Regional Assessment on Ecosystem-based Disaster Risk Reduction and Biodiversity in Asia

Convention on Biological Diversity

Japan Biodiversity Fund

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Table of Contents

Figures

Tables

Boxes

Abbreviations

BCN	Bird Conservation Nepal
CBD	UN Convention on Biological Diversity
CBEMR	Community-based ecological mangrove restoration
CCA	Climate Change Adaptation
CCCA	Cambodia Climate Change Alliance
CCDB	Christian Commission for Development in Bangladesh
COP	Conference of the Parties
CRED	Centre for Research on the Epidemiology of Disasters
CSOs	Civil Society Organisations
DBSSF	Dong Bundh system of Subankhata forest
DDPM	Department of Disaster Prevention and Mitigation
DHM	Department of Hydrology and Meteorology
DMCR	Department of Marine and Coastal Resources
DRM	Disaster Risk Management
DRRM	Disaster Risk Reduction and Management
DSCO	District Soil Conservation Office
DWIDP	Department of Water Induced Disaster Prevention
EbA	Ecosystem based Adaptation
EPIC	Ecosystems Protecting Infrastructure and Communities
FFC	Flood Forecasting Centre
GAR	Global Assessment Report
GLOFs	Glacial Lake Outburst Floods
HFA	Hyogo Framework for Action
IBA	Important Bird Areas

ICIMOD	International Centre for Integrated Mountain Development
LDCs	Least Developed Countries
MFF	Mangroves for the Future
MTR	Manas Tiger Reserve
NAPA	National Adaptation Programmes of Action
NDRRMP	National Disaster Risk Reduction And Management Plan
NFPP	Natural Forest Protection Program
PA	Protected Areas
PEDRR	Partnership for Environment and Disaster Risk Reduction
SIDS	Small Island Developing States
SLCP	Sloping Land Conversion Program
UNFCCC	United Nations Framework Convention on Climate Change

Executive summary

Background

The Asia region includes some of the most diverse ecosystems on the planet, from the large high-altitude Himalayan ecosystem to the Indo-Burma hotspot, Heart of Borneo rainforest ecosystem and the Coral Triangle ecosystem. The region is also home to five of the world's megadiverse countries: People's Republic of China, Indonesia, India, Malaysia and the Philippines.

This biodiversity is, however, under increasing pressure with rapid economic growth in the region leading to expansion of industrial agriculture, large-scale infrastructure development and rapid land-use change. In addition, drivers such as illegal wildlife trade, invasive alien species and climate change have further exacerbated the loss of biodiversity. Recent studies have shown a significant decline in the state of ecosystems and in their ability to provide vital goods and services.

Scope

The Asia regional assessment is one of six regional assessments that will be carried out across the world. The regional information on Asia was collected focusing on the countries' experiences on Eco-DRR with specific emphasis on biodiversity conservation. The assessment includes a review of the policy and practice related to the application of ecosystem-based approaches to address disaster risk reduction (DRR) including the impacts of climate change.

In the regional assessment for Asia, there is in-depth analysis provided on eight countries, namely, Bangladesh, Cambodia, People's Republic of China, India, Nepal, Philippines, Thailand and Viet Nam and in addition three specific case studies have been presented from Japan, Pakistan and Sri Lanka.

The countries chosen for assessment primarily comprise those that have the highest frequency of natural hazard occurrence. Due to the nature of the disasters and the availability of data, careful and selective empirical studies have been undertaken on the effects of hazards and their relation with ecosystems for recovery and prevention.

This assessment aims to develop an understanding of the ecosystem-based approach to DRR. The assessment also explores the possible entry points in terms of integrating biodiversity conservation measures into DRR frameworks at national and sub-national levels.

The assessment targets existing policies and their implementation through different case studies from the selected vulnerable countries so as to further look for context-based solutions that are effective and efficient in addressing disaster risk reduction.

This Asia regional assessment analyses the vicious cycle of disasters, increased risk of climate-related hazards and ecosystem degradation. Second, it defines the central role of ecosystems in disaster risk reduction and their intrinsic links with the existing habitat types; and third, it assesses the challenges for enhanced ecosystem management for disaster risk reduction and biodiversity conservation.

Analysis

In this report, the policy frameworks as well as significant policies related to disaster risk reduction and climate change adaptation and mitigation have been analysed to understand to what extent these have incorporated ecosystem-based approaches and specifically biodiversity conservation measures. In addition, each of the Intended Nationally Determined Contributions to the UNFCCC has been analysed. On the other hand, the biodiversity conservation policies and recent official Communications to the UN Convention on Biological Diversity Secretariat have also been analysed to determine to what extent these refer to disaster risk reduction and/or climate change and also recognise biodiversity conservation to address disaster risk reduction and climate change adaptation and mitigation.

The report also includes eight specific evidence-based project level case studies for each of the countries of focus that clearly demonstrate the application of biodiversity conservation towards addressing disaster risk reduction including in the face of climate change impacts. These include: mangrove restoration initiatives in coastal areas of Thailand, Viet Nam and Cambodia; effective utilisation of the invasive water hyacinth plant for addressing sustainable livelihoods of flood affected communities in Bangladesh; land conservation programmes using natural vegetation to reduce impact of landslides in China and Nepal; applying traditional nature-based technologies to address flood risk hazard in India; and restoring degraded lagoons by fostering natural propagation of coral reefs in the Philippines.

Introduction

The Asia region accounts for 4.3 billion people which is nearly 55% of the world's population with 573 million people added between 2010 and 2014 and China and India on their own accounting for 1.4 billion and 1.2 billion people, respectively. This is in spite of the fact that Asia's population growth rate of 0.9% is now lower than the global population growth rate of 1.1%.

In addition, Asia has among the most culturally diverse demographic compositions on the planet with wide diversity in the cultural heritage of different nationalities, societies and ethnic groups including indigenous or equivalent communities. Asia also has large populations of the practitioners of the world's largest religious denominations including Islam, Christianity, Buddhism, Hinduism and Asia-specific religions such as Taoism, Sikhism, Jainism, Confucianism and Shintoism. These diverse cultural specificities and religious denominations have contributed to the complexity of Asian society. Asia also has significant populations of Indigenous peoples' communities that have traditionally coexisted with their natural environments with some of their cultural norms, mores and specificities shaped by the complex interactions with nature.

Asian countries are continuing to spur global economic growth with GDP in the region expected to increase by 6.3% in 2015–2016 primarily driven by growth in South Asia and ASEAN, which will balance the slowing growth in Northeast Asia. The developing countries of Asia have contributed 2.3% of the overall 40% annual GDP growth from the time of the economic crisis in 2009 onwards, thereby contributing more than 60% to the global GDP growth increase (ADB, 2015). Even though the Asia region has witnessed significant economic development and reduction in poverty, it continues to account for the largest number of absolute poor on the planet. In addition, with the growth in population in urban areas located in coastal and riverine areas, the exposure and corresponding vulnerability of the population to natural disasters is increasing significantly.

Well-managed ecosystems, such as wetlands, forests and coastal systems, act as natural infrastructure, reducing physical exposure to common natural hazards, such as landslides,

flooding, avalanches, storm surges, wildfires and drought (Renaud et al., 2013). Such natural infrastructure also provides multiple benefits for increasing the socio-economic resilience of people and communities by sustaining local livelihoods and providing essential needs such as food, water and building materials (Morawetz & Nehren, 2005), catering for future needs as well as the urgent current ones.

The objective of the assessment is to highlight the role and opportunities biodiversity conservation provides for Ecosystem-based disaster risk reduction (Eco-DRR). This report is also expected to support the implementation of the Aichi Targets by clearly demonstrating that disaster risk reduction and biodiversity conservation are mutually reinforcing.

According to Estrella and Saalismaa (2010, "***Eco-DRR is the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development".***

In spite of the many benefits of ecosystem-based solutions, many challenges remain for it to become accepted and practised in disaster risk reduction and adaptation measures (ibid). This assessment elaborates on the challenges and opportunities for implementing ecosystem-based solutions for disaster risk reduction.

1. Approach and process

This section will outline the approaches used to assess the policy and institutional context for biodiversity conservation for DRR using selected country examples in Asia.

