RISK ASSESSMENT ROADMAP

MYANMAR

Risk Assessment Roadmap

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In technical collaboration with

With support from

Foreword

The Republic of the Union of Myanmar is prone to a wide range of disasters caused by various natural and human-made hazards. The already high level of disaster risk is further compounded by climate change and variability, environmental degradation, and haphazard development. This was recently illustrated by the devastating floods caused by heavy rainfall, and exacerbated by rains and winds brought by Cyclone Komen that severely affected 12 of the country's 14 states and regions and displaced over 1.6 million people. The coastal impacted by the floods were already overwhelmed by Cyclone Nargis in 2008 and have not yet fully recovered from the crippling damage and losses that reached 11.7 trillion Myanmar Kyats. Cyclone Nargis affected 2.4 million people and left almost 140,000 people dead in its wake.

Since the Cyclone Nargis catastrophe, Myanmar has accelerated programs meant to reduce and manage disaster risk. The Myanmar Action Plan on Disaster Risk Reduction or MAPDRR, which is aligned with the Hyogo Framework for Action (HFA) and the ASEAN Agreement on Disaster Management and Emergency Response (AADMER), prioritizes seven components. Component 2, in particular, focuses on hazard, vulnerability and risk assessment. This Risk Assessment Roadmap therefore is a manifestation of this component and a contribution to the implementation of MAPDRR.

In an environment of broad-based consultation and participation, the Risk Assessment Roadmap was developed, detailing the step-by-step, structured process and scientific methodologies behind risk identification and assessment that allow it to be repeated, updated, and reused even when institutional frameworks and political priorities change. The Roadmap proposes several implementation mechanisms well aware that there is a possibility that the current institutional landscape may evolve in the coming months. In the same vein, the Risk Assessment Roadmap is projected to become part of the revised MAPDRR.

The Roadmap, endorsed by the Republic of the Union of Myanmar, is envisaged to be implemented within five years, by which time the country will hopefully have increased its capacities and knowledge for risk-informed decision making and development planning and thus will have minimized the impacts of future disasters on its people.

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Acknowledgments

The Roadmap for Risk Assessment was developed as a collaborative effort of key stakeholders and partners from the Government of the Republic of the Union of Myanmar, non-government organizations, and key UN agencies. The development of the Roadmap built on a series of consultations that were held with relevant stakeholders listed in the annexes of this document as well as inputs from the numerous participants who actively participated in the consultation workshop held on 15 September 2015 in Nay Pyi Taw.

Through the introduction of the disaster risk assessment framework, the Asian Disaster Preparedness Center in Bangkok, Thailand provided full technical assistance and guidance for detailing the Roadmap. We appreciate the tireless efforts of Engr. Bandula Wickramaarachchi, Senior Technical Specialist, Department of Risk Assessment and Monitoring, Dr. Peeranan Towashiraporn, Director and Dr. Marqueza L. Reyes, Head, Department of Risk Assessment and Monitoring throughout the journey of developing the Roadmap.

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Finally, the Relief and Resettlement Department and Ministry of Social Welfare Relief and Resettlement extends its gratitude to all agencies, organizations, and individuals that supported the development of the Risk Assessment Roadmap.

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Content

1. Introduction

The Republic of the Union of Myanmar is prone to natural disasters caused mainly by cyclone, earthquake, flood, drought, and fire. Aside from the country's exposure to natural hazards, climate variability, environmental degradation, and haphazard development contribute to the likelihood of incurring increased damage and losses in the event of a disaster. Indeed, disasters destroy hard-earned development gains. In the aftermath of past disasters, the Government has had to divert existing resources earmarked for development projects to finance emergency relief, response and recovery activities. Further, vulnerable communities take a longer time to recover from disaster impacts, making it more difficult to stabilize the local economy and ultimately impeding national progress. If the country and its communities become more resilient to disaster, losses will be mitigated and the recovery process accelerated.

Devastating catastrophes in the past as well as recurring disasters adversely affecting Myanmar and its people highlight both the need to reduce disaster risk and to build resilience. To address the need to effectively manage disaster risk before and after a disaster, risk assessments should be regularly conducted. The process of risk assessment is the first step in understanding the disaster risk of a particular geographic area. It provides an in-depth understanding of a particular hazard, vulnerabilities of exposed population, society and their assets, and the likelihood and consequences of the hazard, including the magnitude and distribution of potential damage and losses that may occur. Risk assessment requires end-to-end engagement of partners and stakeholders through a collaborative and inclusive approach that supports national priorities and local capacities, and at the same time complies with internationally accepted standards.

Background of the project

After Cyclone Nargis in 2008, the Republic of the Union of Myanmar overhauled its reactive approach to disaster management and started to focus its efforts on reducing vulnerabilities and risk. The Myanmar Action Plan on Disaster Risk Reduction (MAPDRR) was developed to help guide all stakeholders to contribute in making the country safer and more resilient against disasters. One of the priority projects under MAPDRR is the development of the "Hazard and Vulnerability Atlas of Myanmar." Investments have been made in building disaster risk knowledge with reliable risk information at national and sub-national levels to enable risk-informed development planning as well as enhance disaster preparedness, mitigation and prevention. Although DRR stakeholders working in the country have focused their efforts on gathering such information, these

initiatives remain fragmented at best and have yet to be conducted in a standardized manner.

