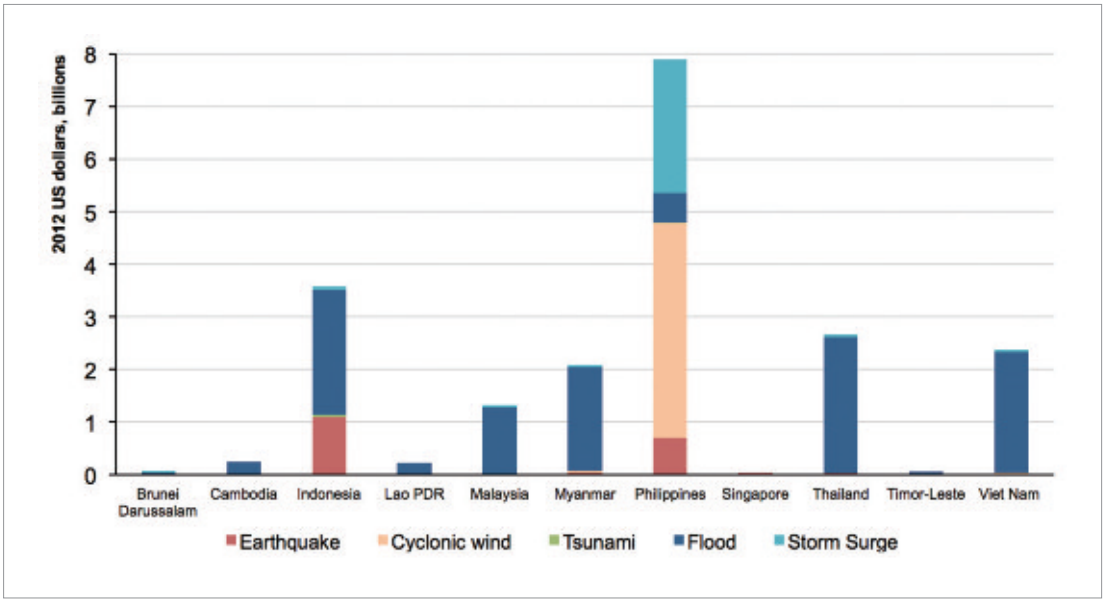
(Fig.6) Breakdown of predicted annual average losses by type of hazard and subregion

Source : ESCAP (2015) Asia-Pacific Disaster Report 2015, Figure I-18, which is based on data from UNISDR (2015) Global Assessment Report on Disaster Risk Reduction 2015

[13] ESCAP (2015) Asia-Pacific Disaster Report 2015.

In terms of regional distribution of AAL, the highest losses are expected in East and Northeast Asia, followed by Southeast Asia. Throughout the Asia-Pacific region, it is likely that floods continue to have the highest impacts in terms of AAL. In Southeast Asia, floods was also expected to have the greatest economic losses in the future, while storm surge and wind were also estimated to have significant AAL.

Expected AAL of countries differ depending on the geophysical and hydro-meteorological conditions of countries. Floods were expected to have the dominant impacts in the riparian countries of the Mekong River basin – Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam, while expected impacts of earthquakes are significant in Indonesia and the Philippines. In case of the Philippines which is located in the middle of many typhoon tracks, cyclonic winds are expected to have the highest contributions to its AAL (Fig.7).



(Fig.7) AAL by hazard type in Southeast Asia
Source : ESCAP based on data from UNISDR (2015) Global Assessment Report on Disaster Risk Reduction 2015

ADDITIONAL CHALLENGES

It is important to understand that not only the existing disaster risk of the region, but also additional factors to disaster risk such as – urbanization, population growth, environmental degradation and climate variability.

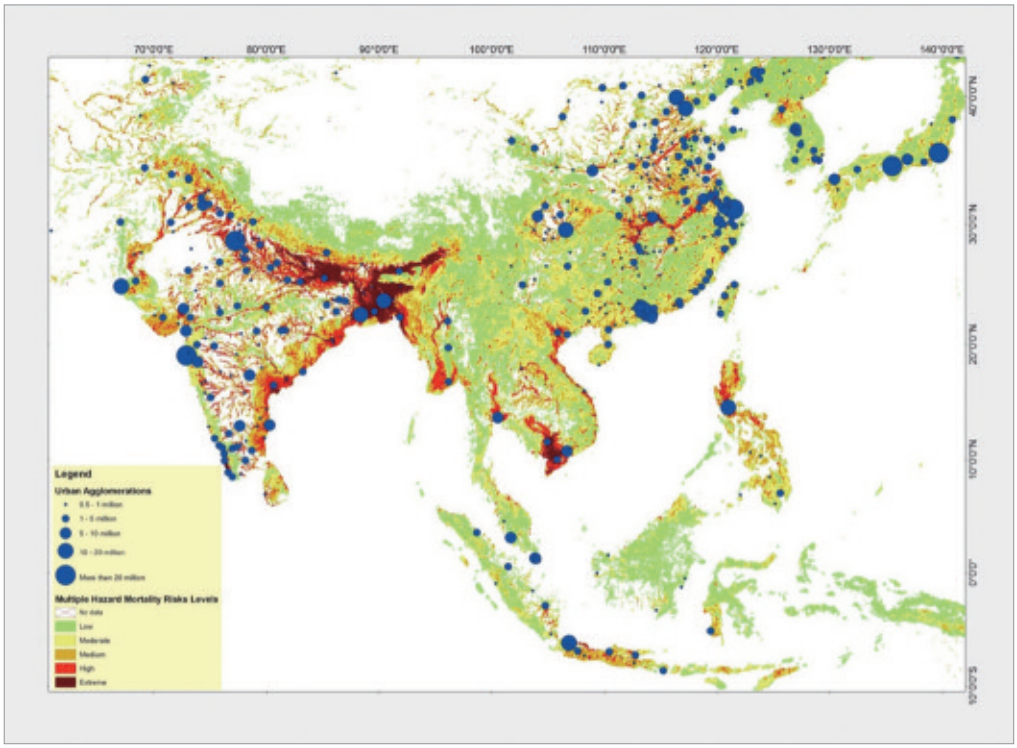
Population growth and urbanization

While the high exposure of countries in the region to natural hazards is highlighted earlier, this is likely to increase substantially with population growth associated with economic development. While many countries of the region have been the economic engine of the world, resulting in the tremendous investments made in the region, Asia-Pacific region is also the most populous region with approximately 4.4 billion people, 60 per cent of the global population.[14] This is expected to grow continuously, and over 750 million additional people are likely to live in the Asia-Pacific region by 2050.[15]

[14] Source: ESCAP Online Statistical Database (Accessed on 19 October 2016)
[15] Source: ESCAP Online Statistical Database (Accessed on 19 October 2016)

Moreover, rapid urbanization being experienced in the region is adding pressure to disaster risk reduction and building resilience, as many of large and medium size cities are located in the areas with significant risk from tropical cyclones, earthquakes, floods and landslides. Asia-Pacific witnesses very rapid rates of urbanization, and the proportion of population living in cities jumped from 20 per cent in 1950 to 48 per cent in 2015.[16] More than two billion people is living in urban areas and additional one billion is expected by 2050.[17]

However, many of major cities in the region are in high disaster risk areas (Fig.8). In the Asia-Pacific region, around 740 million people in cities are already at extreme to high disaster risks.[18] Accordingly, the large and increasing number of people in the region, associated with rapid urbanization processes, is likely to increase the regional exposure to natural hazards significantly. Moreover, it should be noted that many cities are outgrowing the capacity of basic services such as roads, water supplies, and sewage disposal systems, and increasing number of people are exposed particularly in informal settlements that are often the most vulnerable to disasters.[19]



(Fig.8) Asia-Pacific cities exposed to multiple hazards
Source : ESCAP (2015) Asia-Pacific Disaster Report 2015, Figure I-20.

Environmental degradation

In addition, degradation of natural environment is another important matter to consider in terms of disaster risk reduction and building resilience. Healthy natural environment with robust ecosystems offer a buffer against natural hazards, but over the past 50 years, humans have exploited forests, grasslands, deserts, agricultural lands and freshwater which in turn undermined the intrinsic value of environment. The negative impact of degraded ecosystem is evident in many parts of the region. This complicates the interplay between human and diverse ecosystems and reduces the capacity to protect themselves against hazards.

[16] Source : ESCAP Online Statistical Database (Accessed on 19 October 2016)
[17] UN-DESA (2014) World Urbanization Prospects: the 2014 revision
[18] ESCAP (2015) Asia-Pacific Disaster Report 2015
[19] ESCAP (2015) Asia-Pacific Disaster Report 2015

Climate Change

Climate variability is another risk factor that catalyzes the frequency and severity of water-related disasters. Although there are few data available for assessing changes in frequency and severity of extreme events, changing climate will have various impacts on occurrence and intensity of water-related hazards in different parts of the world.[20] The impacts of climate change to extreme events are still uncertain and will differ from areas to areas, but the changes in the patterns of extreme events will have significant impacts on disaster risk posed in the region. Therefore, it is of great concern that such risk factors should also be taken into consideration at the national and regional level to improve disaster management process, and to ensure sustainability of our development efforts.

REGIONAL COOPERATION

In Asia-Pacific, the devastating impacts of natural disasters in human lives and livelihoods should not be underestimated. In particular, floods and tropical cyclones, as well as earthquakes and tsunamis, have resulted in a large number of lives lost and in huge economic losses. The number of fatalities is mostly attributable to high-impact disasters such as earthquakes and tsunamis. However, the cumulative impacts of recurrent water-related disasters are not less than those of earthquakes and tsunamis. In particular, South-East Asia is the most prone to water-related disasters. Moreover, the disaster risk posed by the region is presumably increasing with continued population growth associated with rapid urbanization process. The frequency and severity of water-related disasters are also changing, although their impacts are still uncertain and will vary from country to country.

In addressing these regional challenges to sustainable development, cooperation among countries that share the risk is necessary. Regional cooperation mechanisms can facilitate the cooperation among countries through sharing of knowledge, information, expertise and experiences in managing their respective disaster risk. ESCAP, as requested by countries in Asia-Pacific, has fostered regional cooperation in addressing disaster risk and established and supported regional cooperation mechanisms for multiple hazards.

In particular, ESCAP supported the two subregional platforms in addressing the risk from tropical cyclones, the ESCAP/WMO Typhoon Committee (TC) and the WMO/ESCAP Panel on Tropical Cyclones (PTC). The ESCAP Regional Drought Mechanism provides comprehensive, near real-time monitoring and early warning system for Cambodia, Mongolia, Myanmar Nepal and Sri Lanka, with services provided by China, India, Japan, Thailand and others. ESCAP has also involved in Mekong River Commission (MRC), and is working on the establishment of regional cooperation mechanisms for transboundary floods, glacial lake outburst floods and landslides.[21]

[20] IPCC (2012) Summary for Policymakers. In : Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
[21] E/ESCAP/72/18.

Box 2

ASEAN-UN Joint Strategic Plan of Action on Disaster Management

ASEAN and UN partners agreed on working together on disaster management and developed the Joint Strategic Plan of Action on Disaster Management (JSPADM III). This is to support the achievement of the Sendai Framework for Disaster Risk Reduction (2015-2030) and to help ASEAN countries to prepare and respond to disasters.

The partnership between ASEAN and UN agencies has been built upon the operations for the Thai Floods (2011), Typhoon Bopha (2012), Typhoon Haiyan (2013), and the Myanmar Floods (2015). On the basis of previous events, ASEAN and UN recognized that it is necessary to enhance collaboration to raise awareness, mobilize resource effectively, and monitor and evaluate response and recovery.

It identifies eight priority programs with expected outputs and activities articulated as can be seen in the table below.

Pillars	UN Lead Agency	Priority Programme	Objective
Risk Awareness and Assessment	ESCAP	AWARE	A risk aware ASEAN Community
Prevention and Mitigation	UNISDR	BUILD SAFELY	Safely Building safe ASEAN infrastructure and essential services
		ADVANCE	A disaster resilient and climate adaptive ASEAN Community
		PROTECT	Protecting economic and social gains of ASEAN Community integration through risk transfer and social protection
Preparedness and Response	WFP	RESPOND as ONE	Transforming mechanisms for ASEAN's leadership in response
		EQUIP	Enhance capacities for One ASEAN One Response
Recovery	UNDP	RECOVER	ASEAN resilient recovery
Knowledge and Innovation Management	OCHA	LEAD	ASEAN leadership for excellence and innovation in disaster management

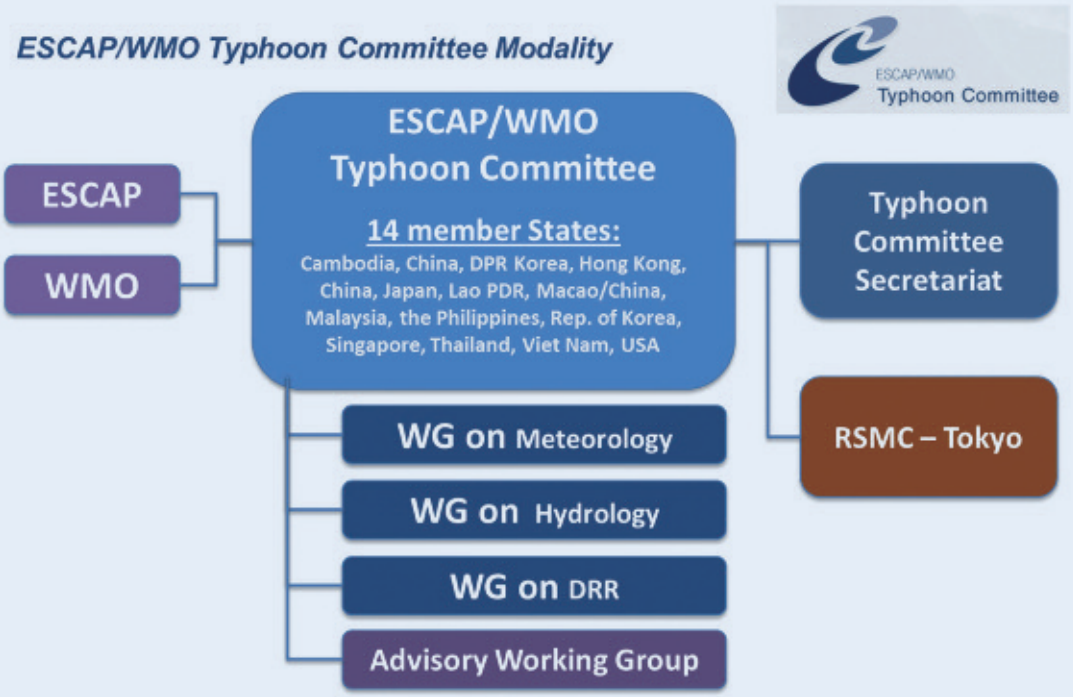
Box 3

The ESCAP/WMO Typhoon Committee

The ESCAP/WMO Typhoon Committee (TC) is an intergovernmental platform, established by the Governments of ESCAP member countries under the joint auspices of ESCAP and the World Meteorological Organization (WMO) in 1968 to minimize the typhoon damages in the region and to facilitate closer regional cooperation.[22] As of 2016, there are fourteen member countries, including several ASEAN member States (see the figure below).

Its work is primarily centered on reducing the damage caused by typhoons and floods, and focus on the followings: 1) review the progress made in the various fields of typhoon damage prevention, 2) recommend the participating governments on plans and measures the improvement of community preparedness and disaster prevention, 3) promote the interested Governments and other interested organization for the coordination of research on typhoons, and 4) provide financial and technical support for plans and programs upon request.

With the financial support from the ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness, the project on Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning System had implemented jointly with the WMO/ESCAP Panel on Tropical Cyclones (PTC). As the outcome of this project, the Manual on SSOP was published and cooperation mechanism was established between TC and the PTC.



[22] See E/ESCAP/72/INF/3.

Executive Summary Report

ASEAN

ASEAN

By Dr. Keizrul bin Abdullah
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1. Introduction

The Republic of Korea through the Chuncheon Global Water Forum embarked on a joint project with ASEAN titled "Building Resilience for Sustainable ASEAN (from Water Related Disasters)" in early 2016. The objective of the project was to strengthen resilience in the ASEAN Member States against water-related disasters in Southeast Asia through close cooperation between ASEAN and Korea, by sharing knowledge and experience for effective policy-making in the respective national governments.

In the context of a broader regional cooperation, each ASEAN Member State compiled a National Assessment Report outlining the country's situation with respect to water-related disasters, their experiences and their national policies to deal with and mitigate the impacts from such disasters. To enable better correlating of the experiences, a template was developed for the National Assessment Report to give an overview of the current situation in the country, the changing scenarios and the future direction. On completion of the Reports, a Consultative Workshop was convened in Seoul, South Korea, in February 2017 to share the experiences and policy recommendations, and to stimulate multilateral dialogue aimed at identifying areas of regional cooperation to more effectively mitigate the negative consequences of water-related hazards in the ASEAN region.

This Report is a synthesis of the National Assessment Reports and the deliberations and recommendations from the Consultative Workshop.

2. ASEAN Region

The Association of Southeast Asian Nations (or ASEAN), is a regional organisation of ten countries, which promotes inter-governmental cooperation and facilitates economic integration amongst its members. Its principal aims include accelerating economic growth, social progress and socio-cultural evolution among its members, alongside the protection of regional stability and the provision of a mechanism for member countries to resolve differences peacefully.

ASEAN was established on 8 August 1967 in Bangkok, Thailand, with the signing of the ASEAN Declaration by the Founding Fathers, namely Indonesia, Malaysia, the Philippines, Singapore and Thailand. Brunei Darussalam joined in 1984, Viet Nam in 1995, Lao PDR and Myanmar in 1997, and Cambodia in 1999, making up what is today the ten Member States of ASEAN.

ASEAN covers a land area of 4.488 million square kilometres, 3% of the total land area of Earth. ASEAN territorial waters cover an area about three times larger than its land counterpart. ASEAN shares land borders with India, China, Bangladesh, East Timor, and Papua New Guinea, and maritime borders with India, China, Palau and Australia. Member countries have a combined population of approximately 628.9 million people, the third largest in the world after China and India. The breakdown by country is shown in the table below.

(Table 2) Total Land Area and Population of ASEAN Member States

Country	Total Land Area(sq km)	Total Population(1,000 persons)
Brunei DS	5,769	417
Cambodia	181,035	15,405
Indonesia	1,913,579	255,462
Lao PDR	236,800	6,902
Malaysia	330,290	30,485
Myanmar	676,577	52,476
Philippines	300,000	101,562
Singapore	719	5,607
Thailand	513,120	68,979
Viet Nam	330,951	91,713
ASEAN	**4,488,839**	**629,008**

In 2015, ASEAN's combined GDP at current price was US$2.432 trillion. If ASEAN were a single entity, it would rank as the sixth largest economy in the world, behind the USA, China, Japan, Germany and the United Kingdom. ASEAN's GDP per capita (Purchasing Power Parity) was US$11,009 in 2015, with two of its member states, Singapore and Brunei Darussalam among the top 5 economies with the highest GDP per capita (PPP) in the world.[1]

Under the ASEAN Socio-Cultural Community Blueprint, there is a Section on 'Building Disaster-resilient Nations and Safer Communities' with the strategic objective to strengthen effective mechanisms and capabilities to prevent and reduce disaster losses in lives, and in social, economic and environmental assets of ASEAN Member States and to jointly respond to disaster emergencies through concerted national efforts and intensified regional and international cooperation. The actions to be taken are :

i Fully implement the ASEAN Agreement on Disaster Management and Emergency Response;

ii Support the establishment and operationalisation of the ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) to facilitate cooperation and coordination among ASEAN Member States and with relevant UN agencies and international organisations;

iii Institutionalise capacity building programmes in areas of priority concern of Member States, and promote technical cooperation, joint research and networking to increase the capacity and capability of Member States in responding to disasters and reducing losses from disasters;

iv Establish a fully functioning ASEAN Disaster Information Sharing and Communica-tion Network, to promote sharing of information and best practices and facilitate decision making process;

v Implement or enhance public awareness and education programmes on a regular basis, and promote public participation in programmes related to disaster risk reduction and emergency response in order to promote community resilience to disasters;

vi Promote partnership with relevant stakeholders, including local communities, non-governmental organisations and private enterprises, and strengthen cooperation with United Nations and relevant international organisations;

vii Carry both national and ASEAN flag or logo to promote the visibility of ASEAN among the first responders engaged in humanitarian missions;

[1] ASEAN Web Site http://asean.org

viii Promote sustainable livelihood options through socio-economic development activi-ties to minimise disaster risks and enhance community-coping capacities;

ix Strengthen community-based disaster preparedness and participation through promo-tion of indigenous knowledge and practices, implementation of public awareness and education and sharing of best practices and lessons learnt to build a disaster-resilient community;

x Promote wider utilisation of services of existing regional facilities, such as ASEAN Specialised Meteorological Centre (ASMC) and ASEAN Earthquake Information Centre (AEIC), in providing early warning information and technical advisories to enhance regional disaster preparedness;

xi Establish an ASEAN volunteer programme to assist disaster stricken areas which will also enhance ASEAN togetherness, and

xii Promote multi-sectoral coordination and planning on Pandemic Preparedness and Response at the regional level including development of a regional Multi-Sectoral Pandemic Preparedness and Response Plan.

3. Climatic, Hydrological and Physical Characteristics of the Region

The ASEAN region covers a huge area ranging from latitudes 28° North to 11° South and longitudes 92° East to 141° East. Hence the climatic characteristics of the region varies widely among the different countries.

Indonesia, the largest country in ASEAN, has an almost entirely tropical climate, with the coastal plains averaging 28° C, the inland and mountain areas averaging 26° C, and the higher mountain regions 23° C. The relative humidity is quite high, ranging between 70 and 90 percent. Myanmar, the northern most country, has a monsoon climate with three main seasons. The hottest period is between February and May, when there is little or no rain and temperatures can rise above 40° C. The rainy season is generally from May to October, giving way to dry, cooler weather from October to February. Viet Nam has two different weather patterns, the north having a distinct summer and winter season when temperatures can drop to 10° C; while the south is more tropical with a rainy season from April to November and a dry season from November to April.

Hydrologically ASEAN can be divided into two zones, with Brunei Darussalam, Indonesia, Malaysia and Singapore being strongly influenced by the North-east Monsoon running from October to February; while the rest of ASEAN get the bulk of their annual rainfall during the typhoon season. While annual rainfall can reach a peak of 6,000 mm in Indonesia, most of the northern countries have a distinct dry season resulting in annual rainfall dropping to as low as 600 to 750 mm. In the north-east, the Philippines experiences torrential rains and thunderstorms from July to November, which is the typhoon season. These typhoons or tropical cyclones contribute at least 30 percent of the annual rainfall in the northern Philippines, while for the southern islands it is under 10 percent. Whilst the percentage may look small, the precipitation is generally delivered over a few days, resulting in very high rainfall intensities. The wettest known tropical cyclone to impact the Philippines archipelago was a 1911 cyclone, which dropped over 1,168 mm of rainfall within a 24-hour period in Baguio. The table below shows the rainy season and annual rainfall for the different ASEAN countries.

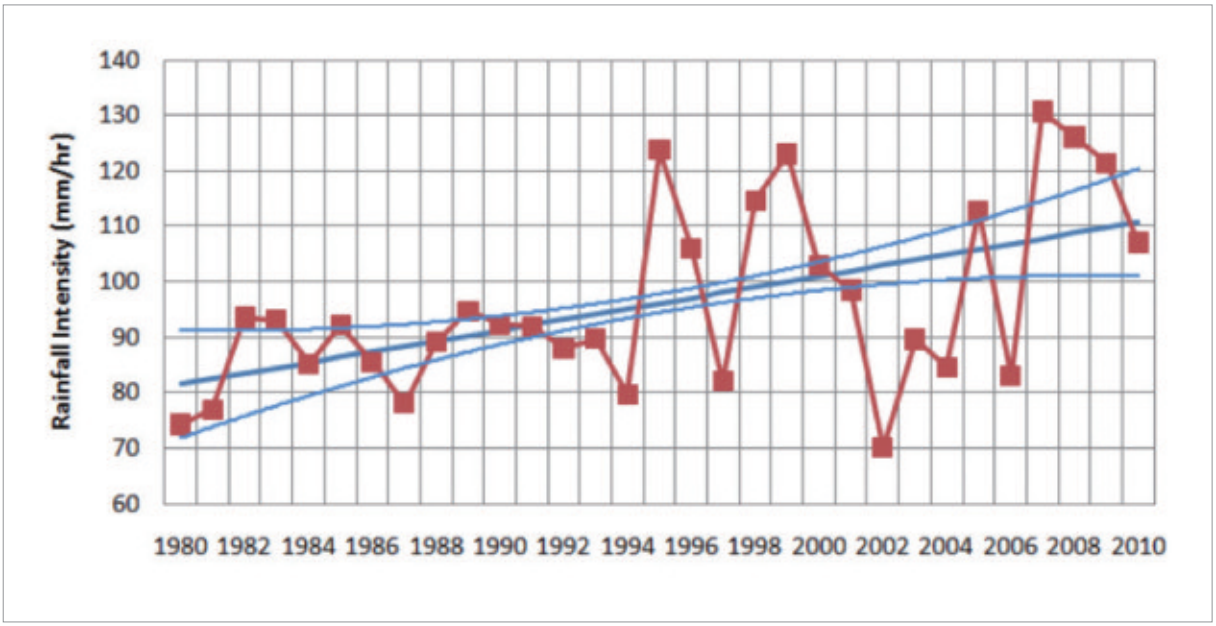
(Table 3) Information of Rainy Season and Annual Rainfall of ASEAN Countries

Country	Rainy Season	Annual Rainfall (mm)
Brunei DS	October to December	2,500 to 4,000
Cambodia	May to October	3,000
Indonesia	November to March	1800 to 6,000
Lao PDR	May to October	1,400 to 3,500

Malaysia	November to March	2,940 to 3,640
Myanmar	May to October	750 to 5,000
Philippines	July to November	1,000 to 4,000
Singapore	December to March	2,330
Thailand	May to October	1,000 to 4,000
Viet Nam	April to November	600 to 5,000

Another factor that highly influences the weather pattern and climate of the ASEAN region is the natural phenomenon called El Niño and La Niña, together known as the El Niño Southern Oscillation (ENSO). El Niño produces below normal rainfall causing droughts and stresses on water resources while La Niña produces above normal or excessive rainfall. The onset and the length of rainy season are also affected by ENSO. The 1997-98 El Niño is generally considered to be the worst in recent times, causing water shortage in most part of ASEAN, forest fires and huge damage to the regional economy especially in the agricultural sector.

Temperature and precipitation are both projected to increase in the future over all of Southeast Asia from Climate Change. Under IPCC scenarios, it is projected that temperature may increase anywhere from 0.72° to 3.92° C and precipitation may decrease by 2 % or increase by up to 12 % by the end of this century. Annual precipitation for the Mekong Basin will increase by 13.5 % from the historical average of 1509 mm to 1712 mm by 2030. Indonesia, with some 80,000 km of coastline, is one of the most vulnerable countries to the impacts of climate change, especially on sea level rise, which is currently increasing at about 1-3 mm/year in the coastal areas of Asia. Singapore has recorded a general uptrend in annual average rainfall from 2,192 mm in 1980 to 2,727 mm in 2014 i.e. an increase of 24.4 %. In addition, there is strong evidence of a trend towards higher rainfall intensities, and increasing frequency of high intensity rain events as can be seen in the figure[2] below.



(Fig.9) Annual maximum 60-min rainfall. The blue lines denote the trend and the 95 % confidence interval

[2] Singapore National Assessment Report

Geographically the five northern countries are located on the Asian Continent mainland while Malaysia and Singapore are situated on the southern-most peninsular of Asia. Indonesia and the Philippines are archipelagos of 17,508 and 7,107 islands respectively, and both countries are located in the Pacific Ring of Fire, where earthquakes and volcanic eruptions frequently occur. In addition, the Philippines is located astride the typhoon belt and is particularly vulnerable to tropical cyclones. Nearly one-third of the world's tropical cyclones form within the western Pacific with the area just northeast of the Philippines being the most active place. On average, up to 20 tropical cyclones enter Filipino waters annually, with about half of them making landfall. After passing through the Philippines, the tropical cyclones move west-wards towards Viet Nam and beyond. Myanmar in the west lies in the path of tropical cyclones generated in the Bay of Bengal.

A tropical cyclone is categorized according to its wind speed. The lowest category is a tropical depression which has wind speeds not exceeding 60 km/h. A tropical depression is upgraded to a tropical storm should its sustained wind speed exceed 65 km/h; and should the storm intensify further and reach sustained wind speeds of 90 km/h then it will be classified as a severe tropical storm. Once the cyclone's maximum sustained winds reach 120 km/h it will be designated as a typhoon. In recent years, tropical cyclones have been increasing in frequency and intensity, and as a result in 2009, typhoons were further divided into three sub-categories viz. typhoon, severe typhoon and super typhoon. A typhoon has wind speeds of 120 km/h, a severe typhoon has winds of at least 150 km/h, and a super typhoon has winds of at least 190 km/h. Typhoons bring heavy rainfall which when combined with the strong winds and storm surges, can cause large scale flooding and result in enormous destruction and loss of life.

4. Water-Related Hazards and Disasters

Over the period 2005-2014, the most disaster-prone subregion in Asia and the Pacific was South-East Asia, with 512 events and 177,000 deaths i.e. 3 per 100,000 people[3]. Water-related hazards are floods, storms, typhoons, debris and mud flows, landslides, tsunamis, land subsidence and droughts. Although the main water-related disasters are tsunamis, tropical cyclones and floods, other types of hazards such as landslides and droughts are also significant. The table below shows the major water-related hazards and disasters for the ASEAN countries.

(Table 4) Water-Related Hazards and Disasters of ASEAN Member States

Country	Water-Related Hazards and Disasters
Brunei DS	Floods, Flash Floods
Cambodia	Floods, Droughts, Storms, River Bank Collapse
Indonesia	Tsunamis, Floods, Landslides, Droughts, Debris Mudflows
Lao PDR	Floods, Droughts, Storms
Malaysia	Floods, Flash Floods, Droughts, Landslide, Debris and Mud Flows
Myanmar	Tropical Cyclones, Floods, Droughts, Landslides
Philippines	Typhoons, Floods, Tsunamis, Landslides, Droughts
Singapore	Flash Floods
Thailand	Floods, Droughts
Viet Nam	Floods, Storms, Flash Floods, Droughts, Landslides

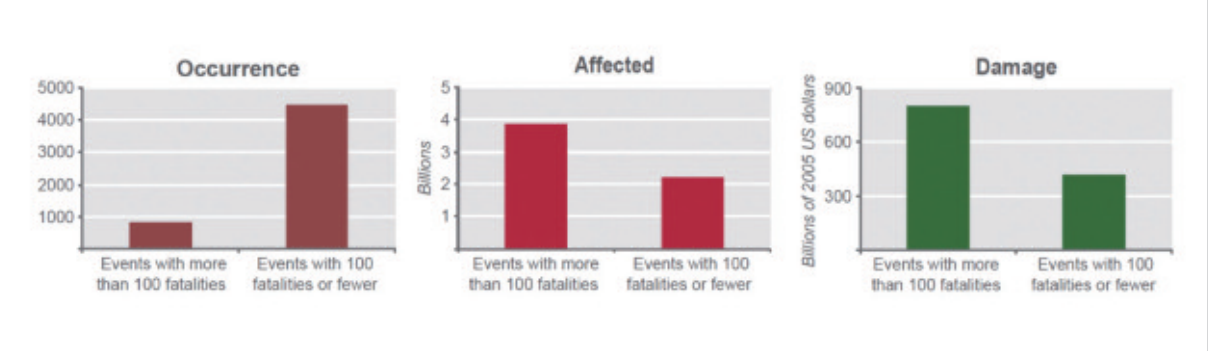
[3] Asia-Pacific Disaster Report 2015, UNESCAP

Among the ASEAN countries, Indonesia is the most prone to water-related hazards, and more than 98 % of disasters are hydro-meteorological in nature. On the average, Indonesia experiences 1,124 water-related disasters each year causing an average annual loss and damage of about Rp 30 trillion (US$ 2.25 billion). In fact, the most devastating water-related disaster to hit the ASEAN region in the past century was the 26 December 2004 Aceh tsunami[4] that affected not only Aceh, but also many countries from Asia to Africa, resulting in a death toll of 230,000 to 280,000 people. The tsunami was caused by the Sumatra-Andaman earthquake with the epicentre off the west coast of Sumatra, Indonesia, and which had a moment magnitude of 9.1 to 9.3. It is the third largest earthquake ever recorded on a seismograph and had the longest duration of faulting ever observed, between 8.3 and 10 minutes. The sudden vertical rise of the seabed by several metres during the earthquake displaced massive volumes of water, resulting in a tsunami wave that reached a height of up to 24 metres along the west and north coastline of Aceh province in northern Sumatra.

Next in line are the destruction and loss of lives from tropical cyclones. On 2 May 2008, tropical cyclone Nargis, a category 3 cyclone made landfall in Myanmar, causing the worst natural disaster in the country's recorded history, with a death toll that may have exceeded 138,000. Nargis was the eighth deadliest cyclone recorded worldwide and with damage estimated at more than US$ 10 billion, was the most destructive ever recorded in the Indian Ocean. On the Pacific Ocean, in November 2013, Super Typhoon Haiyan, known in the Philippines as Yolanda, slammed into the Visayas region of the Philippines, killing more than 6,300 people and resulting in US$ 9.7 billion in losses and damages. Haiyan is believed to have been the strongest typhoon ever to strike land anywhere in the world, and the strongest typhoon ever recorded in terms of wind speed, with wind gusts of up to 380 km/h.

Although tsunamis and tropical cyclones are high-impact disasters with high fatalities which tend to grab the headlines, they are relatively rare and it is the multiple but recurring events with fewer fatalities that cumulatively affect more people and caused greater overall damage.

(see figure[5] below) In fact, the impacts from smaller disasters are more likely to be under-reported or excluded from disaster databases. Also, some events like droughts are often overlooked because they develop quite slowly.



(Fig.10) Cumulative Impacts of Smaller, Recurrent Dissaters, 1970-2014

[4] Also called the 2004 Indian Ocean tsunami, South Asian tsunami, Indonesian tsunami, Boxing Day tsunami

[5] (Fig.1-5), Asia-Pacific Disaster Report 2015, UNESCAP

From the National Assessment Reports, the most pervasive water-related hazard was identified as floods. The table below shows the impact of floods in the ASEAN countries. There are two types of floods viz. river floods which is widespread when flood waters overtop the river banks; and flash floods caused by short-term intense and heavy rainfall or thunderstorms. Flash floods are more common in the urban areas.

(Table 5) The Status of Floods in ASEAN Countries

Country	Floods
Brunei DS	Flash floods caused by short-term heavy rain is the main weather disaster in Brunei.
Cambodia	Cambodia's vast flood plain makes large portions of the country naturally susceptible to annual flooding particularly along the Tonle Sap and Mekong river watersheds. One of the worst floods occurred in 2000 affecting 3,448,600 people (20 % of population) and with 387,000 temporarily evacuated from their homes and villages.
Indonesia	Floods are the most pervasive hazard affecting Indonesia, and is driven by annual rains during the monsoon season. Deforestation is a major factor affecting floods. In 2007, floods inundated 50 % of land in metro Jakarta, causing 80 deaths, displacing 400,000 people and leaving US$ 500 million in damages.
Lao PDR	The most frequent water-related disasters are from flooding along the Mekong River which affected more than 4 million people and causing damages of over US$ 70 million. More than 500 people were killed.
Malaysia	Floods are the most serious disasters based on the frequency of occurrence and damages incurred. Some 5.7 million people (21 % of population) live in flood prone areas which covers 33,000 km² (10 % of country). Between 2002 to 2012, the average annual damage has increased by 25 % to almost US$ 10,000 per km².
Myanmar	The most common natural disasters that are experienced are floods. Floods cause a considerable loss of lives and great property damage. In October 2011, more than 100 people were killed in flash floods caused by heavy storms in central Myanmar. On the average, some 4,500 people are killed by floods each year.
Philippines	Flooding is one of the major problems in the Philippines. From 2005 to 2015, the country experienced 73 major flooding incidents affecting 18.2 million people and claiming an average of 77 lives annually. Total damage from floods over the past 11 years was estimated at US$ 2.5 billion, or US$ 225 million per year.
Singapore	Intense bouts of rainfall can sometimes exceed the drainage system capacity resulting in flash floods. However, these floods are localised and generally subside in under an hour.
Thailand	The worst occurrence of flooding in Thailand was the great flood of 2011, which inundated approximately 6 million ha of land covering 66 of 77 provinces, affected more than 13 million people and caused total damage and loss amounting to US$ 46.5 billion.
Viet Nam	Central Viet Nam is the region that is most vulnerable to flash floods with river levels rising 2 to 5 m/hour to as high as 30 m. The flood waters then flow very quickly downstream where the land is low and poorly drained, leading to prolonged inundation to a depth of 2 to 4 m. The most severe floods in 250 years occurred in August 1971 when the Hong River broke through its dykes and over 100,000 people lost their lives.

Although floods are the most serious disasters based on the frequency of occurrence and damages incurred, the ASEAN region is not spared from droughts, especially during El Niño events. The table below gives the drought situation in the ASEAN countries. The 1997 El Niño was particularly strong and it caused severe droughts in many countries.

(Table 6) The status of Droughts in ASEAN Countries

Country	Droughts
Brunei DS	Not an issue
Cambodia	An unusually dry season, without rain or with rain deficit
Indonesia	Droughts can seriously harm rice production, putting an estimated 7.5 million people into food insecurity. The most recent severe drought occurred in 1997 which was associated with a very strong El Niño. It caused 672 deaths, affected 1 million people and caused US$ 88 million in damages. It also resulted in record wildfires which caused haze in neighbouring countries.
Lao PDR	Droughts have affected a large proportion of the population with more than 4.25 million affected in 5 drought events though there was no loss of lives. The total damage caused was US$ 1 million.
Malaysia	The three driest years (1963, 1997 and 2002) have been recorded during El Niño events. Recent droughts have caused water shortages forcing the authorities to impose water rationing in several states, affecting more than 1.8 million consumers.
Myanmar	Droughts are not a serious issue in Myanmar except in the middle part of the country which is considered to be a dry zone area.
Philippines	The major drought events in the Philippines are associated with the occurrences of El Niño events. The most recent El Niño induced drought occurred from August 2015 to April 2016 and affected some 182,000 people and caused US$ 84.4 million of damage, mainly to the agricultural sector.
Singapore	Not an issue.
Thailand	In 2015, Thailand experienced the worst drought in the last few decades, caused by the lower amount of rainfall and usable water in dams across the country. The upper and central parts of Thailand have medium and high risks in drought.
Viet Nam	Due to the characteristics of terrain, climate and hydrology of Viet Nam, droughts are common occurrences. From 1960 to 2006, there were 34 drought events. The most severe drought of recent times was the 1997-1998 drought when the Central Highlands, the South East and the Mekong River Delta had almost no rain from March to June 1998. The temperature in the first months of 1998 was 1^{o} to 3^{o} C higher than the long term average, and water levels in rivers were lower by 0.5 to 1.5m. The agricultural sector was worst affected with damage to 750,000 ha of rice fields and 236,000 ha of industrial crops and fruit trees. 3.1 million people suffered from lack of water for domestic consumption.

In dealing with floods, ASEAN countries use both structural and non-structural measures. Structural measures include river improvement works, construction of bunds/dykes/levees, construction of flood mitigation dams and flood retention ponds,

river works such as diversion channels, control structures, weirs and tidal barrages. Non-structural measures include land use planning and zoning, flood hazard maps, flood forecasting and warning systems, flood proofing.

To deal with droughts, most of the ASEAN countries focus on developing more water supply systems both for domestic and industrial use, as well as for irrigated agriculture.

5. Legal and Institutional Setup in the Country

Among the ASEAN countries there is no specific law on water-related hazards and disasters, though the majority of countries have some legislation on Disaster Management (see table below).