The qualitative research was carried out to document the development and application of ecosystem and biodiversity conservation approaches for DRR and CCA challenges. This was conducted in the selected countries from the perspectives of institutions, national policy, sustainable livelihoods, climate change adaptation and disaster management (including prevention and mitigation).

At the core of its country level work, this regional assessment supported in-depth case studies on the hazards facing individual countries. Hazards may be the same for different countries, but the approaches and strategies adopted vary across countries in the region, which this study clearly fleshes out in terms of specificities emerging from differing institutional arrangements, geographical settings and socio-economic conditions.

The formulation of this report began with an extensive literature review, followed by semi-structured questionnaire surveys with the stakeholders from the disaster risk reduction related institutions. The questionnaire survey was carried out primarily to triangulate data gathered and fill the knowledge gaps.

1.1. Sources of information

Extensive sources of information have been used for this assessment. Please refer to the references and bibliography section for the list of documents studied and referenced.

Primary and secondary data are the two major sources of information for this assessment. Secondary sources of information include scientific articles, policy documents, country specific examples, case studies, project documents, etc. In addition, responses were obtained from targeted respondents including relevant government, NGO, INGO and other stakeholders through a questionnaire circulated to supplement information and data gaps.

2. Regional overview of disasters

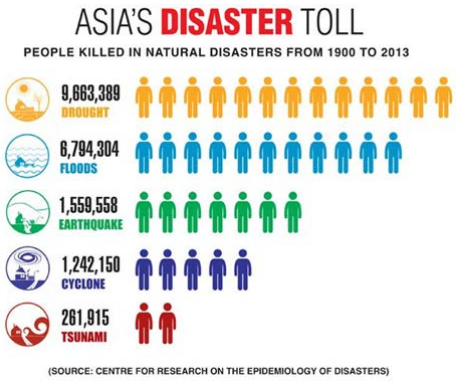
While Asia occupies 30% of the world's land mass, it has accounted for the occurrence of 40% of the world's disasters in the past decade, resulting in a disproportionate 80% of the world's disaster related deaths. According to data collected by the Centre for Research on the

Epidemiology of Disasters (CRED), the “human toll from natural hazards in the last 100 years has been staggering. Since 1900, across Asia, droughts have killed 9,663,389 people, floods 6,794,304, earthquakes 1,559,558, cyclones 1,242,150 and tsunamis 261,915 people as shown in figures 1 and 2”.

Asia suffers frequently from hazards of various kinds that have significant socioeconomic impacts. Disasters caused by hydro-meteorological events such as tropical cyclones, floods, landslides and droughts have affected most countries in the region. Reducing risks to these natural hazards therefore means combining concerted local and national action with effective regional cooperation (UNESCAP, 2015). These natural hazards have various consequences for the economies and the livelihoods of people living in this region.

Over the period 2005–2014, the Asia-Pacific region had 1,625 reported disaster events. Approximately 500,000 people lost their lives, around 1.4 billion people were affected, and there was US$ 523 billion worth of economic damage (UNESCAP, 2015). The severity of the consequences of these hazards has depended on natural and societal factors.

Natural factors characterise the probability that extreme events will occur, dictated by hydro meteorological or geological attributes. Societal factors involve how society, including the government, prepares to cope with the event and responds to the event.



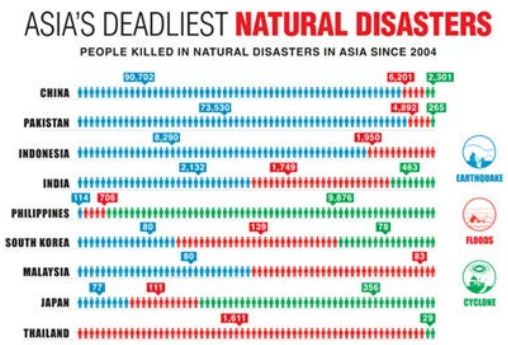


Figure 1 & Figure 2**:** Asia’s disaster toll and the casualties in the last 10 years.

Source: CRED; Accessed online January 2016

Apart from being geographically prone to various types of natural hazards, the dense population and expanding coastal cities in Asian countries increases exposure to hazard, thereby making places and populations more vulnerable.

According to UNESCAP (2015), “the most disaster-prone Asia sub-region has been south-east Asia, specifically countries along the earthquake-prone Pacific ‘Ring of Fire’ or along major typhoon tracks”. South and south-west Asia also face high seismic and flood risks.

The greatest economic damage, however, has been in Asia compared to other regions with the former having the greatest concentration of population, exposed economic assets and a majority of people depending on natural resources for livelihoods (farmers). In general, the most vulnerable countries are those with special needs − including Small Island Developing States (SIDS), Least Developed Countries (LDCs) and landlocked developing countries (UNESCAP, 2015).

2.1. Types of hazards and vulnerable countries

In the Asia region[1], between 1970 and 2015, the most significant natural hazards were floods, storms, earthquakes and droughts in the descending order of magnitude in terms of occurrences and people affected (see table 1) whereas in terms of the monetary value of total damage, the most significant natural hazards were earthquakes, floods, storms and droughts.

To put the financial losses for one year in perspective, in 2012 alone Asia lost US$ 15 billion due to natural hazards, according to data released by CRED. This is a decrease from 2011, when the region recorded a staggering US$ 300 billion loss mostly due to Japan’s tsunami and Thailand’s floods.

Based on the International Disaster Database EM-DAT, floods and storms are the ones with most occurrences followed by earthquakes and landslides; see table 1. Also, figure 2 shows that

[1] The Asia region referred to in this report is contiguous with the statutory membership region of IUCN South and East Asia, which comprises the sub-regions of Northeast Asia (China, Democratic Peoples ‘Republic of Korea, Republic of Korea, Mongolia and Japan), Southeast Asia (overlapping with ASEAN boundaries) and South Asia (overlapping with the SAARC sub-region). It is well understood that other organisations such as UN organisations and multi-lateral organisations have differing definitions for the Asia region. However, for the purpose of this report, the definition is limited to the concerned IUCN statutory membership region.

earthquakes have led to massive loss of human lives in the People's Republic of China, Pakistan, Indonesia and India. Floods and cyclones have killed more people in Thailand and the Philippines. So overall, disasters have taken a heavy toll on Asia's economy.

Table 1: Number and impact of natural hazards in the Asia and the Pacific region by disaster type, 1970 – 2015

Disaster type	Occurrences	Total deaths	Injured	Homeless	Total affected	Total damage (thousand US$)
Earthquakes	*507*	*893,959*	*1,557,921*	*14,754,620*	*138,772,005*	*526,762,374*
Storms	*1,348*	*743,741*	*655,085*	*41,002,893*	*879,685,811*	*230,133,533*
Complex disasters	*4*	*610,000*	*0*	*0*	*9,738,400*	*0*
Floods	*1,565*	*198,479*	*1,144,980*	*72,430,706*	*3,379,770,073*	*414,233,836*
Epidemics	*280*	*46,942*	*124,732*	*0*	*7,705,719*	*0*
Extreme temperature	*129*	*24,137*	*115,557*	*233,000*	*8,4967,795*	*22,054,333*
Landslides	*309*	*19,002*	*4,629*	*3,876,451*	*7,945,244*	*2,594,716*
Droughts	*125*	*5,400*	*0*	*0*	*1,628,278,716*	*39,783,946*
Volcanic activity	*74*	*1,855*	*1,964*	*89,900*	*2,730,255*	*779,151*
Mass movement (dry)	*17*	*1,288*	*185*	*340*	*6,176*	*9,000*
Wildfire	*67*	*715*	*781*	*87,635*	*3,656,082*	*12,588,500*
Insect infestation	*7*	*0*	*0*	*0*	*200*	*925*

Source: EM-DAT; Accessed January 2016

The table 2 below shows the list of Asian countries that are global hotspot regions for disaster risk. In comparison to the previous year's World Risk Index there has not been much change in terms of the ranking of the countries in the Asia region. However, there is an improvement in the ranking of the Philippines now being third climbing down from 2nd last year, probably attributable to adoption of improved disaster risk management measures.

Table 2: Asian countries most at risk worldwide.