The need for a roadmap for risk assessment stemmed from the lack of standardised and systematic effort to national risk assessment effort to date. The road map details the process, activities necessary for each step and the availability and accessibility of technical and financial resources, and coordination mechanisms for the implementation of a national risk assessment. The development of the Roadmap was done through the collaborative efforts of the Relief and Resettlement Department (RRD) of the Ministry of Social Welfare, Relief and Resettlement (MSWRR), the Asian Disaster Preparedness Center (ADPC), and UNICEF. Recognizing the need to integrate risk information in the sectoral plans of the Government of Myanmar, the Roadmap was developed through an inclusive and multi-stakeholder consultation process, including personal interviews, bilateral consultations, and culminating in a Consultation Workshop on the draft Roadmap held on 15 September 2015 in Nay Pyi Taw (See Annex III- List of Partners and Stakeholders and Annex IV - List of Contributors). Sectoral concerns and challenges were identified and considered as priorities to be addressed by the Roadmap. Moreover, mandates and technical capacities of relevant national agencies, particular roles and responsibilities for executing the activities in the Roadmap, have been delineated. Further, the technical capacities of prospective partners were evaluated and considered for resource mobilisation purposes. Recommendations for filling the technical gaps, where identified, are also provided. To avoid duplication, as well as identify gaps and areas that need more support, similar initiatives related to risk assessment were likewise reviewed. Lastly, the Roadmap went through a thorough process of review, verification and endorsement by the Government, key stakeholders, and partners.

Purpose of risk assessment

Risk is defined as a combination of the probability of a natural or anthropogenic hazard and its negative consequences, such as death, damage to property loss of livelihood, disruption of economic activities, and damage to the natural environment. As defined by UNISDR, risk assessment is a methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend[1]. In general, risk assessment answers the following questions:

- What can happen and why?

[1] UNISDR, Terminology on Disaster Risk Reduction, 2009, p. 26

- What are the consequences?
- What is the probability of their future occurrences?
- Are there any factors that can mitigate the consequences of the risk?
- Is the level of risk tolerable or acceptable and does it require further treatment?

The risk assessment process includes:

a) exploration of the spatial and temporal distributions of hazards in terms of intensity, location, and frequency;
b) analysis of exposure and vulnerability of at-risk elements in relation to t human, physical, social, economic and environmental dimensions; and
c) evaluation of the effectiveness of current and alternative coping capacities with respect to likely risk scenarios.

A comprehensive risk assessment not only estimates the magnitude and likelihood of probable losses, but also builds the risk knowledge towards understanding the hazards, underlying causes of vulnerability, and potential damage and losses as well as long-term impacts of a disaster. Moreover, risk assessment provides the basis for determining the acceptable levels of risk of the community and allows for the formulation of disaster risk reduction measures to reduce current risk to acceptable levels. When DRR interventions are implemented, periodic assessments of risk provide information to measure their effectiveness and help in subsequently improving DRR initiatives. Building up risk knowledge is therefore fundamental and an integral part of the decision-making process for disaster risk reduction and sustainable development.

Links to national, regional and global frameworks

Natural Disaster Management Law, 2013

The Natural Disaster Management Law of Myanmar was enacted on 31 July 2013, with the ultimate goal of reducing disaster risk due to natural disasters. The Roadmap is aligned with the objectives contained in Chapter II to:

(a) implement natural disaster management programs systematically and expeditiously in order to reduce disaster risk.

(c) coordinate with national and international government departments and organizations, social organizations, other non-government organizations and regional organizations in carrying out natural disaster management activities.[2]

[2] Natural Disaster Management Low 2013, Myanmar, p. 3

The Roadmap identifies and details the process for assessing risk systematically. Since the recommended activities have to be implemented in collaboration with a number of partners, implementation and coordination mechanisms are also introduced. Further, Chapter IV of the Natural Disaster Management Law requires the formulation of a disaster management plan, in order to reduce the likely damage and losses through various means, including preparatory and preventive measures in the pre-disaster period[3]. As stipulated in the Law, identifying areas where disaster is likely to occur and conducting disaster risk assessments are the first steps to be taken in the pre-disaster period.

Myanmar Action Plan on Disaster Risk Reduction (MAPDRR)

The Roadmap is further aligned with the Myanmar Action Plan on Disaster Risk Reduction (MAPDRR), developed and endorsed in 2012 by the Government of Myanmar. MAPDRR is in line with the Hyogo Framework for Action (HFA) and the ASEAN Agreement on Disaster Management and Emergency Response (AADMER).

Specifically, Component 2 of MAPDRR requires the conduct of Hazard, Vulnerability and Risk Assessment, on which the effective implementation of the other seven components will be based.[4] This component further underlines the importance of conducting vulnerability and risk assessment at various levels and generating the following risk assessment outputs:

1. Hazard and vulnerability atlas of Myanmar
2. Landslide hazard zonation map
3. Flood risk map
4. Drought prone area map
5. Cyclone and storm surge map
6. Seismic zonation map
7. Wider usage of fire hazard zonation map

DRR Working Group Strategic Framework 2013-2018

The Disaster Risk Reduction Working Group (DRR WG), formed during the recovery phase of Cyclone Nargis in 2008, is a network of agencies with a high level of commitment, broad participation, and strong engagement with government line departments, including the Relief and Resettlement Department. Outcomes 2 and 3 of the WG's Strategic Framework pertains directly to risk assessment. It maintains that risk assessment provides the technical basis for formulating disaster management plans and

[3] Natural Disaster Management Low 2013, Myanmar, pp. 13-14
[4] RRD, MAPDRR 2012, pp. 9-13

allocating resources, among others. According to the Strategic Framework, hazard, vulnerability, and risk information likewise builds DRR knowledge and awareness, and facilitates the mainstreaming of DRR into development sectors[5].When conducted, the risk assessment process itself increases the capacities of institutions as well.