(Table 7) Laws and Regulations on Water-Related Hazards and Disasters

Country	Laws and Regulations
Brunei DS	No specific law on water-related hazards and disasters. The Disaster Management Order (2006) defines the legal basis for disaster management.
Cambodia	Law on Disaster Management (2015) to regulate disaster management. The law has the following goals : (i) Prevention, adaptation and mitigation in the pre-disaster period; (ii) Emergency response during the disaster (iii) Recovery in the post-disaster period
Indonesia	Law No. 24/2007 on Disaster Management which outlines the principles, division of labour, organisation and implementation of the national disaster management system. Other laws have been revised to accommodate the principles of disaster risk reduction.
Lao PDR	No specific law on water-related hazards and disasters.
Malaysia	No specific law on water-related hazards and disasters.
Myanmar	No specific law on water-related hazards and disasters.
Philippines	Philippine Disaster Risk Reduction and Management Act 2010 (RA-10121). The Act emphasizes the need for a coherent, comprehensive, integrated and proactive approach across all levels and sectors of government and among vulnerable communities.
Singapore	No specific law on water-related hazards and disasters.
Thailand	The National Disaster Prevention and Mitigation Act, BE 2550
Viet Nam	Law on Natural Disaster Prevention and Control (2014) to prevent and mitigate natural disasters, and to assign responsibilities and coordination mechanisms to support DDR.

Most of the ASEAN countries have adopted the Hyogo Framework for Action (HFA) as the key instrument for implementing disaster risk reduction (DDR). The HFA has identified five priorities as follows : (i) Ensure DDR is a national and a local priority; (ii) Identify, assess and monitor disaster risks and enhance early warning; (iii) Use knowledge, innovation and education to build a culture of safety and resilience at all levels; (iv) Reduce the underlying risk factors; (v) Strengthen disaster preparedness for effective response at all levels. In addition, all the ASEAN Member States have ratified the ASEAN Agreement on Disaster Management and Emergency Response, described in Section 2 above.

The institutional setup in the various ASEAN countries varies according to how significant disasters are in the respective countries (see table below).

(Table 8) The Institutional Setup in ASEAN Member States

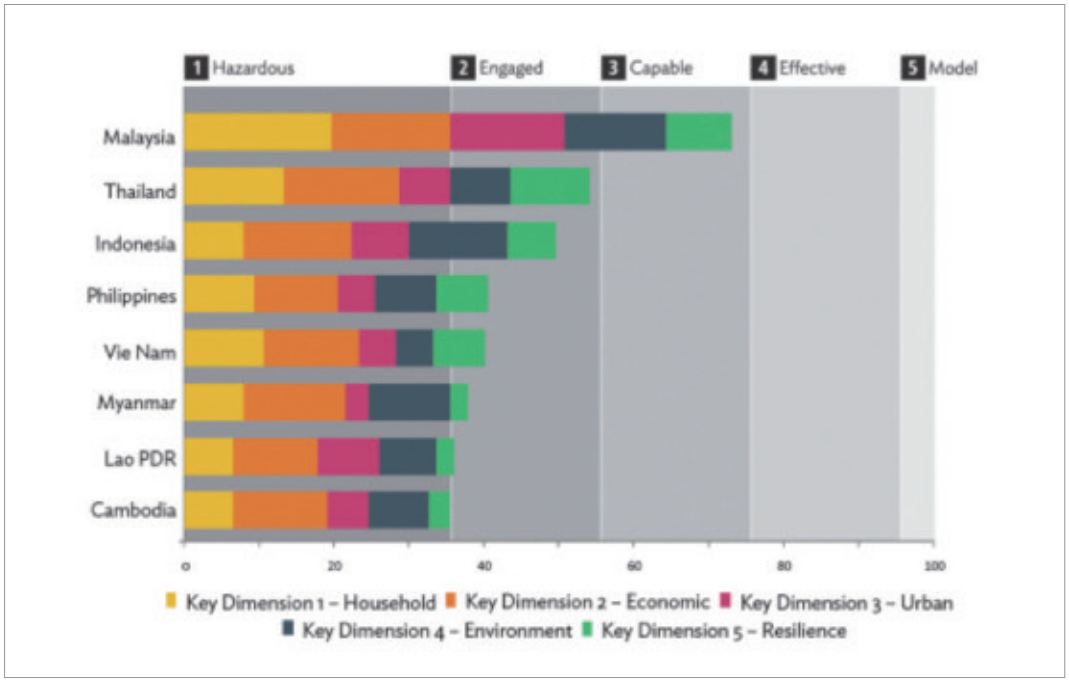
Country	Institutional Setup
Brunei DS	A Ministerial level National Disaster Council at the apex and supported at the operational level by a National Disaster Management Centre.
Cambodia	National Committee for Disaster Management chaired by the Prime Minister leads, administer and coordinate all disaster management activities.
Indonesia	National Agency for Disaster Management with disaster offices in all relevant regions.
Lao PDR	National Disaster Management Committee chaired by the Deputy Prime Minister,
Malaysia	National Security Council chaired by the Deputy Prime Minister. A National Disaster Management Agency established in 2015 and responsible for the operational aspects of hazard management. It is responsible for managing all water-related disasters such as floods, droughts, landslides, debris and mud flows and tsunamis.
Myanmar	Department of Meteorology and Hydrology to take pre-cautionary measures against and minimize the effects of natural disasters. Department of Relief and Resettlement to provide relief for victims of naatural disasters.
Philippines	National Disaster Risk Reduction and Management Council to provide leadership, determine broad DRM policies, oversees DRR implementation and advocate for DRR concerns on broader development issues.
Singapore	The Public Utilities Board (PUB) works closely with other agencies on flood risk management.
Thailand	Department of Disaster Prevention and Mitigation
Viet Nam	Steering Committee for Natural Disaster Prevention and Control. There is also a National Committee for Searching and Rescue.

6. Water Security

In 2007, the Asian Development Bank (ADB) and the Asia-Pacific Water Forum (APWF) prepared the Asian Water Development Outlook (AWDO) with the primary objective to initiate dialogue on the water security of the Asia Pacific region. This first report AWDO-2007 was cautiously optimistic on Asia's water future and pointed out that inappropriate management practices rather than physical scarcity of water were the main cause of water insecurity.

The second edition of the report, AWDO-2013, provided the first quantitative and comprehensive review of water security in the countries of Asia and the Pacific. It developed a water security framework based on 5 key dimensions (KDs) for household, economic, urban, environmental, and resilience to water-related disasters. The overall national water security of each country was assessed as the composite result of the 5 key dimensions, measured on a scale of 1 to 5, with 1 being a low level and 5 being the exemplary level of water security. The third and most recent edition. AWDO-2016, while maintaining the water security framework and key dimensions, probed deeper and provided a more robust set of indicators updated with the latest available data.

The fifth key dimension, KD5 - Resilience to Water-related Disasters, is the most appropriate indicator to reference with, as the theme of the ASEAN-ROK Project is "Building Resilience for Sustainable ASEAN (from water-related disasters)". AWDO-2016[6] noted that the advanced economies demonstrated the strongest performance, whereas the rest of Asia and the Pacific has weak resilience. The results suggested that a minimum level of governance is needed before KD5 can start to increase. Countries with low score in KD5 would need more support in integrated disaster risk management as well as in strengthening governance and investments to increase resilience. The figure[7] below shows the Water Security situation for ASEAN, excluding Brunei Darussalam and Singapore which are advanced economies and ranked above 4:Effective.



(Fig.11) Cumulative Impacts of Smaller, Recurrent Dissaters, 1970-2014

7. Lessons Learnt

Although the ASEAN region covers a huge area (from latitudes 28º North to 11º South and longitudes 92º East to 141º East) and the climatic characteristics varies widely among the different countries, yet there are many similarities with respect to water-related hazards and disasters. All the ASEAN countries have floods as the most frequent natural water-related disaster. In addition, they all suffer from drought problems, especially during El Niño years. The approach to dealing with floods and droughts are also very similar in that all the ASEAN countries use both structural and non-structural measures. Most of the countries have adopted the Hyogo Framework for Action (HFA) as the key instrument for implementing disaster risk reduction (DDR).

Cambodia is currently conducting an assessment of the Community-Based Flood Mitigation and Preparedness Project (CBFMP) which was launched in September 1998. The objective of CBFMP is to establish sustainable, replicable non-governmental mechanisms for disaster mitigation and preparedness with a focus on floods. Under the demonstration phase of the project, village volunteers were trained and supported to identify solutions to reduce the impact of floods to their community, in three highly flood-prone provinces along the Mekong river.

[6] Asian Water Development Outlook 2016, Asian Development Bank
[7] Figure A1.6, AWDO-2016

Indonesia gained considerable experience in disaster management and emergency response from the Aceh tsunami in 2004. Due to the huge scale of the disaster, the rehabilitation and reconstruction phase in Aceh was very different from other disasters and the Indonesian government established a dedicated Agency for Rehabilitation and Reconstruction for Aceh. The experience in Aceh led to the issuance of Law No. 24/2007 on Disaster Management leading to a paradigm shift in disaster management from disaster response to disaster risk reduction. Similarly Thailand gained considerable experience in disaster management from the Great Flood of 2011.
Malaysia introduced a new Urban Storm Water Management Manual in 2000 which changed the traditional concept of rapid disposal of storm water to one based on controlling the problem at source utilising delayed and reduced outflow, on-site storage and water retention measures. The benefits of control at source are reduced flood flows, water quality improvement, ecological enhancement, improved urban amenity through the application of wetlands, landscape for recreation and reuse of storm water. Malaysia also implemented the unique and innovative SMART Tunnel Project which utilises a tunnel to convey flood waters under the city of Kuala Lumpur and converts the tunnel for traffic at other times.

Thailand had a different type of water-related hazard, which is land subsidence due to excessive extraction of ground water especially in Bangkok. They solved this problem based on the pricing policy, i.e. they increased the unit price of water pumps 6 times of the original price.

One issue common to all the ASEAN countries was the difficulty to convince the government to invest more in preventing disasters because governments tend to react rather than to be proactive. Often, it takes a disaster or crisis before governments appreciate the importance of prevention.

Sharing of data, experiences and knowledge amongst the ASEAN countries can be an important measure in dealing with water-related hazards and disasters and can help the countries to learn from each other's successes and failures and avoid committing the same mistakes.

8. Proposals for Regional Cooperation

One of the output from the Consultative Workshop was to develop an ASEAN Regional Agenda for a safer ASEAN. The ASEAN countries were requested to identify possible areas of cooperation in mitigation and adaptation to water-related disasters that could offer mutual benefits in the context of an ASEAN-ROK project. The table below summaries the proposals for regional cooperation.

(Table 9) Proposals for Regional Cooperation from the ASEAN Member States

Country	Proposals for Regional Cooperation
Brunei DS	1. Discussion on water-related hazards and disaster mitigation Acts (laws) from other countries. 2. To seek standard guidelines on the water-related hazards and disasters from other countries as a guideline for Brunei to have its own standards, laws or policies. 3. To create awareness and knowledge on the water-related hazards and disasters mitigation practiced by other countries. 4. To develop and share knowledge on water conservation practices and guidelines practiced in other countries. 5. Discussion on drought management due to extreme climate change and drought mitigation strategies and practices from other countries 6. Further reinforce regional cooperation and develop proposals on water management through capacity strengthening training, information sharing and know-how exchanges.
Cambodia	1. Training and Capacity Building. 2. Disaster Information Sharing and Communication Network. 3. To implement Standard Operating Procedures.
Indonesia	1. Knowledge Sharing - cooperation and exchange of knowledge and experiences on disaster management. 2. Role Sharing for River Basin Management - for trans-boundary river basins.
Lao PDR	1. Strengthening capacity building of related staff from national to local levels. 2. Produce guidelines and its practices application at all levels. 3. Community participation and stakeholders engagement including public private partnership.
Lao PDR (cont.)	4. Knowledge sharing among AMS on water and disaster management. 5. Pilot project, program and research related to water and disaster resilience in different scales. 6. Sustainable financing mechanism for water management and disaster resilience.

Malaysia	1. Sharing of data and information for trans-boundary rivers for mutual benefit between countries involved that will help to optimize resources. 2. Development of water-related hazard maps. 3. Development of early warning and forecasting models for water-related disasters based on modern technology. 4. Development of community-based disaster preparedness. 5. Green technology to address water security issues.
Myanmar	1. Technical and advisory cooperation at regional and global level. 2. Experience and knowledge sharing. 3. Technical sharing and financial assistance or support. 4. Medium and large project on water-related disaster reduction with regional and globa cooperation.
Philippines	1. Establish a Regional (ASEAN) Community of Practice (CoP) dedicated to water- related disaster - to facilitate regular exchange of knowledge and experiences among member countries. 2. Develop and implement a programmatic capacity building program for ASEAN countries to build country level institutional and individual expertise. 3. Develop a regional database to serve as repository of water-related disaster programs/projects/ activities being implemented in ASEAN countries for better knowledge management.
Singapore	1. Sharing best practices on mitigation and adaption of water-related disasters. 2. Sharing information and experiences on mitigating and adapting water-related disasters activities. 3. Capacity building in urban flood management and disaster risk management.
Thailand	1. Joint regional research program for water-related disasters. 2. Exchange of information, training in methods and ideas which can be applied in different situations and countries. 3. Knowledge dissemination and exchange from the national experts. 4. Formal establishment of the ASEAN Academic Networking in Water-related Disaster Management. 5. A technical training on water-related Disaster Management for Planning and Management for Natural Disasters in ASEAN.
Viet Nam	1. Sharing experience and cooperation in water monitoring and observing to enhance warning capacity in water-related disaster to prevent and relieve the damages from natural disasters and enhance water resources protection. 2. Workshop on effects of global climate change on freshwater and to develop practical approaches for sustainable regional water management and measures for reducing damages. 3. Actively promote water cooperation for equal and reasonable water exploitation, wastes management and trans-boundary river basins.

In all there were 40 proposals for regional cooperation from the nine ASEAN countries. Although the proposals were worded differently, they could be summarised into seven broad categories as shown in the table below.

(Table 10) Summary of Proposals for Regional Cooperation

Proposals for Regional Cooperation	Bn	Ca	Id	Lao	My	Mm	Ph	Sg	Th	Vn
Develop common Guidelines, Practices, SOP, Models	√	√		√	√	√	√			√
Knowledge Sharing, Case Studies (success/failures)	√	√	√	√	√	√	√	√	√	√
Capacity Building, Training	√	√		√	√		√	√	√	
Infomation/Expert Network		√					√		√	
Transboundary Issues			√		√					√
Hazard Maps, Community Involvement				√	√					
ODA, Projects, Research				√	√	√			√	

Knowledge and experience sharing was acknowledged by all the ASEAN countries as an important area for regional cooperation. Brunei commented that through knowledge sharing, each country could access the experiences, information and guidelines from fellow ASEAN countries. However, as water-related hazards and disasters encompasses a broad scope with numerous topics and sub-topics, there is a need to identify which priority subject areas to focus on. Cambodia suggested water quality, Malaysia proposed community development, Lao PDR highlighted technology and awareness campaigns, and the Philippines added transboundary issues. It was agreed that all the ASEAN countries will come up with their priority subject list after consultations back home.

The framework mechanism for knowledge sharing was discussed. The Philippines proposed the establishment of an ASEAN Community of Practice (CoP) dedicated to water-related disaster, to facilitate regular exchange of knowledge and experiences among member countries. Increasingly, the trend is to set up knowledge hubs which will be the repository for information, data, knowledge and experiences. Also, ASEAN would need to consider whether to set up its own portal on water-related hazards and disasters, or to put links to related portals into the ASEAN web site.

The ASEAN countries agreed that Capacity Building should be another priority area as there is a pressing need to build capacity in both organisations and people in the region, to be able to better deal with water-related hazards and disasters. Viet Nam spoke on the need to develop common guidelines, SOPs and models; and suggested the establishment of an ASEAN Water Forum through which there could be capacity building activities. Malaysia suggested to focus on 'training the trainers' approach as it would have a bigger outreach. Indonesia proposed the establishment of a regional network for capacity building.

9. Proposal for Next Phase

The Chuncheon Global Water Forum (Chuncheon GWF) explained on the funding system under the ASEAN-ROK cooperation projects. The Republic of Korea (ROK) through the Chuncheon GWF strongly believed that water-related hazards and disaster management should be the top priority topics for a technical cooperation project under the ASEAN-ROK Special Cooperation

Fund. This Fund is derived from the Ministry of Foreign Affairs in the Republic of Korea. In 2014, the Chuncheon GWF had proposed a project "Building Resilience for Sustainable ASEAN (from Water Related Disasters)" and this proposal was accepted by ASEAN and ROK in 2016. The first phase of this project is now substantially completed and there now arises an opportunity to expand this project to a multi-year program base i.e. to carry out the second phase over a two or three years period under a budget of approximately US$ 1 million. The ASEAN countries were requested to deliberate and agree on what would be the priority action at the regional level in this proposed future potential program.

The Philippines noted that knowledge sharing and capacity were important areas as per the discussion above. However, before agreeing on the priority action or theme, it was important that the perspective of the decision makers be considered as well, for they (decision makers) will pose the question "What will be the impact (of this priority action or theme) to the public?" Hence the Group should consider how to put more value into the output of the second phase. So far, the work under the first phase had focussed on water as a hazard and how to dispose to the sea. At the same time, all the ASEAN countries are also suffering from water shortages during periods of drought. Therefore, the excess water from typhoons, heavy rainfall and floods could be regarded as potential resources that could be used beneficially during droughts i.e. "water as hazards and water as resources". Thus, some of the solutions used in addressing water-related disasters could also be solutions for addressing water supply issues.

Brunei supported this proposal, noting that "water is a friend, but water is also an enemy". Lao PDR agreed, noting that in water "sometimes there is too much, but sometimes there is not enough". In Lao PDR, when there is rain, the people do not have buckets to hold the water, and when the sun comes, the water is gone. Myanmar concurred, noting that when the upstream has too much water, it will result in the downstream getting flooded and the downstream community will say "We have no rain, but still get flooded". With Cambodia, Indonesia, Malaysia, Thailand and Viet Nam all giving their support, there was consensus to the Philippines' proposal.

The ASEAN countries noted that the World Meteorological Organisation (WMO) has an Associated Programme with ICHARM called "Integrated Flood Management where the objective is to minimise the risks of floods and to increase the benefits. The Group requested the Chuncheon GWF to prepare a draft project proposal on "water as a hazard, water as a resource" and to table this proposal at the next meeting of the ASEAN Working Group on Water Resources Management (AWGWRM) scheduled in April 2017.

Executive Summary Report

BRUNEI DARUSSALAM

BRUNEI DARUSSALAM

By Ministry of Development and Othman &
Associates Consulting Engineer

Negara Brunei Darussalam (Brunei) is located on the north side of the island of Borneo and divided at the east and west areas by Malaysia. Its capital Bandar Seri Begawan is located at the mouth of the Brunei River which runs through the western part of Brunei (refer Fig.12).

(Fig.12) Map of Borneo

Brunei is split into four separate districts namely Brunei-Muara, Tutong, Belait and Temburong (refer Fig.13). The country has a tropical rainforest climate with uniform temperature, high humidity and high annual rainfall. There are two (2) monsoon regimes which affect rainfall patterns; the Southwest Monsoon (May to September) and the Northeast Monsoon (November to March). The Northeast Monsoon brings heavy rainfall and the Southwest Monsoon normally signifies relatively drier weather.

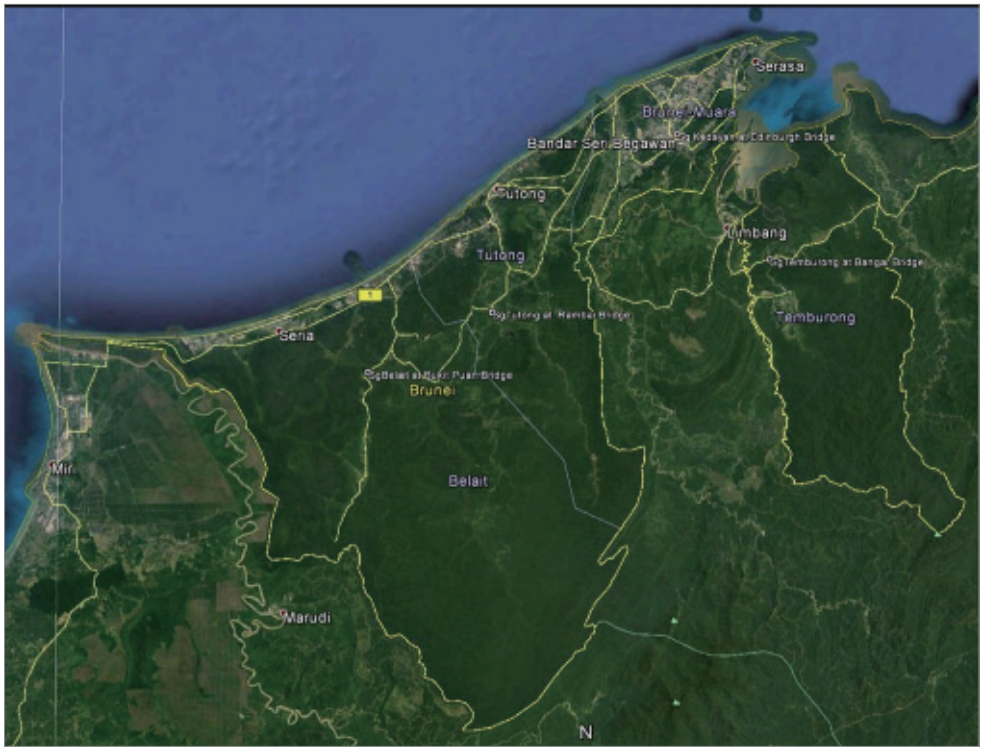
(Fig.13) Negara Brunei Darussalam Districts

Brunei joined ASEAN on 8th January 1984 after it became independent from the United Kingdom. Brunei is an economically strong country with the second highest GDP per capita amongst the ASEAN countries after Singapore (Trading Economics, 2016). It is also characterized by its high economic level and well-developed social welfare system.

Brunei's government is a constitutional monarchy, and the current ruler (Sultan) is His Majesty Sultan Haji Hassanal Bolkiah Mu'izzaddin Waddaulah Ibni Al-Marhum Sultan Haji Omar 'Ali Saifuddien Sa'adul Khairi Waddien, Sultan and Yang Di-Pertuan of Negara Brunei Darussalam. It is expected that Brunei will promote the development of other industries that will support the country's economy after the era of fossil fuel production.

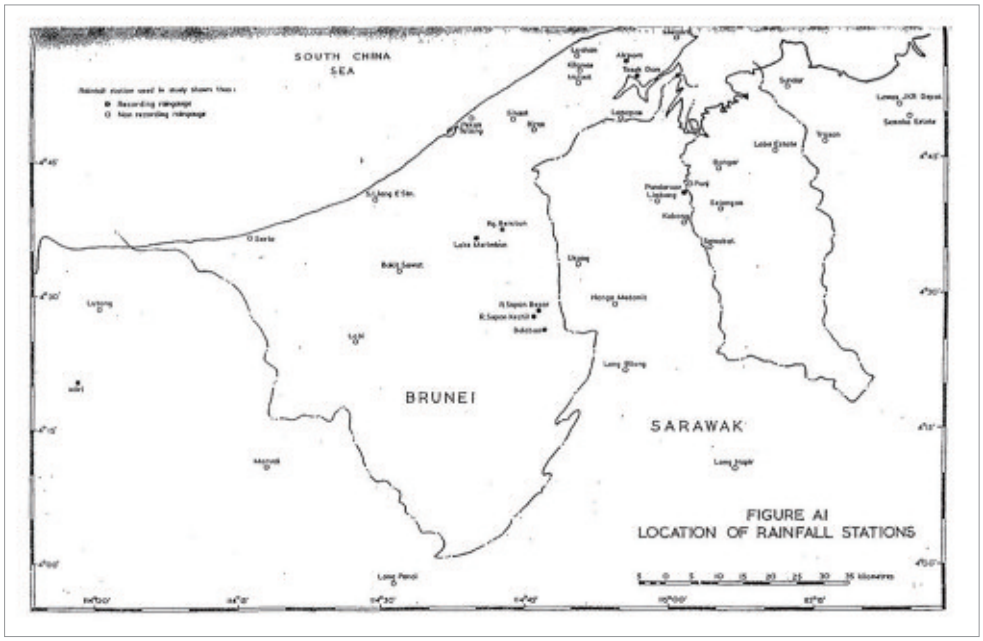
Frequent disasters in Brunei are floods and flash floods, which have occurred six (6) times since 1960. Brunei similarly to other ASEAN countries experiences both the El Niño (less rain) and La Niña (more rain) phenomena. Although Brunei is not located on a major earthquake area, low level earthquakes and tremors had been felt in the country in the past two decades. Brunei has experienced small earthquakes within the range of 4-5 magnitude in 1992 and 2005. Tsunami disasters are considered to occur due to strong earthquakes occurring in South China Sea but there were no records that Brunei has experienced any earthquakes.

The Brunei Darussalam Meteorological Department (BDMD) is Brunei's National Meteorological Service and is the authority responsible for provision of meteorological and climate services. It currently maintains a weather forecast office that provides warnings, forecast and advisories for government and non-government agencies as well as for the general public. Other than BDMD, the Hydrology section of the Department of Drainage and Sewerage (DDS) has also made an initiative in collecting the hydrological data for the country and there are only four (4) active hydrological stations (one station in each district) (Refer Fig.14).



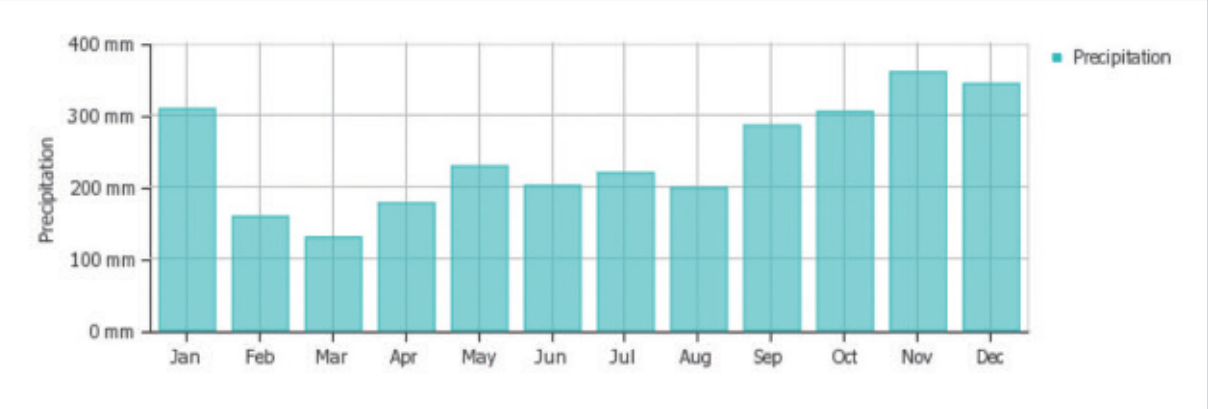
(Fig.14) DDS Active Hydrological Stations in Brunei

Even though each district has its own hydrological station, it is still not sufficient to cover the country's hydrological data. Nonetheless, Public Works Department (PWD) has prepared the rainfall intensities – Duration Frequency Curves at six (6) rainfall stations, Brunei Airport, Rumah Supon Kechil, Rumah Belabau, Kg Benutan, Lake Merimbun and Rumah Supon Besar (Refer Fig.15) which was established in the Urban Drainage Design Standards 1988 and acts as a guideline for design in the country.



(Fig.15) Location of Rainfall Stations

In general, rainfall in Brunei is high throughout the year, typical of equatorial regions. Rainfall in inland areas is generally higher and more evenly distributed compared to the coastal areas as they are more sheltered from the influence of the monsoon. The country has recorded its average lowest and peak precipitation at 162mm (in March) and at 371mm (in November) respectively (Refer Fig.16). However, the mean annual rainfall for the country ranges between 3,000mm to 3,200mm.



(Fig.16) Average monthly precipitation in Brunei Darussalam (Weather and climate, 2016)

Most of the population centred areas in Brunei are low lying and prone to flooding from the combined influences of overtopping of main rivers, ponding due to localised rainfall and tidal and storm surge influences. Since there is limited data and information on the water-related hazards and disasters in Brunei, flood occurrence in Brunei-Muara District is more prone, followed by the Belait District as recorded in the last 6 years data (2010 to 2015) maintained by DDS (Refer Table 11).

(Table 11) Floods reported by District in the past 6 years (estimation of affected area)

	2010	2011	2012	2013	2014	2015
Brunei - Muara	47	98	46	59	21	62
Tutong	25	38	11	19	106	30
Belait	32	23	26	19	38	10
Temburong	9	7	0	0	23	9
Total	**113**	**166**	**83**	**97**	188	**111**

Table 12 shows the list of significant flash flood disasters which had occurred in the past. Flooding (flash floods) caused by short-term heavy rain is the main weather disaster in Brunei. The Tutong and Belait districts have been identified as areas prone to flood damage.

(Table 12) Weather Disasters in Brunei

Year	Disaster	Daily Precipitation
1999	Flash flood La Niña	–
2008	Temburong flash flood	–
2009	Extensive flash flood in Muara, Tutong and Belait District	145.8mm
2013	Bandar Seri Begawan flash flood	181.0mm
2014	Tutong flash flood	189.8mm

In Brunei, there is no specific law about water-related hazards and disasters have been implemented. Instead, the Disaster Management Order (2006) defines the legal basis
for disaster management. Responsibilities and authorities of the National Disaster Management Centre (NDMC) are defined in this order. This centre provides a consistent nationwide to enable government agencies and non-governmental organisations, the private sector and agencies to work together to provide, prevent, respond and recover and mitigate the effects of disasters, regardless of cause, size, location or complexity. In Brunei, the Disaster Management System operates in accordance to the parent committee which was established based on three levels:

1. National Disaster Council (NDC)
2. National Disaster Management Centre (NDMC)
3. District Disaster Management Centre (DDMC)

The relevant authorities involved for each level are shown in Fig.17.

National Disaster Council (NDC)	National Disaster Management Centre (NDMC)	District Disaster Management Centre (DDMC)
• Prime Minister Office (PMO) • Ministry of Home Affair (MOHA) • Ministry of Foreign Affair & Trade (MOFAT) • Relevant Ministries	• Royal Brunei Armed Forces • Royal Police Force • Fire and Rescue • Medical • Health • Public Work Department • Community Development Department • Environment, Parks and Recreational Department • Brunei Shell Petroleum • Petroleum Brunei • Other agencies	• Royal Brunei Armed Forces District Division • Police District Division • Fire and Rescue District Division • Medical District Division • Health District Division • Public Work Department, District Division • Community Development Department, District Division • Electrical Department, District Division • Information Department, District Division • Environment, Parks and Recreational Department, District Division

(Fig.17) Involvement of relevant ministries and agencies under disaster management system

As published in the Asian Water Development Outlook 2016 on 30th August 2016, Asian Development Bank (ADB) has ranked Brunei fifth out of forty-eight (48) countries in Asia-Pacific for water security and ranked second amongst ASEAN member states for water security. The ranking level of the water security was based on five (5) criteria:

1. household access to water and sanitation;
2. productive use of water to sustain economic growth;
3. proper water management and services in urban areas;
4. the health and restoration of rivers and ecosystems; and
5. resilience to water-related disasters.

Apart from achieving full marks in household water access, Brunei scored 96 per cent in sanitation access, scored 14.3 out of 20, in terms of productive use of water to sustain economic growth.

According to previous news reports, Bruneians consume an average of 420 litres of water per day which is equivalent to 280 of 1.5 litres drinking water bottles. This made Brunei the highest amongst ASEAN member states in water consumption.
As there were no specific policies, laws and plans on integrated water resources management that have been implemented in Brunei. Therefore the delivery of an integrated flood management solution will require utilizing the planning system to provide significant elements such as Sustainable Urban Drainage Schemes. It is essential that the local authority development plans and strategies recognize the spatial planning needs of such solutions and is required to contain policies, standards and guidance to ensure that the physical and design requirements of dealing with overland flow and Sustainable Urban Drainage Systems can be incorporated into the essential, i.e. long term, infrastructure of urban areas.

There was also no information on the status of ODA for water-related disasters for the last decade that has been recorded for Brunei, but the Department of Water Services, Public Works Department is directly responsible for the supply of potable water and management of fresh water resources. It manages several water treatment plants with a total capacity of 557 million litres per day and has a modern laboratory to make sure that the quality of treated water meets safe drinking standards.

A Water Resources Management Working Group was established by the National Committee on Environment in 1994 with the following objectives:

1. Establishment of environmental quality objectives, corresponding standards and monitoring requirements for the water resources of Brunei Darussalam;
2. Establishment of a plan of action to mitigate adverse effects on Brunei Darussalam's water resources (present or future) with particular emphasis on the critical activities such as raw sewage discharge from settlements, silt from land clearance, oily waste from workshops and filling station, livestock and chemical wastes from agricultural development, discharges from industrial development and domestic discharges;
3. Establishment of harmonized legal framework for water resource management.

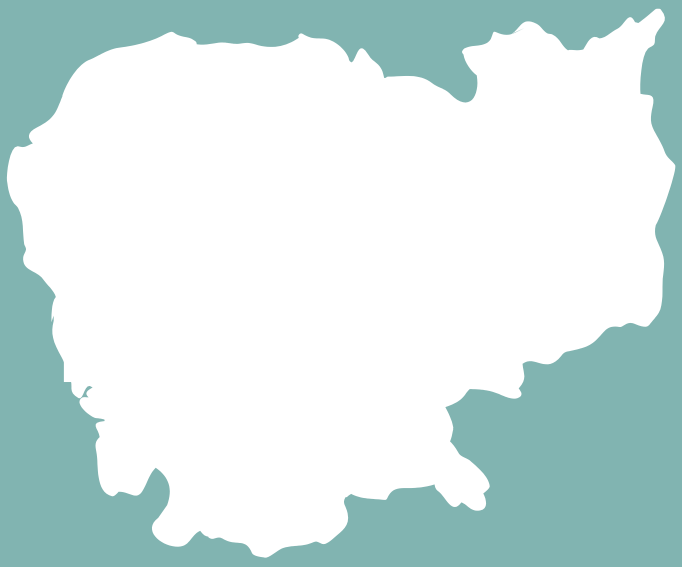
It is clear that there are several guidelines and policies which are still lacking in Brunei, but the country continues to be proactive in mitigating any disasters that possibly happens in Brunei. In the 'Brunei Darussalam Strategic National Action Plan' for Disaster Risk Reduction (SNAP) guidebook which was established by NDMC stated that several recommendations which includes research on law and regulation relating to disaster risk reduction, assessment of comprehensive training needs, establishing early warning systems, information and database coordination, public survey on disaster risk reduction understanding and strengthening the relation between agencies.

In Brunei's view, there are several proposals that may be considered for further regional cooperation after this, which are:

- Discussion on water-related hazards and disaster mitigation acts from other countries.
- To seek standard guidelines on the water-related hazards and disasters from other countries as a guideline for Brunei to have their own standards, laws or policies.
- To create awareness and knowledge on the water-related hazards and disasters mitigation practiced by other countries.
- To develop and share knowledge on water conservation practices and guidelines practiced in other countries.
- Discussion on drought management due to extreme climate change and drought mitigation strategies and practices from other countries.
- Further reinforce regional cooperation and develop proposals on water management through capacity strengthening, training, information sharing and know-how exchanges.

Executive Summary Report

CAMBODIA



CAMBODIA

By Ministry of Environment and Chan Mony

The National Assessment Report on Water-Related Hazards and Disasters in Kingdom of Cambodia provide the overview of the current situation in the whole country that has significant keys are background, climatic and physical characteristic, hydrology and meteorology, water-related hazards and disasters, legal and institutional setup in the Country, water security, national policies and plans on water-related disasters, lessons learnt from the past, status of ODA for water-related disasters, future agenda to mitigate and adapt to water-related disasters, and proposals for regional cooperation.

1.Background

(1) General Description

Cambodia is located on mainland Southeast Asia and situated in the south-western part of Indochinese peninsula, bordered by Thailand and Lao PDR to the North, Vietnam to the East and South, and the Gulf of Thailand to the West. The area of Cambodia is 181,035 km^2. Its shares 2438 kilometers land border from north to east and south with Thailand, Laos and Viet Nam.
The land can be divided into three broad topographical regions.
a. The surrounding mountains chains and plateau areas
b. The country's central plain, which cover about 75% of the total land area.
c. The coastal area, which is located in the south-west and is bordered by the gulf of Thailand.

(2) People

Population = 15.83 million (2016) with annual growth rate 1.6%, density 90 persons/Km^2, urban population = 21.1 %, Cambodia global rank = 71

(3) Government

Cambodia is set up as a multi-party democracy under a constitutional monarchy. The King serves as the head of state and the Prime Minister is the head of the Royal Government of Cambodia

(4) Economy-Overview

GDP = 19.950 billion US dollars in 2016, with annual growth rate 7% ,Agriculture 25.6 %, Industrial 28.9 % and Service 39.6 %, Export = 9.231 billion US dollards (46.3%), Import = 12.804 billion US dollars (64.2%)

2.Climatic and Physical Characteristic

(1) Climate of Cambodia

Cambodia's climate is tropical, with characteristically high temperatures, and two seasons are recognized: a monsoon-driven rainy season (May-October) with south-westerly winds ushering in clouds and moisture that accounts for anywhere between 80-90% of the country's annual precipitation, and a dry season (November-April), with cooler temperatures, particularly between

November and January. Average temperatures are relatively uniform across the country, and are highest (26- 40°C) in the early summer months before the rainy season begins. Cambodia receive the most precipitation (3,000 mm).
Temperatures remain at 25 to 27°C throughout the rest of the year. The wet season arrives with the summer monsoon, in May through November, bringing the heaviest rainfall to the southeast and northwest

(2) Climate Change

Climate Change as changes in weather patterns are being felt across the Country, the impacts of climate change have become a topic of strong public interest. Studies show that the basin is vulnerable to several climate change impacts that include a predicted mean temperature rise of approximately 0.8 degrees Celsius by 2030, as well as a regional increase in annual precipitation of 200mm. With more extreme weather events such as typhoons, the basin is more vulnerable to floods and drought, affecting people's livelihoods and reducing agricultural productivity.

(3) Geography

Cambodia's land consists of mostly low lying areas, flat plains with mountains in the southwest and north. The Cardamom Mountains (1500 m average) located in the southwest, lie in a northwest to southeast direction. The tallest mountain in Cambodia, Phnom Aural (1,771 m), lies in the eastern part of this mountain range. The Elephant Range, an extension of the Cardamom range, lies towards the south and southeast from the Cardamom mountains and rises to an elevation between 500 and 1,000 meters.
The Cardamom and Elephant Mountain Ranges are entirely internal to Cambodia and form the southwestern rim of the Mekong Delta/Tonle Sap plain. These two ranges are bordered on the west by a narrow coastal plain that contains Kampong Saom Bay, which faces the Gulf of Thailand. They enclose most of the country's coastal strip, home to Kampong Saom Bay, cutting it off from much of the rest of the country. Dangrek Mountains, located at the northern end of the Tonle Sap (Great Lake) Basin, has an average elevation of around 500 meters, the highest point of which reaches more than 700 meters.

(4) Land Use and Planning

Cambodia's total land of 181,035 sq km is comprised of 54.1 % forests, 23.4 % agriculture, 6.8 % wetlands, 15.6 % wood and grasslands and 0.1 % settlements. Cambodian agriculture is predominantly organized on the basis of small farmer communities. Rice production dominates the sector, occupying 90% of cultivated area. While Cambodian soils generally exhibit low to medium soil fertility, the vast flood plains of the Mekong and Tonle Sap provide suitable conditions for extensive areas of rain-fed lowland rice.
Rice is the dominant crop, occupying about 2.968 million ha; non-rice crops are grown on about 1.047 million ha (MAFF 2012). Agricultural lands can be categorized into two distinct topographical regions: lowlands and uplands. Lowland soils mainly support rice farming interspersed with field crops, vegetable gardens, and fruit trees. Upland areas are mainly used for rubber plantations, maize, cassava, soybeans, mung beans, peanuts, sesame, sugarcane, and fruit trees (MAFF 2012).

(5) Rivers and River Basins

From its source in the Tibetan Plateau about 5200m above sea level, the Mekong River flows south for 4909 km to the South China Sea, draining a total catchment area of 810, 000 km2. and covering six countries: China, Myanmar, Lao PDR, Thailand, Cambodia and Viet Nam. Cambodia has further defined thirty-nine (39) river basins base on their hydrological characteristics and have divided into five River Basin Groups.