Country	Rank	World Risk Index WRI (%)
Philippines	*3*	*27.98*
Bangladesh	*6*	*19.26*
Cambodia	*8*	*16.82*
Timor-Leste	11	16.23
Brunei Darussalam	12	16.15
Viet Nam	*18*	*12.89*
Indonesia	35	10.39
Myanmar	43	9.01
Bhutan	58	7.71
Sri Lanka	*66*	*7.37*
Pakistan	*72*	*7.03*
India	*78*	*6.88*
People's Republic of China	*80*	*6.80*
Malaysia	88	6.44
Thailand	*89*	*6.38*
Lao PDR	100	5.67
Nepal	*108*	*5.23*
Mongolia	148	2.69
Singapore	161	2.24

Source: World Risk Report (2015)

2.2. Vulnerability analysis of disasters

Asia is home to 4.2 billion people (about 60% of the world population) and is the most rapidly developing economic region in the world. This has contributed to socio-economic development with increased economic opportunities and improved education and health services, among other benefits.

However, economic growth of the region, associated with rapid population growth and urbanisation, has also led to increasing exposure to disaster risks, as reported by the Asia-Pacific Disaster Report 2012 as development activities are resource related (UNESCAP, 2015). For example, the number of people exposed to flooding every year more than doubled from 29.5 to 63.8 million between 1970 and 2010 (Herold & Mouton, 2011) with increasing population, urbanisation and development.

Asia is one of the most disaster-prone regions in the world. It is a region of significant bio-geographical diversity with islands, mountains, extensive coastlines, forests, deltaic plains and deserts.

Compared to the other regions/ continents, Asia's exposure to disaster risks is higher (see figure 3 below). The region is home to geologically new mountain ranges that are especially

prone to earthquakes, landslides, flash floods, avalanches and Glacial Lake Outburst Floods (GLOFs) (UNESCAP, 2014).

Earthquakes and tsunamis have brought devastation over the period, with some of the worst events being the 1976 Great Tangshan Earthquake which killed almost 242,000 people in the People's Republic of China, the 2004 Indian Ocean Tsunami that killed over 220,000, and, more recently, the 2011 Great East Japan Earthquake that killed almost 20,000 people and affected the lives of around 369,000 (UNESCAP, 2015).

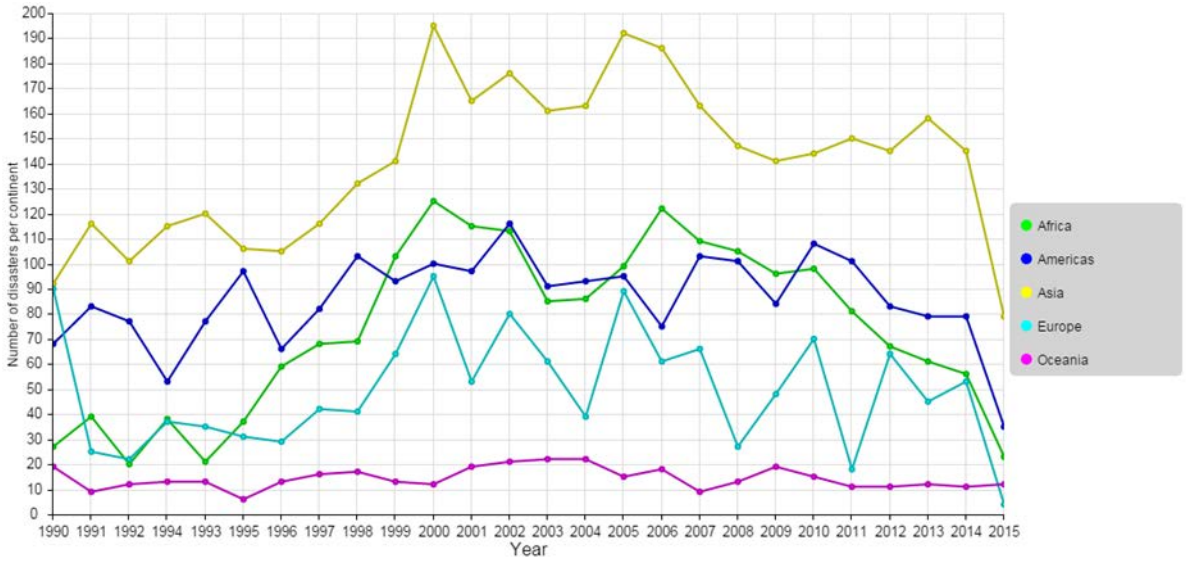


Figure 3: Yearly occurrences of natural hazards in Asia and others.

Source: EM-DAT; Accessed January 2016

Many social, economic and environmental factors determine the vulnerability, exposure and impact of a disaster on people or a country. Countries in Asia are at different levels of exposure and vulnerability to natural hazards and disasters depending on their physical and socio-economic characteristics. Therefore, it is necessary to identify the countries that are more exposed to natural hazards, and learn from their experiences and Eco-DRR practices.

Table 3 shows the list of vulnerable countries with reference to the number of events counts for the different types of hazards as mentioned above (see table 1). The list of the countries (see

table 3) is inclusive of the other vulnerable countries in the Asia region, providing a wide perspective of the other hotspots in the region.

Table 3: Vulnerable countries in the Asia region, 1970 – 2015

Country	Occurrences	Total deaths	Injured	Homeless	Total affected	Total damage (US$)
People's Republic of China	*1,683*	*473,835*	*1,709,816*	*60,198,621*	*3,060,362,666*	*464,949,774*
India	*1,259*	*226,355*	*266,128*	*32,122,277*	*1,924,945,561*	*85,768,376*
Bangladesh	*482*	*544,584*	*354,533*	*8,102,763*	*396,126,366*	*18,077,301*
Philippines	*748*	*70,904*	*213,765*	*6,103,072*	*200,876,936*	*25,885,801*
Thailand	*217*	*16,930*	*16,075*	*331,078*	*90,764,794*	*47,865,364*
Pakistan	*376*	*104,862*	*173,780*	*9,654,990*	*90,920,115*	*28,490,709*
Viet Nam	*258*	*19,430*	*15,532*	*4,691,219*	*85,732,853*	*10,773,482*
Indonesia	*644*	*208,789*	*429,831*	*1,803,438*	*28,290,603*	*29,509,677*
Korea Dem P Rep	*49*	*612,952*	*4,504*	*1,291,477*	*42,123,534*	*24,061,310*
Cambodia	*46*	*3,142*	*719*	*353,755*	*21,352,181*	*1,557,110*
Nepal	*176*	*24,285*	*27,998*	*15,446,786*	*258,439*	*5921,115*
Lao P Dem Rep	*48*	*1,326*	*545*	*1,015,045*	*10,198,816*	*560,979*
Japan	*280*	*33,085*	*194,631*	*809,863*	*6,915,614*	*433,847,600*
Myanmar	*104*	*142,172*	*21,151*	*447,147*	*1,5174,598*	*5,105,513*
Malaysia	*100*	*2,656*	*1,451*	*595,46*	*3,423,214*	*2,207,363*
Mongolia	*30*	*452*	*68*	*150*	*4,220,100*	*1,975,164*
Korea Rep	*154*	*8,042*	*10,342*	*678,158*	*3,040,462*	*16,234,157*
Bhutan	*10*	*304*	*28*	*1,000*	*87,369*	*3,500*
Maldives	*9*	*366*	*2,214*	*36,849*	*268,659*	*506,100*
Timor-Leste	*9*	*29*	*197*	*0*	*13,768*	*0*
Brunei Darussalam	*1*	*0*	*0*	*0*	*0*	*2,000*

Note: Total values are provided. Land area and population density are not considered in this table

Source: EM-DAT; Accessed July 2016

Between 2004 and 2013, natural hazards in Asia and the Pacific caused economic damage of over US$ 560 billion (UNESCAP, 2014). Global warming has increased the number of weather-related disasters. The risk from floods has doubled since 1990, and Asia is home to 75% of the world's at-risk population from floods (ibid). For example, almost 3 million people were affected by flooding in central Thailand in 2011 with heavy rain causing rivers and dams to overflow,

resulting in villages and houses being destroyed. Also in the case of Viet Nam, heavy floods destroyed and damaged over 150,000 homes and affected more than 700,000 people in the country's central provinces.