ASEAN Agreement on Disaster Management and Emergency Response (AADMER)

The ASEAN Agreement on Disaster Management and Emergency Response (AADMER) has been ratified by all 10 Member States and came into force in 2009 as a regional framework for cooperation, coordination, technical assistance, and resource mobilisation in all aspects of disaster management. The AADMER Work Programme for 2010 – 2015 was adopted by the ASEAN Committee on Disaster Management (ACDM) as a rolling plan to be implemented in phases. Risk assessment, early warning and monitoring has been identified as the first strategic component of the AADMER work programme 2010 – 2015. The component aims to reduce losses and damage from disasters, through the identification of hazards, vulnerabilities and risks as proactive measure, and thereby increasing warning time. This component further aims to improve regional risk assessment and early warning activities with a focus on cross-boundary issues that require inter-country collaboration, more inclusive disaster planning and mitigation efforts as well as targeted response and recovery activities[6].

There is also the ASEAN Roadmap for Risk Assessment, which identifies five thrusts:

- Adopting a common disaster terminology among ASEAN Member States;
- Promoting disaster data collection and data sharing;
- Identifying the different purposes, types and outputs of risk assessment undertaken in the region;
- Priorities for research and development and capacity building; and
- Promoting partnerships and role of relevant ASEAN bodies and stakeholders.

Sendai Framework for Disaster Risk Reduction 2015-2030

The Hyogo Framework for action 2005 – 2015 (HFA) underlines the need to "Identify, assess and monitor disaster risks and enhance early warning" as one of its five priorities. HFA further states that, "The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face,

[5] DRR Working Group Myanmar, Strategic Framework 2013 – 2018
[6] ASEAN Secretariat, AADMER Work Programme 2010 – 2015

and of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action taken on the basis of that knowledge."

On March 18, 2015 at the Third UN World Conference on DRR held in Sendai, Japan, "Understanding disaster risk" was identified as Priority 1 in the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR). SFDRR further states that, "Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be leveraged for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response to disasters." Further, SFDRR emphasizes that children and the youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction[7].

Risk assessment initiatives in Myanmar

Several risk assessment projects have been undertaken in Myanmar, such as:

- Seismic hazard assessment of Yangon City, 2015, MGS, MEC and UN-Habitat
- Earthquake risk assessment of Pyay City, 2015, MGS, MES, MEC and UN-Habitat
- Earthquake risk assessment of Bago, Taungoo and Sagaing City, 2013, MGS, MES, MEC and UN-Habitat
- Earthquake Risk Assessment of Mandalay, 2012, ADPC/DMH/ MEC
- Multi Hazard Risk Assessment of Rakhine State of Myanmar, 2011, UNDP/ ADPC/ MES
- Multi Hazard Risk Assessment of Nargis-affected Area, January 2011, UNDP/ TARU/ INRM/ MSR
- Hazard Profiling of Myanmar, 2009, ADPC
- Deterministic and Probabilistic Seismic Zoning Map of Myanmar, 2008 and 2012-Myanmar Earthquake Committee
- Flood Hazard Mapping of Lower Chindwin River Basin, 2005, DOH India

These projects were mostly driven by the interests of the parties involved or by the availability of financial and technical resources and undertaken for certain purposes. Nevertheless, these efforts have contributed to the body of risk knowledge in the country and provide good examples of risk assessment products and outputs that are used for disaster risk reduction and management in Myanmar. Ongoing assessments are also underway, such as:

[7] UNISDR, Sendai Framework for Disaster Risk Reduction 2015-2030, p. 23

- Flood Risk Assessment for Hpa-An City, ongoing, DMH, RRD, DUHD, UNDP and UN-Habitat
- Flood Risk Assessment- Yangon, Mawalamyine and Mandalay - DMH and ADB
- Flood Risk Assessment of Bago River Basin
- Seismic Risk Assessment of Yangon City

At the local level, community risk assessments have been conducted mostly as part of Community-based Disaster Risk Management (CBDRM) programs by different organizations in disaster prone areas, in the delta region during the Nargis Recovery period and Rakhine State after Cyclone Giri. However, CBDRM programs represent only a little percentage of the local risk assessments which should be done at various levels in the country. As per 3W (who, what, where) information of the Myanmar Information

Management Unit (MIMU), 1178 villages/wards (1.65% of all villages/wards in the country) have been covered by CBDRM programmes of different agencies so far.8

Related efforts on risk assessment in Myanmar

There are other initiatives that support the risk assessment process through database development, risk information management and promoting the use of existing risk information:

- Capacity building on risk assessment and for sharing of risk information, ongoing, ADPC – A risk portal is now online for sharing hazard, vulnerability and risk information using a web-based GIS platform. The web portal is temporarily hosted by ADPC, while arrangements for institutionalization of the portal are being established by RRD. Data sharing guidelines are being drafted and a risk assessment handbook is currently under review. Training courses on risk identification, assessment and application, spatial data management and analysis, and content management of the risk portal have been undertaken.
- National Disaster Damage and Loss Database, ongoing, RRD, UNDP and UN-Habitat – The development of a damage and loss database using the software DesInventar is being piloted in several townships in Mandalay and Ayeyarwady State. Integration of this database into the Myanmar web-based risk portal will be explored.

[8] www.themimu.info/3w/index.php.

2. Disaster Risk Context of Myanmar

Over the past few decades, losses suffered as a result of disasters in Myanmar have increased significantly. Cyclone Nargis in 2008, which remains the worst disaster ever recorded in Myanmar's history, devastated the Ayeyarwady Delta region, with a death toll of 138,366, and damage worth 4.1 billion US dollars[10]. Given the geographic setting of the country, apart from frequent storms, Myanmar is prone to natural disasters caused by flood, earthquake, tsunami, landslide, storm surge, drought, and fire. (*Table 1*). Climate change exacerbates the threat due to hydrological and meteorological hazards.