Five Groups as follow :
(1) The Coastal Basin Group: The South-west part of the county
(2) The 3 S Basin Group: The Se kong, the Se San and Sre Pok Rivers

(3) Upper Mekong Basin Group: The upper part of the Mekong River
(4) Mekong Delta Basin Group: This covers the Mekong River from about midway between kratie-Kampong Cham to the border of Cambodia and Viet Nam, including the Vaico River basin.
(5) Tonle Sap Basin Group: The centre of the country and covers the the entire catment of the Tonle Sap Great Lake.

3. Hydrology and Meteorology

The Mekong River and its tributaries comprise one of the largest river systems in the world. The central Tonle Sap - Great Lake has several input rivers, the most important being the Tonle Sap river during the rainy season, which contributes 62 percent of the total water supply. The other rivers in the sub-basin and direct rainfall on the lake contribute the remaining 38 percent.
Except for the smaller rivers in the southeast, most of the major rivers and river systems in Cambodia drain into the Tonle Sap or into the Mekong River. The Cardamom Mountains and Elephant Range from a separate drainage divide. To the east the rivers flow into the Tonle Sap, as in the south- west rivers flow into the Gulf of Thailand. Toward the southern slopes of the Elephant Mountains, small rivers flow south-eastward on the eastern side of the divide.
Cambodia has a total of 80 manuals and 12 automated hydrological stations.The meteorological observing network is composed of 21 Synoptic stations distributed in every province of Cambodia. Out of these stations, 8 are automatic weather stations (AWS) and 13 stations are manuals by the conventional analogue system.
The 200 rainfall stations all over Cambodia. The rain gauges are being manned by staff from provincial offices and others by part-time observers. Their status is uncertain and need complete review including network expansion to attain acceptable coverage density.
The department of water quality management, Ministry of Environment operates the water quality monitoring network in Cambodia. The 29 stations are situated along the Mekong River, the Tonle Sap Great Lake and its tributaries, wetland and waste water treatment plan.

4. Water-Related Hazards and Disasters

Cambodia is prone to a number of natural disasters including flood, lightening, drought, fire, storm, epidemics, pest outbreak and river bank collapse. Yet little was known about the impact of disasters at national and sub-national levels due to a lack of systematic organization and collection of information. There was general lack of reliable information about disaster losses and damage in line ministries and the few existing data sets were not well organized in a systematic manner to assist in useful analysis.
The floods and drought the primary natural hazards to affect the country. These have caused significant loss of life and substantial damages to infrastructure, agriculture and livelihoods. The frequent natural disasters have exacerbated the vulnerability of the mostly poor and rural population. The issues with significant humanitarian impact, including climate change, landmines, environmental degradation, water and sanitation, health and other developmental issues, also affect Cambodia, severely obstructing development in a country seeking to rise out of years of internal conflict and instability.

(1) Disaster Types and Disaster Profile in Cambodia

a. Flood = 38 %
b. Drought = 14.6 %
c. Storm = 16.3 %
d. Lightening = 8.4 %

e. Fire = 20 %
f. River Bank Collapse = 0.5 %
g. Pest Outbreak = 1.1 %
h. Epidemic = 0.6 %

(2) Flood

Floods have repeatedly occurred in Cambodia over the past decade with the country experiencing three types of flood events: (1) Mainstream flooding, (2) Tributary flooding, (3) Flash floods. These floods are swift and last only for a few days but often cause severe damage to crops and infrastructure especially in tributaries around the Tonle Sap Lake. Flash floods have been reported to affect the provinces of Kandal, Kampong Speu, Kampot, Pursat, Battambang, Kampong Chhnang, Rattanakiri, Preah Vihea, and Odor Meanchey.

Major flooding events affecting a significant population occur every five years or so (in 1961, 1966, 1978, 1984, 1991, 1996, 2000, 2001 and 2002). One of the worst floods in the country's history occurred in the year 2000 where the NCDM reported that an estimated 750,618 families representing 3,448,624 people, including 85,000 families or 387,000 people were temporarily evacuated from their homes and villages. Three hundred forty-seven (347), 80% of whom was children were killed and total physical damage was estimated at US$150 million. In 2001, floods caused the death of 62 people (70% children) and an estimated US$20 million damages, and in 2002, 29 people (40% children) were killed where estimated damages were US$14 million.

The high rainfall uneven distributed throughout the country. Some regions can be expected high level of rainfall, which lead to floods, while the others may face shortage of rainfall, leading to drought. Floods (and occasional droughts and windstorms) are quite frequent in Cambodia over the last decade and appear to be increasing since 1989 after which statistics are available. Severe floods have resulted in a high number of casualties and destruction of infrastructures. The most severe floods, which occurred in 2000, killed some 350 people and caused US $150 million in damages to crops and infrastructures. The severe floods occurred during the period 2000-2002 was the worst in recent history, resulted in 438 casualties, which included a high number of internally displaced people, hundreds of deaths and economic losses, and caused damage amounting to US $ 205m in total (NCDM, 2002).

The 2013 monsoon rainy season (May - October 2013) saw large-scale flooding return to South-East Asia after acalmer 2012. Consequently, in the third week of the last quarter of 2013, a combination of successive typhoons, a significant rise in the level of the Mekong River, trans- boundary flash floods in the western provinces and heavier-than-average monsoon rains caused extensive flooding across Cambodia. On 18 October 2013, the National Committee for Disaster Management (NCDM) reported that the floods affected 377,354 households and 1.8 million individuals living in 20 provinces. The floods killed 168 people, the majority of whom were children (HRF, 2013b).

Damage and loss from the 2013 floods were concentrated in the north-west and south-east parts of the country. In some cases, water flowed and receded for a protracted period, causing the administration of basic public services (education and health) to malfunction, and forcing people to relocate to safer areas. The Government acted quickly, delivering immediate emergency aid. It was assisted by its many partners in development who specialize in humanitarian aid.

Recognizing the long-term effects of the floods on vulnerable people, and the affected areas' development perspectives, the NCDM, with assistance from UNDP and together with its partners in development and line ministries, carried out a Post-Flood Early Recovery Needs Assessment (PFERNA) to assess the extent of the damage and loss, and to define a comprehensive and feasible recovery plan. The PFERNA estimated the total damage and loss caused by the 2013 floods to be 356 million US$, of which 153 million US$ represented the destruction of physical assets (damage) in the affected areas, and 203 million US$ represented estimated losses in production and economic flows. Damage represented 43 percent of the total economic impact of the floods, while the remaining 57 percent was loss, as represented in the table above.

(3) Drought

Drought does not cause human life loss like other disasters, but its impact on livelihood, especially on agriculture, livestock and water is significant. The following section presents and discusses when and where drought occurred in the last 18 years in Cambodia and its impact on industrial and subsidiary crops, transplant rice fields and paddy fields.

Drought is classified as a slow onset natural hazard, which occurs because of deficiency of rainfall over an extended period-of-time, such as a season, a year, and/or several years as the result of climatic variability. Droughts can be classified into three broad categories (1) Meteorological drought (2) Hydrological drought (3) Agricultural drought

Drought in Cambodia is usually associated with crop production as most agricultural production is from rain fed cropping. Over the last 25 years there have been a significant number of distinct drought events, occurring in 1986-87, 1994, 1997-98, 2001, 2002, 2004, 2005, 2009, 2011, 2012, 2014, 2015 and 2016.

2012 Drought : In August 2012, drought affected 11 of 24 provinces in Cambodia, 14,190 hectares of rice fields, and destroyed 3,151 hectares of rice seedlings. The hardest drought affected provinces were Kampong Speu, Takeo, Svay Rieng, Kandal, Prey Veng, Kampot, Battambang, Pursat, Banteay Meanchey, Uddar Meanchey, and Preah Vihear.

2011 Drought : In 2011, drought affected 3,804 hectares and destroyed 53 hectares of rice.

2010 Drought : In 2010, 12 provinces of 24 provinces were affected by severe droughts. Some 14,103 hectares of transplanted rice were affected and over 3,429 hectares of transplanted rice seedlings and 5,415 hectares of subsidiary crops were damaged.

2009 Drought : In 2009, 13 provinces of 24 provinces were affected by severe drought. Some 57,965 hectares of rice crops were affected and 2,621 hectares were destroyed.

2002 and 2004 Drought : According to the Ministry of Environment, the worst drought years were recorded in 2002 and 2004. The drought in 2002 affected 43 districts in eight provinces. Some 442,419 families (2,017,340 individuals) were affected. The total estimated damage was US$ 9 million. According to FAO and WFP reports, the 2004-2005 drought affected 14 of 24 provinces. Rice and crop production was affected in all provinces and about half a million rural people faced food insecurity.

(Table 13) Drought Disasters in Cambodia for the period 1987to 2005

Year	Disaster Type	Occurrence	Total Deaths	Injured	Affected	Homeless	Total Affected	Total Damage (US$ x 1,000)
1987	Drought	1	–	–	–	–	–	–
1994	Drought	1	–	–	5000000	–	5000000	100000
2001	Drought	1	–	–	300000	–	300000	–
2002	Drought	1	–	–	650000	–	650000	38000
2005	Drought	1	–	–	600000	–	600000	–

Source : EM-DAT: The OFDA/CRED International Disaster Database

(4) Storm

Extreme weather events such as storms or typhoons are usually considered the fourth major problem in Cambodia because the country is protected by surrounding mountain ranges. Storms do occasionally affect the country with most of the storm-related damage caused by localized floods associated with heavy rain. Tropical storms can also affect the level of Mekong River flooding

experienced on a given year. The storm incursions into the Mekong basin spread from the South China Sea towards the east and Southeast across Vietnam and the Southern China. Greatest damage occurs when these arrive during September and October when the seasonal discharge of the Mekong River is already high and a second significant peak to the annual flood is generated.

(Table 14) Storm in Cambodia for the Period 1997 to 2009

Year	Disaster Type	Occurrence	Total Deaths	Injured	Affected	Homeless	Total Affected	Total Damage (US$ x 1,000)
1997	Storm	1	25	–	–	–	–	10
2009	Storm	2	19	91	178000	–	178091	–

5. Legal and Institutional setup in the country

I. Legal

A. Law on Disaster Management (10 July 2015)
The objective of this law is to regulate disaster management in the Kingdom of Cambodia. The law has the following goals: (i) Prevention, adaptation and mitigation in the pre-disaster period, due to natural or human-made causes; (ii) Emergency response during the disaster; (iii) Recovery in the post-disaster period. The act provides for the establishment of the National Committee for Disaster Management to lead, administer and coordinate all disaster management activities.

1. Sub-decree No. 30 ANKR.BK, dated 9 April 2002 on the Organization and Functioning of the National and Sub-National Committees for Disaster Management;
2. Sub-decree No. 61 ANKR.BK, dated 29 June 2006 on the establishment of the Commune Committee for Disaster Management (CCDM); Direction No. 315 NCDM, dated 21 July 2010 on the establishment of the Village Disaster Management Team (VDMT) for the implementation of CBDRM.

B. Law on Environmental Protection and Natural Resources Management (24 December 1996)
The purposes of this law are:

- to protect and promote environmental quality and public health through the prevention, reduction, and control of pollution
- to assess the environmental impact of all proposed projects prior to the issuance of a decision by the Royal Government
- to ensure the rational and sustainable conservation, development, management, and use of the natural resources of the Kingdom of Cambodia
- to encourage and enable the public to participate in environmental protection and natural resource management
- to suppress any acts that cause harm to the environment

There are 4 sub-Degree were identified:
1. Sub-Degree on Water Pollution Control
2. Sub-Degree on Solid Waste Management
3. Sub-Decree on EIA Process
4. Sub-Decree on Air Pollution and Noise Disturbance Control

C. Law on the Water Resources Management, 29 June 2007

The general purpose of this Law is to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people. This Law determines:

- the rights and obligations of water users,
- the fundamental principles of water resources management, and
- the participation of users and their associations in the sustainable development of water resources.

4. Sub-decrees were identified:
   1. River Basin Management
   2. Water Allocation and Licensing
   3. Water Quality
   4. Farmer Water User Community

II. Institutional Set up for Disaster Management

A. The National Committee for Disaster Management (NCDM) of the Royal Government of Cambodia

To lead the Disaster Management in the Kingdom of Cambodia. Functions and Responsibilities to make recommendations to the Royal Government and issue principles, main policies to assure safety and security of people from disasters and issue warnings on Disaster Preparedness and Management cum the measures for Emergency Response and interventions during disaster.

Functions and Responsibilities

To make recommendations to the Royal Government and issue principles, main policies to assure safety and security of people from disasters and issue warnings on Disaster Preparedness and Management cum the measures for Emergency Response and interventions during disaster.

To coordinate with the Ministries of the Royal Government, UN agencies, IOs, NGOs, International Communities, National Associations, and Local Donors in order to appeal for aid for Emergency Response and Rehabilitation.

To disseminate Disaster Management works to communities and strengthen the line from the National level (Ministries / Institutions concerned) to the provincial/ Municipal/District/ Precinct level along with human resource development aiming to manage Disaster works firmly and effectively.

To put forward a proposal to the Royal Government on reserves, funds, fuel, means of working, equipment and human resources for Disaster Prevention and intervention in Emergency Response and Rehabilitation before, during, and after disaster.

B. Cambodia Red Cross (CRC)

C. Ministries Involved in Dasaster Management

1. Ministry of Interior (MINT)
2. Ministry of National Defense (MND)
3. Ministry of Environment (MOE)
4. Ministry of Economy and Finance (MEF)
5. Ministry of Public Works and Transport (MPWT)
6. Ministry of Agriculture, Forestry and Fisheries (MAFF)
7. Ministry of Health (MOH)
8. Ministry of Information (MINF)
9. Ministry of Education, Youth, and Sport (MEYS)
10. Ministry of Cults and Religion (MCAR)
11. Ministry of Rural Development (MRD)

12. Ministry of Industry, Mines, and Energy (MIME)
13. Ministry of Women's Affairs and Veterans (MWAV)
14. Ministry of Social Affairs, Labor, Vocational Training, and Youth Rehabilitation (MOSALVY)
15. Ministry of Posts and Telecommunications (MPT)
16. Ministry of Tourism (MOT)
17. Ministry of Water Resources and Meteorology (MWRM)
18. Ministry of Land Management, Urban Planning and Construction (MLMUPC)

6. Water Security

(Table 15) Total Water

Total Water					
Estimated coverage 2015					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	23%	2%	21%	42%	35%
1995	30%	3%	27%	38%	32%
2000	42%	7%	35%	31%	27%
2005	53%	12%	41%	25%	27%
2010	64%	16%	48%	19%	17%
2015	76%	21%	55%	12%	12%

Source : WHO/UNICEF JMP

(Table 16) Total Sanitation

Total Sanitation				
Estimated coverage 2015				
Year	Improved	Shared	Other unimproved	Open defecation
1990	3%	0%	8%	89%
1995	8%	1%	7%	84%
2000	16%	3%	6%	75%
2005	25%	5%	4%	66%
2010	34%	7%	2%	57%
2015	42%	8%	3%	47%

Source : WHO/UNICEF JMP)

7. National Policies and Plans on Water-Related Disasters

1. National Water Resources Policy (2004)

The goals of water resources policy are to ensure effective and sustainable management of water resources in the further 20 years. More specifically are:(1) Protect, manage and use water resources with effective, equitable and sustainable manner, (2) Solve the water problem in collaboration with related institutions within public and private sectors; (3) Develop and carry out the

national strategy and policy towards water resource management;(4) Direct stakeholders for developing, managing and utilizing the water resources; and (5)Achieve the national policy on poverty reduction and sustainable national economy development

2. Cambodia Climate Change Strategic Plan (CCCSP) 2014 – 2023

The vision, mission and goals of the CCCSP were formulated based on the analysis of institutional capacity, observed climate change impacts and climate change projections.

Vision : Cambodia develops towards a green, low-carbon, climate-resilient, equitable, sustainable and knowledge-based society.

Mission : Creating a national framework for engaging the public, private sector, civil society organizations and development partners in a participatory process for responding to climate change to support sustainable development.

Goals :

- Reducing vulnerability to climate change impacts of people, in particular the most vulnerable, and critical systems (natural and societal);
- Shifting towards a green development path by promoting low-carbon development and technologies; Promoting public awareness and participation in climate change response actions

3. National Strategic Development Plan 2014-2018

NSDP has Key Policy Priorities and Actions as follows:

(1) Good Governance: The Core of the Rectangular Strategy
(2) Overarching Environment for the Implementing the Strategy
(3) Promotion of Agricultural Sector
(4) The Development of Physical Infrastructure
(5) Private Sector Development and Employment
(6) Capacity Building and Human Resource Development

4. Strategic National Action Plan for Disaster Risk Reduction 2008 – 2013

In 2005, 168 nations, including Cambodia, participated in the World Conference on Disaster Reduction (WCDR) held in Kobe, Japan, which resulted in a resolution for the implementation of a 10-year international disaster risk reduction strategy, known as the Hyogo Framework for Action (HFA). To address the implementation of the HFA in Cambodia, the National Committee for Disaster Management (NCDM) and the Ministry of Planning(MOP) formulated the "Strategic National Action Plan for Disaster Risk Reduction 2008 –2013" (SNAP-DRR).

According to the NCDM and Ministry of Planning, "The primary motivation of the Royal Government of Cambodia in the formulation of an Action Plan for Disaster Risk Reduction (DRR) is to reduce the vulnerability of its people, especiallythe poor, to the effects of natural, environmental and human-induced hazards. This can best be achieved by strengthening the disaster management system in Cambodia and by incorporating a disaster risk reduction perspective into the policies, strategies and plans of government in all sectors and at all levels. The Action Plan was conceived and formulated to serve as the "road map" or guide for strengthening and undertaking disaster risk reduction in Cambodia."

8. Lessons Learnt from the Past

Lessons Learned from Community Based Flood Mitigation and Preparedness

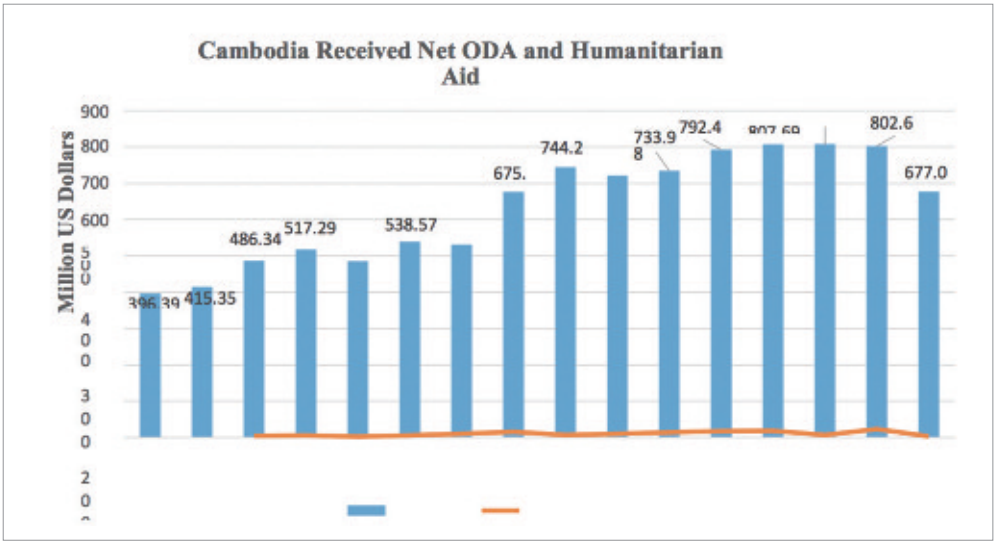
The Management Committee of the Cambodia Community-Based Flood Mitigation and Preparedness Project (CBFMP) proposes to conduct a research assessment of the experience of CBFMP project implementation in the three target provinces of Kandal, Prey Veng and Kampong Cham. The assessment will identify lessons learned and develop replication case studies.

The objectives of this assessment and lessons learned are to:

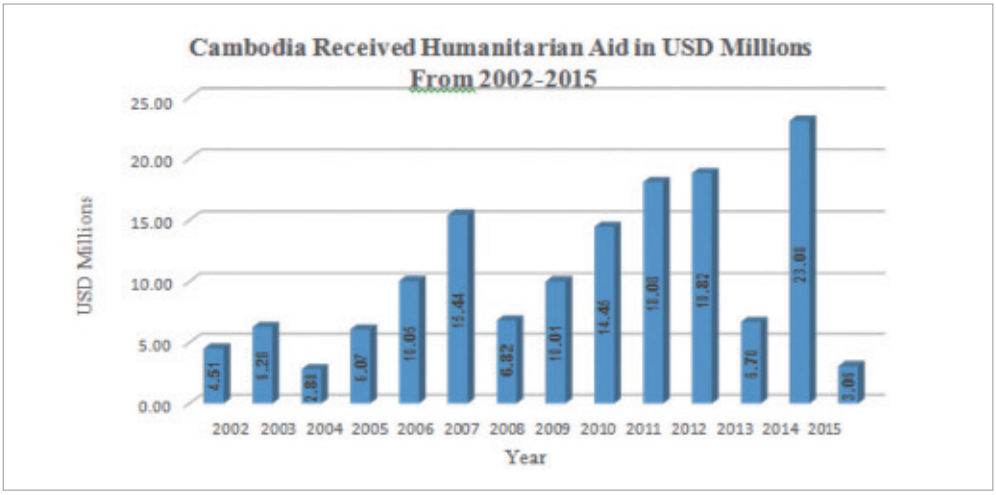
- Document the progress of community activities including its constraints and successes,
- Develop representative, written case studies of the progress of CBFMP
- activities to be repeated or replicated in other areas. The purpose of the study is to identify lessons learned from the CBFMP process, including but not limited to:
- Strengths and weaknesses of the training, in course content, participant understanding, preparation for leadership,
- Effectiveness of CRC Branch and Headquarters support,
- Community understanding and involvement in flood mitigation activities,
- Facilitating the enhancement or adaptation of traditional coping strategies

9. Status of ODA for Water-Related Disasters

1) Overview



(Fig.18) The Trend of Cambodia Received Net ODA in USD Million from 2000 to 2015 and Provide to Humanitarian Aid Sector
Source : OECD



(Fig.19) ODA Grants for Humanitarian from year 2005 to 2014 in
(1) Reconstruction Relief & Rehabilitation (2) Disaster Prevention & Preparedness (3) Emergency Response (Source : OECD)

(Table 17) Top Ten Donors of Gross Official Development Assistance (ODA) 2014-2015 Average

Rank	Donors	USD
1	Japan	116.52
2	AsDB Special Funds	109.28
3	United States	83.30
4	Korea	71.01
5	France	67.97
6	Australia	64.12
7	EU Institutions	50.17
8	Germany	46.97
9	Global Fund	40.27
10	Sweden	32.10

Source : OECD

2) The ODA Governance Framework of Cambodia

The National Strategic Development Plan updated (2014-2018) is National ODA the framework to operationalize the third phase of Rectangular Strategy of the Government. Most of the priority sectors have developed strategic plans that promote national ownership and support increased alignment. The NSDP is intended to guide resource allocations to priority sectors and to promote the integration of development assistance with national systems. It is therefore of strategic importance for development partners to align their assistance with these national priorities and systems. Official Development Assistance (ODA) is a major source of financing of development programs of the Royal Government of Cambodia and has contributed to the implementation of major public development projects in Cambodia. ODA has been highlighted by the Government as an important source of financial and technical input to attain the NSDP objectives and the Cambodia Millennium Development Goals.

10. Future Agenda to Mitigate and Adapt to Water-Related Disasters

1. Key Disaster Reduction

To overcome Water-Related Disaster Cambodia has the six key disaster risk reduction components are identified as follows:

1. Ensure that disaster risk reduction is a national and a local priority
2. Strengthening sub-national and community-based disaster risk management
3. Identify, assess and monitor hazard risks and enhance early warning
4. Use knowledge innovation and education to build a culture of safety and resilience
5. Mainstreaming DRR into Policies and Programs of Relevant Government Ministries
6. Strengthen disaster preparedness for effective response at all levels

2. Mitigation

(1) The most effective flood mitigation methods in Cambodia are relocation and elevation. However, when these methods are not feasible, structural flood proofing and mitigation methods may be an alternative.

(2) Flood proofing is defined as any combination of structural and non-structural measures, which reduce or eliminate damages and loss caused by floods and droughts.

(3) Structural measures aim to reduce flood risk by controlling the flow of water. Non- structural measures are actions taken to mitigate flood loss and damages through better planning and management of watershed development
(4) Structural measures range from engineered structures, such as flood defenses and drainage channels to more natural and sustainable complementary or alternative measures such as wetlands and natural buffers. However, structural measures can be overtopped by events beyond their design capacity and result in significant damage and loss. As well, structural measures transfer flood risk by reducing flood risk in one location only to increase it in another location. Structural solutions have a high upfront investment cost, may induce complacency by their presence, and can result in a significant increase in damages if they fail.
(5) Non-structural measures manage risk by building the capacity of people to cope with flood and droughts. Non-structural measures, such as an early warning system, are a key component of a flood and drought mitigation and risk reduction strategy. Non-structural measures do not usually require large upfront investments, but rely on an improved understanding and awareness of floods and droughts, on an adequate forecast system, and on the affect population taking appropriate actions.

11. Proposal for Regional Cooperation

(1) Training and Capacity Building
(2) Disaster information sharing and communication network
(3) Standard Operating Procedure
(4) Transboundary Water

5. Training and Capacity Building

It is important to reduce the vulnerabilities and enhance its capacity for disaster mitigation and reconstruction to achieve resilience to disasters. The area possible to be built as follows:

- Disaster risk identification,
- Monitoring and early warning,
- Prevention and mitigation,
- Preparedness and response,
- Rehabilitation,
- Technical cooperation and research,
- Mechanisms for coordination, and
- Simplified customs and immigration procedures.

6. Disaster Information Sharing and Communication Network

ASEAN member state should share disaster information through their government organization that has role and responsible for the alert status of natural disaster such as storm flood which to support preparedness measures.

7. Standard Operating Procedure

The implement Standard Operating Procedure for Regional Standby Arrangements and Coordination of Joint Disaster Relief and Emergency Response Operations, will enable the ASEAN Member States to mobilize and deploy critical resources and capacity for rapid disaster relief and emergency response.

8. Transboundary Water

Recent years, we observe that the countries located in upstream Mekong River have high development such as Hydro Power Dam, in Main Stream Mekong River and its Tributaries. On the other hand, Industrial growth rapidly that finally their wastewater discharges to Mekong River. Therefore, the water level of Mekong River will be decrease and water quality along river also to be contaminated. We would like to proposed transboundary water management, Ambient water quality monitoring network and data sharing, exchange of information and joint monitoring and assessment.

The information based on well-organized measurement networks and monitoring programmes is a prerequisite for accurate assessments of water resources and problems. Assessment is essential for making informed decisions and formulating policy at the local, national and transboundary levels.

Finally, Countries that sharing the same river have to sharing benefits and sharing responsibilities.

Executive Summary Report

LAOS

LAOS

By Ministry of Natural Resources and Environment
and Khemngeun Pongmala

Country profile

Lao PDR is a land link country in Southeastern Asia, northeast of Thailand, west of Vietnam. The total area is 236,800 km2 where has land area of 230,800 km2 and water area of 6,000 km2.The Mekong river (70 km) is a natural border with Thailand in most areas; flows through nearly 1,900 km of Lao total area; with the main 13 tributaries from Lao PDR; catchment area in Lao PDR: 213.060 km2 (26.8 % of total catchment).

The total population in Lao PDR amounted to 6,492,228. The average population growth rate was 2.47 percent annually from 1985-1995. In the following decades, the annual growth rate decreased to 2.08 percent from 1995-2005 and 1.45 percent from 2005-2015. The GDP of 2015 per Capita is 1,947 US$ and the growth Rate of GDP is 7.56 %.

The population sizes of provinces base on the size of province. Savannakhet is the largest province in Lao PDR. Nearly 1 million or 15 percent of the country's population live in this province. The capital city of Vientiane is the second largest population of 700,000 or 13 percent, while third largest is Champasack with 600,000 or nearly 11 percent of the total.

Lao PDR is a region's most ethnically diverse country.A list of ethnic groups that comprise more than 1 percent of the total population. There are 49 officially recognized ethnic minorities in Laos representing four broad ethno-linguistic families: the Lao-Tai (67% of the population), the Mon-Khmer (21%), Hmong-Lu Mien (8%), and the Chine-Tibetan (3%). These categories further subsume 49 distinct ethnicities and some 200 ethnic subgroups. The result of population and housing consensus report in 2015, documented there slightly over half of the nation's population (53.2%) belong to the Lao ethnic group or Lao Loom and the second and third largest group are Khmou and Hmong respectively.

Lao PDR is covered by Uplands and mountains from the north to the south nearly 80% with the Annamite range in the northeast and east and the LuangPrabang range in the Northwest, among other ranges typically characterized by steep terrain. This mountainous landscape found across most of the north of the country, except Vientiane and the Plain of jar in XiangKhouang Province are plain areas. The western border of Laos is demarcated by the Mekong River which has high density of population and important for transportation. The eastern border with Vietnam are mostly along the crest of the Annamite Chain. The shortest share border are with Cambodia, China and Burma. The southern part of the country contains large level areas in Savannakhét and Champasak provinces which are the first largest province in Laos. The country is divided into 64 watersheds as shown in figure 5. Fifty-three watersheds or 91% of the land area drain into the Mekong River which is the world's 12th-longest river and the 7th-longest in Asia. The remaining eleven watersheds, located in XiengKhouang and Huaphan provinces, drain into rivers in Vietnam.

Climatic and Physical Characteristic of the Country

Lao PDR has a typical monsoon climate with two distinct seasons: Rainy season from May to October and Dry season from November to April. The average temperature across the country during 2010 - 2015. The average maximum temperature found

in the north and south (33.4OC) while the lowest temperature found mostly in northern part of Laos (20.4OC). The southwest monsoon prevails from mid-May to early October, while the northeast monsoon dominates from early November to mid-March. Generally, the average annual rainfall ranges between 1400 mm and 2500 mm and exceeds 3500 mm over the central and southwest region. The precipitation regime of the LMB is driven by the Southwest Monsoon and by westward tracking TWSs that landfall on the Viet Nam coast and travel into the basin.

Climate change context become a major concern linked to flood and drought risk. Water related disaster in Lao PRD are related with climate variation impacted by both El Niño and La Niña. In many locations, especially in thetropics, La Niña (cold episodes) produces the opposite climate variations from El Niño (warm episodes). The Annual MekongFlood Report 2010, as well as the Mekong region are prone to drought during El Niño. Theseregions are typically wetter than normal during La Niña. In addition, water related disaster are closely linked to climate change and environmental degradation. Climate change and rapid deforestation – forest degradation from human agricultural activities increase the risk high frequency and sever flood and drought. The studies in 2008 showed that the annual precipitation for the Mekong Basin will increase by 13.5% from the historical average of 1509 mm to 1712 mm by 2030. The greatest changes are projected for the wet season months from May to September. The projected changes in dry season precipitation are much smaller, but the median projection indicates small decreases (<3 mm) in mean monthly precipitation in February, March and November.

Water-Related Hazards and Disasters

- Climate change

  Climate change context become a major concern linked to flood and drought risk. The increasing of rainfall or more intense rainfall link to sever flood or higher flood risk. The following four trend climate change have the potential to significantly increase the risk of flood - drought and affect livelihoods. The combination of high intense of rainfall and higher temperatures will affect crop product such as paddy, coffee, cassava, and maize (CLEAR 2015).

  Report on Climate Change's Impacts to Water Resource Sector, 2009 presented the studies of 2008 which showed that the annual precipitation for the Mekong Basin will increase by 13.5% from the historical average of 1509 mm to 1712 mm by 2030. The greatest changes are projected for the wet season months from May to September. The projected changes in dry season precipitation are much smaller, but the median projection indicates small decreases (<3 mm) in mean monthly precipitation in February, March and November. No change in precipitation is projected for January and December, and a small increase of 2 mm or 3% is projected for April.

  The drier extremes of the model projections indicate precipitation decreasing in all months in the dry season, with decreases of up to 25% from historic values. Other projections indicate precipitation increases in dry months of up to 22% (Country Assessment Report for Lao PDR, 2012).

- Flood and Drought:

  The disaster profile in Lao PDR has been published by EM-DAT, 2014. The profile shows that drought has affected a large population. More than 4.25 million were affected in five drought events. Epidemics have proven to be the biggest killer with about 863 people killed in nine events. More frequent events are floods in the Mekong River which have affected more than 4.0 million people. Table 4 summarizes the disaster profile of Lao PDR during 1900 to 2014. From 2014 – 2016, there were 227,604 people were affected by disastersand 5,010,440.7 USD of total damage cost.

Beside the flood and storms, drought has resulted in damages of up to 40 Million US$ in 1988 and 20 Million US$ in 1989. A large number of Lao population are most vulnerable to periodic droughts, since they lives in rural area and depends largely on agriculture. In recent years, natural disasters resulting from climate abnormalities have resulted in frequent droughts and floods shows the historical account of damages caused by drought.

(Table 18) The Status of Natural Disasters in Laos

Disaster		No. of Events	No. of Pers. Killed	Total No. of Pers. Affected	Damage (000 US$)
Drought	Drought	5	–	4,250,000	1,000
Epidemic	Unspecified	3	44	9,685	–
	Bacterial Infectious Diseases	2	534	8,244	–
	Viral Infectious Diseases	4	285	38,000	–
Flood	Unspecified	10	76	1,878,600	2,480
	Flash flood	1	34	430,000	–
	General flood	10	392	1,723,258	70,128
Storm	Unspecified	2	8	38,435	302,301
	Tropical cyclone	3	64	1,397,764	103,650

(Table 19) The Status of Natural Disasters during 2014-2016

Year	Disaster		No. of Events	No. of Pers. Killed	Total No. of Pers. Affected	Damage (US$)
2014						
	Flood	Flash flood	1	5	92,165	12,423,218
		General flood	2			
	Storm	Unspecified	5			
		Tropical typhoon	2			
2015						
	Drought	Drought	1	–	20,367	–
	Flood	Flash flood	1	4	81,132	25,084,844
		General flood	8			
	Storm	Unspecified				
		Tropical typhoon	4			
2016						
	Temperature	Cold	1	5	–	1,210,943
	Drought	Drought	1	1	2,670	84,419
	Flood	General Flood	1	9	31,270	11,300,983

- Earthquake : The Office for the Coordination of Humanitarian Affairs (OCHA) has carried out regional level multi-hazard mapping of the country. Although the Department of Meteorology and Hydrology (DMH) monitor seismic activity in Lao PDR, limited literature and information is available about seismic activity.

- Landslide : The country is prone to landslides, which are mostly the result of heavy precipitation in the Northern provinces. However, there is no detailed database available at any of the focal agencies. This should aid in the development of a database in future.

National Policies and Plans on Water-Related Disasters

The role of Department of Meteorology and hydrology (DMH) is reporting scientific information to the National Disaster Management (Steering) Committee (NDMC) with support from the National Disaster Management Office (NDMO) is responsible for taking prompt actions against hydro-meteorological disasters. The NDMC coordinates with provincial departments, Provincial Disaster Management Committees (DMC) and Labor and Social Welfare Offices.

The Plan of National Disaster Management for the period 2001-2020 has been formulated. Provincial disaster management plans are being formulated capacity building of disaster management personnel from national to community levels are the priorities. Currently, the national early warning system for floods and drought, public awareness, disaster preparedness, prevention and mitigation, and response is on the way of implementation and this National Early Warning Center will complete in 2018.

The Lao PDR adopted the national disaster management framework and established a National Disaster Management Office (NDMO), with overall coordinating responsibility. Institutional framework for disaster has been set up in the country called

(Fig.20) The Protocol in Disseminating Warning from Department of Meteorology and Hydrology (DMH) to the National Disaster Management Office (NDMO)

"National Disaster Management Committee" by the government of Lao PDR which adopted in Degree 220/PM, dated 28 August 2013. The large size of the NDMO may be difficult to act and might have delay the decision making in time of emergency. The protocol of disseminating warning from DMH to the NDMO as following:

The committee designs the emergency response which basically comprises 4 levels as following:

- Level 1 : Local (within the district, it is possible to use district's strong point to regulate or solve the problem by themselves).
- Level 2 : Response or solve issues with the internal resources and capabilities not exceed substantially of the province.
- Level 3 : Beyond the ability of provincial governor, Province can request the supports and help in national level and external urgently.
- Level 4 : All disaster events, emergency response which is exceed the ability of the potential of (declared a national emergency)

Integrated water resource management are important while land use planning as a part of watershed management (WSM) is also important. Both country's policies and regulatory framework have been sufficiently developed for enabling WSM planning and implementation in Laos. However, the gap between theory and practice are remaining concerns for planning and implementations. The funding, low levels of know-how and poor cooperation among involved stakeholders as well as insufficient definition of roles and responsibilities for field level implementation could cause the little consideration of WSM objectives. The key concerns of sustainable WSM in Laos are sustainable funding mechanism.

Recently, the river basin committees have been established within the country which response to the planning and implementation of water resources, reduce the impacts on socio-economic and environment from water related disasters and improving livelihoods.

The Asian Disaster Preparedness Center (ADPC) has drafted a guideline in how to mainstream disaster and climate risk management (DRM/CRM) in the 8th Five Year National Socio-Economic Development Plan III (2016-2020) or the 8th NSEDP. The climate change and disasters like storms, floods, droughts, chills and earthquakes as part of the challenges to socio-economic growth of the Lao PDR is now identified in the draft 8th NSEDP. For making the draft 8th NSEDP clearer and mainstream DRM and CRM are emphasized. The content of each outcome should be revised such as year of achievement, implementing agencies in local level and provincial NSEDP (MPI, NSEDP 2016-2020).

Lessons Learnt from the Past

The last 27 years, there were 28 floods occurred with different magnitudes and duration has been recorded and 8 event were large flood (1981-2008). In term of frequency occurrence, Laos experienced 1 – 1.5 flood annually. Flood has been ranked as the first frequent disaster occurred compare to other natural disaster (MRC, 2015). The flash flood always occurred in the end of rainy season at main tributaries of Mekong River, caused of low atmospheric pressure with southwest monsoon heavy rainfall and Typhoon best track over Lao PDR in some main tributaries of Mekong River. Many training programs have been implemented to response the capacity building of relevant governmental line agencies in the context of disaster risk management, disaster prevention, early warning program for flood and drought, and etc. Challenge and remain issues were found during, the implementation such as:

- For providing the accurate forecasts andwarnings in time, the remain challenge is also a need to better understand the flash flood phenomenon
- Requirement to upgrade and update and increase the density of hydro-meteorological stations
- Capacity building in knowledge sharing of Disaster and Mitigation

- Capacity building in emergency response to the disaster.
- Sustainable funding mechanism and clear responsibilities among governmental line agencies.

Status of ODA for Water-Related Disasters for the last decade

Lao PDR still relies on official development assistance (ODA) for a significant share of its socio-economic development investments. The experience of development cooperation during the past decade contrast many challenges and concerns (UNDP, 2015) following:

(1) The support by development partners to Lao PDR's progress towards global goals needs to be better coordinated, more results-oriented, and avoid duplication. This will require the alignment of development partners' programs and priorities behind the country's plans, policies and goals. It will also need the Government to exert a strong coordinating role.
(2) Lao PDR needs to identify alternative development financing sources, such as South-South cooperation, public-private partnerships and philanthropic organizations, to reduce the dependence on current external sources.

The comparison of the planned disbursements and actual disbursements from the years 2011 to 2015 which showed the overall total actual disbursement over the years is higher than the planned disbursement by 34%. However, Development Partners continue the support to Lao PDR due to the increasing of disbursement of ODA from 2012 to an average of 400 million US dollars.

Official Development Assistance (ODA) has important role in the country's development. ODA is a result of strong collaboration between Lao PDR and its Development Partners. It is important to assessment on Aid Management Platform (AMP), in order to move forward to better ODA management(MPI, 2015).