The EM-DAT database indicates that, in general, the economic impacts of flood related disasters were notably higher in Pakistan, Afghanistan and Nepal. However, the magnitude of vulnerability and its characteristics in these countries tend to vary along with their corresponding impacts on lives and property. In terms of human mortality, Bangladesh, Pakistan, Bhutan and India were found to be most susceptible to human impacts (Pathak et al., 2008).

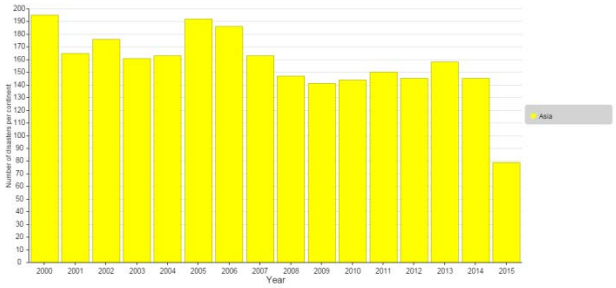
Although Bhutan has seen a lesser number of flood related disasters, the higher concentration of population living within disaster prone regions makes them vulnerable. In summary, complex interactions between natural and socio-economic conditions play a dominant role to define and characterise the type and magnitude of vulnerability to hazard occurrence and their economic and human impacts.

As described above, disasters have impacts on the physical, social and economic aspects of lives. LDCs and SIDS are highly exposed to disaster risk. Natural hazards often jeopardise hard-earned development gains in the region, and at the national level, vulnerable people generally suffer more when a disaster strikes. However, it is also exacerbated by the reduced ability of the poor to cope with disasters, especially women, children, ethnic and other marginalised minorities, older people and excluded individuals among them.

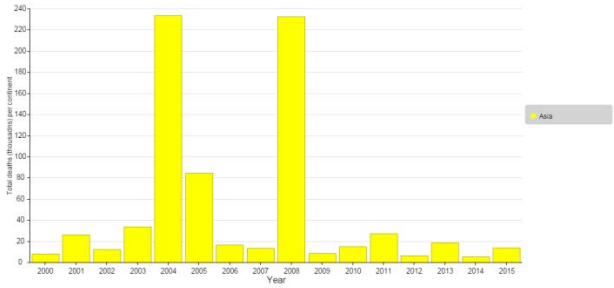
From the figure 4 (a, b, c & d), a significant increase in the number of reported natural hazards as well as the economic losses caused by them can be noted. According to the disaster data collected by EM-DAT, World Risk Assessment, CRED and others, countries in the Asia region that are most vulnerable to disasters are Bangladesh, Cambodia, People's Republic of China, Nepal, Pakistan and others that fall under the category of LDCs, SIDS and landlocked underdeveloped countries.

a) Total number of disasters occurring in Asia from 2000–2015

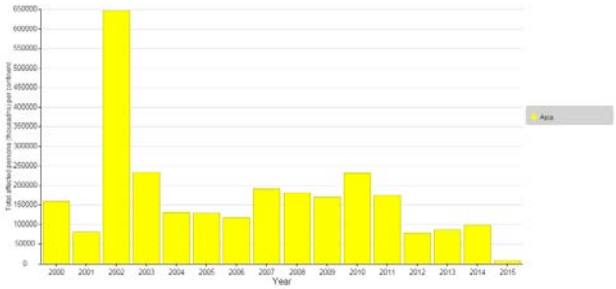
b) Total number of yearly deaths in Asia due to different types of disasters



c) Total number of people affected in Asia in different years



d) Total economic damage annually for the period 2000–2015



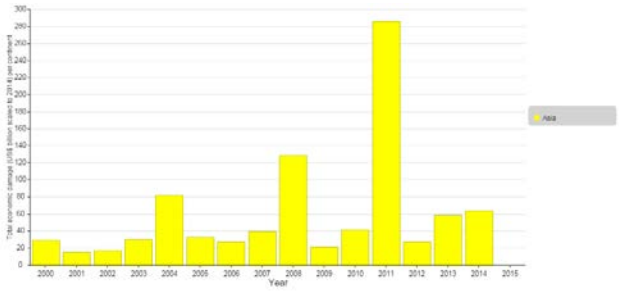


Figure 4 a, b, c, d: Disaster occurrences and their human impact in the Asia region (2000–2015)

Source: EM-DAT; Accessed January 2016

2.3. Overview of ecosystems and biodiversity in the Asia Region

The Asia region includes some of the most diverse ecosystems on the planet, from the large high-altitude Himalayan ecosystem to the Indo-Burma hotspot, Heart of Borneo rainforest ecosystem and the Coral Triangle ecosystem. The region is also home to five of the world's megadiverse countries: People's Republic of China, Indonesia, India, Malaysia and the Philippines.

This biodiversity is, however, under increasing pressure with rapid economic growth in the region leading to expansion of industrial agriculture, large-scale infrastructure development and rapid land-use change. In addition, drivers such as illegal wildlife trade, invasive alien species and climate change have further exacerbated the loss of biodiversity.

Recent studies have shown a significant decline in the state of ecosystems and in their ability to provide vital goods and services. A study by the Asian Development Bank and WWF has shown

that the region as a whole has a 'bio capacity deficit', which implies that countries increasingly need more land and sea area for their consumption needs than is currently available within the region (WWF, 2012).

About 21.25 million hectares of forests have been lost in Borneo over the last 25 years and 8.5 million hectares of forests were lost in the Greater Mekong sub-region between 1990 and 2005 (WWF, 2012). Many of these large ecosystems are trans-boundary, and their health is vital for human well-being. For example, the Lower Mekong Basin provides water and other resources for 60 million people and the value of its capture fisheries is estimated at between US$ 1.4 billion and US$ 3.9 billion per year (IUCN, 2010).

Growth in populations and resulting consumption has increased material intensity in the region since 2000 leading to increased demand for natural resources (ADB, ESCAP and UNEP, 2012). The ecological footprint (the impact of a person or community on the environment, expressed as the amount of land required to sustain their use of natural resources) of Asian countries is rapidly expanding, with the People's Republic of China, India, Indonesia and Japan contributing 3/4 of the overall ecological footprint of the Asia and Pacific region. WWF predicts that by 2020, seven of the 20 countries with the largest ecological footprints will be from Asia (WWF, 2012).

Status of species

According to the IUCN Red List, five countries in the region are among the 20 countries with the highest number of threatened species. Indonesia ranks first, followed by the People's Republic of China, India, Malaysia and Thailand. Further analysis of the recent Red List data shows that the percentage of threatened species increases when restricted to endemic species with rates of threatened species among native endemics being as high as 88% for Sri Lanka, 66% for India, 50% for Nepal, 44% for Indonesia and 43% for Lao PDR. The average for Asia is around 33% (http://www.iucnredlist.org/initiatives/mammals/analysis/geographic-patterns). This is also evident from the fact that the levels of endemicity in the region are very high, with Southeast Asia containing the highest mean proportion of country-endemic bird and mammal species at 9% and 11% respectively of overall populations; and it is facing the highest habitat loss of anywhere in the world (Sodhi, et al., 2010).

Five biodiversity hotspots are found within the region: Indo-Burma; Eastern Himalayas; mountains of Southwest China; Philippines; and Western Ghats and Sri Lanka. Of these, the Indo-Burma hotspot is the most densely populated and is facing the maximum threat, with only

5% of its natural habitat remaining (CEPF, 2011). The Eastern Himalayan eco-region, primarily comprising Nepal, Bhutan and North-eastern India, is one of the most biologically diverse regions in Asia due to the convergence of multiple bio-geographic zones with species of the Indo-Malayan Southeast Asian tropical zone, Palaearctic Realm, temperate East Asia and Deccan Plateau occurring in this region (CEPF, 2005).