Table 1 Top 10 hazards ranked on number of deaths reported from year 2000[9]

Type	Date	Total deaths
Storm	02/05/2008	138,366
Storm	19/05/2004	236
Flood	19/10/2011	151
Earthquake	24/03/2011	74
Earthquake	26/12/2004	71
Landslide	17/06/2010	68
Flood	02/06/2001	51
Storm	22/10/2010	45
Earthquake	11/11/2012	38
Storm	29/04/2006	34

Hazardscape of Myanmar

The Natural Disaster Management Law of 2013 of Myanmar defines natural disasters as the destruction to life and property, livelihood, infrastructures, education and health of the public, to the environment, and damage to crops. In the Law, natural or human-induced hazards are identified as the following:

1. Fire, landslide, storm, flood, drought, earthquake, tsunami, avalanche, heat or cold wave, volcanic eruption, erosion of banks and shores.
2. Outbreak of contagious human diseases.
3. Pests or plant diseases, starvation, or outbreak of animal diseases.

[9] http://www.emdat.be/country_profile/index.html, visited on 04/07/2015

[10] Myanmar Agriculture at a Glance 2008, Department of Agriculture Planning, Ministry of Agriculture and Irrigation, pg. 14.

4. Maritime, industrial, chemical or nuclear accident, oil spill, or leakage of natural gases.
5. Violence and armed insurgencies.[11]

Geographically, Myanmar can be divided into three ecological regions:

1. Fertile delta and coastal regions (Rakhine, Mon and Tanintharyi)
2. Central plains (Dry Zone) (Magway, Mandalay and Sagaing)
3. Northern mountainous regions (Chin Hills and Shan Plateau)

There are significant differences in settlement patterns, agricultural systems, and economic activities due to the varying characteristics of topography, climate, and ecology. Most of the prevailing hazards are also influenced by geography and seasons. There are three distinct seasons in Myanmar: cold and dry season, from November to February, hot-dry season from March to April, and wet season between May and October. Annual rainfall in the coastal regions varies between 2,500 and 5000 millimetres, while average annual rainfall in the Dry Zone is less than 1,000 millimetres[12]. As a whole, the topography of the country generates a diversity of climatic conditions. *Table 2* describes the geographic and seasonal characteristics of hazards and the corresponding concerned government agencies. This determines the spatial domain to be considered in hazard assessment and knowledgeable technical agencies.

Table 2 Geographic characteristic of Hazards and concern technical agencies

Hazard	Geography			Seasonal impacts[13]	Concerned Government Agencies
	Coastal regions	Central plains	Mountainous regions		
Forest fire			■	December to May	Forest Department
City fire	■	■	■	January to May	Fire Services Department
Storm/storm surge	■			April, May, October	Department of Mereology and Hydrology
Riverine flood	■	■		May to October	Irrigation Department, Department of Meteorology and Hydrology

[11] Natural Disaster Management Low 2013, Myanmar, p. 1
[12] http://www.weather-and-climate.com, visited on 04/08/2015
[13] RRD, ADPC, Institutional Arrangements for Disaster Management in Myanmar, pp. 4-7

Hazard	Geography			Seasonal impacts[13]	Concerned Government Agencies
	Coastal regions	Central plains	Mountainous regions		
Flash flood	■	■	■	May to October	Department of Meteorology and Hydrology
Earthquake	■	■	■	Year around	Department of Meteorology and Hydrology
Landslide			■	May to October	Ministry of Construction
Drought		■		December to May	Department of Meteorology and Hydrology, Dry Zone Greening Department
Tsunami	■			Year around	Department of Meteorology and Hydrology
Salt intrusion	■			Year around	Department of Meteorology and Hydrology
River bank erosion	■	■		May to October	Development of Water Resources, Rivers and Creeks Department
Epidemic	■	■	■	Year around	Public Health Department

Socio-economic vulnerability in Myanmar

Human vulnerability is described as the difficulty in withstanding, coping with and recovering from the impact of a given hazard scenario. Certain characteristics and circumstances of individuals, communities, systems, or assets make them susceptible to the damaging effects of a hazard event. For example, socioeconomic conditions can make it more difficult for a poor community to cope with the effects of riverine flooding as well as prolong the process of economic recovery. In a disaster situation therefore, certain groups of people may be more vulnerable than others. The concept of vulnerability expresses the multidimensionality of disasters by focusing attention on the totality of relationships in a given social situation which constitute a condition that, in combination with environmental forces, produces a disaster.[14] Poverty and social marginalization are often considered as root causes of human vulnerability.

Factors such as age, gender, physiological status, and educational attainment influence the degree of vulnerability of the exposed population, which can either make them less

[14] Bankoff et al. 2004.

or more vulnerable. It is widely recognized that certain groups of people such as children, women, the elderly, and people with disabilities are most vulnerable to disaster. Children, for example, have specific needs and require focused attention in order to protect their well-being and development. Children who survive a disaster usually experience anxiety, and separation from their parents also become a threat to having a healthy childhood. The loss of home and livelihood of their family may also lead to homelessness and extreme poverty. Hence, a disaster can be very distressing to children, and may affect their lifelong development potential (Figure 1). Moreover, children with disabilities are more vulnerable and sensitive to disasters. In Myanmar, statistics show that around 318,000 (2%) children younger than 15 years are disabled, of which 249,000 (78%) are of school-age[15].

With a population of nearly 52 million according to the provisional results of the 2014 Myanmar Census, the country is roughly 52 percent female and 48 percent male. Based on the 2011 population estimate, those aged between 0–14 years old constituted 27.5 percent of the population, 15–64 years, 67.5 percent, and 65 years and over, 5 percent.