Future Agenda to Mitigate and Adapt to Water-Related Disasters

The progress Lao PDR towards the MDGs, has presented the major challenges, opportunities and new areas for actions. The post-2015 agenda of SDGs are broader than the development agenda in the past decade. It is important that SDGs need to be adapted to the Lao context and formulated in line with national goals and priorities. Disaster and Climate Risks is one of the agenda to achieve in the 8thFive Year National Socio-Economic Development Plan (2016-2020) while the 8th NSEDP is response to the SDGs agenda (UNDP, 2015). It is important to assign future agenda for mitigate and adapt to water related disasters:
(i) Protecting environmental resources can help to mitigate the climate change and promoting resilience.
(ii) Cooperation with partners and stakeholders: In term of disaster mitigation and management, it is necessary to strengthen cooperation among LBM countries as well as Asian countries.
(iii) Challenges and remain issues

Proposals for Regional Cooperation

In order to response for the future agenda, the proposal for regional cooperation are:
1. Strengthening capacity building of related staff from national to local levels;
2. Produce guidelines and its practices application at all levels;
3. Community participation and stakeholders engagement including public private partnership;
4. Knowledge sharing among AMS on water and disaster management;
5. pilot project, program and research related to water and disaster resilience in different scales, etc
6. Sustainable financing mechanism for water management and disaster resilience.

Executive Summary Report

MALAYSIA

MALAYSIA

By Department of Irrigation and Drainage
and Dato' Ir. Hj. Hanapi bin Mohamad Noor

1. BACKGROUND

The Association of South East Asian Nations (ASEAN) - Republic of Korea (ROK) Cooperation Project, through the Chuncheon Global Water Forum aims to strengthen resilience in the ASEAN countries against water-related disasters in Southeast Asia through close cooperation between ASEAN and ROK for effective policy-making in the respective national governments and through broader regional cooperation. To achieve this aim, each ASEAN Member State will prepare a comprehensive national report which will be discussed in a regional workshop that will be a catalyst to stimulate multilateral dialogue and will serve as an expert forum to assist the national policy-making processes and regional cooperation to more effectively mitigate and adapt to the negative consequences of water-related hazards and disasters.

Flood top the lists of water-related disasters in Malaysia which happen almost every year. Other less significant disasters occurring are drought, landslides, debris and mud flows and tsunamis. A total of 33,298 square kilometers which is about 10.1% of the total area of the country lies in flood-prone areas in which 5.7 million people live which represents about 21 % of Malaysia's population.

This National Assessment Report for Malaysia will incorporate climatic, hydrology and physical characteristics, economic and social information, water-related disaster status and issues, national policy, legal and institutional set-up, water security issues, lessons learnt from the past, future agenda to mitigate and adapt to water related disasters and proposals for regional cooperation.

2. PHYSICAL CHARACTERISTICS AND CLIMATE

Malaysia, which is divided into two parts that is Peninsular Malaysia and East Malaysia in the island of Borneo, has a total land area of 330,803 sq.km, of which 329,613 sq.km is land and 1190 sq.km is water body. Peninsular Malaysia is an area of forested mountain ranges running north-south and low-lying coastal plains on the east and west side. The west coast consists of mangrove swamps and mudflats which separate into bays and inlets. In the west, the plains have been cleared and cultivated with paddy, oil palm and coconut, while the unsheltered east coast consists of tranquil beaches backed by dense jungle. In Malaysian Borneo, Sarawak has alluvial and, in places, swampy coastal plains with rivers penetrating the jungle-covered hills and mountains of the interior. Sabah has a narrow coastal plain which gives way to mountains and jungle.
The climate of Malaysia is tropical, with an annual Southwest Monsoon from May to September and Northeast Monsoon from November to Mac. Malaysia weather benefits from a tropical climate with high temperatures and high humidity throughout the year. Daytime temperatures rise above 30°C year-round and night-time temperatures rarely drop below 20°C. Historically, Malaysia is not affected by typhoon.

3. HYDROLOGY AND METEOROLOGY

There is no different hydrological zone in Malaysia probably due to the small size of the country lying in the same equatorial belt. There is also no distinct wet and dry season although 60% of rain falls during the 5-months Northeast Monsoon period between the months of November to March. The remaining rain falls during the Southwest Monsoon and the inter monsoon period. The mean annual rainfall for Malaysia is 2940mm with a breakdown of 2495 mm in Peninsular Malaysia, 2560mm in Sabah and 3640mm in Sarawak.

Analysis carried out by the Department of Irrigation and Drainage (DID) Malaysia shows some changing trends in rainfall patterns observed in certain parts of the country possibly due to climate change scenarios. For example, in 2014 the East Coast of Peninsular Malaysia recorded the highest cumulative rainfall for the year with more than 3200mm in which 1300 mm (40%) fell in the month of December alone. Compared to the mean annual rainfall of 2495mm for Peninsular Malaysia, year 2014 recorded more than 28% higher rainfall in East Coast of Peninsular Malaysia.

DID is the main agency in Malaysia operating a network of hydrological stations and maintaining the national hydrological database. As of year 2016, DID operate and manage a total of 2439 hydrological stations throughout the country consisting of 1663 rainfall stations, 423 river water level stations, 164 river flow gauging stations, 57 evaporation stations and 132 suspended sediment stations.

The Department of Meteorology Malaysia (MMD) is responsible for the management of meteorology data to be used for weather forecast. Currently, MMD has 12 weather radar stations and 8 more stations will be built under the 11th Malaysia Plan (2016-2020). The new weather radar to be purchased will be 5 units of type S-band (300 km2 radius) and 3 units X-band (150-200 km2 radius).

4. WATER RELATED HAZARDS AND DISASTERS

(i) Floods

Flood is the most serious disaster in Malaysia based on the frequency of occurrence and damages caused by floods. Flood occurs almost every year in flood prone areas of the country but with different severity. The two common types of flooding are long duration floods due river overflows which occur during monsoon seasons and shorter duration flash floods which generally occur occasionally due to inadequate drainage system during heavy rains.
The total flood-prone areas in Malaysia estimated as of year 2010 under a study carried out in 2012 is 33,298 square kilometers, which is equivalent 10.1 % of the total area of Malaysia. Approximately 5.7 million people or 21 % of the Malaysian population live in this flood-prone areas and are therefore exposed to the consequences of flooding such as loss of life, damage to property and livelihood being affected,. Comparison made from studies based on same parameters carried out using 2000 and 2010 data shows 25.8% increase in annual average flood damages from RM915 million to RM1,151 million covering damages to residential areas in both rural and urban households, agricultural crops (paddy, rubber, oil palm and coconut) and livestock.

Since 1965 there were 9 major flood events recorded in Malaysia with more than 50,000 victims evacuated in each event. The worst flood event occurred in December 2014 in the east coast States of Peninsular Malaysia covering Kelantan, Pahang and Terengganu with more than 500,000 victims forced to be evacuated.

(ii) Drought

Drought is the second most serious hazards in Malaysia after flood which frequently occur during dry periods in certain parts of the country. Recent droughts in Malaysia had caused water shortage forcing the authorities to impose water rationing in several States especially in Peninsular Malaysia such as Selangor, Kedah, Perak, Melaka, Negeri Sembilan and Johor. The most recent severe flood event occurred in the States of Selangor, Johore and Perak between January and April 2014. It is also expected that climate change would likely induce greater severity and longer duration of drought in future.

Since 1990 Malaysia experienced several events of water shortage caused by drought. In 1991, the entire State of Malacca was affected by water crisis when the Durian Tunggal Dam that supplies potable water for the State almost dried up and water rationing was imposed throughout the State which involved more than 600,000 people. In 1998 Malaysia was affected by the El-Nino phenomena which brought dry weather for almost 6 months from April to September 1998.

Hot and dry weather spells in the first half of 2014 had caused water supply crisis in the Klang Valley covering Kuala Lumpur, Putrajaya and the State of Selangor with water rationing imposed, affecting more than 1 million people. It was just recently in August 2015, two dams in the State of Johor, that is Sg Lebam Dam and Sg Layang Dam which supply water to 655,000 consumers, have drop below critical levels as the hot spells continue in the southern Peninsular Malaysia.

(iii) Landslides

Land slides is another disaster in Malaysia which occur occasionally from time to time. Areas at risk of land slides are in highlands and hilly slopes where disturbances to hydrological cycle took place due to urbanization, deforestation and extensive farming on hill slopes. Well known tragedies caused by landslides were the collapse of Highland Tower building in Kuala Lumpur in 1993 causing 48 deaths and the 1996 Pos Dipang tragedy in Perak in which 44 people died.
There are 7 other major land slide events that occur since the Highland Tower tragedy in 1993 causing many deaths and damages to properties. Most of the land slides were located in hilly land slopes and occur during heavy rain with high intensities.

(iv) Debris and Mudflows

Debris and mud flows frequently occur in Cameron Highlands in the State of Pahang which is also a popular hilly resort tourist destination. The recent severe disaster involving debris and mud flows was in October 2013 and November 2014 due to overflow of Sg Ringlet and Sg Bertam rivers. Losses and damages include 3 deaths and affecting 80 houses, 100 vehicles, public buildings and infrastructure for vegetable agriculture areas.

DID Malaysia has recently developed a Flash Flood and Sediment Disaster Forecasting and Warning Model for Cameron Highlands using rainfall indicator which enable early warning to be issued to the affected people.

(v) Tsunamis

Tsunamis is not a common hazard in Malaysia. The last tsunamis occurred on 26th December 2004 which was triggered by an earthquake in the Indian Ocean with epicenter on the west coast of Sumatera, Indonesia. The affected areas hit by Tsunamis were the northern coastal areas on the west coast of Peninsular Malaysia and the islands of Penang and Langkawi.

The total number of deaths in the 2004 tsunamis were 68 where 52 people died in Penang, 12 in Kedah, 3 in Perak and 1 in

Selangor. The direction of high sea waves generated by tsunamis came from the north-west hitting west coast of Peninsular Malaysia.

In addressing the various hazards mentioned above, the Government have carried out both structural and non-structural measures. DID Malaysia and the Public Works Department (PWD) Malaysia are the two main government agencies given the responsibility to plan and implement structural measures in dealing with disasters. DID Malaysia is responsible for implementing flood mitigation works which include debris and mudflows. DID Malaysia is also involved in the planning and implementation of projects related to droughts which include the management of water resources to ensure water security for the country. PWD Malaysia on the other hand is responsible in planning and implementing projects to address issues related to land slides.

Generally, structural measures implemented by DID Malaysia to mitigate floods, debris and mud flows are river improvement works, construction of river bunds, levees, flood mitigation dams, flood detention ponds, diversion channels, tidal barrages and pumping systems. Structural measures for the prevention of land slides implemented by PWD Malaysia generally involved construction of hill slope protection, slope stabilization and improvement of drainage system.

Non-structural measures are usually carried out for the purpose of preventive actions to reduce the impact of water-related disasters to the country and its people. Some of the non-structural measures that have been carried out by DID Malaysia and other related agencies are development of flood hazard maps, environmental friendly urban water management approach, landuse zoning, Environmental Impact Assessment for new land development projects, flood warning and forecasting systems and landslide warning systems.

The Government provided financial allocation to address the issues of hazards especially floods. Following the December 2014 and January 2015 major floods in Kelantan, Terengganu, Pahang, Perak, Johor, Sabah and Sarawak which resulted in devastating damages forcing about 500,000 people to be evacuated, the Prime Minister has to convene a special Parliamentary Session on 20th January 2015. A special budget allocation was approved as follows:

(i) RM893 million for flood mitigation works,
(ii) RM800 million as initial allocation to repair and reconstruct basic infrastructure such as schools, hospitals, roads and bridges,
(iii) RM500 million rehabilitation works and welfare program,
(iv) RM500 million for flood relief loan Guarantee Scheme.

In the Five-Year Malaysia Development Plan, DID Malaysia as the Government Agency responsible for implementing and managing flood mitigation projects was allocated a relatively big budget. In the 11th Malaysia Plan (2016-2020), DID Malaysia was given a total allocation of RM8.5 billion out of which 72% goes to flood management.

5. LEGAL AND INSTITUTIONAL SETUP IN THE COUNTRY

The relationship, powers and responsibilities of the Federal and State Governments are stipulated in the Malaysian Constitution. It may generally be stated that "water" is largely a State matter. This jurisdiction would include rivers, lakes, streams, and water beneath the surface of the land. However, water is not a matter exclusively within the sole jurisdiction of the States. The Federal Government has powers over specific matters including federal works, trans-boundary rivers, canals and various aspects of water resource utilization such as hydropower generation, navigation, marine fisheries and mining. The Federal Government

may also make laws related to items listed in the Concurrent List and these include water supplies, town and country planning, drainage, wildlife and rehabilitation of land with soil erosion. Parliament also may make laws with respect to any matter in the State List for the purpose of promoting uniformity of laws among States and to implement international conventions and agreements.
Before 2000, almost all States in Malaysia adopt the Waters Act(1920) in managing water resources, except for Sabah, Sarawak and Selangor, who have their own State Laws. After year 2000, five more States that is Kedah, Malacca, Pahang, Negeri Sembilan and Perak enact their own water-related laws.

For the sake of uniformity in water resources laws to be implemented in all States in Malaysia, a review of the current legislations related to integrated management of water resources was carried out as part of the review of the National Water Resources Study (2000-2050) in 2011. Currently, the draft National Water Resources Act, which is more comprehensive, covering all aspect of water resources management including water –related hazards is in the consultation process with all stakeholders and is expected to be tabled in the Parliament in 2017.

As for institutional setup, a major institutional restructuring took place in 2004 with the setting up of the Ministry of Natural Resources and Environment (NRE) to look after the administration of the nation's natural resources of land, water, forests, and minerals which also covers some aspects of water-related hazards management. The Ministry's function is to formulate, manage, and enforce policies, legislation, and guidelines related to water resources for the country.

The restructuring also sets the stage for the separation of 'water resources' management from the 'water delivery services' management. The management of water delivery services is now left to the Ministry of Energy, Green Technology and Water (KeTTHA) for potable water supplies, and the Ministry of Agriculture and Agro- based Industry for irrigation of agriculture lands. This leaves the responsibility for supporting the states in their water resources management functions with the NRE. Although NRE is entrusted to look after water as a resource, the administration of water is still taken up by a number of agencies and ministries.

A National Water Resources Council (NWRC) was formed in 1998, designed to be the national apex body for water resource governance in Malaysia. The Council is currently being chaired by the Deputy Prime Minister and serves as an advisory body on matters related to water governance. The secretariat of the NWRC is shared jointly by NRE and KeTTHA. The NWRC members comprise a select group of Federal Ministers related to water administration, and the Chief Ministers from all the States.

In 2015, a new agency was formed by the Government which will be responsible for the operational aspects of hazard management, named as the National Disaster Management Agency(NADMA). The establishment of NADMA was in response to the 2014 major flood which was considered as one of the worst flood in Malaysian history where about 500,000 victims need to be evacuated. NADMA which is under the Prime Minister's Department has been strengthened in terms of resources to take over the function of disaster and crisis management from the National Security Council.

6. WATER SECURITY

From the latest National Water Resources Study (2011), the annual hydrological cycle for Malaysia shows that out of average annual amount of 970 billion cubic meter of water available from rainfall, 413 billion cubic meter (43%) is loss through evaporation and 63 billion cubic meter(6%) infiltrates into the ground, leaving total amount of 494 billion cubic meter(51%) of water as available surface runoff to be used for the domestic, industrial and agricultural sectors.

The total demand of water for all sectors in Malaysia was at 14.8 BCM in 2010, that is only about 3% of the total surface runoff. The total demand for water covering all sectors is projected to increase to 18.2 BCM in year 2050, an increase of about 23 %. Water demand based on sectors shows that the water demand for the irrigation sector will decrease from 51% of the total water use in 2010 to 34% in 2050. However, the potable water demand for domestic and industry which was 33% in 2010 is projected to increase to 44% of the total water use in 2050. The rise in potable water demand is attributed to the increase in population, urbanization and future development in the industrial and service sector of the country.

On the current status of the National Water Security Index, the findings of ADB based on the Asian Water Development Outlook 2016 shows that the National Water Security Index for Malaysia is currently at Stage 3 – Capable, with a total score of 73.4 on a 1-100 point scale. The total score for Malaysia has increased from 60.6 in 2013 to 73.4 in 2016. At Stage 3 for the National Water Security Index, it shows that Malaysia is under Capable Category in which access to safe drinking water and sanitation facilities is further improving; in rural areas water productivity in economic activities has improved; water quality is improving through regulation and wastewater treatment; first measures are taken to restore ecological health of the water bodies; and the most serious water-related risks are being addressed.

According to stakeholders, the most serious threats to water security in Malaysia are:

- Water pollution (including pollution from livestock)
- Water for agricultural (to ensure food security)
- Incompatible land use (encroachment into water catchment areas)
- Poor water governance and water management (need to ensure sustainable water yield at water intake points)
- Water for environment (protection of water ecosystem)
- Impacts of climate change and the need to adapt to its impacts

There are several efforts taken by the Government to ensure water security for the Country. The establishment of the Ministry of Natural Resources and Environment Malaysia (NRE) in 2004 has committed the Federal Government to review the National Water Resources Study (2000-2050), especially in terms of water resources governance, including setting priorities at the Federal and State levels on water resources management and development. The bold objective was to formulate a unified and comprehensive National Water Resources Policy (NWR Policy) and a National Water Resources Law (NWR Law) to ensure security and sustainability of water resources for all (including nature and the environment), in an era of rapid economic development and a growing population. These factors have important implications on how Malaysia will manage its water resources in the years ahead.

The National Water Resources Study (2011) which serve as an important management instrument for water resources management also covers engineering studies and environmental assessment which include a review of water resources availability and demand for all water users, proposal for water resources projects for all water users up to 2050, potable water supply immediate works to meet demand up to 2020 and development of a framework for a Decision Support System (DSS).

Under the 11th Malaysia Plan (2016-2020), DID Malaysia is currently working on the Development of National Water Balance Management System at river basin level for Muda River in Kedah. There are 4 other river basins approved for implementation under the current development plan, that is, Kedah River, Malacca River, Bernam River and Klang River. Some important outputs from the modelling system will include water accounting, water availability from all sources, water demand for all sectors, water prioritization, water allocation and water auditing. The system is designed to provide advanced two months forecast and provide two weeks early warning in advance prior to expected water shortage.

7. NATIONAL POLICIES AND PLANS RELATED TO WATER-RELATED HAZARDS AND WATER RESOURCES MANAGEMENT

The Malaysian government has made a number of national commitments related to water resources management and water-related hazards. The following is a list of some of the major commitments:

- National Water Vision (2000)
- National Outline Perspective Development Plan 3 (2001 – 2010) (OPP3)
- The 5 year National Development Plans (Currently, 11th Malaysia Plan 2016-2020)
- National Physical Plan
- National Solid Waste Strategic Plan
- Policies and guidelines endorsed by the National Water Resources Council
- Agreement by the states in 2005 to a change in the Federal Constitution, allowing water services to be in the concurrent list so as to allow the Federal government to take over responsibility for the management and provision of water supply services from the states.

A National Water Vision was proposed at the National Consultation Meeting on IWRM on 28 June 1999. The Vision statement reads as follows:
"In support of Wawasan 2020 (towards achieving developed nation status), Malaysia will conserve and manage its water resources to ensure adequate and safe water for all (including the environment)".

The National Water Vision has identified four principal objectives. They are :

- Water for people – all communities will have access to safe, adequate and affordable water supply, hygiene and sanitation;
- Water for food and rural development – provisions for sufficient water to ensure national food security and promote rural development;
- Water for economic development – provisions for sufficient water to spur and sustain economic growth within the context of a knowledge-based economy and e-commerce; and
- Water for the environment – protection of the water environment to preserve water resources (both surface and groundwater resources) and the natural flow regimes, biodiversity and cultural heritage as well as the mitigation of water related hazards.

To achieve the objectives of the National Water Vision, a National Framework for Action for water reforms was formulated, with the following goals:

- Managing water resources efficiently and effectively (addressing both quantity and quality aspects) as water demands increase in tandem with population growth and industrialization;
- Moving forward towards integrated river basin management,
- Translating awareness to political will and capacities to create an enabling environment for the much-needed institutional reforms to deal with deterioration of water quality, decrease in water availability and conflicts among users,
- Moving towards adequate (safe) and affordable water services (befitting a developed nation status by 2020) through the provisions of adequate infrastructure.

The following is a list of the new water-related policies that were introduced after year 2000:

(i) National Water Resources Policy (2012)
(ii) National Climate Change Policy (2010)
(iii) National Mineral Policy
(iv) Food Security Policy
(v) National Solid Waste Management Policy
(vi) National Biodiversity Policy
(vii) National Urbanization Policy (2005)
(viii) Green Technology Policy (2010)

Prior to the launching of the National Water Resources Policy in 2012, the water-related policies were covered under the functions of a number of federal ministries and also state authorities. This is because the Federal Constitution has given State Governments almost exclusive right to act as the custodians of water for the people.

On IWRM implementation, the adoption of the IWRM approach in addressing water resources issues in Malaysia has seen several concrete measures achieved such as:

(i) The formulation of a National Water Vision to focus attention on the importance of and need for security and sustainability in the country;
(ii) The setting up of a dedicated Ministry for Natural Resources and Environment to look after natural resources, which include water resources;
(iii) The establishment of the National Water Resources Council (NWRC) as an apex advisory body for all matters relating to water and water resources in the country;
(iv) The integration of IWRM into the National Five-Year Development Plans and all other official planning documents; and
(v) The initiation of capacity-building programs for water reform through implementation of formal and informal training on all aspects of water resources, and through the usage of various platforms such as seminars, forums and dedicated projects, to disseminate the rationale and integrated approach in the management of water resources.

Looking at the current development strategies and goals of the country, Malaysia is on the right track towards achieving the global 2030 Sustainable Development Goals Agenda. The current five-year development plan, the Eleventh Malaysia Plan 2016 - 2020, formulated with People as the centrepiece of all development efforts, in many aspects mirrors the multi-dimensional nature of the SDGs and will serve as an overarching and guiding policy for sustainable development in this country. With the theme "Anchoring Growth on People", the Eleventh Malaysia Plan sets out six strategic thrusts designed to drive the economy forward, address challenges and embrace opportunities in the rapidly changing global landscape. Global sustainable development goals are integrated into the planning framework as part of the national outcomes for the strategic thrusts. The 6 Strategic Thrusts of the Eleventh Malaysia Plan are:

(I) Enhancing Inclusiveness Towards an Equitable Society
(ii) Improving Wellbeing for All
(iii) Accelerating Human Capital Development for an Advanced Nation
(iv) Pursuing Green Growth for Sustainability and Resilience
(v) Strengthening Infrastructure to Support Economic Expansion
(vi) Re-engineering Economic Growth for Greater Prosperity

8. LESSONS LEARNT FROM THE PAST

Two success stories are highlighted in this report related to Malaysia's effort in addressing issues of water-related hazards especially on floods, that is, the SMART Tunnel storm management project and the Urban Storm Water Management Practice (MSMA).

SMART which stands for Stormwater Management and Road Tunnel was built in 2003 as part of the Kuala Lumpur Flood Mitigation Plan . The 9.7 km tunnel, completed in 2007 at a cost of RM1.9 billion, has two main objectives:

(i) Provide a stormwater management system to reduce flooding in Kuala Lumpur city centre due to stormwater from the Klang-Ampang catchment,
(ii) Reduce traffic congestion at the southern main gateway to Kuala Lumpur city centre.

Since its opening in 2007, flood prone areas in the Kuala Lumpur city centre have been spared from major floods.

For the urban storm water management practice, since 1979, drainage engineers in Malaysia apply traditional design practices in urban storm water management using Urban Drainage Design Standards and Procedures published by DID Malaysia. The traditional approach was rapid flow in which drains were designed to convey storm water as fast as possible. In year 2000, a new manual based on delayed flow concept was introduced by DID Malaysia known as MSMA (Manual Saliran Mesra Alam or Urban Storm Water Management Manual). This new, comprehensive and integrated storm water management strategies are found to be more sustainable, incorporating runoff source control and delayed disposal on a catchment wide which should result in flood reduction, water quality improvement and ecological enhancement. Other benefits include improved urban amenity through the application of wetlands, landscape for recreation, potential beneficial reuse of stormwater and recharge of depleted urban groundwater aquifers to enhance stream base flow during dry seasons. MSMA is further revised in 2011 by DID Malaysia to make it more practical for users and improvement in the aspect of water quality and control at source practices.

From past experience on water-related hazards and water security, in general, there are a number of lessons learnt as follows:

a) Authorities should adopt a more proactive measures and not to be seen taking a reactive approach in addressing issues of water-related hazards and water security.

b) There is an urgent need to implement the Integrated Flood Management (IFM) approach to address the increased incidences and cost of flood damages.

c) There is a need to legislate and define designated flood protection zones to address the issue of uncontrolled development in flood prone areas.

d) Malaysia still does not have a uniform law on water resources management for all the States. Since legislation is a primary requirement for better governance which need to be followed with effective enforcement, it is important to speed up the approval process of the current draft National Water Resources Act which looks into aspects of institutional structure, corporate governance and accountability;

e) For the management of dry spell (drought-like) conditions in a river basin, all States should have a drought management plan ranging from water stress to water shortage (drought-like conditions) to extreme conditions of long periods of no rain (drought).

f) Development of a climate change mitigation and adaptation plan for drought-like conditions. All States should develop a plan to include the mitigation and adaptation for climate change-impact, such as the risk of climate variability of rain not falling at the desired catchment locations.

g) Water resources need to be seen as a limited resource with an economic value to the nation. The legislative framework therefore must adopt an approach that seeks to regulate water resources as an economic asset to be managed in a holistic manner;

h) Need to get more public participation and engagement with all stakeholders in dealing with water-hazards and water security issues.

i) Although there is total solution in addressing water-related hazards especially floods, projects could not be implemented fully due to limited funding from the Government. Implementation of flood mitigation projects through a number of phases not only take longer time to complete and increase in cost but also will cause delay in resolving problems.

j) Having laws alone is not adequate without effective enforcement. This may need strong political will and resources to enable enforcement authorities to act without fear or favour.

k) Capacity building and HRD issues in IWRM is still lacking despite various efforts carried out by government agencies and NGOs since the launching of the National Water Vision in year 2000.

9. STATUS OF ODA FOR WATER-RELATED DISASTERS AND WATER SECURITY

Currently in Malaysia, Japan through the Japan International Cooperation Agency(JICA) is the most active organization providing Official Development Assistance (ODA) in terms of bilateral assistance in the form of technical cooperation, Japanese ODA loans and grant aid since 1966. Among projects related to water undertaken by JICA as part of ODA program are:

(i) River management training program (1977-1986)
(ii) National Water Resources Study (1982)
(iii) Research and development for geo-hazard risk reduction from landslides and floods (2011-2016).

The status of JICA bilateral ODA in the field of water and disaster during the 2005-2015 period is still active and on-going.

The Danish International Development Agency (DANIDA) is also actively involved in providing development assistance to Malaysia. The main objective is to promote continuous improvement of the Danish engagement in maintaining and expanding public support, focusing in developing countries. The strategy of DANIDA is to ensure that Danish research results are used to contribute to new knowledge-based solutions in developing countries.
Among the projects related to water undertaken under ODA program by DANIDA in Malaysia are:

(i) Study in Integrated River Basin Management System for Kedah River in the State of Kedah (2008)
(ii) Study in Integrated River basin Management System for Selangor River in the State of Selangor (2008)
(iii) Development of draft River Basin Management laws for the States of Kedah and Selangor.

Similar to JICA, the status of DANIDA bilateral ODA in the field of water and disaster during the 2005-2015 period is also active and on-going.

As for global partnership for development, Malaysia is expected to move from being a net recipient of official development assistance to becoming a development partner and is increasingly sharing knowledge and experience in economic and social development with other countries.

10. FUTURE AGENDA TO MITIGATE AND ADAPT TO WATER-RELATED DISASTERS

Malaysia recognizes the adverse effect and impacts of climate change and undertakes to mainstream national responses that consolidate economic, social and environmental development goals. The Government has taken initiative to formulate the National Climate Change Policy in 2009 which incorporate five main principles as follows:

(i) Development on a Sustainable Path
(ii) Conservation of Environment and Natural Resources
(iii) Coordinated Implementation
(iv) Effective Participation
(v) Common but Differentiated Responsibilities and Respective Capabilities

Malaysia realizes that the impacts of climate change on water-related hazards and water resources could not be avoided but its negative impacts could be mitigated with the following strategies and measures that are currently under planning and implementation:

(i) Construction of more storage ponds and dams to capture the high flows for release during periods of low flows.
(ii) Implementation of inter-basin and inter-state water transfer.
(iii) mplementation of efficient irrigation water supply in the agricultural sector.
(i) Continuous improvement for efficient potable water supply and demand management for domestic and industry use.
(ii) Prudent landuse planning for new developments in anticipation of sea level rise and raising of coastal bunds with pumping systems to protect existing development areas.
(iii) Provision of structural and non-structural flood mitigation measures in view of increasing rainfall and more extreme flood runoff.

11. PROPOSALS FOR REGIONAL COOPERATION

Based on the issues faced by Malaysia on water-related disasters and water security, the following are some proposed possible areas of cooperation among ASEAN member states:

(i) Sharing of data and information for trans-boundary rivers for mutual benefit between countries involved that will help to optimize resources, such as the Golok River between Malaysia and Thailand,
(ii) Development of water-related hazard maps for important river basins to be used for planning and flood preparedness,
(iii) Development of early warming and forecasting models for water-related disasters based on modern technology,
(iv) Development of community-based disaster preparedness,

(v) Green technology to address water security issues covering infrastructure development, water saving products and alternative water supply,

(vi) Development of programs in the water sector related to adaptation of climate change with a view of strengthening resilience against water-related disasters,

(vii) Setting up of suitable platform or forum to promote cooperation and collaboration among ASEAN countries and other developed countries to share experiences and success stories in addressing water-related disasters and water security issues,

(viii) Strengthening capacity building, education and awareness programs related to water-related disasters and water security for all stakeholders,

(ix) Continuation of Official Development Assistance (ODA) from developed countries to developing ASEAN countries.

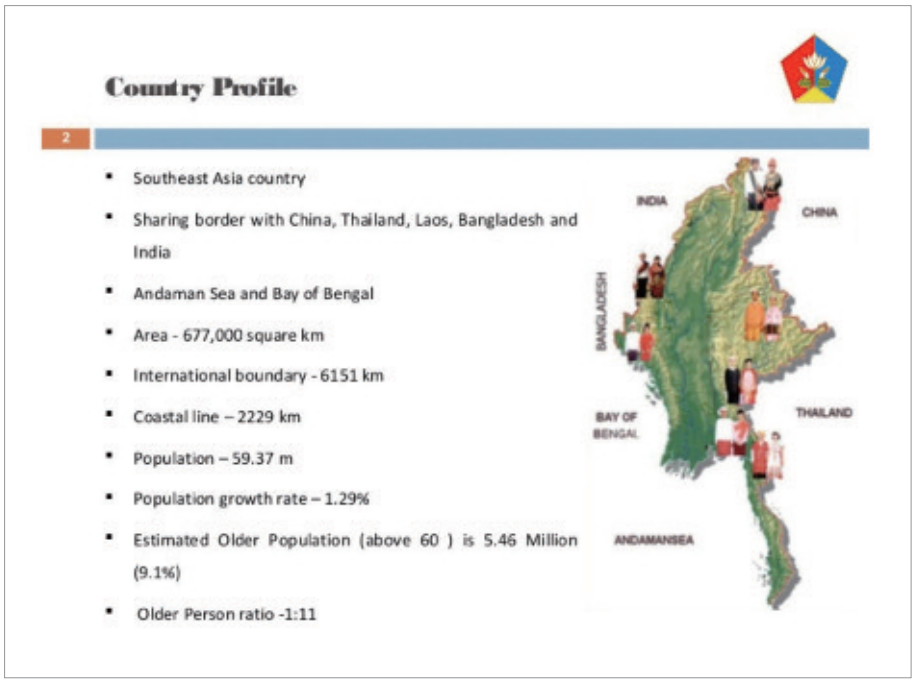
Executive Summary Report

MYANMAR

MYANMAR

By Ministry of Natural Resources and
Environmental Conservation and U Chit Kyaw

1. Background



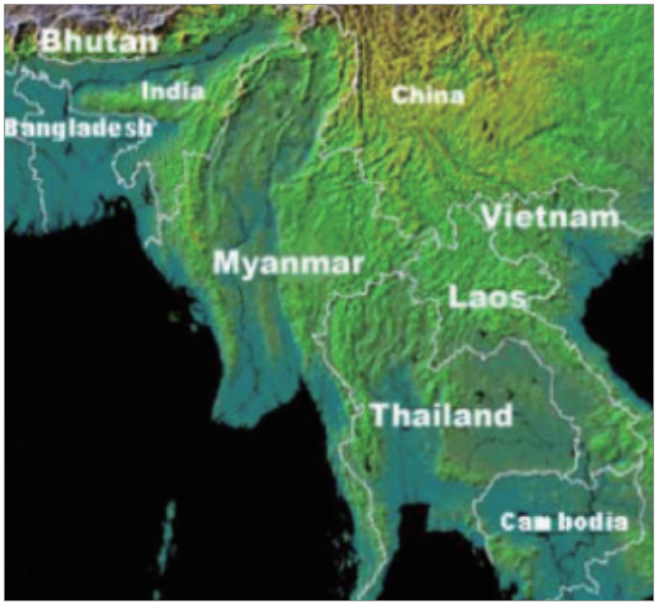
1.1. Topography of Myanmar

Myanmar is a tropical country situated in South East Asia and located between latitudes 10º N and 29.5º N and longitudes 92º E and 101º E. It covers an area of about 678,000 sq.km. The neighboring countries are India, Bangladesh, China, Laos and Thailand.

They are separated from Myanmar mainly by high mountain barriers. Its long coastal seashore of about 1600 km starts in the northern state of Rakhine and finishes at the southern tip of Kawthoung. Myanmar is mountainous in the north and north-west. The eastern region has a plateau that is about 900 m above mean sea level (MSL). It has hilly and flat terrain in the central and southern areas. The Ayeyarwady river is the largest and most useful river in Myanmar. It runs for about 2090 km from the far north, draining an area of 415,500 sq.km, which is nearly 60% of the whole country. It enters the Gulf of Martaban at the head of the Andaman Sea through nine months, forming a delta with an area of approx. 30,000 sq.km.

The most important tributaries of the Ayeyarwady river are the Chindwin, Mu and Myitnge, of which the Chindwin drains 17,000 sq.km to the west of the Ayeyarwady river running 800 km from the extreme northwest of Myanmar.

East of the Ayeyarwady Delta, two other large rivers, namely the Sittaung and the Thanlwin, reach the sea. Although the Sittaung is only half the length of the Chindwin, it drains 33,100 sq.km, which is twice as large an area as that drained by the Chindwin,and is of great economic importance. The Thanlwin River originates in China, flowing for 1100 km through Myanmar territory, and drains about 284,800 sq.km. Apart from the these rivers, there are many other small rivers and streams, as well lakes, spread all over the country.



(Fig.21) Topography of Myanmar

1.2. Myanmar Economy Data

(Table 20) The Economic Situation of Myanmar

	2011	2012	2013	2014	2015
Population (million)	50.1	50.5	51.0	51.4	51.8
GDP per capita (USD)	1,118	1,100	1,112	1,228	–
GDP (USD bn)	56.0	55.6	56.7	63.1	–
Economic Growth (GDP, annual variation in %)	5.6	7.3	8.4	8.5	–
Exchange Rate (vs USD)	5.56	851.7	983.8	1,031	1,301
Exchange Rate (vs USD, aop)	5.44	640.7	933.6	984.4	1,163
Current Account (% of GDP)	-1.9	-4.2	-5.2	-6.1	—
Current Account Balance (USD bn)	-1.1	-2.3	-3.0	-3.9	–
Trade Balance (USD billion)	0.2	-0.3	-0.8	-5.2	–
Exports (USD billion)	9.2	8.9	11.2	11.0	–
Imports (USD billion)	9.0	9.2	12.0	16.2	–
Exports (annual variation in %)	6.7	-3.9	26.5	-1.8	–
Imports (annual variation in %)	89.5	1.4	31.6	34.8	–
International Reserves (USD)	7.0	7.0	4.5	4.8	–
Exteral Debt (% of GDP)	14.6	14.1	12.8	10.1	–

2. Climatic and Physical Characteristic of the Country

Myanmar's climate conditions are defined as summer, rainy and winter season. Two third of Myanmar falls within the tropics and the remaining one third enjoys temperate climate conditions. Coastal regions receiving over 5000 mm and while average annual rainfall in the Dry Zone which is located in Central Myanmar is less than 750mm.

Northern regions of the country are the coolest, with average temperatures of 21°C and mean temperatures of 32°C in the coastal area. During the hot seasons, temperature sometimes reach to 40°C and over in central dry zone areas.

Like other ASEAN countries, Myanmar also suffers from climate change impacts on water cycle by sudden change of weather pattern such as flood and long drought and thus sustainability of water environment in some areas are facing difficulties. Due to the climate change impacts rainfall pattern and rainfall intensity are significantly changed occasionally in some parts of the country depending on the topographical condition. In the middle part of Myanmar, especially in dry zone area, sometime intervals of non-rainy days last more than two or three weeks and annual rainfall intensity is rather less than normal average. During Elnino Year rain fall pattern change and Flood Activities are still difficult in flood Forecasting.

3. Hydrology and Meteorology

Natural and man-made flood disasters present dangers to humans and to their property. They present risks, which can be high especially if they are ignored or proper precautions are not taken. The most common natural disasters that are experienced in Myanmar are tropical cyclone associated with surge, flood and drought.

Flood is an event resulting due to the conditions such as abnormally heavy precipitation, rapid snow melts, coastal storm surges, failure of dams and other control works. It is characterized by quick inception, vigorous growth and evident spread terminating eventually with disastrous impacts. Floods of all kinds cause a considerable loss of human life and great property damage. Floods become disasters mostly when human settlements occupy the flood Observation shows that the percentage occurrence of floods above danger levels in medium and large rivers are 6% in June, 23% in July, 49% in August, 14% in September and 8% in October.

In Myanmar, majority of big cities and towns, economically strategic places in the country usually situate along four major rivers, namely Ayeyarwady, Chindwin, Sittaung and Thanlwin. The topography of the country varies from hilly and mountainous areas in the north and east, semi-arid, dry-zone in the western parts and alluvial plains in the southern delta where Ayerarwady flows into the Andaman sea. Flash floods occurred on the Manchaung (stream), a tributary of the lower Ayeyarwady River, in 1987; on the Shwegyin Chaung (stream) tributary of the Sittaung River in 1997;and on the plain.

The floods in Myanmar, mainly occur during the monsoon months (June to October) .The type of floods occur in Myanmar may be generally classified into two; the wide spread flood and flash flood. The wide spread flood mostly occur along Ayeyarwady, Chindwin, Sittaung and Thanlwin rivers which are major rivers and the flash flood usually occur at the small rivers and stream. The main cause of wide spread flood is heavy rainfall striking at the head water regime for considerable period (1 to 3 days), the flood wave forming at the head water started to move downward and causing flood along the river up to the deltaic area. The flash flood is caused by heavy rainfall fell on the source and the flood wave move downward swiftly. Observation shows that the percentage of occurrence of floods (exceeding danger level) in medium and large rivers of Myanmar are 6% in June, 23% in July, 49% in August, 14% in September and 8% in October. The severe floods had occurred in 2004, 1974, 1997, 1976, 1991,1973,1988 and 1997, and order of the years are arranged with respect to their intensities On May 2, 2008, tropical cyclone Nargis made landfall in Myanmar causing the worst natural disaster in the country's recorded history – with a death toll that may have exceeded 138,000.

A Category 4 storm, Nargis was the eighth deadliest cyclone recorded worldwide. It is one of seven tropical cyclones generated in the Bay of Bengal that had death tolls in excess of 100,000. With damage estimated at more than $10 billion, the storm is the

most destructive ever recorded in the Indian Ocean.(Annual Cyclone frequency are about 6 and Highest number in month of May ,Oct and Nov.)

In recently, more than 100 people have been killed in flash floods in central Myanmar after heavy storms in October 2011. Monsoon rains caused landslides with river breaking their banks where in Pakokku, a town in Magwe division and some 30 kilometres north of Bagan, was hardest hit.35 dead bodies were killed and 106 people were missing in this flood. More than 2,000 houses were also swept away by the mass of water that hit four towns in the Magwe region, and about 6,000 homes were flooded. Furthermore, in some parts of central Myanmar, roads, bridges and buildings were damaged by strong winds and heavy rains.