Protected areas

The origin of protected areas on the planet can possibly be traced to the early Chinese, Japanese and Korean emperors as well as the Buddhist kings of India such as Emperor Asoka. Since then, the protected areas of Asia have become not just the mainstay of in-situ biodiversity, but also include some of the major watersheds of the region, draining some of the largest rivers. In all, some 10,900 pr5000/ P01598 PA01598.00 AVCH-00505otected areas cover 13.9% of the terrestrial area and 1.4% of the marine area of the region. Protected area coverage varies widely across the region. Bhutan and Brunei have more than 40% of terrestrial area under protected area coverage, but 14 countries in the region have less than the 17% coverage agreed by governments in Aichi Biodiversity Target 11 . In addition, protected areas in Asia are not necessarily ecologically representative, with only 35% of eco-region types and 15.4% of marine ecoregion types being protected (Juffe-Bignoli, et al., 2014).

In the 24 countries across the Asia region, 266 sites are designated under various international conventions, including 45 natural and mixed World Heritage sites and 226 Ramsar sites (Juffe-Bignoli, et al., 2014).

According to the first Asia Protected Planet Report (2014), high population densities across the region are exerting tremendous pressure on the existing protected areas. Based on the Protected Area Management Effectiveness (PAME) database, the report identifies deforestation, illegal wildlife trade, invasive species and pollution as being the most serious threats that need to be addressed through the development of innovative approaches and solutions.

Protected area coverage of coastal and marine ecosystems is very low across the region with only four countries (Thailand, Indonesia, Japan and Pakistan) having more than 5% of their relevant areas under PA coverage. The Asia Protected Planet Report identifies a need for Asia to increase its marine and coastal protected area coverage by 1.6 million square kilometres to be able to meet the relevant Aichi Biodiversity Target 11 by 2020 (Juffe-Bignoli, et al., 2014).

About 86% of the protected areas of Asia are under some form of IUCN Management Category, with 77% being classified under Categories IV, V and VI (Juffe-Bignoli, et al., 2014) but the report also identifies the need to improve management effectiveness in order to ensure that protected areas are able to make a significant contribution to maintaining ecosystem services and functions for addressing disaster risk reduction and supporting adaptation to climate change, among others.

2.4. Specific aspects of Eco-DRR related to biodiversity conservation

This assessment is focused on not just ecosystem-based approaches for DRR and CCA but also specifically the role of restoring or conserving biodiversity to support resilience of communities to disasters. This includes examples of mangrove restoration in countries like Thailand and Cambodia as well as other examples of biodiversity conservation.

According to the CBD, biodiversity is not the sum of ecosystems, species and genetic material but represents the variability within and among them. This needs to be understood at three levels: species, genetic (corresponds to genes), and ecosystem.

The CBD defines the ecosystem approach as a strategy to establish integrated management of land, water and living resources that promotes conservation and sustainable use of resources in an equitable way. It also recognises that humans, with their cultural diversity, are an integral component of ecosystems, having impacts on ecosystem functions, natural resources and infrastructure. Indirect damage from humans can result from post-disaster relief and recovery operations that fail to take ecosystems and ecosystems services into account (PEDRR, 2010).

The increasing frequency and intensity of natural, climate-related as well as human-induced disasters are major factors causing ecosystem degradation. Together they reduce the resilience of ecosystems and communities against the impacts of climate change and the increased risk of disasters (MEA, 2005). On the other hand, people derive vital ecosystem services and foods from the natural systems to support their well-being.

Ecosystems play an important role in climate change adaptation and disaster risk reduction. Ecosystem degradation leads to more disasters and reduces the resilience of nature and societies against climate change impacts and disasters. The degradation process reduces the

capacity of the ecosystem to buffer the impacts of climate change, such as more frequent heavy rains, droughts, melting glaciers and sea-level rise.

The IUCN-led EPIC project (a five-year initiative) selected pilot projects in the People's Republic of China, Nepal and Thailand to investigate the role that healthy ecosystems play in reducing disaster risk and supporting community-based adaptation to climate change. It also explored other distinct challenges and opportunities to measure how specific ecosystems might contribute to disaster risk reduction and climate change adaptation in specific economic, environmental and social conditions.

It has provided empirical evidence on the significance of healthy and intact ecosystems on disaster risk reduction (EPIC, accessed online). The main aims of EPIC are to help protect communities from disasters and tackle the adverse effects of climate change, and investigate the role of healthy ecosystems in reducing disaster risk and supporting community-based adaptation to climate change. For example, community-based ecological mangrove restoration for storm surges and other coastal hazards, and eco-engineering for slope stabilisation were initiated in Thailand and the People's Republic of China respectively.

Other academic initiatives are building understanding about how biodiversity is distributed, and how it regulates the structure and functioning of ecosystems (Bardgett & Putten, 2014). Such academic and case-based research has led to the consensus that biodiversity loss reduces most ecosystem functions and impairs their stability over time (ibid). The following sections in the assessment explore the socioeconomic influences on biodiversity, ecosystem services and human well-being under the influence of naturally occurring hazards and climate change in terms of policy and practices.

Box 1: Goods and services provided by mangrove ecosystems in Sri Lanka

The Indian Ocean Tsunami in December 2004 hit large parts of the Sri Lankan coastline. In addition to more than 30,000 fatalities, the waves also affected valuable coastal ecosystems such as lagoons, mangroves and salt marshes. Based on the survey carried out in the south-western Sri Lanka Balapitiya in Maduganga Estuary, areas with coastal tree vegetation were markedly less damaged than areas without such protection (Sudmeier-Rieux & Ash, 2009).

As part of a study conducted by Sudmeier-Rieux and other researchers, the coastal vegetation was mapped along a length of 1.7 km of coastline along with the damaged houses up to 300 m from the shoreline (including the water level at the houses, which was reported by the respondents). Vegetation was a mixture of *Pandanus* (screw pines), coconut palms and various shrubs. After dividing the mapped vegetation into three classes depending on their composition, statistical analyses (linear regression) showed that the buffering effect of the class without *Pandanus* was significantly lower compared to the other two classes. Distance of the houses from the sea was also taken into account.

The analyses further revealed the channelling effect of the inlet, as many houses along the inlet were completely destroyed. The small mangrove strips in front of the houses did not provide any protection in this case, as they were too narrow to reduce the destructive force of the waves significantly (ibid). The study showed on a local level that coastal vegetation has the potential to buffer the impacts of tsunami waves and protect lives and property, with the composition of the vegetation being a very important factor. It also revealed that particular attention should be paid to water bodies connected to the sea, which might be hazardous due to channelling effects. In this case, any vegetation buffer must have a certain width and composition to provide reliable protection. In addition, these mangrove ecosystems also have both direct use and indirect use values. The indirect values of mangroves include providing major income sources, livelihood options and protecting fishery habitats as well.

According to another study carried out by Thushara and Mikkel (2006), “the economic values of mangroves and most importantly their role in coastal DRR should be used to better inform decisions pertaining to manage mangrove ecosystems as well as planning reconstruction activities in the aftermath of the Indian Ocean Tsunami”.

3. Analysis of institutional and policy context related to Eco-DRR

Risk management requires a sound legal and regulatory structure. This refers not just to laws covering disaster management but also legislation for all other relevant sectors (UNESCAP, 2015).

Integrating Eco-DRR approaches is urgently needed in decision making. Recently, some Asia-Pacific countries have introduced specialised legislation on disaster management (UNESCAP, 2015). In the region, developed countries do not have stand-alone national laws but have embedded risk reduction in legislation across various sectors, with substantial resources in both the structural and non-structural measures. Non-structural measures include promoting low-cost community-based initiatives for disaster risk reduction at the local level. On the other hand, most developing countries that are more vulnerable still lack the necessary resources, capacity and initiatives at the national government level.

3.1. DRR & CCA related frameworks

The importance of integrating ecosystem approaches into disaster risk reduction is now well recognised at the level of international conventions and agreements such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Sendai Framework for Disaster Risk Reduction.

It is also extremely important for national policies and planning frameworks to recognise the intrinsic links between disaster risk reduction, climate change adaptation and mitigation and the role of ecosystems in addressing these risks.

While the Hyogo Framework for Action (UNISDR, 2005) recognised ecosystem management as an essential element of reducing underlying risk factors, efforts at environmental management for disaster risk reduction have been largely conducted on an ad hoc basis. The main exception is the Convention on Biological Diversity (CBD), whose Ad Hoc Technical Expert Group on Biodiversity and Climate Change has specifically addressed the links between ecosystem management, climate change adaptation and disaster risk reduction.