Ranked 150th of 187 on the Human Development Index, Myanmar's HDI value for 2013 is 0.524— which is in the low human development category—positioning the country above the average of 0.493 for countries in this low human development group and below the average of 0.703 for countries in East Asia and the Pacific. HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life (i.e. life expectancy), access to knowledge (mean years of education among the adult population and expected years of schooling for children of school-entry age) and a decent standard of living (i.e. Gross National Income (GNI) per capita expressed in constant 2011 international dollars converted using purchasing power parity (PPP) rates). [16]

Myanmar is also ethnically diverse, with about 135 distinct ethnic groups officially recognized by the government. For most of its independent years, the country has been engrossed in rampant ethnic strife, which has become one of the world's longest-running ongoing civil wars. Such human-induced risk compounds the vulnerabilities to disaster and climate change of the population that are already mired in poverty and have limited access to basic social services and infrastructure.

Risk index and ranking of Myanmar

[15] Ministry of National Planning and economic Development, Situation Analysis of Children in Myanmar, 2012

16 UNDP, Human Development Report 2014, Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MMR.pdf

The synthesis report on ASEAN disaster risks[17], provides indicators on national level risks for the region. To measure potential economic impact on national economies, the study estimated the economic vulnerability (EV) rankings of each country in terms of likely economic losses as a percentage of that country's Gross Domestic Product (GDP) at a disaster event with a 200-year return period. As indicated in Figure 2, Myanmar has the highest EV ranking in the region, followed by Laos, Indonesia, Cambodia, Vietnam, Philippines, Thailand, and Malaysia. For a 20-year return period (an event with 5 per cent probability of exceedance) loss for all natural hazards would reach $873 million (1.54 per cent of GDP PPP), while for a 200-year return period (an event with 0.5 per cent probability of exceedance, which generally corresponds to a catastrophic event) loss would amount to $3.093 billion (5.48 per cent of GDP of Myanmar).

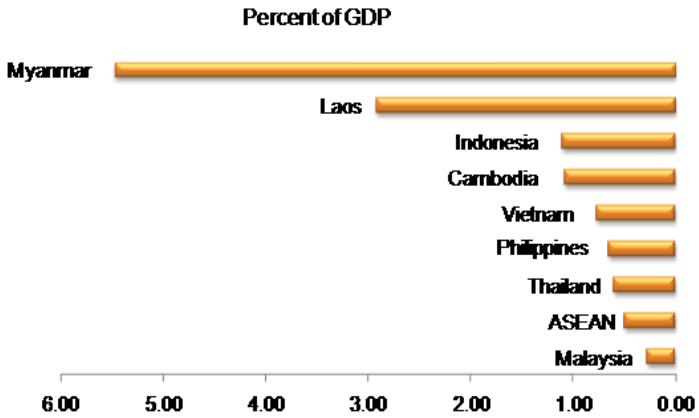


Figure 2 Economic Loss Potential for annual probability of exceedance of 0.5 per cent

Based on another assessment, the UNISDR **Global Assessment Report 2015** (GAR) ranks Myanmar as the highest in terms of average annual loss in relation to social expenditure[18] (see Figure 3).

[17] ASEAN Disaster Risk Management Initiative, Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment, 2010

[18] UNISDR, Global Assessment report 2015, p. 64

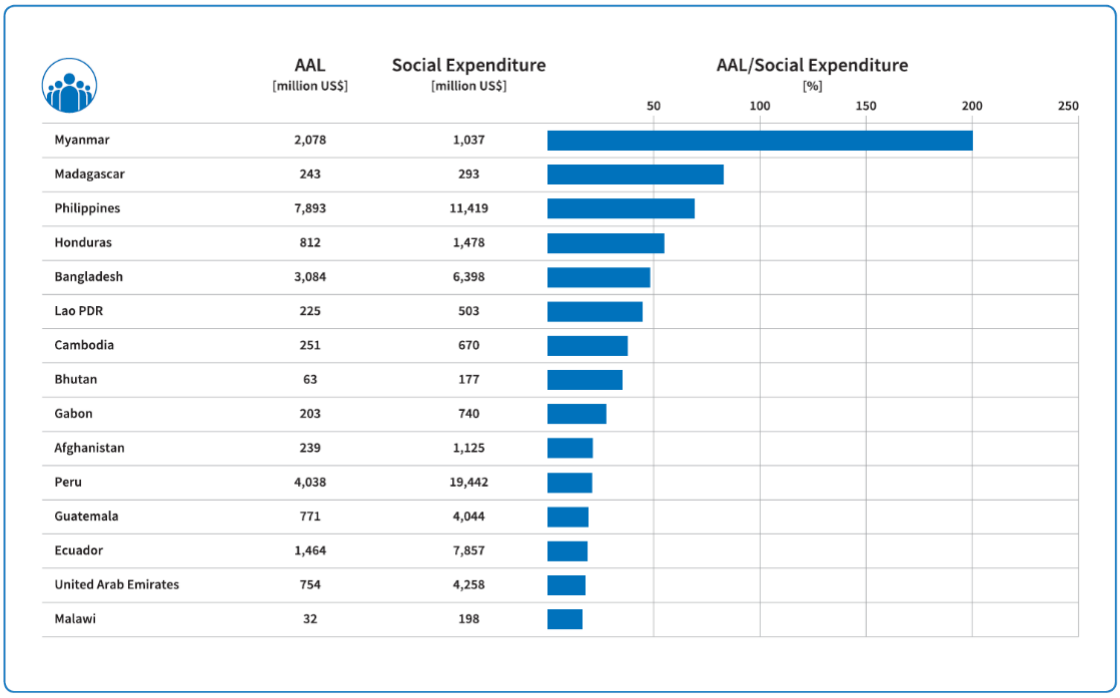


Figure 3 Top 15 countries based on multi-hazard average annual loss in relation to social expenditure.