4. Water related Hazards and Disasters

In general, the catchment areas of major rivers in the north and central zone are prone to riverine floods. The Southern Delta faces riverine floods when there is flood tide and high river water flow at the same period. In these areas, the lands are protected from floods by eastern dykes, but there are times when flood overpower the dykes and cause losses of lives and properties.

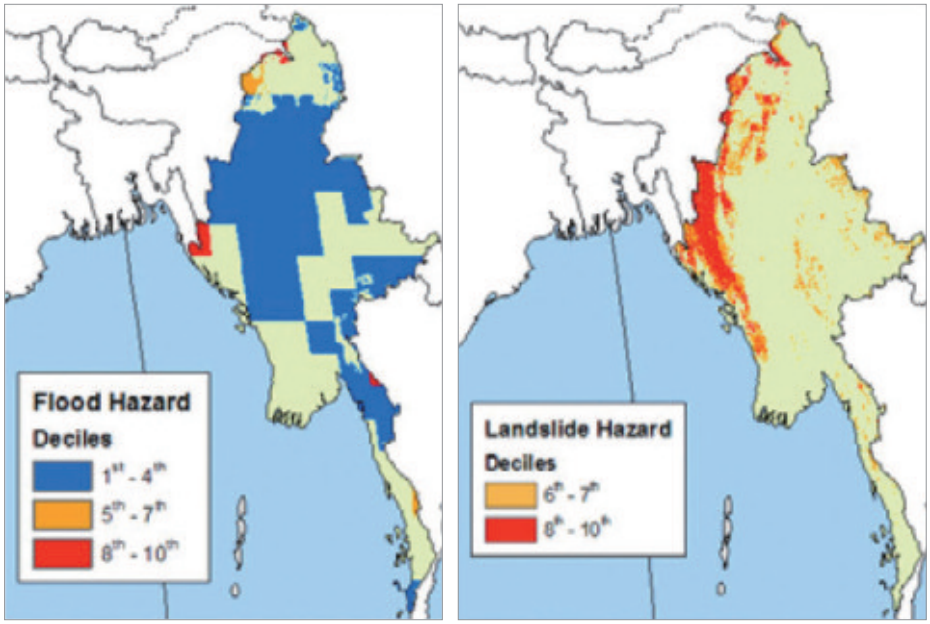
(Table 21) Lead Time for Ayeyarwady River

Stations	Lead Time
Myitkyina to Bhamo	1 day and 12 hrs
Bhamo to Katha	1 day and 12 hr
Katha to Mandalay / Sagaing	3 day and 12 hrs
Mandalay / Sagaing to Nyaung Oo	1 day and 18 hrs
Nyaung to Chauk	1 day
Chauk to Minbu / Magway	1 day
Minbu / Magway to Aunglan	1 day
Aunglan to Pyay	1 day
Pyay to Hinthada	1 day

If the water level rose at upstream of Ayeyarwady river (Myitkyina), its can reach at Hinthada and Zalun next 12 to 15 days

The mountainous and hilly Kayin, Kachin, Shan, Mon and Chin States areas are threatened by flash floods. In Kachin State, at the confluences of the Ayeyarwady River,the snow in the higher altitude melt and flash floods occur quite frequently at the beginning of summer. Along the coastal region in Rakhine State, floods are secondary hazard generated by cyclones.

Furthermore, the Ayeyarwady River basin and the catchment occupy 60% of the country area traversing Chin, Kachin, Shan States and Mandalay, Magwe, Bago,Yangon and Ayeyarwady Divisions. Floods, in consequence, can occur over a wide range of region.



(Fig.22) Flood risk area and Landslide risk area
Source : Hazard Profile of Myanmar

4.1. Landslides in Maynmar

Myanmar has experienced many types of geologic hazards including earthquakes, landslides and subsidence in karst area. Among these, earthquakes and landslides are major hazards affecting the country. Geographically, Myanmar has two mountainous provinces: namely the Western Ranges and the Eastern Highland. These provinces are inherently unstable regions of the country. The steep slopes, unstable geological conditions, and heavy monsoon rains combine to make the mountainous areas one of the most hazard-prone areas in Myanmar. More recently there has been an increase in human settlement in hazard-prone areas as a result of rapid population growth, as well as improvement in accessibility by road and the onset of other infrastructure developments.

4.2. Frequency and Impact

Various sizes of landslides had frequently occurred in mountainous regions of Myanmar especially in the Western Ranges and some localities in the Eastern Highland, especially along the western flank of the Tanintharyi Ranges.

In Eastern High Ranges, landslides of all types were occurred along the western flank of the Kachin, Shan and Tanintharyi Ranges. In Tanintharyi area, some rural houses and primary school were buried in the debris materials during the rainy season in 1999.

The landslide hazards, which frequently occur in Shan State is along the railroad in hilly terrain, lying between the Yinmabin Plain and the Kywedatson Plain. Both plains are in metamorphic and igneous terrain, which were weathered deeply. They are more exposed in the East of Kyauk Pan Oo Stream. In 2001, subsidence events were occurred in Nansang area due to the karst formation. There were no any impacts due to those events. However, landslides in Mogok have observed as some types of mud movements and caused the loss of lives and properties in June, 2008.

4.3. Storm Surge

Powerful storm winds push water up onto the shoreline.

This event are most frequently occurs when a severe cyclonic storm makes landfall. Severe cyclonic storms are especially effective at producing a storm surge for these reasons:-

1) Severe cyclonic storms have very powerful sustained winds that can reach over 100 miles per hour. 2) Severe cyclonic storms are low pressure storms and that low pressure causes a rise in sea level beneath the storm.
3) dump a lot of rain 4) strong winds of the storm can generate large waves on top of the combined high tide and storm surge elevations.

(Fig.23) Coastal Regions of Myanmar

Notable storm surges, which have affected Myanmar, have been during May 1967, 1968, 1970, 1975, 1982, 1992, 1994, 2008 and 2010; of which the 1982 (Gwa), 1994 (Maungdaw), 2008 (Nargis) and 2010 (Giri) caused the heaviest loss of lives and damage.

(Fig.24) After Storm Surges

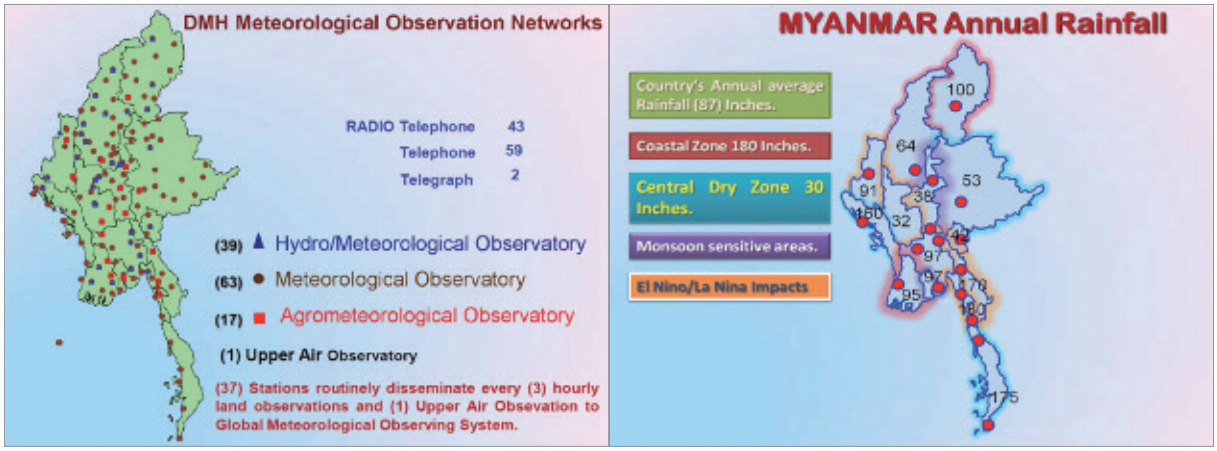
5. Legal and Institutional Setup in the Country.

5.1. The Department of Meteorology and Hydrology (DMH) of Myanmar has an Organizational Structure, headed by the Director General and followed by the Deputy Director General. The major divisions under the Department of Meteorology and Hydrology of Myanmar and organization structure are as follows:

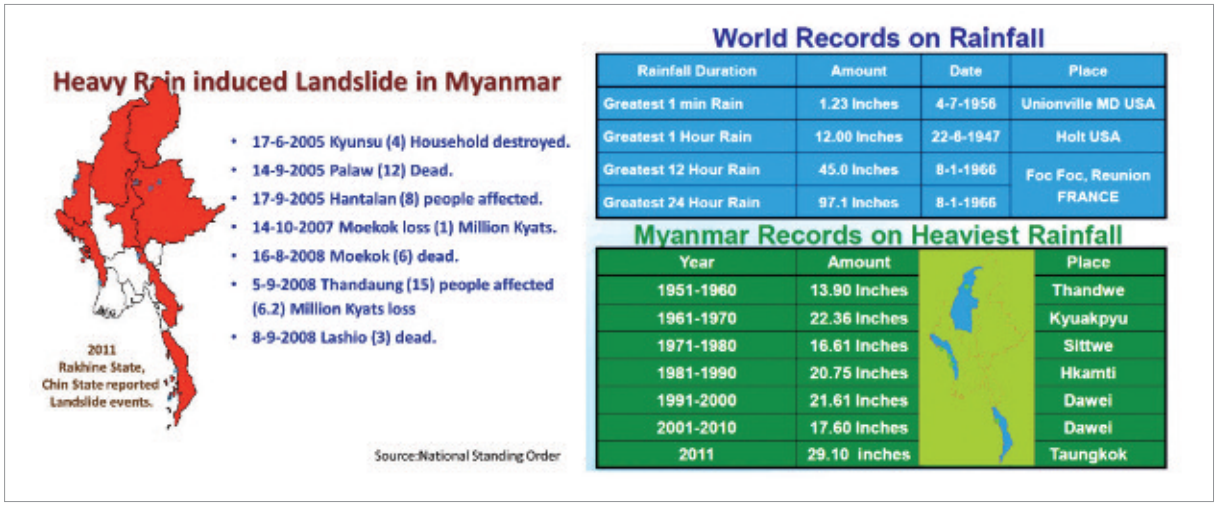
Responsible for observation, data exchange, monitoring, forecasting, warning issue for Cyclone, river Flood, Flash flood, daily weather forecasts and water levels issuing. And then Earthquake monitoring and information issuing.

5.1.2. Warning System

Whenever warnings are issued by the NMC and the RFS of the DMH, the message is sent to the respective stations by telephone or single side band (SSB) transceiver. As soon as the head of the station receives the warning, he immediately informs the local authorities and other related departments so that they can take necessary action. At the same time, warnings are disseminated to the general public by radio, television and newspaper.



Date	Region	Township	Types
25-6-2011	Rakhine	Gwa	13.46 Inches Heavy Rain & Landslides.
19-7-2011	Rakhine	Gwa	Floods & Landslide 13.07 Inches Heavy Rain
4-8-2011	Chin	Tidain	Heavy Rain / Landslide



(Fig.25) Heavy Rain induced Landslides events occurred in 2011

5.2. Relief and Resettlement of Department (RRD)

RRD has a responsibility for certain objectives as follows;

To offer self-learning opportunities to respective authorities and local communities who have not participated in regular Disaster Management Courses (DMCs).To strengthen the close connectivity amongst the DRR practitioners and institutions locally, regionally and globally. To accelerate the collaboration on Disaster Risk Management in ASEAN as the member state.To give the disaster information of the country in time and to publicize the Relief and Rehabilitation activities in a transparent way.

5.3. Other Organization Structure and Hazard Control

The Ministries under the Government of the Union of Myanmar must implement their main duties and, at the same time, do sector-wise work on flash flood control in coordination with the committee as follows:

a) Ministry of Defense: military assets are used for flash flood prevention, relief and rehabilitation and security measure. b) Ministry of Social Welfare, Relief and Resettlement: public education, relief, resettlement and livelihood supplies. c) Ministry of Communication, Post and Telegraph: communication services (Now under Ministry of Transport and communication).d) Ministry of Transport(Now so called Ministry of Transport and communication): weather forecasting, issue of warnings for flash flood transport service, maintenance of water ways of rivers and creeks. e) Ministry of Construction: urban development, durability of buildings, roads and bridges. f) Ministry of Health: health care activities. g) City Development Committee (Yangon, Mandalay): urban development and hazard reduction. h) Ministry of Progress of Border Areas and National Races and Development Affairs: urban, rural development affairs all over the country. i) Ministry of Information: public education, release of warnings through media. j) Ministry of Home Affairs: preventative measure against flash flood hazards in various regions, relief and resettlement activities and security measures. k) Ministry of Agriculture: the construction and maintenance of dams and dykes before, during and after flash floods.

Voluntary organizations such as, the Myanmar Red Cross Society, Myanmar Maternal and Child Welfare Association, Union Solidity and Development Association and Voluntary Fire Brigade also participate in flash flood preparedness and relief measures and organization-wise cooperation with ministries and committees.

6. Water Security

Image: boat-Inle-lake-shan-state-myanmar-traditional.

Starting on May 24th, a three-day meeting for the High Level Roundtable on Water Security took place in Yangon, Myanmar. The talks — which received wide support from various UN agencies, regional development partners, and leaders within civil society — supplemented initiatives put forth by the Global Water Partnership (GWP), a worldwide intergovernmental network focused on creating a water-secure world built on responsible water management and sustainable government practices.

The United Nations has emphasized the issue of water security as crucial in ameliorating high poverty levels, overturning systemic violence, addressing human rights inequities, mitigating and adapting to climate change, improving agricultural and manufacturing practices, and providing for sustainable energy production — all of which, because of Myanmar's tumultuous past, are somewhat overdue and yet, due to Myanmar's new democratic posturing, now provide the country with the opportunity to lead in efforts to address a multitude of issues (1).

Myanmar is at a crucial juncture where its increasing population and developing economy are looking progressively towards water resources in order to support growth. In the IMF's latest annual assessment, Myanmar was listed as one of the fastest-growing economies in Asia; although economic advancements remain steady, the country must creatively close gaps of vulnerability in areas of industrial infrastructure and confidently press forward with further development of resource structures (4). According to the Water Environment Partnership in Asia (WEPA), 90% of Myanmar's current water consumption goes towards agriculture while the remaining 10% is allocated for industry and domestic use. Even so, Myanmar is only utilizing 5%

of potential water resource usage, indicating a vast possibility for consequential water resource development through capacity building and thoughtful governance — both of which international, regional, and civil society actors are willing to provide guidance on (5).

This multi-stakeholder approach to the sustainable development of Myanmar's water infrastructure will largely impact other dimensions, some of which are more obvious — such as food security, biodiversity, health and sanitation, energy production, employment, poverty — and others which are more discreetly related such as education, ethnic conflict, and gender equality. Overall development requires an interdisciplinary understanding — a message reiterated by the Ministerial Declaration at the Third World Water Forum (WWF3), which stated that "water is a driving force for sustainable development including environmental integrity, and the eradication of poverty and hunger, indispensable for human health and welfare."

7. National Policies and Plans on Water Related Disasters.

On 24 May 2016, a High-Level Roundtable on Water Security and the Sustainable Development Goals was convened in Yangon, Myanmar. The meeting was organized by (GWP), the meeting identified the challenges posed by water insecurity in Myanmar, as well as addressing the link between water security and five key Sustainable Development Goals (SDGs) – SDG Five on Gender, SDG Six on Water and Sanitation, SDG 11 on Cities, SDG 13 on Climate Change and Disaster Risk Reduction, and SDG 17 on Partnerships.

Comment; Myanmar is naturally endowed with plentiful water sources, with 1,168 km^3 per year of total renewable water resources. Despite this abundance, regional and seasonal variation is so great that the country suffers from a range of climate-related water insecurities, including flooding, droughts, and cyclones. Decades of mismanagement and weak investment under past government rule has led to poor water access, with one-third of the population continuing to drink from unimproved water sources.

The 2030 Agenda for Sustainable Development established 17 Sustainable Development Goals agreed on at the UN General Assembly in September 2015. SDG Six aims to ensure Water, Sanitation and Hygiene (WASH) for all as well as the promotion of Integrated Water Resources Management (IWRM). Myanmar is yet to develop a comprehensive plan for IWRM, however it has taken steps toward the goal with initiatives such as the Ayeyarwady (Irrawaddy) Integrated River Basin Management (AIRBM) Project (2015-17), an initiative funded by a US$1 million ($1.39 million) loan from the World Bank.

8. Lessons Learnt from the Past

8.1.Monsoon floods in Chin State, Myanmar

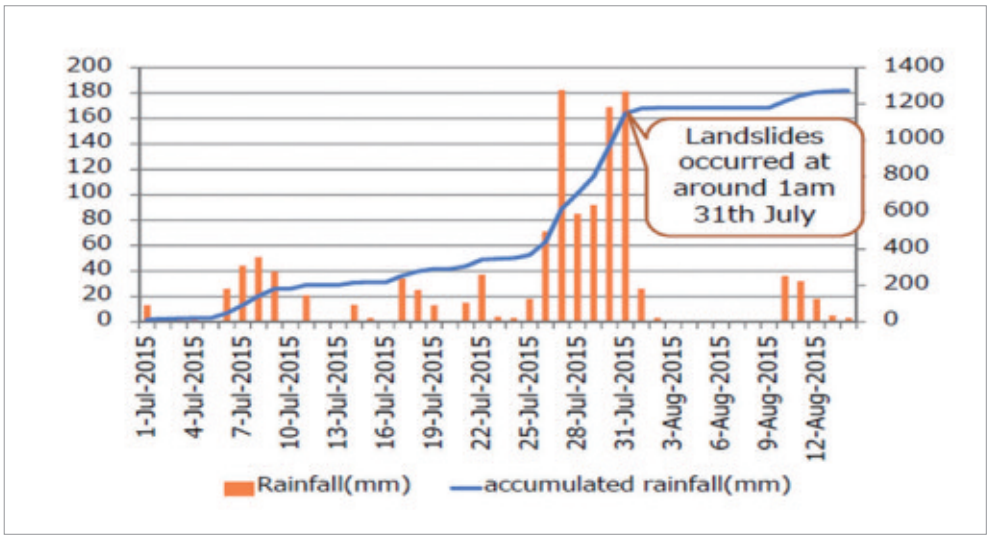
Hakha. Eighty-seven families displaced by floods and landslides are currently staying in tents on the school 2015.Children at a school in grounds. Photo: OCHA/Eva ModvigChildren at a school in Hakha. Eighty-seven families displaced by floods and landslides are currently staying in tents on the school grounds. Photo: OCHA

The road to Hakha, in remote Chin State in western Myanmar, is not an easy one to travel at the best of times. Even without landslides and rains, it takes between seven and eight hours to drive. Now it often takes longer as sections are still blocked by mud and stones following landslides caused by the heavy rains and floods in July and August(2015).

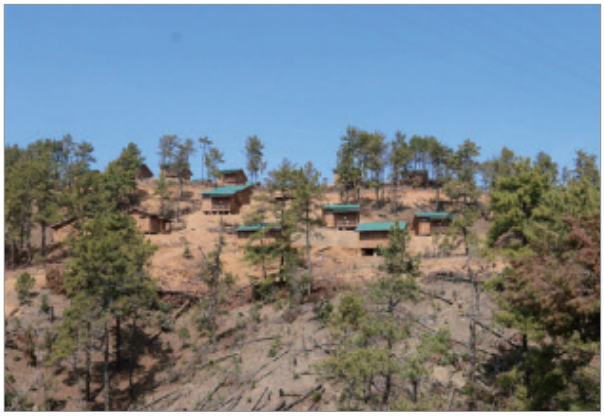
Overall, close to 1.7 million people were temporarily displaced and 172 killed by floods, landslides and strong winds that affected 12 of Myanmar's 14 states since June 2015, according to the Government. While most of those displaced were able to return home shortly after as flood waters receded, almost 11,000 people remain in evacuation sites in Chin State and neighboring Sagaing Region as of early November.

(Fig.26) (a,b) Flash Floods and landslides in the Chin region of Myanmar displaced thousands of people this summer.(When I arrived at Kalay and Hakha last Nov 29 to Dec 10 2016,I have seen and some measuring study in that areas for my report) Months after the landslides, roads in the capital of Chin state, Hakha, have been cleared. But in the rural areas, aid is hard to find.(Now JICA renovate that Kalay to Hakha road by their funds).

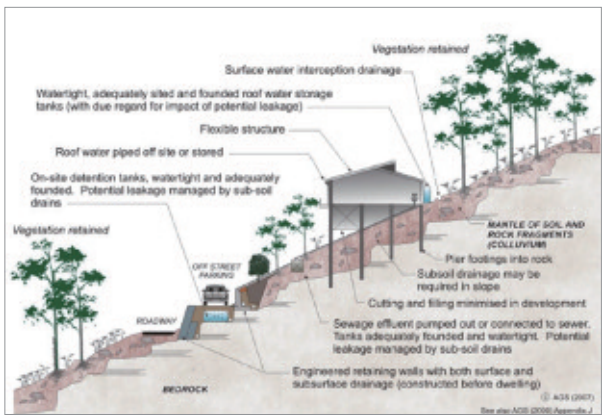
Case Study



(Fig.27) Heavy Rainfall due to Landslide at Hakha (Chin State)



(Fig.28) Relocate housing

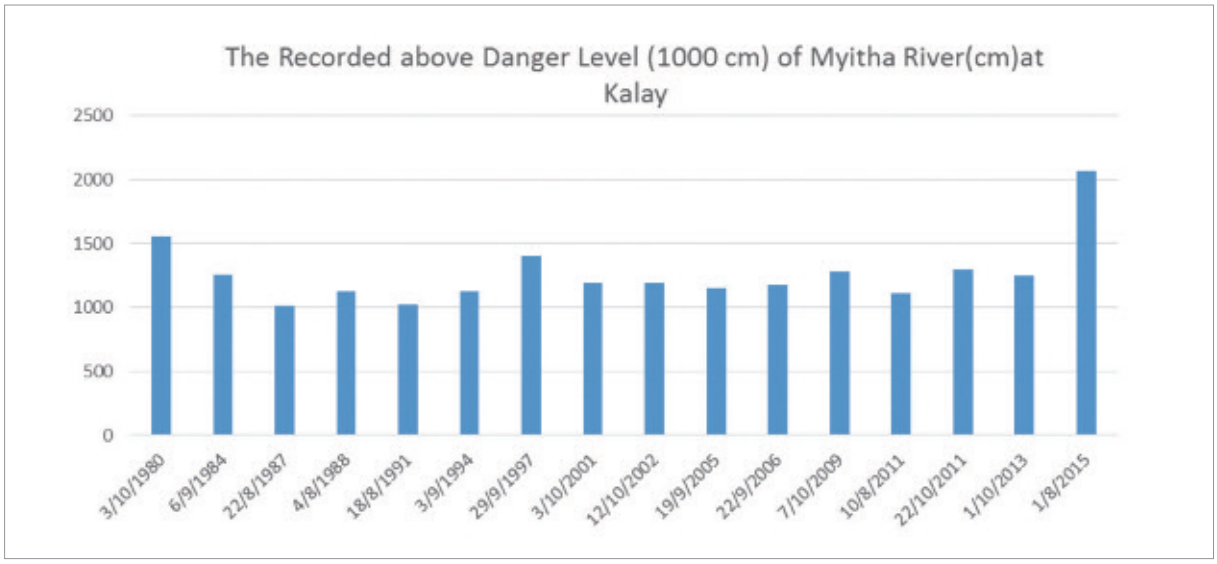


(Fig.29) Design for land slide DRR

(Fig.30) Retaining wall design

(Fig.31) Drainage design

8.3. Severe Flood in Kalay(lower Sagaing region)(with Photos)



(Fig.32) Kalay Flash Flood public records

9. Status of ODA for Water Related Disasters for last decades.

During 2002 -2015 ODA(Grants aid) projects are about (100) supports to Myanmar in Water Related disaster. Some example for Myanmar ODA status as follow;-

(Table 22) The Representing Water ODA for Myanmar

Projects	Purpose	Donor	Organization	Year	Amount	Type
PROJECT FOR RURAL DRINKING WATER SUPPLY IN SHAN STATE	Basic drinking ater supply and basic sanitation	Japan	MOFA	2002	4,488,818 USD	ODA Grants
The Provision of Equipment for Rural Water Supply Project In the Central Dry Zone	Basic drinking water supply	Japan	MOFA	2013	3,814,604 USD	ODA Grants
	River basins' development	Japan	JICA	2008	2,564,773 USD	ODA Grants
UNOPS, Livelihood & food Trust Fund	Water resources policy/admin. mgmt	Switzerland	SDC	2012	2,026,667 USD	ODA Grants
	Water supply & sanit. - large systems	Japan	JICA	2003	1,908,887 USD	ODA Grants
TC AGGREGATED ACTIVITIES	River basins' development	Japan	JICA	2012	1,782,278 USD	ODA Grants
TC AGGREGATED ACTIVITIES	Water resources protection	Japan	JICA	2013	1,726,122 USD	ODA Grants
Save the Children - Cyclone Nargis WASH Activities	Basic drinking water supply and basic sanitation	Australia	AusAID	2010	1,717,366 USD	ODA Grants
UNICEF- Cyclone Nargis WASH Activities	Basic drinking water supply and basic sanitation	Australia	AusAID	2010	1,375,894 USD	ODA Grants

10. Future Agenda to Mitigate and Adapt to Water Related Disasters.

10.1 Implements and maintenance of River system

a. Maintenance to River bed and Banks by regular and master plan.

b. Set up good river flood monitoring, analyzing and forecasting and warning disseminating System in Myanmar.

c. Re-locate Housing system.

d. National Level Plan for Water security for hole country.

e. Fill up in maintenance of Dams, Reservoirs and Reforestation on Catchment
f. Building one system of Flash Flood monitoring and Warning purposes urgently.

10.2 Technical Supports

a. Instrumentation, Installation, Technical transfer from developed countries.
b. Technical cooperation, coordination in these water related disaster issue with partner countries.

10.3 Sustainable development in Myanmar.

a. Each master plan in related official agencies of Myanmar for their capacity development.
b. Individual capacity development programs.

11. Proposals for Regional cooperation.

A. Technical and advisories cooperation with regional level and global status.
B. Experience and Knowledge sharing .
C. Technical sharing and financial (ODA, GRANT aid, and LOAN) Assist or support.
D. Technical Capacity Building Training
E. Medium and Large Project on "Water Related Disaster Reduction" with regional and global cooperation.

Myanmar hope this cooperation Forum out comes can be solve our problems of Water Related Disaster for better future.

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2. Department of Relief and Resettlement issues.
3. Ministry of Finance and Revenue issues
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5. World Bank issues.
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7. Hazard Profile of Myanmar

Executive Summary Report

INDONESIA

INDONESIA

By Ministry of Public Works and Housing and Hendarti

A. Background

Geographically, Indonesia is surrounded by the Indian Ocean to the west and the Pacific Ocean to the east. As an archipelago comprising of 17,000 islands, Indonesia is one of the country with the longest coastlines in the world. Topographically the islands comprise of mountainous areas with narrow to large coastal lowlands. Mountain ranges extend from east to west. The volcanoes in Indonesia are among the most active of the Pacific Ring of Fire.
Furthermore, Indonesian is tectonically active triggered by three tectonic plates consisting of Eurasian Continental Plate, India-Australian Oceanic Plate, and Pacific Oceanic Plate respectively. As consequence, the country is prone areas of geological hazards. Four main geological hazards, i.e., volcanic eruption, earthquake, tsunami, and landslide, occur in Indonesia and considered as major disasters.

Due to its geographical position straddles the equator and between two major continents of Asia and Australia as well as two oceans of Indian and Pacific, Indonesia weather and climate are strongly affected by different characteristics of both two continents and two oceans. As the results, the climate greatly contributes to the water related disasters. Two extreme seasons, namely rain season and dry season as consequence of monsoonal wind movement primarily contributes to disaster events. Climate anomaly, i.e., El Nino/La Nina also affect Indonesia's vulnerability against water related disasters. Typically, Indonesia experiences droughts during El Nino (the warm phase of ENSO) and excessive rain during La Nina (cool phase of ENSO). An el nino incidence will bring great impacts on certain areas in Indonesia if such phenomenon coincides with Positive Mode of IOD (Indian Ocean Dipole) and MJO (Madden-Julian Oscillation).
Precipitation in parts of Indonesia has decreased and is projected to continue to decrease during critical times of the year (i.e., during the dry season) and this leads to prolonged droughts. In other areas, it is projected that rainfall will increase and may occur in fewer, more intense events which could lead to flooding. These types of trends (drying in some parts and flooding in some other areas), combined with an overall shift of the seasonality and timing of rainfall will lead to unpredictable and uncertain water availability and consequently, affect production of agricultural goods and economic instability.
To anticipate such unpredictability, Indonesia has established the Centre for Public Weather Services of BMKG, which provides 24/7 information services on weather watches, alerts and warnings. Such alert services are provided by Jakarta Tropical Cyclone Warning Centre, Marine Meteorology Service, Severe Weather Monitoring and Meteorological Information sub-divisions and supported by other units such as remote sensing division and other monitoring units. Forecast products available at BMKG's official website include 24-hr forecast, 3-days weather advisory, weekly weather advisory, 1-7 days warning of potential extreme weather, seasonal forecast, tropical cyclone bulletin, marine weather services (24-hr, 48-hr, 72-hr wave and wind forecasts), fire weather (fire danger rating system/FDRS) information (1-3-days forecasts), and daily flood potential advisory. Daily weather forecast is aired on TV and radio, published in daily newspapers, and regularly updated at the BMKG website.

BMKG also maintains good working relationship with the Department of Environment, Ministry of Agriculture, Ministry of Public Works and Housing, the National Disaster Management Agency, National Search and Rescue Agency, etc. in providing hydro-meteorological services in the country. In particular, the Directorate for Rivers and Coastal under PUPR also contribute to issue on flood information and forecast to the public. Some of the river basin organizations (RBO's or BBWS/BWS) are improving the

hydrological network and equipment by acquiring new ones, and conducting repair and calibration of existing equipment.

The Ministry of Agriculture, Indonesian Armed Forces and local government also gather meteorological data and information and share their data for the national forecast system. Some of their observation sites are operated in cooperation with BMKG and view of them send data to the national forecast office in real time, but most are in non-real time basis. Some private companies involved in mining activities also operate meteorological observing equipment but none are shared to the BMKG.

B. Assessment of Major Water Related Hazards

The asessement report is base on Indonesia disaster risk assessment which use an approach to demonstrate the potential negative impacts that may arise from a potential disaster. The exposed element at potential risk from hazard, are people, building, environment etc

The assessment and discussion in this report will be focused on the topics of water related disasters. It is important since more than 98% disaster in Indonesia are hydro-meteorological disasters; during 2012 and 2016 occurred hydro-meteorological disasters in average 1,900 events;

Considering on the situation, this report focuses on major water related (hydro-meteorological) disasters as follows: (i) flood; (ii) tsunami; (iii) landslides; and (iv) drought. Other kinds of hydro-meteorological disasters will be also discussed at certain extent. The minor disasters also occur but with small scale and exposure, such as debris and mudflow, storm, typhoons, and land subsidence.

As the fourth largest population country in the world, the disaster threatens livelihood of large population of Indonesia, both in urban and rural areas. At the same time, the disaster also threatens Indonesia's fast growing economy. For example, earthquake and tsunami hitting Nanggroe Aceh Darussalam and North Sumatra in December 2004, claiming the lives of 165,708 people and inflicting property losses of Rp.4.45 trillion; earthquake and tsunami in Pangandaran in July 2006, claiming the lives of 658 people and inflicting property losses of Rp. 967 billion, and flood in Jakarta in February 2007, inundating 145,774 houses and causing losses of Rp.967 billion. The detail assessment of each major water related disaster discussed below.

Flooding. Flooding in Indonesia is driven by annual rains during the monsoon season. The wet season occurs between November and March, when Asian and Pacific air masses influence weather patterns. The dry season between June and October is dictated by the influence of the Australian continent. The areas at highest risk for flooding include the northeast coast of Sumatra, the northwestern coasts of Java, the western and southern regions of Kalimantan, the southern region of Sulawesi, and southern Papua.

Based on the recent disaster risk assessment data from BNPB, flooding causes the largest cumulative impacts comprising of physical loss (IDR 176,329,821 million and economic loss (IDR 140, 520, 440 million. The hazard also threatens of 39,371,167 ha area. Regarding to people will be affected, the hazard exposes of 100,814,666 persons. The high vulnerability of flood found in the following provinces: Riau (1,624 ha), South Sumatra (637 ha), Lampung (492 ha), Bangka Belitung (453 ha), East Nusa Tenggara (193 ha), West Kalimantan (2,168 ha), Central Kalimantan (674 ha), South Kalimantan (437 ha), and Maluku Utara (641 ha). The rest of areas (total 48,318,299 ha) are categorized as moderate vulnerability.

Tsunami. Indonesia is subject to high losses due to this disaster as its position at ring of fire and tectonically active areas. The faults along tectonic plate borders are located on the sea floor rather than on land, which potentially generate more risk of tsunami. Further, the type of plate movement generates shallow, strong earthquakes, which most likely to generate tsunami. Finally, Indonesia's many volcanoes occasionally generate local tsunamis when their eruption disrupts the seafloor. Most of Indonesia's coastline is considered high risk for tsunamis. A new National Tsunami Hazard Assessment for Indonesia found that

regions most likely to experience a tsunami greater than 3 m in any given year were Lampung Barat, the Mentawai Islands, and Nias. Regions with a two to ten percent chance of a 3m tsunami in any given year include Java's southern coast, the south-west coast of Sumatra, and parts of Bali.
Total 961,133 ha among provinces in Indonesia are potentially affected by tsunami. Based on its vulnerability, there are 27 provinces and 218 districts and total 119,688 ha neighborhood/surrounding potentially affected by tsunami, comprising of moderate vulnerability (total area 350,224 ha) and high vulnerability (total area 30,232 ha). The vulnerable areas are inhibited by 3,702,702, who potentially affected by tsunami. Combined physical loss (IDR 71,494,821 million) and economic loss (IDR 7,976,358 million) represent significant loss for the less frequently occurred disaster.

Landslides. Landslide is an important secondary hazard in Indonesia and closely associated with flooding, earthquakes, and volcanic activity. All three primary hazards regularly cause landslides as they work in different ways to weaken the integrity of hillsides. Heavy rainfall can cause ground liquefaction and slope failure. Earthquakes dislodge loose soils and causes rock falls, while volcanoes can cause landslides by either depositing ash which later flows downhill (lahars) or by causing ground deformation that weakens slopes.
Landslide might be even more prevalent when heavy rainfall, earthquakes, or volcanic eruptions combined with poor building practices and deforestation. In all three types of landslides, affected communities generally do not have warning. The people who live in rural areas and the poor are most likely affected by the landslide. While most areas in Indonesia are subject to landslides, northern Sumatra, southern Java, and Papua are most at risk.

Landslide risk potentially occurs at total area of 57,418,460 ha and neighborhood of 41,337,707 ha. The hazard potentially affects 14,131,542 persons and causing significant economic loss (IDR 75,870,343 million) and physical loss (IDR 78,279,825 million.

Drought. Indonesia is vulnerable to drought as less rainfall can seriously disturb rice production. Drought occurs when there is a substantial decrease of water availability as compared to normal conditions– these drought conditions harm crop harvest and threaten food security. In Indonesia, droughts are driven by smaller than expected monsoon seasons and are more likely when El Nino is present. El Nino affects Indonesia by delaying the onset of the wet season, making planting crops difficult and leading to food shortages. Drought is not sudden disaster, start from drought meteorology, drought agriculture, drought hydrology and drought social-economy.
The effects might be severe, especially if the drought occurs in conjunction with other hazards. The most recent severe drought occurred in 1997 which was associated with a very strong El Nino. The drought officially caused 672 deaths, affected 1 million people, and caused USD $88 million in damages. However, these numbers do not accurately reflect the effects of drought. Concurrent with the drought, Indonesia faced the Asian financial crisis and record wildfires. With all these three hazards impacting the country concurrently, the World Food Programme (WFP) estimated 7.5 million people faced food insecurity. Irian Jaya located in West Papua was most affected with food shortages due to the drought.

Though no effect to physical infrastructures, drought is a single hazard (but not sudden disaster, long process of disaster) with catastrophic impacts, potentially affecting 163,101,784 ha areas, threaten livelihood of 228.163.266 persons, causing economic loss of IDR 192.737.143 million and expose 63.781.004 ha neighborhoods. All provinces are vulnerable to drought (except DKI Jakarta), both mild vulnerability (total 494,562) and high vulnerability (total 36,285,003).

C. Structural and Non-Structural Mitigation Measures

Structural mitigation measures have been implemented to mitigate water related disasters, especially for flood retention and flood control such as dam, dike, river improvement, channel construction, river diversion, retention basin, pumping station etc. Some structural mitigation measures also have been implemented for various types of other water related disasters.
Equally important, non-structural mitigation measures have been implemented in water related disasters under Water Resources Management (WRM) context and community empowerment. Some forms of non-structural measures commonly applied, among others: spatial plan, conservation, preparedness, early warning system, public awareness, risks mapping and indexing, training and community participation.

As part of non-structural mitigation measures, forecasting, warning and monitoring systems for disasters have been established and operated in Indonesia, among others:

Tsunami Monitoring. Starting in 2005, the German-Indonesian Tsunami Early Warning System (GITEWS) was created. Personnel at Indonesian institutions were trained to take over responsibility of the warning system. In 2011, the GITEWS gained positive reviews from a commission of international experts before being handed over to Indonesia. Since then, the system is referred to as the Indonesian Tsunami Early Warning System (InaTEWS) and is operated by the Indonesian Service for Meteorology, Climatology and Geophysics BMKG. InaTEWS obtains its data from around 300 measuring stations and a warning can be sent out five minutes after an earthquake occurs.

Flood Forecasting. One example of flood forecasting applied in Bengawan Solo River Basin using IFAS. IFAS consists of a comprehensive flood and runoff analysis package, which supports efficient and effective flood forecasting. IFAS is based on the integration of Geographical Information Systems (GIS) with ground-verified satellite-borne information. Incorporated analysis software allows extraction of river networks and drainage areas from digital terrain elevation maps. IFAS has a rainfall-runoff module, which may be applied in data-poor regions, such as the Solo river basin.

Flood Monitoring. DKI Jakarta Regional Disaster Management Agency also known as Badan Penanggulangan Bencana Daerah (BPBD DKI Jakarta) is currently using the Disaster Information Management System (DIMS) application which manages damage and shelter information, a digital map, and can send messages to staff and other disaster management agencies. The application plays a vital role in the time and dissemination of information during the flood mitigation process by establishing a quick early warning system. This allows BPBD to collect information quickly and make key decisions.
In 2015, Fujitsu Indonesia built a disaster information-sharing system for BPBD which allows Jakarta residents to share disaster information via a smartphone app. Residents can use the app send pictures and comments, and based on their smartphone GPS location, the system will collect rainfall amounts and river levels onto a map. The system is linked to DIMS so when BPBD issues a flood warning in DIMS, alerts are automatically sent to smartphones that have the app installed.

Flood Early Warning System. The provincial public work agency (DPU-DKI) issues riverine flood warnings based on actual water level observations at upstream of the river system. The meteorological institute (BMKG) issues local flood warnings based on expert assessment of numerical weather models. Since these organizations and others involved in flood management did not share their data, a total overview of the status of the water system is lacking. To improve this situation, a flood management information system was implemented. This system collects the operational data of all involved organizations, together with several global data sources. In addition to this system, a flood forecasting system (i.e., J-FEWS) was built for Jakarta. J-FEWS is able to warn for high river discharges and extreme storm surges, and already proved its use during the 2013 floods.

Cyclone Warning. The Jakarta Tropical Cyclone Warning Centre (Jakarta TCWC) began operations in 2008 and is overseen by BMKG. The main function of the TCWC is to provide public on forecasts and warnings for tropical cyclones for the coastal and land areas of Indonesia, along with forecast and warnings for open sea. Jakarta TCWC is a participating member of the World Meteorological Organization (WMO) Tropical Cyclone Program which is assigned to establish national and regionally coordinated systems to ensure that the loss of life and damage caused by tropical cyclones are reduced to a minimum. There are currently six TCWC in the Asia Pacific region.