Apart from this, the institutional arrangements for disaster risk reduction broadly follow one of three models (UNESCAP, 2015). The first model involves a specialised authority, usually chaired by the head of government. The second model involves high-level inter-ministerial coordination. In the third model, disaster management is the exclusive responsibility of a single agency or government department. For many years, most countries used the third model (ibid).

The following is a summary of the existing national policies and institutions of each country in reference to the given concepts in the guidelines. In addition, most of the countries damaged by disasters use the Hyogo Framework as a guiding framework for planning their disaster risk reduction measures.

3.1.1. Bangladesh

3.1.1.1. Policy framework related to DRR and CCA

The Ministry of Disaster Management and Relief has taken the initiative to incorporate disaster and environmental risk issues in sectoral plans (e.g. agriculture, water management, education, livestock, fisheries, water and sanitation, health and small cottage industries). Sector-specific DRR guidelines are being developed through the Ministry's programmes that address the changing environmental, topographic, population and demographic contexts.

This 'national plan for disaster management 2010–2015' is an outcome of the national and international commitments of the Government of Bangladesh (GoB) and the Disaster Management and Relief Division (DM&RD) to address disaster risks comprehensively.

It has been developed with the objective to reduce vulnerability of the poor to the effects of natural, environmental and human induced hazards to a manageable level by:

a) Bringing a paradigm shift in disaster management from conventional response and relief practice to a more comprehensive risk reduction culture; and

b) Strengthening the capacity of the Bangladesh disaster management system in improving the response and recovery management at all levels (Disaster Management Bureau, Govt. of the People's Republic of Bangladesh, 2010).

The decline in precipitation and occurrence of droughts has resulted in the drying up of wetlands and severe degradation of ecosystems (Disaster Management Bureau, Govt. of the People's Republic of Bangladesh, 2010).

In Bangladesh, one of the most climate-vulnerable countries on the planet, the most significant onset of disaster is caused by climate change related impacts and the disaster risk reduction measures are now embedded in the National Adaptation Programme of Action (NAPA). The

intervention measures based on NAPA for climate change adaptation mentioned in the report are as follows:

- Promoting adaptation to coastal crop agriculture to combat salinity intrusion through maize production under Wet Bed No-tillage Method and Sorjan systems of cropping in tidally flooded agro ecosystem.
- Adaptation to agriculture systems in areas prone to enhanced flash flooding in the North East and Central Region through no-tillage potato cultivation under water hyacinth mulch in wet sown condition, and vegetable cultivation on floating beds.
- Promoting adaptation to coastal fisheries through culture of salt-tolerant fish especially in coastal areas of Bangladesh.
- Adaptation to fisheries in areas prone to enhanced flooding in North East and Central Region through adaptive and diversified fish culture practices.
- Construction of flood shelters, and information and assistance centres to cope with enhanced recurrent floods in major floodplains.
- Reduction of climate change hazards through coastal afforestation with community focus.
- Providing drinking water to coastal communities to combat increased salinity due to sea level rise.
- Enhancing resilience of urban infrastructure and industries to impacts of climate change including floods and cyclone.

Bangladesh Climate Change Strategy and Action Plan, 2009

The BCCSAP emphasises among others the importance of water resources management, sustainable forest resource management and protection of floral and faunal species. The report refers to the coastal greenbelt projects involving planting of mangroves along 9,000 km of the coast of the country since the country's independence as part of disaster risk reduction measures and recent climate change adaptation programmes. As part of the BCCSAP 2009–2018, under the set of actions related to mitigation and low carbon development, expanding

social forestry and coastal greenbelt programmes including mangrove restoration were identified as priority actions.

Intended Nationally Determined Contributions, 2015

The Government of Bangladesh has identified provisional conditional action-based contributions for land use, land-use change and forestry. These contributions – which have not been quantified, are related to coastal mangrove plantations, reforestation and afforestation in the reserved forests, plantation in the island areas of Bangladesh and continuation of social and homestead forestry. In terms of the key areas vulnerable to adverse impacts of climate change, it has identified coastal zone management, EbA (including forestry co-management) and community-based conservation of wetlands and coastal areas for which priority actions include biodiversity conservation and ecosystem management.

3.1.1.2. Policy framework related to biodiversity conservation

Fifth National Report of Bangladesh to the CBD, 2015

The 5th National Report to the CBD submitted to the CBD Secretariat in 2015 explicitly identified the impact of climate change on biodiversity as being one of the direct threat drivers to biodiversity loss in the country. It mentions climate change impacts leading to shifts in the distribution of species such as amphibians, grasses and butterflies.

On the other hand, the importance of biodiversity in enhancing resilience to natural disasters is evident from the specific case study presented which identifies the role of ecosystems such as *Haors* or seasonal water depression ecosystems playing a role in reducing flood damage by retaining water during the flood period and replenishing the ground water resources during the dry season. The role of mangrove ecosystems in buffering the impact of regularly occurring natural hazards, primarily cyclones, is well recognised as a significant benefit of the Sunderbans mangrove ecosystem.

The report also promotes plantation programmes using multiple species as opposed to single species plantations, with such programmes being supported by the Bangladesh Climate Change Resilience Fund.

3.1.1.3. Policy gaps and challenges

While the country has developed sound policies and frameworks on DRR and CCA, it lacks the capacity to implement all aspects of these policies and frameworks. On the other hand, the existing frameworks and policies do not accommodate biodiversity conservation related aspects directly. Therefore, the capacity challenges in the DRR and CCA measures include inadequate staffing, financial bottlenecks and a lack of technical resources such as space-based technology. The latter includes technologies such as Geographic Information Systems (GIS), Earth observation satellites, communication satellites, meteorological satellites and global navigation satellite systems (GNSS). They are key tools for comprehensive hazard and risk assessments, response, relief and disaster impact assessment. Space-derived and in-situ geographic information and geospatial data are extremely useful during times of emergency response and reconstruction, especially after the occurrence of major events such as earthquakes or floods (UNOOSA, 2013).

3.1.2. Cambodia

3.1.2.1. Policy framework related to disaster management

The National Committee for Disaster Management (NCDM) was established for overall coordination of disaster management in 1995. The national policy focuses mainly on flood risk management, a process of management rather than prevention. The vision of the NCDM (2008) is to build community resilience to disaster in accordance with the Hyogo Framework for Action. The six components of the DRR framework are as follows:

- Ensure that disaster risk reduction is a national and local priority
- Strengthen sub-national and community-based disaster risk management
- Identify, assess and monitor hazard risks and enhance early warning
- Use knowledge innovation and education to build a culture of safety and resilience
- Mainstream DRR into policies and programmes of relevant government ministries
- Strengthen disaster preparedness for effective response at all levels

Cambodia's Intended Nationally Determined Contribution, 2015

The identified 'priority actions' in Cambodia's INDC include promoting and improving adaptive capacity of communities by supporting community-based adaptation actions that involve restoring natural ecological systems, and implementing management measures for protected areas to adapt to climate change. In terms of its contribution to land use, land-use change and forestry (LULUCF), Cambodia has stated that it will undertake voluntary and conditional actions to achieve the target of increasing forest cover to 60% of the country's land area by 2030. This would also include implementing a programme to improve forest law enforcement, governance and trade of timber.

3.1.2.2. Policy framework related to biodiversity conservation

Cambodia Climate Change Strategic Plan 2014–2023

The CCSP has identified as one of its eight strategic objectives, Strategic Objective 3, "ensure climate resilience of critical ecosystems, biodiversity and cultural heritage sites" thus according considerable importance to understanding the impacts of climate change on biodiversity. Guiding principle 7 of the Strategic Framework of the CCSP is "use a combination of science-based, ecosystem-based and community-based approaches", which clearly recognises the importance of nature-based approaches. Even Strategic Objective 2, which relates to reducing sectoral, regional and gender vulnerability, includes a strategy to improve water and forest ecology, mangrove ecosystems, coastal zones and protected areas. The specific actions under Strategic Objective 3 are focused on enhancing biodiversity conservation and improved ecosystems through restoration efforts, promoting PES including REDD+ and promoting participatory land-use planning.