The **Index for Risk Management** (INFORM), which is a collaboration of the Inter-Agency Standing Committee Task Team for Preparedness and Resilience and the European Commission, also measures the risk of humanitarian crises and disasters. The INFORM Results 2015 ranks Myanmar as the 10th highest country with overall risk index of 6.77 among 191 countries (Figure 4). This risk index has been stable for the last three years. When only the hazard and exposure dimensions are considered, Myanmar ranks 5th with an index of 8.22 (Table 3). If only the natural hazard is considered, Myanmar ranks 3rd highest with an index 9.08[19].

Table 3 *INFORM risk index and breakdown in 3 dimensions*

	Value	Rank	Trend
INFORM	6.78	10	EQUAL
Hazard	8.28	5	EQUAL
Vulnerability	5.38	39	EQUAL
Coping Capacity	7.00	35	EQUAL

[19] Index for risk management results 2015

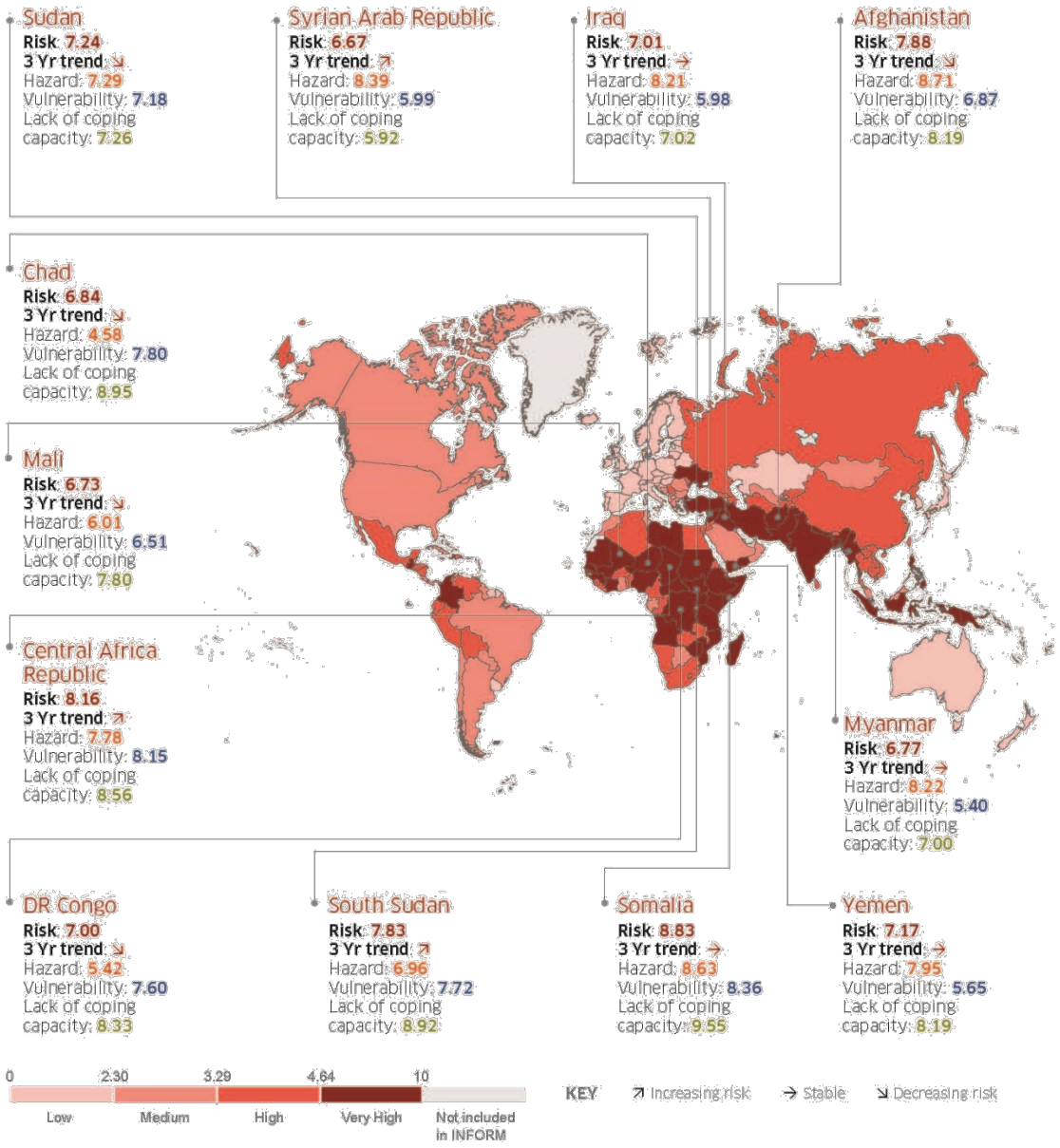


Figure 4 Countries with the highest overall risk based on INFORM, 2015.

The **Global Climate Risk Index 2015**[20] is developed by Germanwatch for quantifying the impacts of extreme weather-related events (storms, floods, heat waves etc.), both in terms of fatalities as well as economic losses based on data from the Munich Re NatCatSERVICE. The 2015 analysis has been done using the most recent data available from 1994 to 2013. The ranking of the countries affected has revealed

[20] Kreft, Ss, Eckstein, D., et al., Global Climate Risk Index 2015, GERMANWATCH

that Honduras, Myanmar and Haiti are the highest impacts for the period from 1994 to 2013 (Table 4).