Drought Warning System. The Indonesia Agency for Meteorology, Climatology and Geophysics (BMKG) has issued meteorological drought information on a regular basis using Standardized Precipitation Index (SPI) method. It was a WMO-recommended tool showing an index calculated based on the probability of the recorded amount of rainfall; negative index values for drought, and positive for wet conditions. SPI can be used to monitor climate condition on a range of time interval (monthly, three monthly, seasonal, annual) that can be utilized for agricultural and hydrological applications.
In addition to its routine products, i.e., averaging one-month and three-month standardized precipitation index (SPI) and monthly percentage of soil moisture content, BMKG has released a climate early warning system consisting of drought monitoring and prediction, which are dry season onset, consecutive dry days (CDD, updated every 10 days), and one-month SPI analysis.

D. Funding, Institutional Setup and Role Sharing

Funding for Disaster. Sources of funding for disasters mitigation in Indonesia come from (1) National Government Budget (APBN), (2) Local Government Budget (APBD), and/or (3) Community (covering individuals, business institutions, non-government organizations, both domestic and overseas).
This DRR funding will continue to be scaled up through increasing the government's commitment by allocating funds for Disaster Management in the State/Regional Budget (APBN/APBD) as recommended in the second global forum in Geneva that 1% of the State/Regional Budget (APBN/APBD) be allocated for Disaster Management funds with 10% allocation for DRR activities. For APBN 2016 budget for social grants and disaster mitigation is allocated 4.5 trillion Rupiah.

Legislation on Water-Related Hazards and Disasters. In 2007 the Government and the Parliament issued Law No 24/2007 on Disaster Management. Additionally, a specific agency in charge of disaster management was established in 2008, i.e. the National Agency for Disaster Management (or BNPB in Indonesian acronym). A set of government regulations was then stipulated to implement the instructions of the Disaster Law of 2007. These regulations are: Government Regulation No 21/2008 on Disaster Management Operation, Government Regulation No 22/2008 on Funding and Management of Disaster Aid, and Government Regulation No 23/ 2008 on Participation of International Organizations and Non-Government Organization in Disaster Management. Other laws have also been revised to accommodate the principles of disaster risk reductions.
At the national level, DRR has been integrated into policy framework at the national and regional government level for preparedness, emergency response and post-disaster recovery. Policies related to disaster management, including that of DRR, have been instituted in the 2004-2009 and 2010-2014 Medium Terms and Annual Development Plans.

Considering the fact that the majority of Indonesian regions are prone to natural disasters, the government planned to establish a disaster office in all relevant regions. By the Head of BNPB Regulation No 3/2008 on the Establishment of BPBD and the Ministry of Home Affairs Regulation No 46/2008 on BPBD Organization and Working Mechanism, such offices were established in provincial, regency and city regions. Today all provinces have established their Local Agency for Disaster Management (BPBD), and more than 60% of the regencies/municipalities have established BPBDs.

On the other spectrum, community groups that have an attention to participate in disaster management and preventions activities evolved sporadically in some regions. In some regions, disaster risk reduction forums or platforms involving government and non-government stakeholders were also established. The role of international organizations such as UNDP is instrumental in maintaining this country-wide movement to deal with natural disasters. At the national level, a National Platform for DRR, a multi-stakeholder body to advocate Disaster Risk Reduction, was set up to provide coordination, analysis and advice to participating stakeholders. These organizations also engage in education and trainings to promote the capacity of local communities to identify, monitor and deal with existing natural hazards.

Institutional Setup. Badan Nasional Penanggulangan Bencana (National Disaster Management Agency, BNPB) was established in 2008. BNPB consists of the president of the BNPB, the Management and Operational Committee, and the Policy Implementation Agency. Being composed of ten ministries (Ministry of Interior, Ministry of Social Affairs, Ministry of Public Works, Ministry of Health, Ministry of Finance, Ministry of Transportation, Ministry of Energy and Mineral Resources, Police and Armed Forces) and other nine experts, the Management and Operational Committee is in charge of advisory and consultation with the BNPB's president. The Policy Implementation Agency is in charge of increasing preparedness, emergency response, and relief and reconstruction. Also, the Indonesian Government is planning to establish the Regional Disaster Management Agency (BPBD). In November 2008, National Platform was established to expand the cooperation among sectors.
Role sharing among agencies for disaster management, at both pre-disaster (prevention and risk reduction) and post disaster (mitigation), as follows:

Pre-Disaster/Prevention/Risk Reduction

1) Mapping of disaster area (BIG, BPPT, ESDM, BMKG, Lapan, etc)
2) Establishment of early warning at disaster prone area, i.e., infrastructure, facilities, technology, socialization (BPPT, LIPI, BMKG, Min. Of Transport)
3) Community empowerment, i.e., promoting on awareness and preparedness (BNPB, Min. Of Home Affairs, Min. Of Social, Min. Of Education)
4) Institutional strengthening, i.e., coordination, mechanism, quick response, service (BNPB, Depdagri, Depsos)

Mitigation (Post Disaster)

1) Emergency response for disaster victims (BNPB, Min. Of Social, Min. Of Healthy, Min. Of Public Works and Housing)
2) Recovery of traumatic condition and other disaster impacts (Min. Of Social Affairs, Min. Of Healthy, Min. Of Education)
3) Rehabilitation of public infrastructure and regulation (Min. Public Works and Housing, Min. Of Energy, and Mineral, Min. Of Transport, BNPB)
4) Reconstruction of infrastructure, social, economic and institutions (Min. Public Works and Housing, Min. Of Energy, and Mineral, Min. Of Transport, Min. Of Agriculture, Min. Of Marine and Fisheries, Min. Of Environment and Forestry, Min. Of Social Affairs, BNPB)

E. Platform, Outlook, and Lesson Learnt

Global and Regional Platform. In addition to national platform, disaster risk reduction (DRR) and disaster mitigation also set up at global and regional level. At global platform countries agreed on:

- UN Resolution : government commitment, community empowerment, reduction of victims and loss due to disaster impacts
- Yokohama Strategy: Integrate DDR into development to improve community resilience to disaster
- Hyogo Framework for Action (HFA): integrate DDR in development, strengthen mechanism and comprehensive institutional approach

Meanwhile, at Regional Platform:
- Beijing's Action Plan (Asia's Agreement for DDR as main priority; Conduct regional cooperation in DDR)
- ASEAN Regional Agreement: regional cooperation for DDR and mitigation of disaster emergency Accordingly, BNPB established cooperation with international organizations, among others:
- Australia-Indonesia Facility for Disaster Reduction (AIFDR) – Phase II, SC-DRR (Safer Community through Disaster Risk Disaster),
- Japan International Cooperation Agency (JICA), University of Hawaii on Managing Partner of the Pacific Disaster Center,
- Asian Development Bank (ADB) on Regional Assistance for Developing a Disaster Risk Financing Project,
- IMDFF-DR (Indonesia Multi Donor Fund Facility on Disaster Recovery), expanding its scope at preparedness, early warning, though still focus on recovery and GFDRR (Global Fund for Disaster Risk Reduction).

Water Development Outlook. As majority of countries in the world, Indonesia in the early stages of incorporating disaster risk reduction into their sector development planning process. Progress can be seen in stronger institutional systems and improved legislation for disaster preparedness and response. Good foundations are being laid for disaster risk reduction in Indonesia.

Indonesia has recognized the need for reform, and, over the past four years, the country's 30-year old water resources law has been amended to:
- enhance integrated water resources management (IWRM) to achieve sustainable resource use,
- manage water in all aspects -- social, ecological and economic,
- achieve a balance between conservation and water use,
- decentralize the management of water resources,
- assure the basic right of water for all people, and
- make future policy in a democratic way.

Sustainable Development Goals (SDGs). Indonesia had success achieving its Millennium Development Goal (MDG) targets of reducing poverty, increasing access to primary education, and reducing the prevalence of certain diseases. With the close of the MDGs, Indonesia now has the opportunity to continue with its development achievements aimed at a range of intersecting issues. Indonesia has just mainstreamed the Post-2015 Development Agenda into its national development planning. In this respect, Indonesia has inter alia reduced public spending on fuel subsidy and enhanced budget allocation for social development programs, such as 'Indonesian Health Card' and 'Indonesian Smart Card', to give poor households better access to healthcare and education."

Indonesia's Medium Term Development Plan 2015 – 2019 has aligned with all 17 SDGs (Sustainable Development Goals). For Indonesia, 2015 and 2016 are pivotal years for development. The choices this country makes on its development path have a bearing on global development prospects, and the Indonesian government continues to reduce poverty and inequality, protect and preserve the country's environment, and protect maternal and child health, among other development goals.

Adaptation and Resilience. Results of water-related disaster management are not up to community expectations (protecting the public from the hazard of disasters); in fact, there are still many districts and cities at high risk for disasters.

The main problems related to society's resilience with respect to water-related disasters are as follows:
(1) Lack of attention and commitment of the government (national, provincial, district or city) in providing resources and funds needed for the O&M of irrigation infrastructure (causing drought problems) and flood prevention infrastructure (causing flood problems)
(2) Dam operation does not include risk assessment downstream.

(3) Lack of monitoring and weak law enforcement. These relate to (a) the communities and industries located in disaster-prone areas; (b) excessive groundwater abstraction leading to land subsidence; and (c) illegal water use, creating drought affecting one and all.
(4) The decline in the availability of water source in the dry season, and increase in the runoff in the wet season as a result of environmental degradation, especially after 1998.
(5) Lack of water resources information and communications system.
(6) Lack of early warning system.
(7) Inadequate evacuation infrastructures and facilities.
(8) Lack of awareness and community participation in disaster management.

Lesson Learnt and Local Wisdom. Cultivating from natural disasters occurred in several regions in Indonesia, such as floods, tsunami, landslides, drought, and so on, there are some lesson learnt and even best practices to be considered. Similarly, some local wisdom related to disaster management are practiced by some local people in Indonesia, which can be considered as lesson and best practices.

FHM (JFM) flood Jakarta. After the floods in February 2007 the Indonesian Ministry of Public Works (PU) requested the Dutch Government for assistance in developing non-structural measures to reduce flood risks in DKI Jakarta. These non-structural measures were seen as complementary to the structural measures that the Indonesian Government was already working on. The lesson learnt can be cultivated form JFM as follows:

- Insight in the causes and characteristics of the floods hitting Jakarta;
- Flood Hazard Mapping modelling framework for Jakarta (FHM modelling framework)
- The basis for a public information campaign to increase awareness of floods
- Experience with actions that communities can take themselves

Sea Defense (tsunami). The objective of Sea Defense assignment is to develop, design and assist in the implementation of a robust Sea Defense and Flood Protection Strategy. This would provide an essential risk management platform for the Aceh Reconstruction program. It would enable a safe habitable environment for the vast housing reconstruction program required. It will also provide a less risky physical environment for the economic recovery, facilitating investment and long term sustainability of the affected areas.

Way Ela (landslide). To avoid the loss of life of the villagers of Negeri Lima already implemented measures as in the Action for Emergency Response (RTD) of Natural Dam Way Ela that drawn up in November 2012 and simulations coordinated by BNPB and BPBDs, has been carried out and attended by related agencies such as the Regional Government of Maluku, local government of Central Maluku, Army/ police, and and The Ministry of Public Works, at February 2013. The results of the RTD, population was being evacuated to minimize casualties, but still one people loss when the Dam was broken in 2014.

Merapi (mud flow) SABO. Many Sabo dams already built in Indonesia, along rivers around the volcano upstream. One of them is sabo dam built at Mount Merapi. Almost all the streams from Merapi flow down toward four districts, namely Boyolali, Klaten, Magelang and Sleman. To capture the debris or lava as well to reduce flow rate and sediment control, there have been built sabo dam in the four districts. Sabo dam also can serve to guide and slow the flow of material in the river, material deposition, and prevent volcanic secondary hazards. The main objective of sabo dam system is to control sediment and reduce excessive sediment yield entering the river flow that pass through the city of Yogyakarta

Drought. Drought in many regions in Indonesia lately increasing as El-Nino phenomenon today. El-Nino influence reducing rainfall in some areas of Indonesia and it's very difficult to prevent because this is global phenomenon. Various efforts have

been done, ongoing, and will continue to be done by the Central Government and Local Government by adopting appropriate technologies and other unconventional measures such as dropping clean water, wells, build some reservoirs, and others. Those micro efforts are effective at a certain scale but still it is necessary to do large-scale application of technology in order to increase the water supply.

Land Subsidence. Jakarta is the capital city of Indonesia located in the west-northern coast of Java island, within a deltaic plain and passes by 13 natural and artificial rivers. Population of this megapolitan recorded about 10.2 million people inhabiting an area of about 660 kilometers2, with relatively rapid urban development. Land subsidence has been reported for many years at several places in Jakarta at different rate. The main causative factors of land subsidence in Jakarta are most probably excessive groundwater extraction, overload of constructions (i.e., settlement of high compressibility soil), and natural consolidation of alluvial soil.

Local Wisdom on Disaster Mitigation. Since the 1990s, local and indigenous knowledge is increasingly recognized in the fields of natural resource management, disaster risk reduction, and climate change adaptation. In the disaster risk reduction field, the 2004 Indian Ocean earthquake and tsunami has been recognized as a turning point, when specialists and scientists began to show interest in such knowledge. However, local and indigenous knowledge is yet to be included in policies on disaster risk reduction or climate change adaptation, and the wealth of documented knowledge and practices have not been adopted to make use of this knowledge to enable communities to increase their resilience.

In Aceh, one of the project sites, much local and indigenous knowledge (LINK) related to reducing disaster risk has been handed down over generations. One example is the traditional regulation surrounding the establishment of settlements around river catchment areas. For big rivers, people are forbidden to build houses closer than 100 m from the river's bank while for small rivers, the distance must be more than 50 m, which prevents damage during flood events. Other Acehnese practices are to prepare for floods by putting chicken cages higher on the ground, and building traditional elevated wooden houses.

Local and indigenous knowledge that became well known after the 2004 Indian Ocean tsunami is Smong, a series of natural phenomena learned through songs, stories and monuments that helped communities in Simeulue Island, located to the west of Sumatra Island, to predict the coming of a tsunami. This information was passed down through the generations after the powerful 1907 tsunami when many islanders were killed (Meyers and Watson 2008).

G. Future Agenda and Proposal for Regional Cooperation

Future Agenda of BNPB. Directions and national priority as confirmed in RPJMN (National Long Term Development Plan) 2015-2019, Renas PB (National Plan on Disaster Management) 2010-2014, and National Action Plan (RAN PRB) 2010-2012, as well as considering the latest 5 (five) years achievements on disaster management, the focal priorities already prepared and formulated as follows:

- strengthening of legal framework on disaster management.
- mainstreaming of disaster management in development.
- improvement of partnership among multi-stakeholders in disaster management.
- fulfilment of governance in disaster management.
- improvement of effectiveness in disaster prevention and mitigation.
- improvement of preparedness and disaster emergency management.
- improvement of capacity in disaster recovery.

Proposals for Regional Cooperation. There are several forms of regional cooperation can be initiated, as refer to the completed and on-going regional cooperation schemes and model under Official Development Assistance (ODA, among others:

Knowledge Sharing. Cooperation in form of knowledge sharing on disaster management is exchanged among countries base on their experiences in special issues related disaster. Knowledge sharing activities are generally supported by knowledge management systems. Embedded knowledge sharing occurs when knowledge is shared through clearly delineated issues/topics, processes, routines, etc. This knowledge can be shared in different ways, such as:

- Scenario planning and debriefing: providing a structured space to create possible scenarios, followed by a discussion of what happened, and how it could have been different.
- Management training.
- Knowledge transfer: deliberately integrating systems, processes, routines, etc., to combine and share relevant knowledge

Capacity Building. Capacity building often refers to strengthening the skills, competencies and abilities of people and communities in aspects related. Concerning disaster management, the capacity building covers:

- Individual level – an individual level requires the development of conditions that allow individual participants to build and enhance knowledge and skills relate to disaster management. It also calls for the establishment of conditions that will allow individuals to engage in the "process of learning and adapting to change"
- Institutional level – an institutional level should involve aiding institutions in developing countries – an existing institutions and supporting them in forming sound policies, organizational structures, and effective methods of disaster management
- Societal level – at the societal level should support the establishment of a more "interactive public", become responsive and accountable.

Role Sharing for River Basin Management. Refer to Permen PUPR 4/2015, WS Sesayap is one of 5 inter basin country. Three sub basins are under inter basin country: Sub basin Sembakung; Sub basin Sebuku; and Sub basin Sebatik. Most of the area, i.e., upstream of the river basin located in Malaysia, while the downstream basin located in Indonesia. It is important to pay attention on integrated water resources management between both countries, especially in coordination. There is an opportunity to talk about role sharing.

Executive Summary Report

PHILIPPINES

PHILIPPINES

By National Water Resources Board and Yolanda Gomez

The Philippines is an archipelago consisting of about 7,107 islands with a land area of approximately 300,000 square kilometers. It is a tropical country located off the southeastern coast of Asia. It has no land boundaries. On its north lies Taiwan. To its west across South China Sea is Vietnam. To the east is the Philippine Sea which is actually part of the Pacific Ocean and to its south across Celebes Sea is Indonesia.

The Philippines is one the most populated countries in the world. According to 2015 census, the population of the Philippines reached 100.98 million, 8.64 million higher than the 2010 census. Its population increased by 1.72 percent annually, on average, for the period 2010 to 2015. This is lower than the annual population growth rate of 2.34% and 1.92% during the period 1990 to 2000 and 2000 to 2010, respectively.

According to the 2016 International Monetary Fund statistics, the Philippine economy is the 36th largest in the world and is one of the largest economies in the ASEAN region. The Philippines is also one of the emerging markets. Considered a newly industrialized country, it has an economy transitioning from one based on agriculture to one based more on services and manufacturing. In 2016, GDP by purchasing power party was estimated to be at $ 811.726 billion.

The Philippines is very much prone to disasters due to its geographic location. In fact, in the 2015 UN report, "The Human Cost of Weather Related Disasters", the Philippines is one of the top five (5) countries hit by the highest number of disasters that is mostly weather-related over the last twenty years. Its susceptibility to natural disasters are attributed to its location in the Pacific Ring of Fire, a major area in the basin of the Pacific Ocean where a large number of earthquakes and volcanic eruptions occur, making the Philippines prone to earthquakes and tsunami. It is also geographically located along the Pacific region near the equator which is very much prone to tropical cyclones and storms.

Natural disasters and hazardous events cause considerable loss of lives, homes, livelihoods and services; they result in injuries, health problems, property damage as well as social and economic disruption. Every year, the lives of millions of Filipinos are affected by the impacts of these hazardous natural phenomena such as tropical storms and other natural hazards that are meteorological, hydrological and geological in nature like flooding and landslide. Although it occurs annually, the rate of incidence and severity varies between years.

From the 2005 to 2015 records of the National Disaster and Risk Reduction and Management Council, an annual average of at least 9.31 million people and 1.93 million families were affected by the direct threat and impacts of water-related hazards. Total cost of damages to properties due to tropical cyclones and associated flooding reached PhP 374,882 million, with agriculture as the most impacted sector accounting to 61% of the total damages. In particular, rice farming is among the hardest hit because it is practiced in open areas and very sensitive to high wind velocity especially during flowering and ripening phases of rice.

Natural disasters leave behind lives shattered by physical injury or the loss of home and job and worse loss of lives. A total of 1.79 million houses were reported damaged and 5.28 million houses partially damaged from 2005 to 2015 due to water-related disasters. A total of 63,335 casualties was likewise recorded of which 13,139 were reported killed. Nearly half of the recorded death occurred in 2013 during the Typhoon Yolanda.

Urban flooding is very common in the Philippines, floods can easily occur even with the light precipitation and continuous heavy downpour during monsoon season. Often times the problem became even worse during high tides since there are urbanized cities with coastal boundary.

Susceptibility of Metro Manila areas to floods is mainly due to its hydrologic and topographic characteristics. The Manila coastal plain has an elevation of less than 5 m above mean sea level, while the Marikina Valley has a slope of less than 1 percent. High tides in Manila and the rise and fluctuating water levels in Laguna Lake contribute to the city's flood hazards. The major river systems, such as the Malabon- Tenejeros-Tullahan River and the Pasig-Marikina River System, have low gradients and meander in low-living areas.

As a tropical country, it is characterized by relatively high temperature, high humidity and ample rain. According to the country's weather bureau, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), two pronounced seasons exist, the rainy season from June to November and the dry season from December to May. Four (4) climate types was also recognized based on rainfall distribution.

Two weather systems prevail in the Philippines according to PAGASA, the northeast monsoon locally known as "amihan" and the southwest monsoon locally known as "habagat". Northeast monsoon is characterized by dry and cold weather during the months of October to later part of March with possibility of light rains in the northern and eastern side of the country. Northeasterly wind swift across the Philippines with its maximum intensity usually felt during the month of January to February, bringing cold weather during these months. Southwest monsoon brings warm and humid weather with frequent heavy rainfall and a prevailing warm and moist wind from the southwest from July to September. The start of southwest monsoon signals the coming of the rainy season. The typhoon season is usually from the month of July to November. Most often typhoons touch the islands between the southern tip of Samar and Northern Luzon. Approximately 15 per cent of typhoons strike areas south of Samar. The least frequently visited is Southern Mindanao. Northern Luzon is visited by approximately 35 per cent of typhoons, Central Luzon by 20 per cent while Southern Luzon and the Central and Northern Islands by approximately 30 per cent.

Rainfall is considered an important climatic element in the Philippines. The geographic distribution of rainfall throughout the Philippines varies due to complex interaction of various factors such as mountain ranges, distance of inland from the coast and upon the direction of the moisture-bearing winds that affects the country at different times. On the average, the Philippines receive an annual rainfall of about 1,000 to 4,000 millimeters.

The Philippines mean annual temperature is 26.6 oC based on the average of all weather stations, excluding Baguio City. January is the coolest month with mean temperature of 25.5oC whereas May is the warmest month with mean temperature of 28.30C.

Another factor that highly influences the weather pattern and climate of the Philippines is the naturally occurring phenomenon called El Niño and La Niña, together known as the El Niño Southern Oscillation (ENSO). The ENSO occurs at irregular intervals between 2 to 9 years and may last for 6 months to more than a year. From 1995 to 2005, three La Niña episodes occurred which brought excessive rainfall due to strong monsoon activity during this cold ENSO. This resulted to massive floods and landslides in the rural areas. Devastating wind and storm surges due to notable increases of strong tropical cyclones negatively impacted communities in the coastal areas.

Climate change projection of temperature indicated that, both minimum and maximum temperature will exhibit increasing trends both in 2020 and 2050 using the A1B scenario. The model results indicate that significant warming will occur in the middle of the next century in the Philippines, with the largest warming occurring in June-July-August (JJA) and March-April-May (MAM) over Mindanao. Under the A1B scenario the projected mean annual temperatures in the Philippines are expected to rise by about 0.9ºC to 1.1ºC for 2020 and 1.9 ºC to 2.2ºC by 2050. Likewise estimated changes in temperature are likely in all parts of the country by 2020 and 2050.

The Philippine islands are volcanic in origin, being part of the Pacific Ring of Fire, and are mostly mountainous. The highest point in the country is the peak of Mount Apo in Mindanao, which is 2,954 meters (9,692 ft) above sea level.

The country is endowed with abundant water resources. Annually, it receives an average rainfall that varies among the different regions from 1,000 to 4,000 mm,feeding numerous river systems, lakes and other bodies of water of the country. Out of the 421 principal river basins, 18 are considered major having a drainage area of at least 1,400 sq. km. Most of them are found in Luzon and Mindanao Regions.

The PAGASA is the duly mandated agency to provide weather, climate, agro- meteorological, and hydrological services in

the Philippines for public safety and in support of economic development. It also disseminates official time service as well as provides basic astronomical services in the country. Its updated strategic plan addresses its capacity development needs in line with the WMO Regional Association V (RA V) Strategic Plan 2012-2015 which involves production of accurate, timely and reliable forecasts and warnings; improvement of delivery of weather, climate, water and related information and services; provision of scientific and technical support to decision makers such as climate change projection, and others.

The Global Climate Risk Index (CRI) by environmental group German watch ranked the Philippines as the number one country most impacted by climate change in 2013 and number 4 in 2014. Based on long-term (1995-2014) Climate Risk Index, the Philippines ranked 4th among the countries most affected by climate change, next only to Honduras, Myanmar and Haiti. The ranking is based on four indicators: number of deaths, number of deaths per 1000 inhabitants, total losses in purchasing power parity (PPP) and losses per unit of Gross Domestic Product.

In terms of vulnerability, the 2016 Climate Change Vulnerability Index (CCVI) released by Verisk Maplecroft, a risk analysis company, ranked the Philippines 13th most climate-vulnerable countries in the world. The ranking was based on the evaluation conducted on 186 countries according to three criteria: exposure (50%), sensitivity (25%) and adaptive capacity (25%).

There are six ways by which Philippine cities can experience the effects of climate change: 1) more intense El Niño or the abnormal warming of the ocean waters in the Southern Pacific which can cause weather imbalance that can lead to abnormally dry conditions and unpredictable storm occurrences; 2) sea surface temperature rise which can cause more powerful storms and destruction of coral reefs; 3) ocean acidification that can cause widespread death of coral reefs; 4) 4-6 meters sea level rise which can submerge low-lying communities; 5) intensified tropical cyclone which can destroy communities, and 6) intensified rainfall, river flow and flooding which can further trigger landslides in the upland area.

Location is a major factor in flooding. Low lying areas, and areas along riverbanks and coastal zones are usually affected by flooding brought about by heavy torrential downpour, tsunami and storm surges. In Metro Manila, flooding is caused by a number of factors: lost, cemented or paved over canals and waterways, clogged and ill-maintained waterways, squatter colonies occupying riverbanks and coastal areas, poor urban planning, population explosion, outdated, incomplete and poorly designed flood control system, heavy siltation of Laguna Bay, deforestation of Sierra

Madre Mountain causing rain waters to rush down the denuded slopes into the Pasig River which typically overflows into Metro Manila.

Historically, the country is affected, on the average, by about 19 to 20 tropical cyclones per year, nine (9) of which has made landfall and caused considerable damages to lives and properties. About an average of 2 to 3 TCs occur from June to November per month.

Of all the regions in the country Northern Luzon is significantly more at risk than the other regions. As shown in Figure 9 it is most frequently hit by tropical cyclones followed by Catanduanes and Northern Samar and least in the Mindanao area.

Out of the top 5 deadliest and most destructive typhoons/storms that hit the Philippines from 2005 to 2015. Typhoon Yolanda (Haiyan) ranked no. 1 in both categories. According to NDRRMC, it is the worst typhoon to ever hit the Philippines to date. It has made 6 landfalls and caused a catastrophic destruction in the Visayas particularly in Samar and Leyte. Typhoon Yolanda (Haiyan) brought devastating storm surges and floods that killed 6,300 persons (around 93% came from Region VIII), outranking Tropical Storm Uring (Thelma) in 1991 as the deadliest Tropical Cyclones in the modern era. TS Uring caused the Ormoc City tragedy that killed 5,101 persons due flash floods (NDRRMC Final Report on the Effects of Typhoon Yolanda. 2013).

Typhoon Yolanda (Haiyan) also caused around 2,098 million USD from damages to agriculture, infrastructure and private properties, followed by Typhoon Pablo (Bopha) and TY Glenda with 948.6 million USD and 848.7 million USD respectively.

From 2005 to 2015 records of NDRRMC, tropical cyclones claimed a total of 13,050 lives or an average of 1,186 lives per year. About 94 million people were affected involving 19.5 million families. Total damages to agricultural production, public infrastructure and private properties were valued at 7.9 billion USD (or an average of 719 million USD per year).

The Philippines' location makes it vulnerable to tsunamis. Being an archipelago along the Pacific Ocean's Ring of Fire, it is surrounded by both bodies of water and trenches. Metro Manila, the country's capital is also vulnerable to tsunamis because it faces the Manila Bay.

Landslides that occur in the Philippines usually brought about by strong typhoon resulting in heavy rainfall triggering landslides. Furthermore, based on the EM-DAT, there were at least seven major landslides that occurred in the country in the last decade. At least 1,254 lives(average of 114 per year) were claimed and 20,645 people were affected. Total damages landslides were estimated to be at least US$ 2,281 million from 2005 to 2015.

The Philippines also experience drought and dry spell. Historical Records from the Philippine Atmospheric, Geophysical and astronomical Services Administration (PAGASA), showed that major drought events in the country are associated with the occurrences of El Niño events. According to Tejada, et al (2014, p. 2), El Niño events are now occurring at two to three year cycle from previous five- year interval. From 1960-2010, the Philippines experienced 15 weak to strong El Niño episodes which caused the adverse socio-economic impacts in the country. (Tejada, et al, 2014, p. 2).

Drought also affected various sectors in different ways, agricultural sector particularly the farming industry is one of the most vulnerable sector in the Philippines. Rice, corn and vegetables that are usually being raised by small-holder farmers and fisher folks are the most affected crops due to crop failures and reduced irrigated areas. El Nino-induced drought from 1994 to 2015 resulted to agricultural damages totaling 687 million USD.

The history of disaster risk reduction and management in the Philippines traces its beginnings from its pre –Commonwealth days up to the present and has overtime has evolved a scheme to address the effects of disasters, both natural and human-induced. In 1978 through Presidential Decree (PD) 1566, the National Disaster and Coordinating Council (NDCC) was established as the highest policy – making body and the focal organization for disaster management of the country. The law also provided for the establishment of regional, provincial, city, municipal and barangays disaster coordinating councils. Today, the legal framework for disaster risk reduction management takes cognizant of the Hyogo Framework for Action (HFA) which is the key instrument for implementing disaster risk reduction, adopted by the Member States of the United Nations. It also recognizes the ASEAN Agreement on Disaster Management and Emergency Response or AADMER which took to force on 24 December 2009 and is a proactive regional framework for cooperation, coordination, technical assistance, and resource mobilization in all aspects of disaster management.

Very recently, the Philippines enacted RA 10120 which aims to "adopt a disaster risk reduction and management approach that is holistic, comprehensive, integrated and proactive in lessening the climate change, and promote the involvement, and the participation of all sectors and all stakeholders concerned ,at all levels, especially the community. The law directs various government agencies to develop, promote and implement a comprehensive National Disaster Risk Reduction and Management Plan (NDRRMP) that aims to strengthen the capacity of the national government and the local government units (LGUs), together with partner stakeholders, to build the disasters resilience of communities and to institutionalize arrangements and measures for reducing disaster risks, including projected climate risks and enhancing disaster preparedness and response capabilities at all levels. The recent passage of the DRRM Act of 2010 or Republic Act (RA) No. 10121 and its implementing rules and regulations supported by the Climate Change Act of 2009 (RA 9729) have significantly strengthened the institutional foundation for DRM and CCA. The DRRM Act emphasizes the need for a coherent, comprehensive, integrated, and proactive approach to DRRM across levels and sectors of government, and among vulnerable communities. It shifts the focus from a purely reactive approach to include risk management and preparedness and establishes links to CCA.

Under the DRRM Act, the former National Disaster Coordinating Council is now called the National Disaster Risk Reduction and Management Council (NDRRMC). NDRRMC is the government focal point for DRM that provides leadership, determines broad DRM policies, oversees DRR implementation, and provides DRR-CCA linkages (with the Climate Change Commission) and advocate for DRR concerns on broader development issues. At the national level, it is headed by the Secretary of the Department of National Defense (DND) as Chairperson with four Vice Chairpersons as follows: the Secretary of Department of Interior and Local Government (DILG) for Disaster Preparedness; the Secretary of the Department of Social Welfare and Services (DSWD) for

Disaster Response; the Secretary of the Department of Science and Technology (DOST) for Disaster Prevention and Mitigation; and the Director General of the National Economic and Development Authority (NEDA) for Disaster Rehabilitation and Recovery. It must be noted that aside from government agencies, the Council's membership has been expanded to include now financial institutions, local governments leagues , the private sector and civil society organization (CSOs) which reflects the 'whole society' approach on disaster risk reduction. In terms of function, the NDRRMC as provided by the law is being empowered with policy making, coordination, integration, supervision, monitoring and evaluation functions.

The Asian Water Development Outlook (AWDO) jointly prepared by the Asian Development Bank (ADB) and the Asia-Pacific Water Forum (APWF) highlight important water management issues in the Asia-Pacific region. Under AWDO, the concept of Water Security is being implemented by identifying 5 key dimensions of water security and developing an approach that quantifies these key dimensions by means of indicators was developed. There are five key dimensions (KDs) of water security are as follows: Household Water Security; Economic Water Security; Urban Water Security; Environmental Water Security and Resilience to Water-Related Disaster.

Overall, the Philippines improved its water security from being "hazardous" (NWS Score = 35) in AWDO 2013 to being "engaged" (NWS Score = 40.4) in the recent AWDO 2016. The increase can be attributed in the improvement in household, economic, environmental and resilience dimensions.

Adoption of IWRM in the Philippines started the formulation of the Medium Term Philippine Development Plan of 2004 to 2010 where IWRM approach was adopted as a general strategy for the water resources sector. The preparation of the National IWRM Framework Plan spearheaded by the National Water Resources Board (NWRB) commenced in 2005 and was finally completed in 2007. Its development was closely guided by the IWRM principles and processes as advocated by GWP. The National IWRM Plan Framework is a directional plan that serves as roadmap and collaborative platform for all stakeholders and water-related agencies to effectively work together to achieve Water for All in a sustainable, equitable and ecologically-balanced manner. Under the National IWRM Plan Framework, a comprehensive plan of action for IWRM was developed consisting of four (4) sustainable outcomes with strategic themes and well defined activities. A number of projects are being implemented by concerned agencies within the framework of IWRM. At the national level, working hand in hand with water related agencies is the Philippine Water Partnership (PWP) who promotes IWRM both as process and a win-win approach in managing land and water resources.

Cognizant of the lessons learned from the Millennium Development Goals (MDGs) experience, the Philippine Government commits itself to the bigger challenges of the Sustainable Development Goals (SDGs) which integrate the social, economic and environmental agenda. Since the initial year of the SDG implementation coincides with a new administration in the country, the more effective and persuasive tool for SDG advocacy is the ongoing process itself of integrating SDGs simultaneously into the long-term vision and goals(Ambisyon Natin 2040) and the national, sectoral and sub-national plans and frameworks. A chapter on the SDGs has been added to the updated Philippine Statistical Development Program 2011-2017 to ensure government support in the generation of data.

RA No. 10121 of 2010 provided for the preparation and implementation of the National Disaster Risk Reduction and Management Plan (NDRRMP). The NDRRMP covers four thematic areas, namely, (1) Disaster Prevention and Mitigation; (2) Disaster Preparedness; (3) Disaster Response; and (4) Disaster Rehabilitation and Recovery, which correspond to the structure of the National Disaster Risk Reduction and Management Council (NDRRMC). By law, the Office of Civil Defense formulates and implements the NDRRMP and ensures that the physical framework, social, economic and environmental plans of communities, cities, municipalities and provinces are consistent with such plan.

The National Economic and Development Authority (NEDA) is the 'primarily agency responsible for formulating continuing, coordinated and fully integrated social and economic policies, plans and programs, which takes into account the: coordination of major socio-economic policies, plans, programs and projects of different government agencies at the national and regional levels prior to their adoption. NEDA's coordination responsibility includes the formulation of the public investment

program (PIP), programming of official development assistance (ODA) in the form of grants, and monitoring and evaluation of plan implementation. The ODA Act of 1996, further defined NEDA's mandate to include the conduct of annual review of the status of all projects financed by ODA, and report findings to the Investment Coordinating Committee (ICC) and Congress. All implementing and oversight agencies shall submit to NEDA reports as may be required by it to assess the performance of ODA-assisted projects. There are two types of ODA. Loans have interest rates from 0% to 7% with maturity period ranging from 10-50 years and 5-10 years grace period. As for grants, there is no repayment obligation and is provided usually in the form of experts, equipment and training.

There are 40 water resources-related projects financed from ODA sources (loans and grants) from 2005 to 2015 which are currently in the NEDA Monitoring and Evaluation Staff (MES) Database. Said projects are grouped into three categories: Disaster / Typhoon Response; Flood Control; and Water Supply and sanitation.

Given the current legal framework and institutional set up, there remains a number of future agenda to improve mitigation and adaptation to disaster in general, and water-related disaster in particular.
With the projected increase in temperature and changing precipitation pattern and the impacts of climate change to the overall hydrology, the Philippines intends continue to pursue and improved current efforts in ensuing effective disaster risk reduction management initiative such as: regular review of disaster governance to make it more responsive and updated; preparation of disaster plans at all level of governance and implement the same; localization of the impacts of climate change by way of downscaling the projections to local levels together with developing and maintaining a database to help local policy makers and planners ; disaster information management to capture and manage data and information for disaster risk management; and flood mitigation and management including the promotion and adoption of energy efficient water infrastructure.

To strengthen regional capacity on managing water related disaster and to promote cooperative efforts among the ASEAN member countries to better understand water related hazards and risks, the following are being proposed:

- Establish a Regional (ASEAN) Community of Practice (CoP) dedicated to water-related disaster- to facilitate regular exchange of knowledge and experiences among member countries
- Develop and implement a programmatic capacity building program for ASEAN countries to build country level institutional and individual expertise
- Develop a regional database to serve as repository of water related disaster programs/projects/activities being implemented in ASEAN countries for better knowledge management

Executive Summary Report

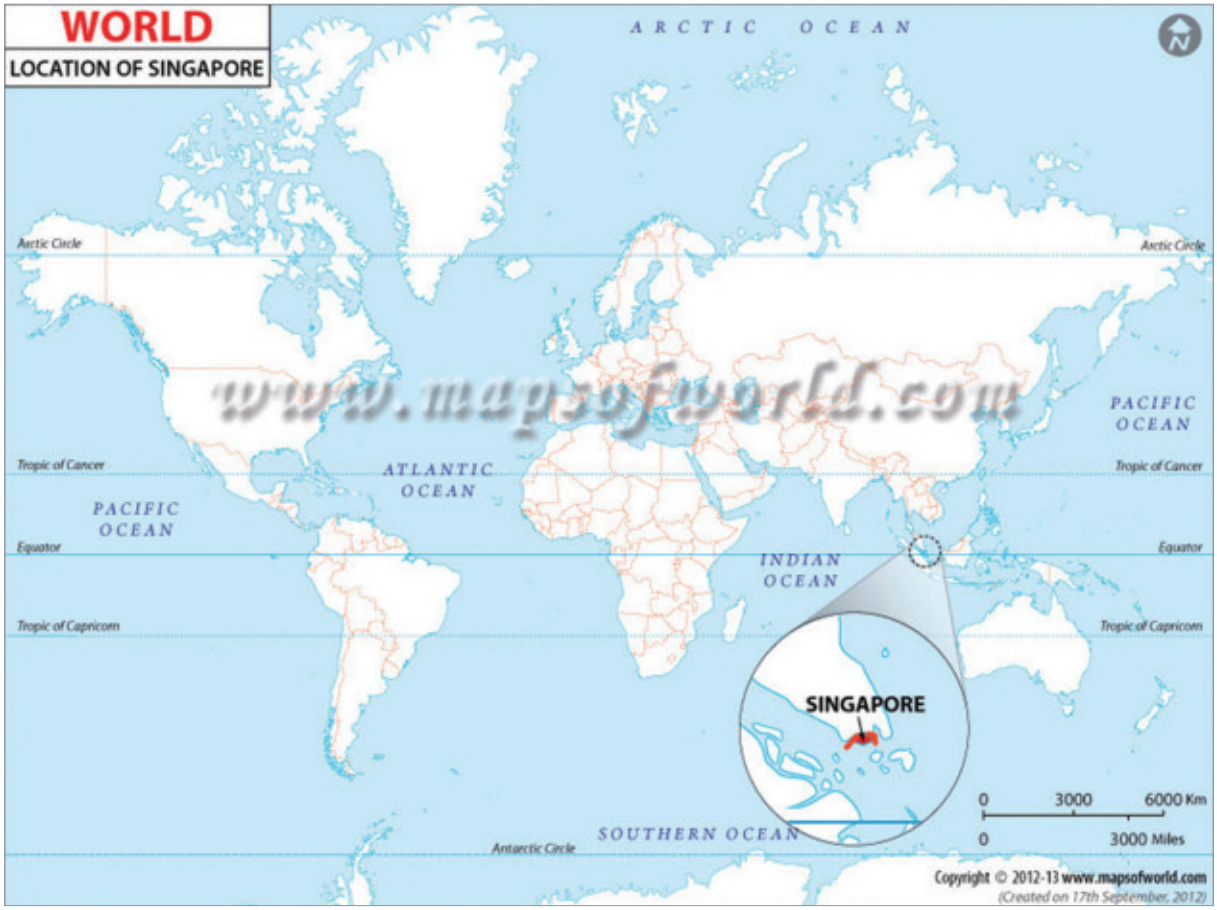
SINGAPORE

SINGAPORE

By Public Utilities Board

1. Background

Singapore is located on the southern tip of the Malay Peninsula in Southeast Asia, between the Indian Ocean and the South China Sea. The country of Singapore is in the Asia continent.