The Fifth National Report to the Convention on Biological Diversity, 2014

The Fifth National Report of Cambodia clearly recognises climate change as a threat to biodiversity in the country, specifically on rice farming and fisheries. The report identifies the role of ecosystem services in enhancing food security in the context of climate change vulnerabilities. Among its eight objectives, the CCSP lists enhancing climate resilience of priority critical ecosystems. The 5th National Report notes that coastal and marine resource management is supporting adaptation of communities to the impacts of climate change. The draft NBSAP has identified the integration of biodiversity objectives into future National Climate Change Action Plans as a priority.

3.1.2.3. Policy gaps and challenges

NCDM has addressed the complexity of various disaster-related issues over the past two decades, yet gaps remain in translating knowledge into action. The disaster management related approaches are both for the aftermath and prevention/ reduction of disaster risk. However, lack of knowledge and action for disaster risk reduction highlights the need for a more integrative process including biodiversity conservation specific aspects of Eco-DRR. Going ahead requires addressing gaps in terms of disaster risk management, adopting concerted bottom-up and top-down actions, and applying local and scientific knowledge.

3.1.3. People's Republic of China

3.1.3.1. Policy framework related to climate change

The People's Republic of China has enacted more than 30 laws and regulations related to disaster management, including the Law on Earthquake Preparedness and Disaster Reduction. The national legislature adopted the Emergency Response Law on 30 August 2007 as the overall legal document governing all emergency responses in the People's Republic of China, including disaster response.

The Comprehensive Disaster Prevention and Reduction Plan (2011–2015) is a comprehensive system involving various central and local government sectors. This involves actions at three levels under the related law and regulations (UNESCAP, 2008):

a) National Master Plan for Responding to Public Emergencies.

b) Five national thematic disaster response plans.

c) Emergency response plans for 15 Government departments and their detailed implementation plans and operation norms.

In 2011 and 2012, the Chinese government took effective measures to enhance national capability to adapt to climate change and reduce the negative impact of climate change on economic and social development, production and the people's welfare. The three main areas of focus for adaptation outlined here are agriculture, public health and water resources. For example, the Ministry of Agriculture has implemented multiple measures to support agricultural production to cope with the extreme weather conditions the country will be experiencing in the future. It also promotes the cultivation of high quality seed varieties with high yield potential and

resistance to drought, flooding, high temperature, diseases and pests. It also increased subsidies to accelerate the cultivation, reproduction and dissemination of superior crop strains.

The Chinese government is also employing multiple EbA approaches, mainly through forestry. The Ministry of Environmental Protection organised and implemented the Biodiversity Conservation Strategy and Action Plan of the People's Republic of China (2011–2030), which carried out a basic investigation of biological resources, and actively promoted the establishment of nature reserves. The Chinese government has also implemented 39 wetland protection programmes nationwide, including the construction of more than 100 stations for wetland protection and management. The protection programme has brought more than 330,000 hectares of new wetland under protection, restoring 23,000 hectares of existing wetlands, establishing four new wetlands of international importance and also resulted in the creation of 85 pilot national wetland parks.

The Chinese government has also targeted marine ecosystems within their EbA efforts. The State Oceanic Administration prepared the National Marine Economic Development Plan for the 12th Five-Year Plan Period and the Plan for the National Island Protection; both were approved by the State Council. The administration also created the guidance and management methods for the management and protection of the oceanic islands, which included the building of a monitoring and evaluation system, which monitors how various marine ecosystem types respond to climate change.

China's policies and actions on climate change, 2014

The priority document produced by the National Development Reform Commission (NDRC) identified policies and actions under mitigation for energy conservation and improving energy efficiency that enhance ecological productivity. The next set of priority policies and actions related to increasing carbon sink capacity that includes enhanced implementation of forest restoration measures including piloting REDD+, increasing the area of forest carbon sink and improving monitoring of forest carbon stocks. In terms of adaptation, policies and actions related to water resource management include conservation, protection and management of water resources. Further adaptation policies and actions relate to the Ecosystem category, which include conservation of ancient woodlands, wetland protection and restoration efforts, and assessing impacts of climate change on biodiversity using an assessment index developed by the Ministry of Environmental Protection.

Enhanced actions on climate change: China's Intended Nationally Determined Contributions, 2015

As part of its INDCs actions for improving regional strategies on climate change, the Government will seek to define ecological red lines, to formulate strict criteria for industrial development in ecologically sensitive zones. As part of actions to build a low-carbon energy system, it has identified the promotion of development of hydropower, which is ecologically and socially sustainable. Another set of actions relates to increasing carbon sinks, which include enhancing afforestation in an ecologically sound manner, strengthening forest disaster prevention and forest resources protection, improving protection and restoring wetlands and enhancing restoration efforts for grasslands and rangelands.

3.1.3.2. Policy framework related to biodiversity conservation

China National Biodiversity Conservation Strategy and Action Plan (2011–2030)

The China NBSAP identifies climate change as a major factor adversely affecting the status of biodiversity. The NBSAP's Action 25 specifically calls for the development of an action plan to address climate change impacts on biodiversity. The NBSAP also refers to the need to strengthen evaluation and monitoring of the impacts of climate change on biodiversity in the country. On the other hand, the NBSAP does not refer to disasters.

China's Fifth National Report on the Implementation of the Convention on Biological Diversity, 2014

The 5th National Report to CBD refers to climate change leading to changes in the phenology, distribution and migration patterns of species, creating conditions for the proliferation of certain invasive species, and leading to localised extinction of certain species, among other effects. It also reported that climate change has modified the population structure in terms of distribution and density of marine species in the Yellow Sea. The Government has also commissioned research projects to understand the status of ecosystems in the face of climate change and subsequently identify solutions that integrate biodiversity conservation for enhancing resilience to climate change.

The recognition of the role of biodiversity is clearly also evident from China's biodiversity target aligned to the CBD Strategic Plan Target 15 which includes increasing forest areas through restoration efforts and restoration of grassland areas to enhance productivity. The National

Development Reform Commission has developed a Comprehensive Work Programme for Energy Conservation and Pollution Abatement and a Programme for GHG Emission Control that demonstrate clear synergies between climate change adaptation and biodiversity conservation, leading to measures to enhance carbon sinks and strengthen ecosystem management.

3.1.3.3. Policy gaps and challenges

The disaster management system of the People's Republic of China has improved significantly in relation to the past. However, many problems still exist when serious disasters occur (Lixin, et al., 2011).

The legal system in China is guided by the principle of "one law for one event" where each law and regulation targets one disaster event and biodiversity context (Lixin, et al., 2011). This signals a lack of comprehensive disaster risk reduction laws and regulations.

However, with increasing disaster experiences, the Government has decided to further strengthen national disaster risk reduction efforts and to enhance its institutional and technical preparations for disaster response mechanisms as well as include biodiversity conservation specific aspects of Eco-DRR in implementation.

Although the People's Republic of China has built its disaster management system with ecosystem approaches and national policy for climate change adaptation and gained achievements in some aspects, the disaster management system is still a segmental model and is not an integrated management system (ibid).

3.1.4. India

3.1.4.1. Policy framework related to disaster management

The paradigm shift from the erstwhile relief-centric response to a proactive prevention, mitigation and preparedness-driven approach for conserving developmental gains and to minimise loss of life, livelihood and property took place in 2005. It was the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister, State Disaster Management Authorities (SDMAs) headed by the Chief Ministers, and District Disaster Management Authorities (DDMAs) headed by the Deputy Commissioner to lead and adopt a holistic and integrated approach to disaster management.

India now has:

1. National Disaster Management Policy
2. National Disaster Response, Mitigation Plans
3. Capacity Development Plans (draft)
4. National Disaster Management Plan (draft).