Table 4 The long term Climate Risk Index (CRI): the 10 countries most affected from 1994 to 2013 (annual averages)

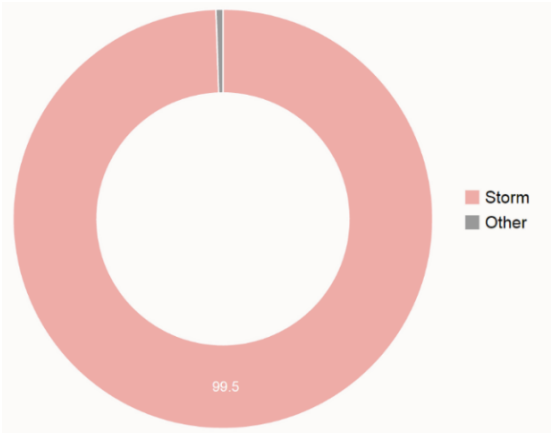
CRI 1994–2013	Country	CRI score	Death toll	Deaths per 100,000 inhabitants	Total losses in million US$ PPP	Losses per unit GDP in %	Number of Events (total 1994–2013)
1 (1)	Honduras	10.33	309.70	4.60	813.56	3.30	69
2 (2)	Myanmar	14.00	7137.40	14.80	1256.20	0.87	41
3 (3)	Haiti	16.17	307.80	3.41	261.41	1.86	61
4 (4)	Nicaragua	16.67	160.15	2.98	301.75	1.71	49
5 (7)	Philippines	19.50	933.85	1.13	2786.28	0.74	328
6 (5)	Bangladesh	20.83	749.10	0.54	3128.80	1.20	228
7 (6)	Vietnam	23.50	391.70	0.48	2918.12	1.01	216
8 (8)	Dominican Republic	31.00	210.45	2.38	274.06	0.37	54
9 (10)	Guatemala	31.17	83.20	0.68	477.79	0.62	80
10 (12)	Pakistan	31.50	456.95	0.31	3988.92	0.77	141

Priority hazards for risk assessment

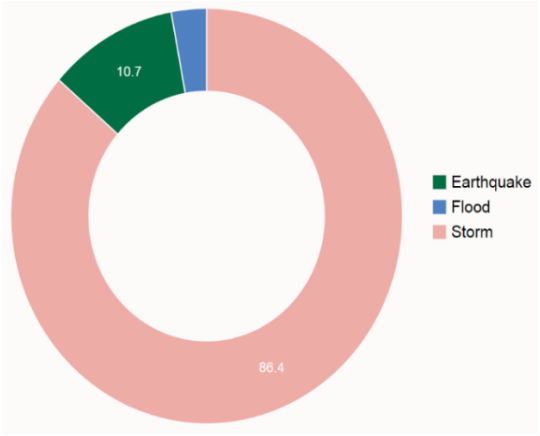
Prioritizing hazards to be considered for risk assessment can be done using various indicators. Using EM-DAT data from 1990 to 2014, results based on four indicators: mortality, economic loss, frequency of occurrence, and contribution to AAL, are shown in Table 6.

Table 6 *Analysis based on internationally reported losses 1909 - 2014*[21]

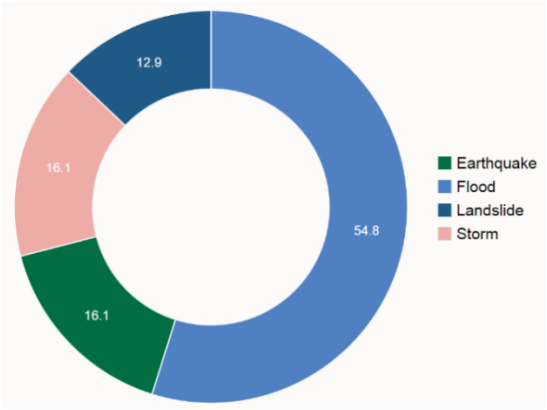
[21] http://www.preventionweb.net/countries/mmr/data/, visited on 08/07/2015



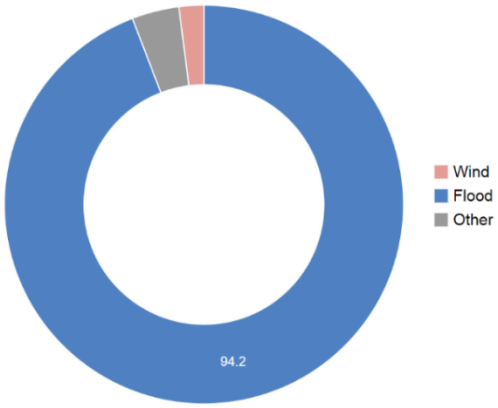
Mortality



Economic Losses



Frequency



Contribution to AAL

Considering the recurrence of hazard, flood was the most frequent, accounting for 55% of the total number of events, followed by storm and earthquake with 16% each, and landslide, 13%. During the key informants' interviews, fire was also identified as a priority. Since the EM-DAT database reports only disasters in which at least 10 people were killed, or 100 or more people reported affected, or when a declaration of a state of emergency or call for international assistance is made, it is possible that many urban fires in Myanmar were not included in the database.

In terms of mortality and total economic losses due to past incidents, it appears that storm should be ranked highest. However in comparing and ranking the risk, the Average Annual Loss (AAL), which is the expected loss per annum associated with the occurrence of future perils assuming a very long observation timeframe, provides a much more meaningful measure. It considers the damage caused on the exposed

elements by small, moderate and extreme events. In terms of financial impacts measured by Average Annual Loss (AAL), flood contributes the highest with 94% of the total AAL, followed by storm with 2%.