(Fig.33) Location of Singapore

(Table 23) Facts about Singapore

Facts about Singapore	
Continent	Asia
Country	Singapore
City	Singapore
Location	1° 18′ 0″ N, 103° 48′ 0″ E (1.3, 103.8)
Size	719.2 sq km
Population Size	5,607,300 (mid 2016)
GDP	SGD 402,159.8 mil (2016)
GDP per capita	SGD 73,167 (2016)
Impact of water-related disasters on the economy	Nil

(source: http://www.singstat.gov.sg/statistics/latest-data)

2. Climatic and Physical Characteristic of the Country

Singapore is situated near the equator and has a typically tropical climate, with abundant rainfall, high and uniform temperatures, and high humidity all year round. Many of its climate variables, such as temperature and relative humidity, do not show large month-to-month variation. However, many variables exhibit prominent diurnal (or daily) variations from hour to hour, indicating the strong influence that solar heating has on the local climate.

Seasons

Singapore's climate is characterised by two monsoon seasons separated by inter-monsoonal periods (see table below). The Northeast Monsoon occurs from December to early March, and the Southwest Monsoon from June to September. The major weather systems affecting Singapore that can lead to heavy rainfall are:

Monsoon surges, or strong wind episodes in the Northeast Monsoon flow bringing about major rainfall events;

Sumatra squalls, an organised line of thunderstorms travelling eastward across Singapore, having developed over the island of Sumatra or Straits of Malacca west of us;

Afternoon and evening thunderstorms caused by strong surface heating and by the sea breeze circulation that develops in the afternoon.

The occurrence of these events at different times of year is outlined in the following table.

(Table 24) Weather Features of Singapore all the year

Period	Prevailing Winds	Weather Features
Northeast Monsoon Season(December-early March)	Northerly to northeasterly winds	Early Northeast Monsoon (Wet Phase) • Monsoon Surges cause widespread continuous moderate to heavy rain, at times with 25-35 km/h winds in the first half of the season, usually from December to early January. • Rapid development of afternoon and early evening showers Late Northeast Monsoon (Dry Phase) • Windy and relatively dry in the later part of the season, usually from late January to early March.
Inter-monsoon Period (Late March-May)	Light and variable, interacting with land and sea breezes	• Thunderstorms, at times severe, occur in the afternoon and early evening. • Hot afternoons are common (maximum temperature above 32°C).
Southwest Monsoon Season(June-September)	Southeasterly to southerly	• Occasional "Sumatra Squalls" with wind gusts of 40-80 km/h occuring between the predawn hours and midday. • Short duration showers/thunderstorms in the afternoon are common.
Inter-monsoon Period (October-November)	Light and variable, interacting with land and sea breezes	• Thunderstorms, at times severe, occur in the afternoon and early evening. • Generally wetter than the Inter-monsoon Period earlier in the year.

El Niño-Southern Oscillation (ENSO) is a primary cause for climate anomalies (departures from normal conditions) in many parts of the world. During El Niño episodes, the weakening and even reversal of the normal pattern of rising moist air over tropical Asia and sinking air over the eastern Pacific alters the normal wind circulation in the tropical regions. The shift in tropical convection results in prolonged drier and warmer than normal conditions in many parts of Southeast Asia including Singapore. The effect is reversed during La Niña episodes, which typically bring wetter than normal conditions to the region.

(source: http://www.weather.gov.sg/climate-climate-of-singapore/)

Singapore is not insulated from the impact of climate change. From 1972 to 2014, the annual mean temperature has increased from 26.6°C to 27.7°C. The higher trend over Singapore may have been due to the urbanisation, and could also be influenced by regional variations in the man-made global warming effect.

The mean sea level in the Straits of Singapore has also increased at the rate of 1.2mm to 1.7mm per year in the period 1975 to 2009. Rainfall has become more intense in recent years. According to Singapore's Second National Climate Change Study, there has been a general uptrend in annual average rainfall from 2192mm in 1980 to 2727mm in 2014. However it is not scientifically possible, using the research information that is currently available, to definitively attribute these observed rainfall changes in Singapore to global warming, natural climate variability or other effects (such as urbanisation).

Past climate trends over Singapore have shown an increase in surface air temperatures and the frequency of heavy rainfall over

the past few decades. However, the climate system is complex and the past trends and the magnitude of the change will not necessarily continue into the future. Climate projections using tools like climate modelling is thus necessary to project the future climate for planning and adapting to climate change.

(source: https://www.nccs.gov.sg/climate-change-and-singapore/national-circumstances/impact-climate-change-singapore, http://www.weather.gov.sg/climate-past-climate-trends/)

The island mostly lies within 15 meters above sea level. The center of the island is comprises of rounded hill, gentle spurs and valleys which are made up of igneous rocks and granite that ascends the peaks of Bukit Batong with 106 meters, Bukit Panjang with 132 meters, Bukit Gombak with 139 meters and the highest point of Singapore Bukit Timah at 166 meters. The valley of sedimentary rocks dominates the northwest part of the island, while on the west and southwest region the sedimentary rocks mount a series of narrow ridges that includes Mount Faber, Pasir Laba, and Pasir Panjang. To the eastern region of the island are sandy and flat lands where the streams have cut steep gullies.

Singapore does not have any significant, accessible natural aquifers, which are layers of underground rock that are able to hold water. Instead, we rely on reservoirs for collecting and storing rainwater.

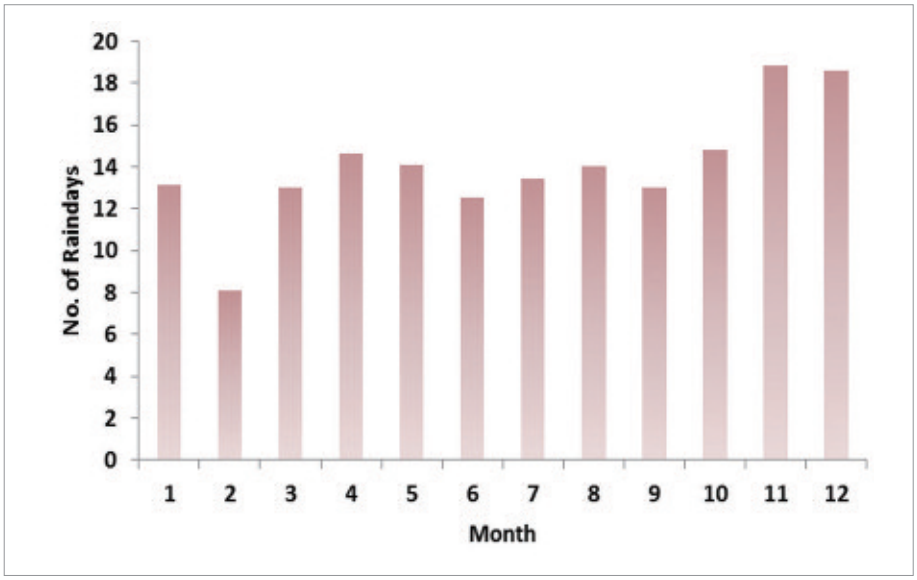
To make the best use of the rainfall we receive, the water catchment area in Singapore has been progressively expanded over the years. An extensive network of drains, canals, rivers and storm water ponds collects and channels rainwater to our reservoirs for storage

3. Hydrology and Meteorology

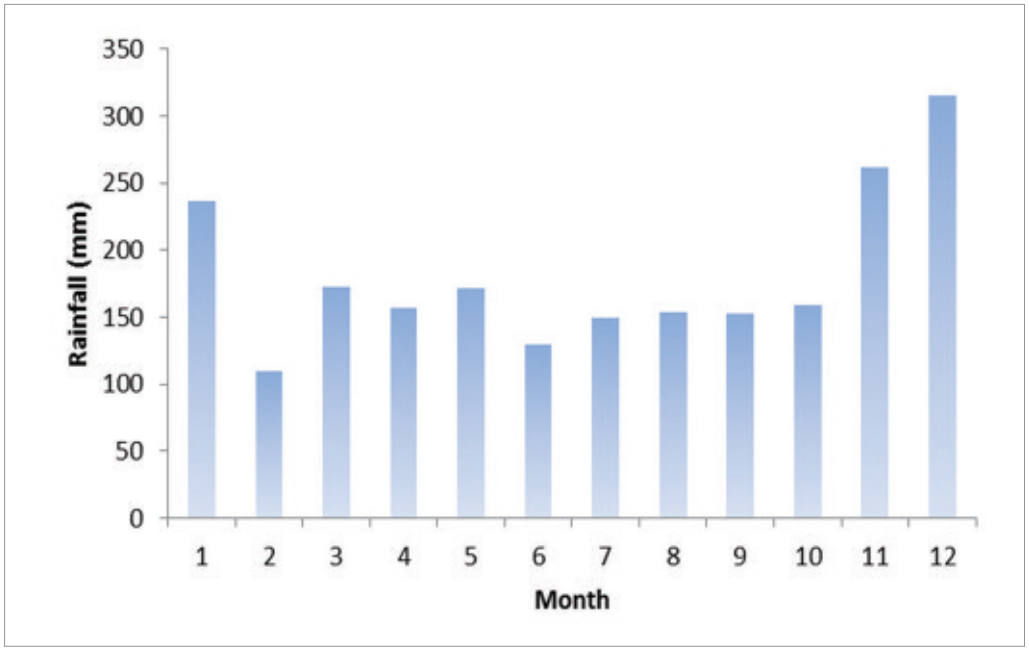
Rainfall

Rainfall is plentiful in Singapore and it rains an average of 178 days1 of the year. Much of the rain is heavy and accompanied by thunder. The long-term mean annual rainfall total is 2331.2mm (based on long-term records from 1869 to 2015).

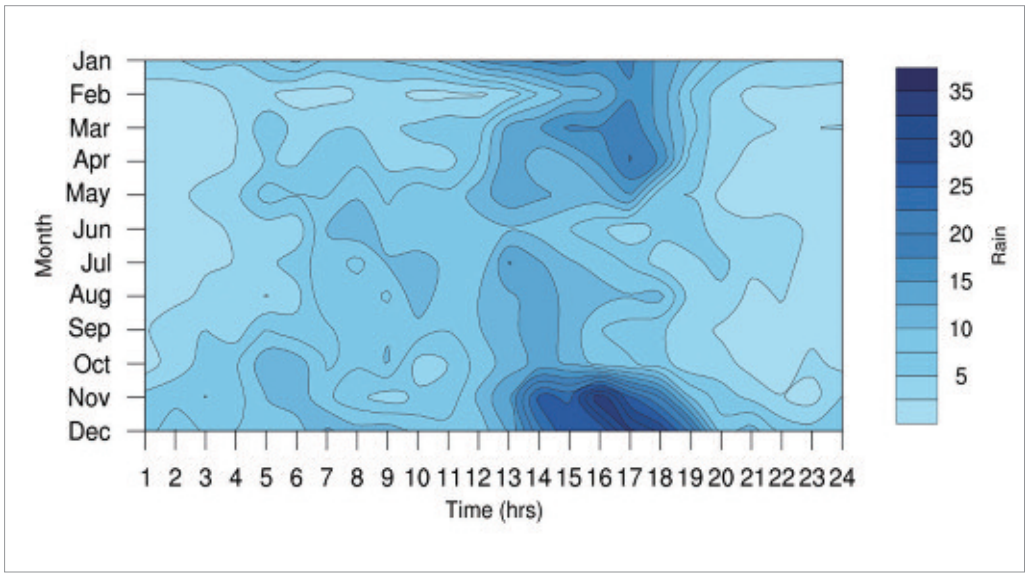
[1 A day is considered to have "rained" if the total rainfall for that day is 0.2mm or more.]



(Fig.34) Average number of rain days per month (1982-2015).
Source : Data from Changi Climate Station



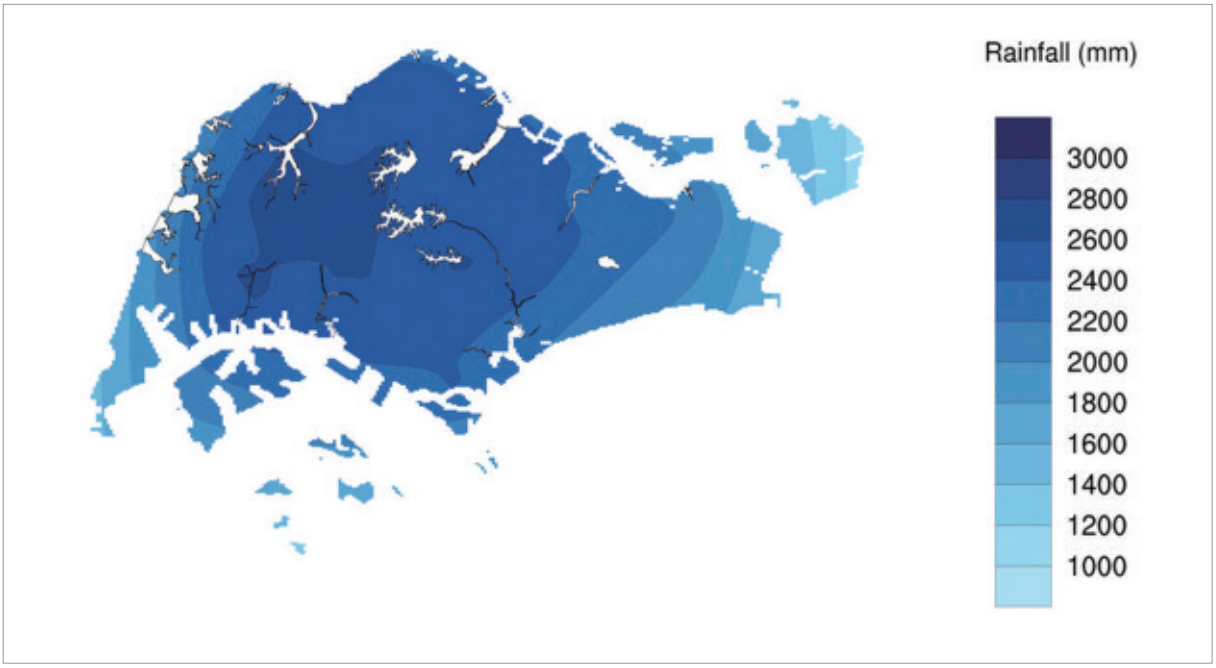
(Fig.35) Monthly rainfall for Singapore (mm) (1982-2015)
Source : Data from Changi Climate Station



(Fig. 36) Hourly variation of rainfall for each month (1982-2015).
Source : Data from Changi Climate Station

While there is no distinct wet or dry season in Singapore, monthly variations in rainfall do exists. Higher rainfall occurs from November to January during the wet phase of Northeast Monsoon season (Figs. 34 – 36), when the major tropical rainbelt (the Intertropical Convergence Zone ITCZ) is positioned near to us. The driest month is February which is during the dry phase of the Northeast Monsoon when the rain-belt has moved further south to affect Java.

Rainfall in Singapore shows a marked diurnal variation (Fig. 36), with rainfall occurring more frequently during the daytime, particularly in the afternoons when solar heating is strongest. In terms of spatial distribution, rainfall is higher over the northern and western parts of Singapore and decreases towards the eastern part of the island (Fig. 37).

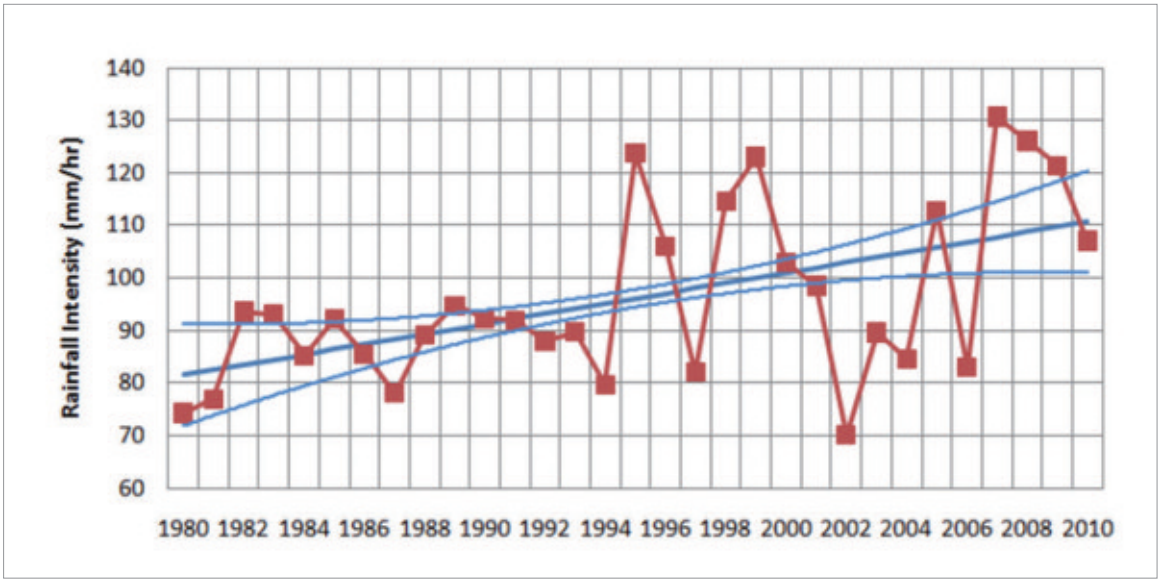


(Fig.37) Annual average rainfall distribution (1982-2015)
source : http://www.weather.gov.sg/climate-climate-of-singapore/

MSS has a network of meteorological observing stations, both manned and automated; these provide real-time observations across Singapore. There are five manned observation stations located at Changi, Seletar, Sembawang, Tengah, and Paya Lebar, as well as an Upper Air Observatory located at Upper Paya Lebar. There are over 60 automatic weather stations island-wide, with about 20 of these stations equipped with the full complement of rainfall, temperature, humidity, surface wind and air pressure sensors.
(source : http://www.weather.gov.sg/learn_observations/)

There is strong evidence of a trend towards higher rainfall intensities, and increasing frequency of high intensity rain events.

Figure 38 shows strong year-to-year variability in the maximum rainfall intensity, which are typical at most tropical locations. It shows that the amplitude of that variability increased considerably over the last 30 years. Before 1995, all but one of the annual maximum intensities was under 110 mm/60 min, varying in a range from 80 to 115 mm/60 min. After 1995, over two thirds of all annual maximum intensities were over 110 mm/hr, varying in a range from 96 to 147 mm/60 min.



(Fig.38) Annual maximum 60-min rainfall total of 28 Stations (1980 – 2010). The blue lines denote the trend and the 95% confidence interval.

The 60-min monthly maximum rainfall total refers to the highest rainfall amount over a continuous period of 60 minutes during any time of the month.

(source : https://www.pub.gov.sg/Documents/fullReport.pdf)

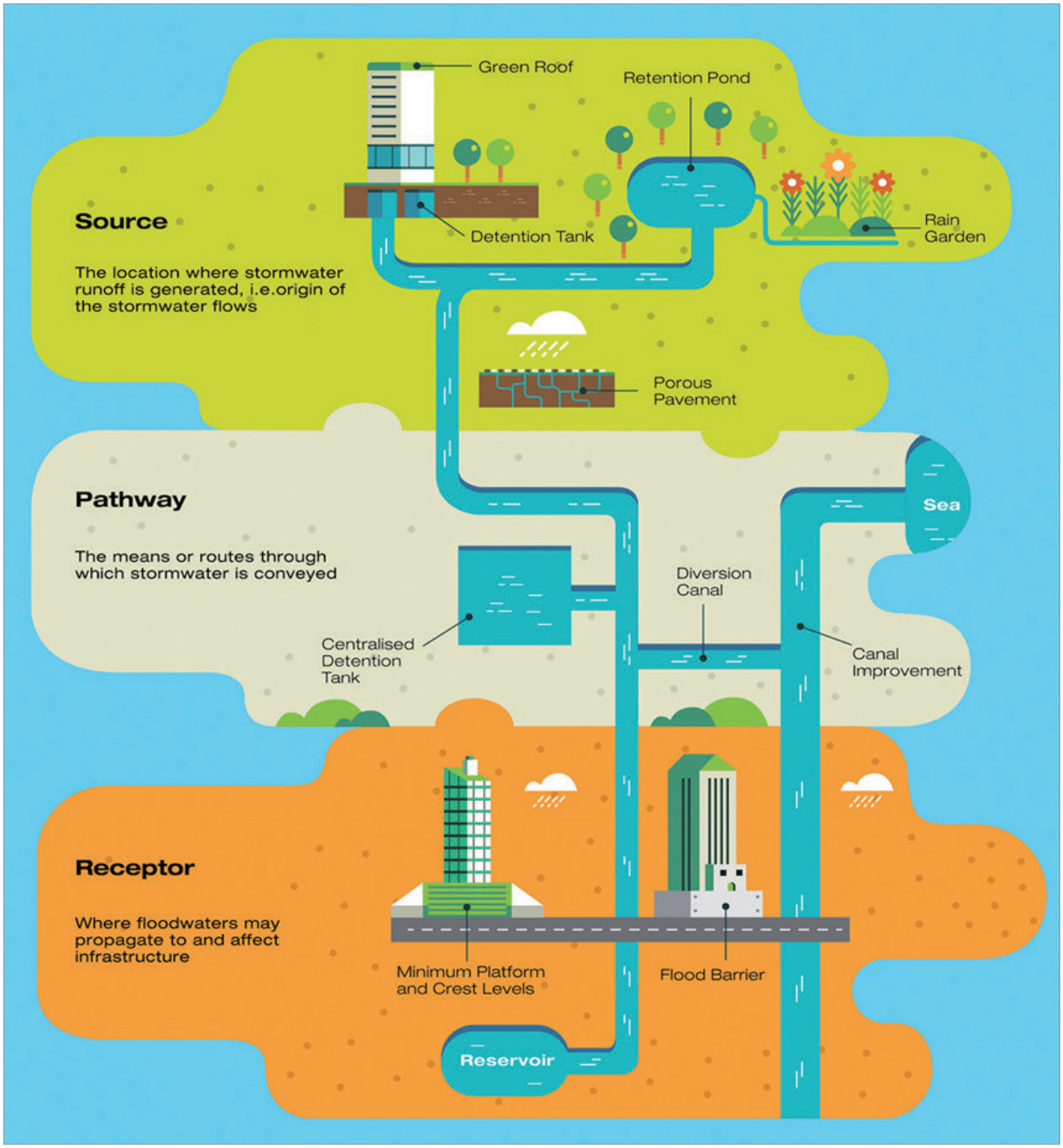
4. Water-Related Hazards and Disasters

Singapore has an extensive drainage system comprising 7,000km of drains and canals that channel rainwater to our reservoirs or the sea. Most times, our drains are able to cope with the rain that we receive. However, intense bouts of rainfall can sometimes exceed the capacity that the drains are designed for, resulting in flash floods. These floods are localised and generally subside in under an hour.

(source: http://www.mewr.gov.sg/topic/flash-floods)

PUB has adopted a holistic approach that will add flexibility and adaptability to Singapore's drainage system to cope with higher intensity storms. Through the "Source-Pathway-Receptor" approach, measures are not only carried out along the Pathway (e.g., through widening and deepening of drains and canals), but also implemented at the Source where stormwater runoff is generated (e.g. through on-site detention) and at the Receptor where floods may occur (e.g. through platform levels, crest protection and flood barriers).

Since January 2014, developers of new and redeveloped sites are required to implement "source solutions" to slow down surface runoff and reduce the peak flow of stormwater into the public drainage system. These on-site measures could include detention tanks and/or green features.



(Fig.39) Singapore's Drainage System

In 2011, PUB also raised the minimum land reclamation, platform and crest levels for new developments and redevelopment sites under its revised Code of Practice on Surface Water Drainage. These "receptor" measures provide additional flood protection for buildings and key infrastructure.

PUB has been assisting and offering consultative advice to building owners.

To better protect against floods, buildings can add structural measures such as humps and flood barriers to protect their basement levels from floodwaters. They can also link the water-level sensors in the basement carparks to their alarm systems in order to warn their users of flooding.

Tanglin Mall

(Fig.40) Flood barrier not activated

(Fig.41) Flood barrier raised

(source: https://www.pub.gov.sg/Documents/Flash%20Floods%20FAQ.pdf, https://www.nccs.gov.sg/climate-change-and-singapore/domestic-actions/adapting-climate-change/drainage-and-flood-protection, https://www.pub.gov.sg/drainage/floodmanagement/floodprotectionmeasures)

Over the last 30 years, Singapore has invested some $2 billion in building and upgrading Singapore's drainage infrastructure. This has reduced flood prone areas by almost a hundred-fold, from 3,200 ha in the 1970s to 36 ha in 2013. Today, our drainage system is guided by PUB's source– pathway–receptor approach which addresses flood protection not just along the drains and canals ("pathways") but also in areas generating stormwater runoff ("source") and where floods may occur ("receptors"). (Sustainable Singapore Blueprint 2015, 2015)

During heavy rain events, the public can be updated on rising water levels in drains or canals and flash floods via:

- PUB's Facebook
- PUB's Twitter
- PUB's free mobile app MyWaters

The public can also subscribe to a free SMS alert service to keep tabs on the water level in a canal or drain at a designated location via PUB's website.

For the latest weather reports and news on floods, the public can also tune in to radio traffic watch broadcasts.

In addition, the public can access selected CCTV images of road conditions in low-lying areas and hotspots via PUB's website or MyWaters mobile app.

Water level sensors provide data on water levels in the drains and canals. This data sent to PUB staff enhances PUB's monitoring of real-time site conditions during heavy storms and response time.

The public can also subscribe to SMS alerts of data from a location of their choice.

Public can obtain the latest weather information via NEA weather forecast hotline at 65427788, www.weather.gov.sg, radio broadcasts and NEA's myENV free mobile app. The public can also subscribe to heavy rain warning SMS alert service provided by the Meteorological Service Singapore (MSS).

(source : https://www.pub.gov.sg/Documents/Flash%20Floods%20FAQ.pdf)

5. Legal and Institutional Setup in the Country

The Code of Practice on Surface Water Drainage contains information on basic planning, design and procedural requirements for surface water drainage. It specifies the minimum engineering requirements for the provision of functional facilities for surface water drainage.

PUB takes every flood incident seriously and assesses the cause of any flood.

Where necessary, PUB works with other agencies to improve the drainage system or raise road levels to reduce the risk of floods recurring. PUB also engages building owners on appropriate flood protection measures to protect their developments from floods.

PUB has also raised the minimum platform and crest level requirements for new developments, and Land Transport Authority (LTA) is installing flood barriers at selected MRT stations to protect our critical transport infrastructure.

PUB will work with Building & Construction Authority (BCA) to study and raise the level of protection at our coastal installations, including reservoir structures, treatment plants and pumping stations, to prevent disruption to our water and used water services.

Along with the Meteorological Service Singapore's heavy rain warning service, public can obtain timely information to help them plan their activities. This helps improve overall public resilience towards floods.

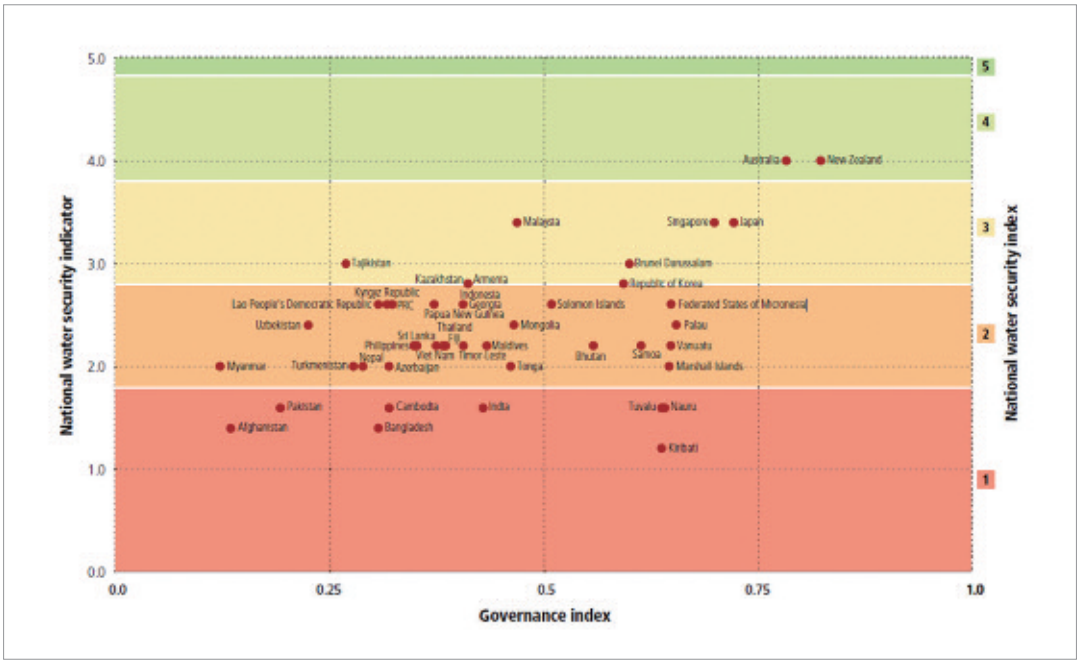
In times of flash flood, PUB works closely with other agencies/ media to manage site conditions and update the public.

PUB must continue to engage stakeholders (public agencies, developers, public) at various platforms on flood risk management. (Sustainable Singapore Blueprint 2015, 2015)

(Source : http://aseaniwrm.water.gov.my/wp-content/uploads/2015/08/Singapore-2010-Report-Flood-Management.pdf)

6. Water Security

Index	Stage
5	Model
4	Effective
3	Capable
2	Engaged
1	Hazardous



(Fig.42) Description of National Water Security Stages
Source : https://www.adb.org/sites/default/files/publication/30190/asian-water-development-outlook-2013.pdf

Singapore's water policies have evolved over the years as the focus shifted from survival to sustainability. Our holistic approach to water management, however, can be distilled into three key strategies:

(1) Collect every drop of water

As a city-state with scare land, we have to make every drop of rain count. We plan to increase Singapore's water catchment from two-thirds to 90% in the long run. Our separate rainwater and used water infrastructure, good land use planning policies and string environmental controls also protect the collected rainwater from pollution.

(2) Reuse water endlessly

Water can always be reclaimed and retreated so it can be used again. PUB is a world leader in this. Recycling water is the most sustainable and cost-effective way to increase our water supply, and it also does so exponentially.

To increase the recycling rate, we will:

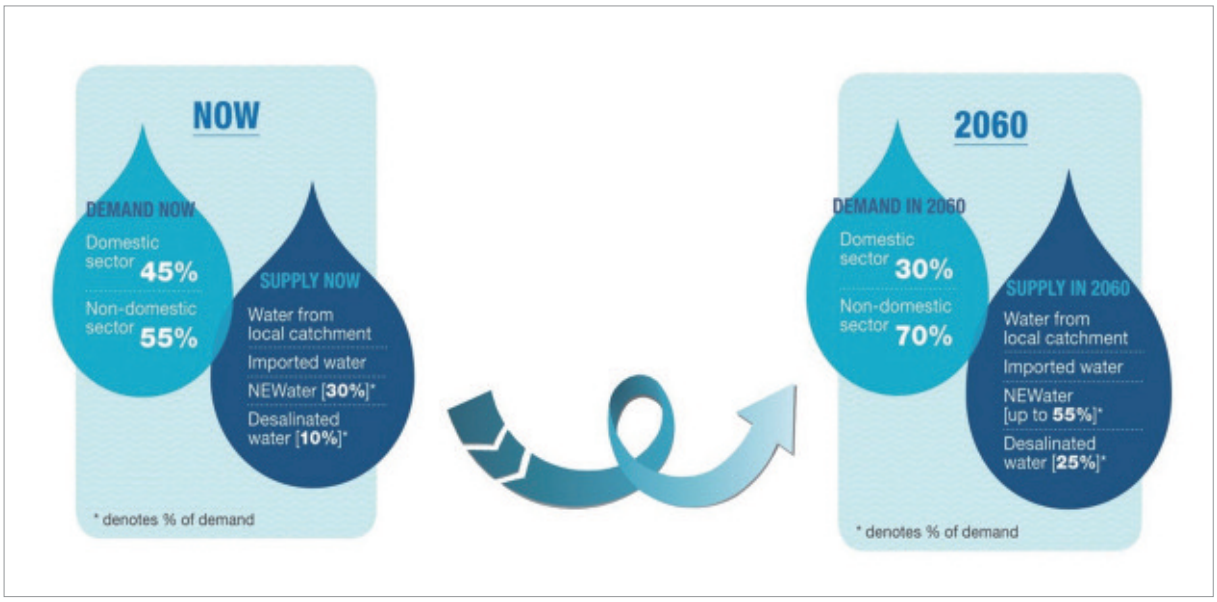
- Further close the water loop by reclaiming used water from industrial sources for non-potable use. Such water is now treated and discharged to the sea.
- Increase water recovery from water reclamation and NEWater treatment. The NEWater process currently turns 75% of feed water into NEWater;
- Reduce losses from PUB's supply by encouraging seafront companies on Jurong Island to use seawater for cooling processes, instead of freshwater.

3. Desalinate more seawater

As an island surrounded by the sea, desalination is a natural option for Singapore, especially when membrane technology has made it economically viable. We will continue investing in research and technology to find better and less expensive ways of desalting seawater.

By 2060, Singapore's water use is expected to more than double from about 430 million gallons a day (mgd) now. We will increase our water recycling and desalination capacity to meet the rising demand. Together, these two sources will supply up to 85% of our future water needs.

Water Demand and Supply

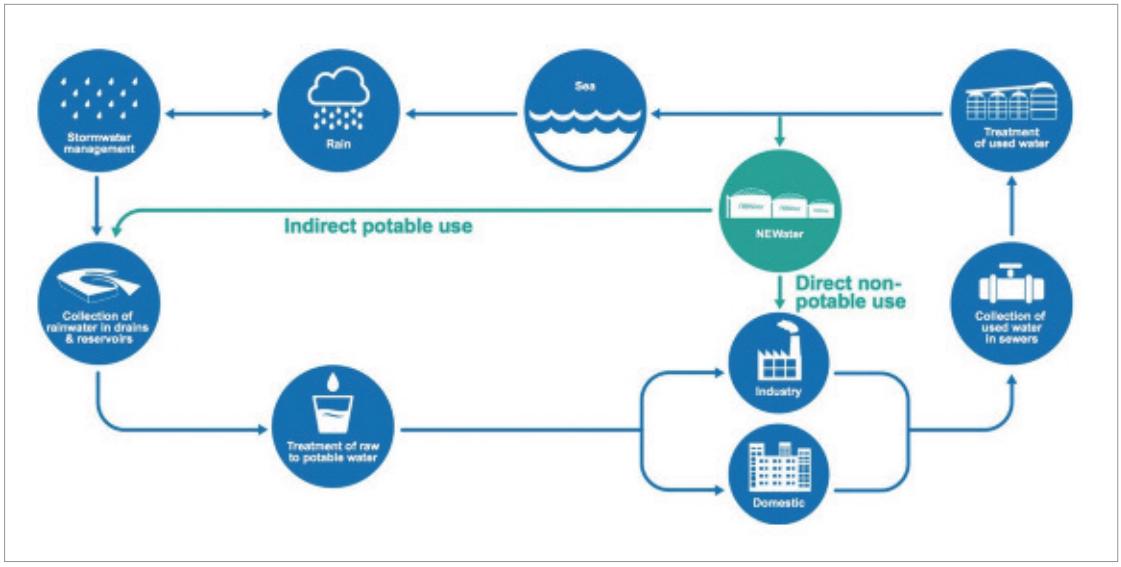


(Fig.43) Expectation of Singapore's Water Use by 2060

Source : https://www.pub.gov.sg/Documents/PUBOurWaterOurFuture.pdf

7. National Policies and Plans on Water-Related Disasters

PUB manages the entire water loop.



(Fig.44) Water Loop managed by PUB

Singapore supports the 2030 Agenda and the 17 SDGs. As a small country with limited land and no natural resources, Singapore appreciates the challenges of sustainable development. This is why we participated actively in the negotiations on the 2030 Agenda and welcome the consensus reached.
From our own development experience, we understand that there is no single model of development that is applicable to all. Thus, we believe that the SDGs should focus on bringing concrete and substantive improvements, and that countries should be free to pursue the goals in whatever manner they choose.

Singapore's Contributions to the SDGs

Singapore has been sharing our experience on sustainable development with fellow developing countries through technical assistance under the Singapore Cooperation Programme (SCP). Since 1992, we have trained more than 100, 000 officials in areas such as sustainable urban management and water management. Nonetheless, the unprecedented scale and ambition of the 2030 Agenda require renewed commitment and enhanced partnership from all stakeholders.

To support our fellow developing countries in their implementation of the 2030 Agenda and the SDGs, Singapore launched the Sustainable Development Programme (SDP) under the Singapore Cooperation Programme. We aim to do this by building capacity at three levels:

1) Collaborating with the Singapore-based UN Development Programme Global Centre for Public Service Excellence to jointly offer programmes on good governance and public sector leadership for senior officials. We conducted the first run of this programme titled "Transformational Leadership for the 2030 Agenda" from 16 to 20 May 2016 and have committed to support additional runs.
2) Developing a multi-year capacity building programme on sustainable urbanisation.
3) Partnering reputable Singaporean NGOs to conduct pilot projects in water and sanitation in regional countries.

(source: https://www.mfa.gov.sg/content/mfa/international_issues/2030-agenda-for-sustainable-development.html)

PUB adopts the 3 key strategies:-

- Providing adequate drainage infrastructure ahead of new developments
- Implementing flood protection measures by stipulating requirements such as minimum platform levels and crest levels in the COP
- Improving drainage in flood prone areas continually by widening or deepening drains and/or raising low-lying roads

The Sewerage & Drainage Act empowers PUB to ensure that proper drainage systems are designed for the purposes of flood protection.

(source : http://aseaniwrm.water.gov.my/wp-content/uploads/2015/08/Singapore-2013-Report-Flood-Management.pdf)

PUB continues to strengthen flood response capability in settling up a dedicated Operation Centre equipped with live feeds of water level sensors, CCTVs, media reports, etc While the impact of climate change is being studied, PUB has (since Nov 2011) designed drains to a higher design standard & require new developments to meet a higher platform level. When the study is finalized, appropriate additional measures will be taken.

(source : http://aseaniwrm.water.gov.my/wp-content/uploads/2015/08/Singapore-2013-Report-Stormwater-Management.pdf)

8. Lessons Learnt from the Past

The flood events of 2010 and 2011 along Orchard Road and other parts of Singapore have affected the public's perception of PUB's drainage and flood management approaches over the years.

PUB should develop and implement a strategic public outreach programme to publicise and educate the general public proactively on its drainage plans and flood management approaches so as to enhance public awareness and preparedness towards floods.

PUB could leverage its previous successful experiences in public education and engagement (Water Conservation Campaigns, Promotion of NEWater, Active, Beautiful and Clean Waters Programme) and replicate them to help the public better understand the importance of Singapore's drainage systems and flood management strategies.

(source : https://www.pub.gov.sg/Documents/fullReport.pdf)

9. Future Agenda to Mitigate and Adapt to Water-Related Disasters

Climate change can affect water supply, as increasing rainfall intensity could overwhelm our drainage system and create flooding, while dry weather will reduce the reliability of our water supply.

NEWater and desalinated water are not dependent on rainfall and can be used to supplement water from local reservoirs in an extended dry spell.

NEWater can now meet about 30% of Singapore's water needs. A fifth plant to be completed by 2016 will boost its contribution to 40%. During dry months, we also top up reservoirs with NEWater, and further treat the blended water at the waterworks before supplying it to the population. NEWater is the pillar of Singapore's water sustainability, and by 2060, we will expand its capacity by four times, to meet up to 55% of our future water needs.

Two desalination plants with a combined capacity of 100mgd can now meet 25% of Singapore's water needs. By 2020, we will build two more 30mgd desalination plannts at Tuas and Marina East to boost our drought resilience. We are also exploring the potential of building a fifth plant on Jurong Island. We plan to double our desalination capacity by 2030, and triple it by 2060 to meet up to 30% of our future water needs.

(source: https://www.nccs.gov.sg/climate-change-and-singapore/domestic-actions/adapting-climate-change/water-resource-management)

What is the trend on climate change and hydrology in the Country? What are the future opportunities and risks? What supporting policies and legislation are lacking?

Based on the rainfall intensity records over the past 30 years, there is strong evidence of a trend towards higher rainfall intensities and frequency of intense rains. These uptrends are consistent with the Inter-governmental Panel on Climate Change 4th Assessment Report (IPCC AR4) and could add further strain on Singapore's existing drainage infrastructure. Based on these observations PUB and Meteorological Service Singapore may wish to consider further studies so as to better understand the past trends and project likely future trends to facilitate its drainage design and flood management purposes.

(source: https://www.pub.gov.sg/Documents/fullReport.pdf)

10. Proposals for Regional Cooperation

- Sharing best practices on mitigation and adaption of water-related disasters
- Sharing information and experiences on mitigating and adapting water-related disasters activities
- Capacity building in urban flood management and disaster risk management

Executive Summary Report

THAILAND

THAILAND

By Ministry of Natural Resources
and Environment and Pongsak Suttinon

This assessment report outlines the findings of review of water related disaster in Thailand, including backgrounds, climatic and physical characteristic, hydrology and meteorology of Thailand, water-related hazards and disasters, water institutional service and water resources laws in Thailand, Water security, National policies and plans on water-related disasters, lessons learnt from the 2011 Floods, future agenda to mitigate and adapt to water-related disasters and proposals for regional cooperation.

Geography and Topography

Thailand is located in Southeast Asia between latitudes 5o37′ N to 20o27′ N and longitudes 97o22′ E to 105o37′ E. It is bordered by (1) the north and west mountainous area with Myanmar; (2) the north and east stretch of the Mekong River with Laos; (3) the east border with Mekong River and mountain with Cambodia; and (4) the south area connected to Malaysia. Thailand consists of 5 regions: (1) Northern, (2) Northeastern, (3) Central, (4) Eastern and (5) Southern region.

Socio-Economic Development

Thailand has a population of about 65.7 million in an area of 514,000 sq.km. About 52% of the population lives in rural area, composed of 5.8 million farm families and 10 million non-farm families. The population grows at about 0.3% annually. Bangkok which is the capital of Thailand has a largest number of population in Thailand. Big cities of each region also provide large number of population such as (1) Chiang Mai province in northern part, (2) Nakon Ratchasima province in north-eastern region, (3) Chonburi province in eastern part and (4) Nakhon Si Thammarat province in the south.

According to Thailand's gross domestic product (GDP), service sector dominates the economy more than 60%. Manufacturing and agricultural sectors generate 30% and 10% of national GDP, respectively. Bangkok metropolitan, vicinities and large city in each region produce a majority of Gross Provincial Product (GPP). However, each socio- economic sector in each province has different characteristic based on physical (soil, weather, water) condition, basic infrastructure, cultural and historical issues.

Agriculture dominates the regional economy especially in rural area. It employs about 35% of the total number of population. The contribution of rice and rice products as a proportion of crop GDP was 28% in 2015. Rubber also generates 27% of crop GDP. Maize, sugarcane and cassava contributed 10%. Some 5 million ha out of a gross cultivable area of 24 million ha are irrigated area under service of Royal Irrigation Department (RID). Manufacturing and service sectors played a relatively major role in Bangkok and vicinity including the huge industrial estate in the eastern part of Thailand.

The distribution of GPP per capita among various sectors is calculated based on GPP and number of population in each province. The calculation results show that citizen in Bangkok and vicinity who generate income from service sector and people in the eastern part of Thailand who produce a number of manufacturing products play a major role to generate GPP per capita in Thailand.

Non-agricultural activities are the main economic engine; however, agricultural sector is still important especially in social viewpoint. Until now, Thailand is still an agricultural country and agricultural products constitute the largest component of regional income especially in rural area. At the present time, several irrigation schemes have been constructed. The completed irrigation systems up to 2015 can supply the area of 4.8 million ha. The system of those projects after their completion in the last decades made Chao Phraya River Basin as the main irrigation service area of Thailand. This is the main reason why farmer in this area can produce the second or third rice in dry season with water supply from RID. One of the interesting issues is that the farmer in this area can generate more GPP per capita in agricultural sector than the other rice-producing area from the previous reason. However, agricultural GPP per capita in some area of the north-eastern, eastern and southern parts of Thailand are high. This causes by the greater value added from fruit in the eastern part and rubber in the rest.

For manufacturing and service sector, a number of completed National Economic and Social Development Plans in the past generated higher GPP per capita in urbanized and industrialised area as successful regional development.

However, after socio-economic development in a number of regions, some area still faces a poverty problem. Thailand need new strategic use of tools such as economic development (Thailand 4.0), education, health service, income gap reduction and distribution to improve the quality of life in each region especially in the northern, north-eastern and southern parts of Thailand.

Climatic and Physical Characteristic of the Country

Thailand is mainly under the influence of southwest and northeast monsoons. There are three seasons based on meteorological viewpoint as follow: (1) Rainy or Southwest monsoon season is generally between May to October. This season provides rainfall over the country and generates river runoff for agricultural activities; (2) Winter or Northeast monsoon season is normally from October to February. However, only upper Thailand is quite cold during this period. In the Southern part of Thailand, it is still rainy season with a great amount of rainfall; (3) Summer season is started from February to May. April is generally hottest month of the year.

According to 15 degrees north of the equator, Thailand has atropical climate and the average temperature is 28 with a range of 19 to 38 oC (66-100 F). Based on the climatic and physical characteristic of Thailand, average annual rainfall varies from a minimum of 1,000 mm in the northern to approximately 4,000 mm. in the southern part of Thailand.

There are 25 major river basins in Thailand. Two main river systems are Chao Phraya in the central of Thailand and Mekong River Basin in North-eastern region. The issue of Chao Phraya river basin is multi- river basin issue. The northern river basin (Ping, Wang, Yom, Nan) supply water to this area. This causes difficulty in water resources management. The other issue is international river basin management in Mekong area which needs cooperation among each country.

Chao Phraya river basin is the main water resources to meet the socio-economic development of Thailand. The Chao Phraya with the Ping, Wang, Yom, Nan cover the majority of the north and central area of the country. These four tributaries originated in the northern mountainous area flow southwardly and come into concurrence at Nakon Sawan province where the Chao Phraya River is formed to the gulf of Thailand. These river basins can generate approximately 40 % of national GDP of Thailand. This causes a number of water resources projects in these river basins including two large hydropower dam in this region.

Hydrology and Meteorology

In Thailand, the weather in all season was hot for the whole country. The average temperature is shown with the range of 23 to 30 oC in all season. Winter is slightly cooler than the other season.
Based on physical and climate characteristics in Thailand, rainfall in rainy season from May to October plays an important role approximately 80 % of all rainfall depth in all regions except the east coast of southern Thailand. This causes a huge amount of river runoff resulting in flooding in some area. Only 20 % of rainfall in the rest may result in water shortage in some regions.

Water-Related Hazards and Disasters

In the past, Thailand suffered its water-related hazards and disasters such as the great flood 2011 and the drought in 2015.

The great flood 2011 in Thailand caused by a number of issues such as (1) excessive and continuous rainfall from successive and powerful monsoons and (2) subsequent, numerous dam breaches. This flood inundated approximately 6 million ha of land covering 66 of 77 provinces of Thailand. This flood also affected more than 13 million people with the total damage and loss amounted to THB 1.43 trillion or USD 46.5 billion. In 2015, Thailand was experiencing the worst drought in last decades, caused by the lower amount of rainfall and usable water in dams across the country.

The upper and central parts of Thailand have medium and high risks in drought. This caused risk of the rice farmers for lower income because of critical water shortage.

For flood risk map, some area in upper Chao Phraya River, Chi and Moon River are under high risk of flood. The great flood in the upper Chao Phraya River may cause huge damage and loss in the socio-economic development center (industrialized and urbanized area) in Bangkok and vicinity, the lower Chao Phraya River.

The satellite images and GIS information of continuous water-related disaster in the past from 2006 to 2014 illustrate the big flood events in each period and area. It is certain that investments in this flood prone area may cause high risk with huge damage and loss.
Based on the great flood in 2011, the Royal Thai Government and the

World Bank assessed the economic and social impact of this flood. Total impact or effect is defined as the combination of damage and losses. By the definition, on the one hand, damage is a set of destruction of physical assets, occur immediately and can be built back. On the other hand, losses are (1) forgone production/income, (2) higher expenditures, and (3) occurrence over a period of time and cannot be recovered. The total damage and losses from the 2011 floods in Thailand amounted to THB 1.43 trillion (USD 6.5 billion), with losses accounting for 56 percent of the total. Based on theassessment report, it is estimated that the floods will reduce real GDP growth in 2011 by 1.1 percent from pre-flood projections. Overall, approximately 90 percent of the damage and losses from the 2011 floods were borne by the private sector. Recovery and reconstruction needs are estimated to be THB 1.5 trillion (USD 50 billion) over a five-year period.

From the information of water-related risk maps with poverty map, we can calculate and understand where the poor live under these risks. The poor are generally vulnerable to flood and drought because of lack of budget, education and opportunity to access supports. This causes rice farmers face greater problem in the future because of water shortage and difficulties to access water supply and severe situations under flood risk. This information shows the prioritized area that policy makers or responsible

agencies should carefully consider and concentrate to support the poor to build resilience.

The Royal Thai Government and the World Bank summarised disaster risk management (DRM) and recommendations. One of the main recommendations is that coordination among policy maker and responsible agencies is necessary to (1) strengthen communication and risk awareness, (2) mainstream DRM to policy implementation, (3) reform institutional structure and (4) finance disaster risk.

Water institutional service and water resources laws in Thailand

In Thailand, there are a number of government agencies concerned with the development and use of water in each issue. The main water- related governmental agencies in national level can be concluded and shown as:

(1)Policy Coordination: Department of Water Resources (DWR) under Ministry of Natural Resources and Environment (MoNRE)

(2)Service Provider: Royal Irrigation Department (RID) under Ministry of Agriculture and Cooperatives (MoAC); Metropolitan and Provincial Waterworks Authorities (MWA & PWA) under Ministry of Interior (MoI); Electricity Generation Authorities of Thailand (EGAT) under Ministry of Energy (MoE); Eastern Water Resource Development and Management PLC (East Water)

(3)Groundwater Management: Department of Groundwater Resources (DGR) under Ministry of Natural Resources and Environment (MoNRE)

For decades, Thailand has legislation force to control development and use of natural resources especially land, forest, natural mineral. However, there is no water law which is one of the most important natural resources. In present (2016), water law is drafted with the main issue as follow:

1. Water is public property.
2. All individual have the right to use water as necessarily without causing any damages to the riparian land owners or the customary users.
3. In case of water shortage or usage may jeopardize the environment, prohibition or reduction of water usage must be exerted temporarily.
4. Utilization of water is divided into 3 types and permission might be asked through different bodies, which are no permission, the river basin committee and NWRC
5. Organization administration and water fund
6. Water resources rehabilitation and solving of flood and drought
7. The feature of this law is transformation the water issue from "function-oriented" water legislation to "resource-oriented" water law.

Water-related legislation in Thailand can be shown as follow:

1. Irrigation

1.1. Field Dikes and Ditches Act, B.E. 2505

1.2. The People's Irrigation Act, B.E. 2482

1.3. The State Irrigation Act, B.E. 2485

2. Agriculture, forest, and fisheries

2.1. Agricultural Land Consolidation Act, B.E. 2517

2.2. Agricultural Land Reform Act, B.E. 2518

2.3. Cooperatives Society Act, B.E. 2511

2.4. Fisheries Act, B.E. 2490
2.5. Forest Act, B.E. 2484
2.6. Land Development Act, B.E. 2526

3. Canal and navigation
3.1. Act for Eradication of Phaktob Java, B.E. 2456 (Water hyacinth)
3.2. Canals Conservation Act, R.S. 121
3.3. Conservation of Water Supply Canal Act, B.E. 2526
3.4. Navigation in Thai Waters Act, B.E. 2456

4. Hydraulic Power Generation, Energy, and Water Supply
4.1. Energy Conservation Promotion Act, B.E. 2535
4.2. Energy Development and Promotion Act, B.E. 2535
4.3. Electricity Generating Authority of Thailand Act, B.E. 2511
4.4. Metropolitan Waterworks Authority Act, B.E. 2510

5. Environment, Groundwater and National Land and Property
5.1. Enhancement and Conservation of National Environmental Quality Act, B.E. 2535
5.2. Exploitation of Improvement Property Act, B.E. 2530 3
5.3. Groundwater Act, B.E. 2530
5.4. Ratchaphatsadu Land Act (State's Property)

6. Disaster
6.1. The National Disaster Prevention and Mitigation Act, B.E. 2550

Water Security

Asian Development Bank (ADB) proposed water security as not only providing sufficient water for socio-economic development, but also having healthy ecosystems and protecting people from water-related. It consists of 5 sectors: (1) household water security; (2) economic water security; (3) urban water security; (4) environmental water security; (5) resilience to water- related disasters.
For Thailand, water security in all 5 sectors is illustrated in each province. It shows that some area is still need to be supported to increase water security especially area with high poverty rate.
This information is useful for policy makers or responsible agencies to support decision making in priority for increasing water security by key dimension.

National Policies and Plans on Water-Related Disasters

In 2015, the National Water Resources Board of Thailand launched the National Water Resources Management Strategy (2015-2026) with the vision "Clean water provision for all villages' domestic use, secured production, mitigation of flood damage, standard water quality, and sustainable water management with balanced development and participation from all sectors". This consists of main 6 strategies as follow:

1. Strategy for addressing water shortage for domestic use
2. Strategy for addressing water shortage for production (agriculture and industry)
3. Strategy for flood prevention and mitigation
4. Strategy for water quality management
5. Strategy for upstream forest rehabilitation and soil erosion prevention
6. Strategy for water management

As can be seen in the water-related-disaster strategies, the 1st and 2nd strategies concentrated in water shortage issues and the 3rd was responsible for flood.

Lessons Learnt from the 2011 Floods

The assessment team of the Ministry of Finance, Royal Thai Government and The World Bank investigated the needs of affected people from the field visit in the inundation area and meeting with public and public sectors. The assessment results from this team can be concluded in issues of risk assessments for public knowledge, early warning communication, emergency management and coordination, coordinated emergency preparedness, disaster response versus preparedness, urban vulnerability, evacuation planning and Community Based Disaster Risk Management (CBDRM).

Future Agenda to Mitigate and Adapt to Water-Related Disasters

After establishment of The Department of Disaster Preparedness and Mitigation (DDPM) under the Ministry of Interior in 2002, the National Disaster Prevention and Mitigation Act (NDPMA) was passed and mandated in 2007. Based on this act, the DDPM became the focal organization for the coordination of all types of disasters. The main features of this act are

1. The scope of disaster management activities is for all types of disasters,
2. Designating National Disaster Prevention and Mitigation Committee become the coordinating body for policy formulation,
3. Designation DPPM is national focal point for disaster management activities,
4. Formulation of three disaster prevention and mitigation plans for National, Provincial and Bangkok Metropolitan Administration,
5. Clear identification of responsible authorities and persons for disaster management tasks at all levels. (DDPM)

Based on this act, Thailand clarifies responsible agencies and persons with the mandate to manage all type of disasters.
In 2015, the National Water Resources Board of Thailand launched
the National Water Resources Management Strategy (2015-2026). One of the main strategies is "strategy 3 Disaster Prevention and Mitigation". The main goals are (1) Reduce damage from flooding in urban areas and major economic zones; (2) Improve major waterways and tributaries; (3) Improve water drainage/flood diversion structure from community areas; (4) Provide catchment for flood inundation; (5) Provide and improve river basin pattern; (6) Support for adaptation and evacuation. These goals will provide the short, medium and long term framework with responsible organizations.

Proposals for Regional Cooperation

Many ASEAN countries have similar physical conditions, socio- economic development and water-related disasters. Regional cooperation in our region with support from international expert could be increasingly advantageous. In case of Thailand, we faced the worst flood in 2011 and drought in 2015 during the last decades. From these events, the international organization and institute support Thailand in a number of tool and knowledge. We suggest that future regional cooperation could be proposed as:

1. Joint regional research program for water-related disaster,
2. Exchange of information, training in methods and ideas which can be applied in different situations and countries,
3. Knowledge dissemination and exchange from the national experts,
4. Formal establishment of the ASEAN Academic Networking in Water-related Disaster Management,
5. A technical training on Water-related Disaster Management for Planning and Management for Natural Disasters in ASEAN

Executive Summary Report

VIETNAM

VIETNAM

By Ministry of Natural Resources
and Environment and Dang Thi Lan Huong

Background

Vietnam's mainland stretches from 23023 to 08002 north latitude and widens from 102008 to 109028 east longitude. The mainland has an area of 330.991 km2, length counted in straight line from north to south stays at more than 2.000km, width from west to east maximizes at 600km and minimize at 50km. The S shaped country has a coastline of 3730km, a coastline of 1 kilometer per an area of 100 square kilometers in average. Vietnam shares its border with China in the north with border length of 1,150 km, Laos with length of 1,650 km and Cambodia with length of 930 km in the west. Vietnam has sea border in the east, south and southeast. The country's average population in 2015 is at an estimate of 91.70 million persons. The 2015 s GDP is estimated to increase by 6.68% over 2014, higher than the proposed target of 6.2%. Of the general growth, the sector of agriculture, forestry and fishery

rise 2.41%, lower than 2014 s growth rate of 3.44%, contribute 0.4 percentage points to the general rate of growth; the sector of industry and construction rise 9.64%, much higher than the rate 6.42% of the previous year and contributes 3.2 percentage points; the services sector rise 6.33%, contribute 2.43 percentage points.

Topographical conditions

Vietnam's topography is very diverse with mountains, hills, plains, coasts and continental shelf. It's result of tectonic process in a long time of millions of years in the past. The topography is lower from the northwest to the southeast. Thus, almost the rivers in Vietnam have the stream following that direction. Mountains and hills, which occupy three quarters of Vietnam's territory, are the main landscape in Vietnam. However, 85% among them are low mountains and hills under 1,000 meters high. There are only 1% of mountains that have the height over 2,000 meters.

Climatic and physical characteristics

Vietnam territory is located in the tropical humid area with many unique features compared with other countries. The climate characteristics are controlled by convergence inter-tropical and impacted strongly by the monsoon circulation. The average annual temperature Vietnam is changed in the range of below 10oC to over 27oC. It tends to increase steadily from the North to the South and reduce with the increase of the terrain. Annual changes of average monthly temperature have the one peak in the North and the Central and two peaks in the South. January has lowest average monthly temperature throughout the country and the highest one is July in the North and the Central coastal area, March in the

Central Highland and the South. Annual mean relative humidity changes in the range of 75- 90% and it does not show any changes by zones. However, the relative humidity is low in the low valley and the Central coastal area and high in the high mountain area with high rainfall.

Regarding the rainfall characteristics in the territory, because of the differences of humid sources, rain-caused elements and terrain's characteristics etc. so that the rainfall distribution is unequal in the territory and strongly change by the terrain's level. But the rain- caused impacts on climate in Viet Nam are diversified. Temperate rain, low depression rain in the Southwestern, rain caused by storm and tropical depression, rain caused by the Northeast monsoon, rain caused by temperature storm etc. Rain caused by the Northeast monsoon happens mostly in the winter especially in the end of winter in the North and North Central

Region. Temperate rain is in the mountainous area in the northern midland and mountainous in the beginning and the end of winter. Rain caused by temperature storm happens in the beginning of summer locally in some areas especially in the northern midland, north Central Region. Rain caused by storm and rain caused by the West South depression and tropical depression happens in the summer in the whole country and occupies 60-80% of total annual rainfall. But because of the divided terrain so the rainfall is distributed unequally in the country and in the region. So that some regions have higher rainfall than others.

Climate change

In the period of 1958-2014, temperatures show increasing trends in most observed stations. The annual average temperatures increased by about 0.62°C for the whole country, (about 0.10°C/decade), and in period of 1958-2014 by 0,420C. Annual rainfalls show lightly increasing trends in the whole country. The biggest increase trend is found in the winter and spring months, and the decrease trend is the autumn months. In general, annual rainfall had decreasing trends in the northern regions (from 5.8%÷12.5% over 57 years) and increasing trends in the southern region (from 6.9%÷19.8% over 57 years).
Number of droughts, especially severe droughts, increased over the country. From 2000 to present, severe drought almost happens every year. According to statistics of the period 1959-2015, there were 12 annual typhoons in average and tropical depressions operating in the East Sea. Storms and tropical depression over the East Sea impacted and landed in Vietnam have been less varied. Vietnam has updated climate change and sea level rise scenarios for 2016.

River and hydrology of the country

Vietnam has a dense network of rivers, there are 3,450 rivers that have flow regularly and length of 10km or more, including 13 major rivers; 390 interprovincial rivers, streams and 3045 inner province rivers and streams. By source of international waters, Vietnam has 206 international rivers, including 91 rivers over 10km in length. In territory, there are eight major river basins, including Bằng Giang - Kỳ, Hồng - Thái Bình, Mã, Cả, Vũ gia Thu Bồn, Ba,
Đồng Nai and Mekong (including C u Long, Sê San and Srepok). The total area of the basins is 1.167 million km2.
The total annual amount of surface water in Vietnam is about 830 m3. About 60% of Vietnam's surface water is generated outside the country, only 310 billion m3 annually is generated in the territory of Vietnam. Water resources are unevenly distributed in space and time, leading to water shortage happens locally in some areas, sometimes it becomes serious even in large river basins. Similar to the rainfall distribution, 70-80% total annual flow concentrates on flooding season. The dry season occupies only 20-30% annual flow. Flow regime in the tide affected rivers are often complex and governed by the tidal regime.

Hydrological and meteorological data and network

The total number of surface-water monitoring stations: There are 354 hydrology stations in total, in which 122 level 1 stations; 36 level 2 stations; 196 level 3 stations. Observation parameters: Water level; Flow discharge; Water temperature; Chemical contents of water. Frequency of monitoring: follow the Vietnam standards issued by the MONRE (Circular 29/2011/TT-BTNMT). Methods for monitoring: mainly manual.

Natural disasters and water related disasters hazards

Geographic position and topographic condition form special climate characteristic resulting to serious and diversified disasters in Vietnam. Natural disaster occurs almost round year in Vietnam, there are typical disasters in each season and particular characters in each region. Vietnam suffers from many kinds of disasters, such as: flood, storm, tropical depression, storm surge, inundation, whirlwind, flash flood, river bank and coastline erosion, hail rain, drought, landslide, forest fire,...

Flood

Flood rising intensity, amplitude and peaks in rivers are usually very high. Almost all the provinces and cities in Vietnam are affected by flood. The region which has been extremely vulnerable and frequently faced to flood are the Central Vietnam. Flood remaining and duration of inundation in downstream plains is often prolonged in some days in the Central Vietnam, in many days in the North Vietnam and even in months in Cuu Long River delta. The loss caused by natural disasters in Vietnam is considered as one of the big loss in the world. Flood, inundation destroyed material and technical bases, exhausted food, food-staff sources, destroyed crop harvests, cultivated lands and might lead to starvation, instability of cultural, social life and environment, etc. in a large area and finally it caused long time consequences that need many years afterward to be overcome. According to statistics, floods occurring in 1971, 1978, 1983, 1986, 1989, 1994, 1996, 1997, 1999, 2000 and 2001 caused the most serious material losses;

1964, 1978, 1989, 1993, 1994, 1995, 1996, 1997, 1999, 2011 are the years with largest inundated area, biggest damages in agriculture, transport and water resources.

Storm

Storms, tropical depressions affecting Viet Nam are those that completely change weather phenomena (wind, cloud, rain) in an area or in many areas of our countries. According to data from 1956 to present, on average, our country was affected by over seven storms and tropical depressions annually, of which about 3.15 storms and 2.93 tropical depressions directly affected Viet Nam and 0.83 storms and 0.4 tropical depressions indirectly affected. Storms and tropical depressions affect Viet Nam from March to December, of which, storms and tropical depressions frequency in June, July, August, September, October, and December is considerable, storms and tropical depressions frequency in September, October is big (there are 1 to 1.5 storms per month on average). In damage caused by storms and tropical depressions, the greatest loss here is people. Therefore, about 186 people were killed or missing annually and the loss resulted from flooding rains is very severe.

The main harmful factors of storms and tropical depressions are strong winds, heavy rains, surges and other consequences. Storms and tropical depressions can cause damage in the following fields: Damage to aquatic production and offshore structures; Damage to hydraulic structures; Damage to transportation structures; Damage to housing; Damage to infrastructure; Damage to other economic sectors. Some biggest storm hit to Vietnam caused severe damage such as Typhoon Linda or Typhoon number 5 happened in November 1997, Chanchu typhoon (typhoon number 1) entered Viet Nam in May 2006, typhoon Damrey in September 2005, Haiyan typhoon or typhoon in December 2013.

Flash flood

The surveys carried out recently show that the number of flash floods per year in Vietnam is increasing year by year. In some

provinces, flash floods have occurred more than three times over 30 years such as: Lai Chau, Lao Cai, Hoa Binh provinces. In other provinces. Flash floods occurred in dry areas with small flow module such as in Nam Muc (Lai Chau province), or the rivers in Phan Rang province and Phan Thiet province. This phenomenon reflects the environmental depreciation in Vietnam, especially the forest environment in the mountainous areas of Vietnam. Most of the flash floods occurred in the remote mountainous areas. For that reason, flash floods have not caused any huge economic loss because of sparse residence and low socio-economic development. However, flash floods cause huge damages in affected provinces and it takes a long time to recover the consequences of flash floods in affected provinces.

After analyzing flash flood occurrences in the history, usage of maps to divide vulnerable areas, and comprehensive development of each area in the coming years, it is right to state that Northern mountainous areas are the most vulnerable areas, especially some provinces in the Northwest such as Son La, Lai Chau, Ha Giang Provinces. Besides, some provinces in the Central part such as Binh Thuan and Ninh Thuan Provinces and the Highlands such as Dac Lac and Lam Dong Provinces are also at risk of flash floods. Some typical flash floods such as the flash flood caused by break downs of reservoirs in Dac Lac province, 1990; The flash flood in Lai Chau township, 27 June 1990; The flash flood in Son La township, 27 July 1991; The flash flood in Muong Lay townlet, 23 July 1994; the flash flood in Ham Tan, Binh Thuan Province in July 1999; The flash flood in 2002, The flash flood in 2005; The flash flood in 2008; The flash flood in 2009,

Drought

Because of the characteristics of terrain, climate, hydrology, in Viet Nam, drought happens every year. If only considering the agricultural production, according to statistic, within 46 years (from 1960 to 2006), there are 34 drought (occupying 74%) in which drought happen in the winter-spring season for 11 years, in the harvesting season for 11 years and in summer-autumn for 12 years. In 1998, there was a serious drought happened nationwide and especially strong in the Central, the Central Highland and the South. Its damages was about 5,000 billion VND.

The characteristic of high slope terrain, flora cover is reducing in long time. It is a potential risk of drought that will affect agricultural production and life of people. It shows clearly in places that the terrain is incapable to keep the water or low water regulation between rainy and dry season. Those are rock mountains areas, bare hills, areas with high slope and short basin etc. which occupies 1/3 total natural areas of the country. Deforestation and the habits of shifting farming, shifting living, burring fields for plantation are contributing to the reduction of water storage and regulation of the terrain and make desertification. Drought and the water coming to the interior field, residential areas have close and interactive connection and increase the impacts of drought on production and life of people.

Detail of several typical droughts in the recent years: drought 1992-1993; Drought 1997-1998; drought in 2001 in Phu Yen, Quang Nam, Quang Binh, Quang Tri provinces; Widespread drought in 2004 and 2005 were not affected much as compared with that in 1997- 1998; serious drought in the North during the dry season 2008 and 2009; Drought in the ending of 2013 to March 2014; drought in 2015-2016

Landslide

In Vietnam, landslides that cause considerable loss of lives and properties have a scale from medium to very large. Separate slide masses on hill or mountainsides have a volume up to 1-2 million m3 (Lai Chau, Hoa Binh, Dak Lak, Quang Nam, Quang Ngai ...). In opencast mines arise slide masses with a volume of 1-2 million m3 (Deo Nai, Coc Sau mines). Along basins of rivers, topples - slides are tens of million m3 (Red Ngu - Cuu Long river; Huong Ho

- Huong river ; Vu Gia, Thu Bon rivers, etc). Below is damage caused by landslide.

(1) Damage at regional landslide in combination with big spates
(2) The damage as a result of rock, gravel, sand sedimentation in some big landslides and floods
(3) Some transport - irrigation - damages which concern the landslides during rainy storm in the Central Provinces of Vietnam in November - December, 1999.

Warning systems and responding measures

Early warning systems have effectively been operated in some cases of natural disasters such as river flooding and storm. There was a special attention and big investment in early warning systems focused on two types of common natural disasters of flood and storms. Flood forecasting capacity have been improved as installation of large number of automatically hydrological monitoring stations. However, it is needed to continue improvement of technical capacity and equipment required to predict flash floods, especially in the remote mountainous region. Forecasting capacity of storm and tropical depression of the National Centre for Hydrometeorological Forecasting has meet the target forecast for leading 72 hours as stipulated by the National Strategy.
Early warning systems are gradually being improved with support of large coverage networks of the Internet and mobile phones. The communication system rapidly developed in Vietnam and provision of communication equipment contribute to timely inform warning signals to the most vulnerable groups such as fishermen, ethnic minority groups living in remote mountainous areas and the poor. In water related disaster sectors, responding and adapting measures are as follows: Measures for Reservoir Safety; Measures for Landslide and Erosion Protection; Measures for reducing losses caused by landslides in riverside areas; Measures for reducing losses caused by erosion in coastal areas; Mitigation Measures for Drought; Preparedness and Mitigation Measures for Inundation Disaster; Measures for Mitigation Flash Floods

Water security

Compared with other countries, the water security of Vietnam remains low, even very low. Average water storage per capita is 411 m3/person (2010), but if only consider the actual amount of water used for the purposes (water security), the rate of Viet Nam is only 82m3 / person, lower than many other countries in the region. Currently, water security of Viet Nam are facing big challenges. There are some major challenges as follows: i) most of the large river basins of Vietnam are transboundary river basins which Vietnam is a downstream country. Total amount of water flown from the neighboring countries is approximately 63% of the country's annual average volume; ii) the water resources of Viet Nam is unevenly distributed in space and time, concentrated mainly in the 4-5 months of rainy season (accounting for 75-85% of the annual rainfall), dry season rainfall accounts only 15-25%; iii)
Water pollution, degradation and depletion because of socio-economic development activities in the country has not yet improved. iv) the economic growth increases the water sources exploitation and use of sectors, urbans while the water waste, inefficient use of water is still popular. In recent years the annual GDP growth rate of the economy is about 7.5%; v) climate change will impact significantly on the water resources of Vietnam. Viet Nam is one of the five countries most impacted by climate change in which water resources is the most and earlies impacted by climate change because of unpredictable changes of rainfall and sea level rise.
The challenges mentioned above can simultaneously occur. It will be the most difficult issue for the water resources management of Vietnam the coming years, especially in the context of maintaining the goals of green growth and water security for sustainable development. Facing those challenges, there are many measures and new management approach has been studied and applied such as integrated water resources management approach, water management by river basin basis, water-energy-food nexus approach, green growth approach. In order to archive the water security in the diverse ear, Viet Nam

government takes many efforts for integrated management and pays attention on six major duties. Facing those challenge as mentioned above, in order to ensure the water source for daily life of the people and the sustainable development of economic sectors, we need to improve the water resource management.
The national water security score of Viet Nam is 40.2 (five key dimensions respectively are 10.7; 12.6; 5.0; 5.3; and 6.6) and national water security index is 2 in the year of 2016.

Institutional Setup for Natural Disaster Prevention and Control, and Searching and Rescue

Steering Committee for Natural Disaster Prevention and Control, and Committee for Searching and Rescue are established at national, provincial, district and commune levels. The Committees has been established by the Prime Minister, in charge of inter-agency coordination to assist the Government and the Prime Minister in organizing, directing national disaster prevention, response and consequence solving, and also searching and rescue. The members of Central Steering Committee are leaders of the Government Office, ministries and other organizations. The members of the Committee work on a part-time basis.

Forecast, warnings and communication\

Forecasts, disaster warnings should be timely, accurate and consistent, in popular language (Vietnamese) to cope with needs of many objects, and in special case and to vulnerable objects, the forecasts must be conveyed into minority language. Geophysics Institute under the Vietnam Academy of Science and Technology is responsible for earthquakes, tsunamis forecasting and warning of disaster risk levels, bulletins of earthquakes, tsunami. Natural Resources and Environment Ministry is responsible for issuing disaster forecasts and warnings relating to meteorological, hydrological and oceanographic and disaster risk levels.

Organizations involved in Natural Disaster Prevention and Control in Vietnam

Many political organizations - social participate and support the State management agencies in disaster management and the consequences caused by water disaster. The Law on Natural Disaster Prevention and Control also have clearly defined rights and obligations of agencies, socio-political organizations, socio-political-professional organizations, social organizations and socio-professional organizations, economic organizations. Important principle of action formed for a long time and widely effectively applied in practice of natural disaster prevention and control, especially in response and early recovery periods, is "four-on- spot" motto including local commanders, local forces, local equipment/measures, supplies, and logistics. The active participation of the armed forces (army and police), Red Cross volunteers, youths, the members of the local unions paly very important role in disaster risk reduction activities. Community based disaster risk management (CBDRM) has widely been applied in Viet Nam.

Law on Natural Disaster Prevention and Control

This Law is an important milestone of Vietnam to mitigate the risk of natural disasters, and as the highest legal basis in the field of Natural Disaster Prevention and Control in Vietnam in order to prevent and mitigate natural disasters. The responsibilities and coordination mechanisms to support disaster risk reduction/response of the all relevant agencies from the central to local levels is assigned in the Law. The law also mentions regulations and guidelines for international cooperation in Natural Disaster Prevention and Control. Decree No. 66/2014/ND-CP details and guides a number of articles of the Law on Natural Disaster Prevention and Control.

National Strategy for natural disaster prevention, response and mitigation\

This strategy was enacted with the aim of mobilizing all resources to implement effective prevention, preparedness and mitigation of natural disasters from present to 2020 to minimize loss of human life and property, mitigate the destruction/ damage of natural resources, environment and cultural heritage, and contribute to ensuring the sustainable development of the country and ensuring national defense, security. The "Implementation plan for National Strategy for natural disaster prevention, response and mitigation to 2020" have been approved by Prime Minister with priorities have been set out in the Strategy and all provinces of Viet Nam developed Action plan for disaster management.

Monitoring and evaluation Framework of implementation of "National Strategy for natural disaster prevention, response and mitigation to 2020"

M & E framework for implementing the national strategy should ensure the following principles: (1) Simple, feasibility, compatibility, flexibility, practicality and efficiency; (2) Ensure transparency; (3) The broad participation; (4) Based on the evidence; (5) Clear implementation mechanisms. There are about 138 indexes of 10 groups, and each group is corresponding to an activity in the implementation strategy plans.

Main points of policies on water-related disasters

There are many policy document on natural disaters included water-related disasres focused on: Forecasting - warning; Dike protection; Water exploitation and uses, protection of irrigation works, hydropower, flood prevention and water supply for the downstream; Rescue and Support during and after disasters; Strengthening capacity for local decision making; Institutional setup, and Water resources management

Integrated and comprehensive water resources management

Integrated and comprehensive water resources management became consistent view of Vietnam throughout the National Water Resources Strategy Towards the Year 2020, the Law on water resources, and National Action Plan on Improving the effectiveness of management, protection and use of water resources. The management method has also been shown consistently in all decrees, decisions and circulars as well as in the implementation of manage water resources policies at all levels.

Sustainable development strategy in Viet Nam

The Sustainable Development Strategy for Vietnam 2011-2020 includes natural disaster damage mitigation, actively effective adaption to climate change, especially sea level rise is one of the strategic objectives. The priority orientation for sustainable development in the 2011-2020 period mentions disaster prevention. Through the provincial and ministerial level action plan, duties and responsibilities for specific measures have been defined to mainstream effectively integrate disaster risk mitigation into sustainable development policies and planning at all levels.

International cooperation

Orientation of international cooperation in the disaster prevention is to commit contributing into targets of Sendai Framework for Action disaster mitigation period 2015- 2030, and to focus on international cooperation, develop global and ASEAN regional partnership disaster prevention. Viet Nam actively involves in regional and international cooperation in disaster warning, forecast, in education, training and technology transfer, in sharing of information, experience and practical lessons to build up agreements, and conventions for disaster prevention, response and mitigation, especially for emergency search and rescue. After 2 years of implementation (2013-2015), Viet Nam has met the majority of the criteria set out in the Hyogo Framework for Action.

Status of ODA for Water-Related Disasters

Viet Nam has Decree on the management and usage of the official development fund (ODA) and preferential loans from foreign donors, management and usage procedure of ODA, preferential loans for programs and projects. Vietnam has actively implemented commitment on enhancing aid effectiveness under the Paris Declaration (2005), Hanoi Agreement (2005), Accra Agenda (2008), Busan Document (2011), Vietnam partnership document (2013), Vietnam was an active member of the aid effectiveness Forum (AEF). The program supports forest sector (FSSP), Partnership of Disaster Mitigation program (NDMP), International Support Group (ISG) is a typical example of how collaboration through the development partners. There are no specific figures on ODA for disaster prevention in general, and for water disaster in particular. Flood prevention, mitigation as well as dike strengthening, water reservoirs construction aiming relief downstream flood, strengthen flood diversion projects, slow flooding for Mekong Delta are within mission and orientation of the General Irrigation Department. Viet Nam received ODA supports from may organizations and Governments.

Challenges and Mitigation, adaptation measures to water related disasters

There are some challenges that Vietnam is facing in managing water related disaster risks related. Some of them are weakness of human resources, financial resources, and institutional capacity as well as specific measures for each type of water related disasters. Water related disasters cause human and property damages to as well as impacts on the Millennium Development Goals, therefore, it is needed to conduct measures to respond and mitigate negative impacts. Viet Nam determines that investment in disaster risk management is an important factor contributing to ensure sustainable development. Investment in construction works for natural disaster prevention should be focused, multiple objectives, and harmony with nature and environmental landscape, and in combination of structural and non-structural measures. In the context of climate change, the points of Viet Nam views are: prevention of natural disasters is a systematic process, including prevention, response and remedial activities. In the prevention of natural disasters, proactive prevention is main measure, and preparedness for natural disasters in all situation, especially in the context of climate change should be conducted. Disaster prevention and control is to ensure the humanity, transparent, equality and also gender equality. Disaster prevention, preparedness and reduction is implemented under principles: working together of the state and people; effective use of state resources; mobilization of all resources of the community, domestic and foreign organization, and individuals. The community-based disaster risk management considered people-centered orientation, based on inherited traditional and local knowledge/experience, and towards building safer community to cope with natural disasters is basic, effective and sustainable measure to prevent and manage natural disasters. Measures for disaster prevention and control is implemented in uniform, inter-regional, inter-agency ways.

Proposal for regional cooperation

Although AMS have different natural characteristics, all countries face to risk and impacts from water related disasters. Thus, sharing information and knowledge in water resources management at regional level is necessary, detailing as following:

Sharing experience and cooperation in water monitoring and observing to enhance warning capacity in water-related disaster to prevent and relieve the damages from natural disasters and enhance water resources protection

Workshop on effects of global climate change on freshwater among AMS to develop practical approaches for sustainable regional water management and measures for reducing water-related disaster damages

Actively promote water cooperation for equal and reasonable water exploitation, wastes management that are discharged into water resources among the upstream and downstream countries of transboundary river basin.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