The ASEAN Disaster Risk Management Initiative likewise analysed the risk arising from different hazards in ten countries in ASEAN. It confirms that, in Myanmar, storm is the dominant risk followed by tsunami, flood, and forest fire. The study further explains the risk in terms of frequency, death rate, and relative vulnerability as given in Table 5. In terms of the average annual economic losses (Figure 5), storm is the dominant risk with an economic AAL of $147.4 million, followed by tsunami, floods, and forest fire.

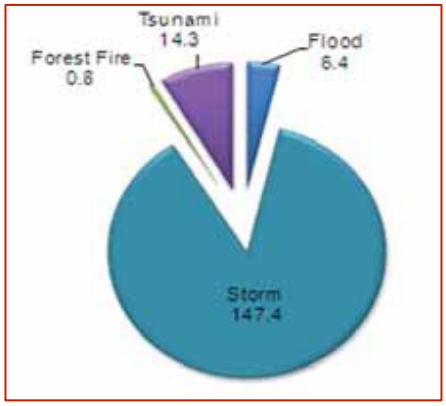


Figure 5. Average annual economic loss (USD million) of Myanmar

Table 5 Disaster statistics (1970 – 2009)

Disaster Risk Statistics (1970-2009)				
Disaster type	*No. of disasters / year*	*Total no. of deaths*	*Deaths/ year*	*Relative vulnerability (deaths/year/ million)*
Flood	0.43	364	9.10	0.19
Storm	0.18	138,864	3471.60	72.12
Epidemic	0.05	40	1.00	0.02
Landslide	0.05	41	1.03	0.02
Forest Fire	0.05	8	0.20	0.00
Earthquake	0.05	-	0.00	0.00
Tsunami	0.03	71	1.78	0.04

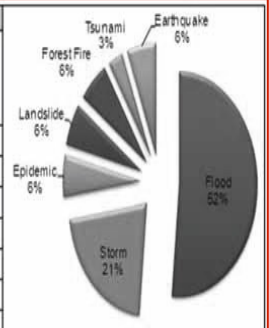


Figure 20: Percentage distribution of reported disasters in Myanmar

Given these and priorities defined by interviewed stakeholders, there are three clusters of hazards to be prioritized in the assessment of risk (Table 7).

Table 7 *Priority hazards for risk assessment*

Rank	Hazard
Priority cluster 1	Flood (highest AAL)
	Storm (highest mortality)
	Urban fire (highest occurrence)
	Drought (affect more people)
	Landslide (severe disruption to transportation)
Priority cluster 2	Earthquake (high occurrence)
	Tsunami (high severity)
	Erosion of banks and shores
	Heat or cold wave (affect more people)
	Outbreak of contagious human diseases

Rank	Hazard
Priority cluster 3	Outbreak of pests or plant diseases
	Forest fire
	Avalanche
	Volcanic eruption
	Outbreak of animal diseases
	Maritime accident, oil spill and leakage of natural gas
	Industrial and chemical accident
	Violence and armed insurgencies
	Nuclear accident

Table 8 Sectors and subsectors in Myanmar

Sector	Sub-sectors
Agriculture	Agriculture
	Fisheries
	Livestock
Communication	Digital infrastructure
	Telecommunication
	Mass media
Education	Education
	Early-child development
	Basic education
	Higher education
	Vocational training
	Monastic education
	Disabled children education
	Education sector infrastructure
	Teacher training
	Curriculum development
Environment	Land and water
	Marine environment
	Ecosystem services for DRR
Finance and Economy	National and local planning
	Fiscal management
	Equity and eradicating poverty
Health	Child health
	Public health
	Health sector infrastructure
Urban development and Infrastructure	Housing and urban land use
	Public assets
	Critical facilities
	Energy
Rural Development	Rural infrastructure
	Rural housing
	Water and sanitation

Sector	Sub-sectors
	Land use
	Livelihood
Social	Social protection
	Enabling disadvantaged groups
	Child protection
	Women
	Elderly
Transport	Road network
	Water transport
	Seaports and airports
Water	River basins
	Dams and Reservoirs
	Irrigation, drainage and control structures
	Ground water extraction
	River pumping

Sectoral concerns

Even though disaster consequences are hazard specific, the risk has to be assessed along sectoral lines to facilitate the mainstreaming of risk in sectoral planning. In developing the Roadmap, consultations with key partners and stakeholders from different sectors were conducted. They participated in workshops, a series of focus group discussions, and interviews facilitated by ADPC. From the concerns expressed by the stakeholders, risk shall primarily be measured in the sectors listed in

Table 8. The outcomes of the consultations were also analysed to determine sectoral sensitivities to hazards, as shown in *Table 9*. The consultations further pointed out sectoral objectives with respect to disaster risk management and essential applications of risk assessment in the respective sectors. Inputs and recommendations of the stakeholders such as applications and customised formats of risk assessment outputs were also noted, as tabulated in *Table 10*.

Table 9 Sectoral sensitivities to hazards

Hazard	Sectors									
	Social	Infrastructure	Agriculture	Transport	Education	Finance and Economy	Rural Development	Health	Environment	Water
Drought	■		■		▫	▫	▫	■	■	■
Earthquake	■	■		■	■	■	■			
Epidemic	■				▫	▫	▫	■		
Flash flood	■	▫	▫	■		▫	▫	▫		▫
Forest fire						▫			■	▫
Landslide	■	■		■		▫	■	▫	▫	▫
River bank erosion	■		▫			▫	■		▫	▫
Riverine flood	■	■	■	■	■	■	■	▫		■
Salt intrusion	▫		■			▫	■	■	■	■
Storm/storm surge	■	■	■	■	■	■	■	▫	▫	▫
Tsunami	■	■	■	■	■	■	■	▫	▫	▫
Urban fire	■	■				▫				

■ Primary/high sensitivity ▫ Secondary/low sensitivity □ No significant sensitivity