The national policy on disaster management 2009 has replaced the policy of 2005. This policy aims at:

a) Promoting a culture of preparedness and resilience at all levels through knowledge, innovation and education;

b) Encouraging mitigation measures based on technology, traditional knowledge and environmental sustainability;

c) Mainstreaming disaster management into the developmental planning process;

d) Establishing institutional and techno-legal frameworks to create an enabling regulatory environment and a compliance regime;

e) Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks;

f) Developing contemporary forecasting and early warning systems backed by responsive and fail-safe communication with information technology support;

g) Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society;

h) Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living; and

i) Promoting a productive and proactive partnership with the media for disaster management (Govt. of India, 2009).

National Action Plan on Climate Change, 2008

The National Action Plan of India adopted in 2008 is being implemented through Eight Missions, with the overall focus of implementation being promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation. One of the Missions is the 'National Mission for sustaining the Himalayan Ecosystem' which has the objective of developing management measures for sustaining and safeguarding the Himalayan glaciers, glacial lakes and other mountain ecosystems. The stated aim is to maintain two-thirds of the area under forest cover to prevent erosion and land degradation, and to maintain the stability of this fragile ecosystem. The 'National Mission for Green India' was launched to

enhance forest ecosystems including increasing the area under forest cover from 23% to 33% through forest restoration and afforestation programmes. The 'National Water Mission' in addition to focusing on overall management of surface and ground water also prioritises conservation of wetlands.

India's Intended Nationally Determined Contributions: Working towards climate justice, 2015

The INDC refers to some of India's actions on climate change including its efforts on afforestation and improvement in carbon stock in forests by 5% between 2005 and 2013. In addition, it refers to the Green India Mission, which has an objective of increasing forest cover by 5 million hectares. In terms of water related adaptation actions, the country has set up the National River Conservation Directorate for the conservation of rivers, lakes and wetlands. In terms of coastal region and islands, there is specific mention of MFF in enhancing coastal resilience of communities, as well as reference to ecosystem-based integrated coastal zone management initiatives being implemented. The Government of India also started a programme called 'Island Protection Zone' in 2011 which focuses on disaster risk reduction through bioshields developed by restoring mangroves and other coastal vegetation, and conservation of beaches and sand dunes. In linking its INDC to UNFCCC, one of the contributions is to create additional carbon sinks of 2.5 to 3.0 billion tonnes of CO^2 equivalent through additional forest and tree cover by 2030.

3.1.4.2. Policy framework related to biodiversity conservation

National Biodiversity Action Plan, 2014

The India National Biodiversity Action Plan (NBAP) specifically provides an update on various Action Points of the NBAP of 2008, with one of the Actions being "Assessment of vulnerability and adaptation to climate change, and desertification" with action points to enhance understanding of the impacts of climate change on biodiversity across the various major ecosystems of the country ranging from the Himalayan ecosystem to the marine ecosystems. One of the action points was also to integrate biodiversity concerns into measures for energy conservation and adoption of renewable energy technologies with a focus on local biomass resources. India's action plan for implementing the CBD Programme of Work on Protected Areas (PoWPA) includes Action 5 to address 'Climate Change Resilience and Adaptation Assessment' by undertaking comprehensive assessment studies for targeted PAs.

India's Fifth National Report to the Convention on Biological Diversity, 2014

The introductory section of India's 5th National Report to the CBD Secretariat clearly recognises the important role played by biodiversity in protecting people from natural disasters. It refers to one of the indicators for National Biodiversity Aichi Target 2 being "trends in biodiversity-inclusive climate change adaptation and mitigation measures formulated/implemented", which directly addresses the integration of biodiversity conservation and climate change. The report also clearly recognises the importance of forests as repositories of carbon stocks, including soil, litter, deadwood, below-ground biomass and above-ground biomass. In the report, climate change is identified as a major threat to biodiversity in terms of sectors as well as biomes and major ecosystems.

3.1.4.3. Policy gaps and challenges

India has a comprehensive DRM framework at the national level. Given the level of decentralisation, robust DRM frameworks at the state level are provided throughout the country. Very few States have yet carried out micro-level risk analyses.

The Wildlife Institute of India recommends that policy links between ECO-DRR and PA creation and management need to be further strengthened to enhance protection of such areas, recognising their role in reducing natural disaster risks by serving as natural buffers as well as providers of vital ecosystem goods and services.

This calls for detailed risk assessment and cost-benefit analysis that incorporates Eco-DRR and biodiversity features. Such an exercise will help local and national governments in adopting appropriate strategies for integrating DRR into ongoing programmes and sectoral development plans at different levels.

Therefore, it is also important to enhance the capacity of policy makers and development planners to formulate appropriate mitigation measures based on risk assessments that include biodiversity considerations.

3.1.5. Nepal

3.1.5.1. Policy framework related to CCA

A national framework on climate change adaptation indicates the commitment of the Government of Nepal towards safeguarding and proactively protecting lives and property. This is an integrated/ inclusive framework for reducing disaster risk through multi-stakeholder

participation processes. The process defines five main priorities and associated activities by assigning responsibilities to each sector line agency (UNISDR, 2011.

The five priorities recommended in the implementation process are:

a) put a vibrant institutional framework in place for its implementation by prioritising disaster risk reduction at both the national and local levels;

b) strengthen assessment, identification, monitoring, and early warning system on potential disaster;

c) make use of knowledge, new ideas, and education for the development of safety and disaster resilient culture at all levels;

d) minimise existing risk factors; and

e) make disaster preparedness strong enough for effective response.

The strategy also analyses policy frameworks, legal provisions and institutional structures. The framework has adopted disaster management, and includes a brief review of existing legal and institutional arrangements from central to local levels, their capabilities to cope with different types of disasters, and their technical capacities to facilitate preparation of Action Plans on disaster risk reduction. The overall objective of the strategy is to reduce disaster risks in the process of implementing development programmes for national development. However, similar to the DRR policy gaps of India, Nepal also requires a detailed risk assessment by consolidating Eco-DRR including the biodiversity aspects.

Intended Nationally Determined Contributions, 2015

The INDC refers to the Government of Nepal's efforts to strengthen the institutional framework for ensuring implementation of climate change actions including REDD+ measures. It refers to synergies with the Forestry Sector Strategy (2016–2025) that aims to enhance Nepal's forest carbon stock by at least 5% by 2025 and also reduce the annual rate of deforestation by 0.05%. The NAPA and the framework for the local adaptation plans for action focus on improved ecosystem management including through community forestry initiatives. The INDC also specifically mentions the implementation of the environmentally friendly governance framework across the country, which includes objectives such as planting trees in at least 10% of the open/barren lands. In terms of its INDC commitment, one of the contributions is to maintain 40%

of the total area of the country under forest cover and improved sustainable management of forests.

3.1.5.2. Policy framework related to biodiversity conservation

Nepal National Biodiversity Strategy and Action Plan, 2014–2020

The Nepal NBSAP recognises the importance of dealing with the impacts of climate change on several sectors and themes including as they relate to biodiversity. The NBSAP identifies that lack of understanding of the impacts of climate change on biodiversity along with other factors leads to difficulties in implementing climate change adaptation and mitigation actions. The report also refers to the importance of biodiversity services as low cost and locally appropriate adaptation options and that biologically diverse systems store more carbon than other areas. The NBSAP also identifies potential impacts of climate change on biodiversity including shifts in range of species in terms of altitude, and vulnerable species likely to be pushed into extinction. The report refers to the Mountain EBA project as well as the USAID funded Hariyo Ban project as examples of climate change related projects that contribute to strengthening biodiversity conservation.

Strategic Approach 11 in the NBSAP, "Promotion of landscape conservation and climate resilient approaches for ecosystems and biodiversity management", directly relates to promoting biodiversity conservation for enhancing resilience to climate change. Under CC Strategy A of the NBSAP, CCA3 is on developing guidelines for integrating biodiversity conservation considerations into climate change adaptation projects and programmes. Action B1 is on integrating the climate risk vulnerability approach into biodiversity management related projects and programmes. Action Point FG-D2 is to promote EbA for climate change funded initiatives to enhance conservation of biodiversity and ecosystem services. The communications focus also identifies the importance of communicating messages related to the integrated links between biodiversity and climate change.

Nepal Fifth National Report to Convention on Biological Diversity, 2014

The Nepal 5th National Report identifies climate change as a key factor for the loss of biodiversity in mountain ecosystems in the future. It recognises current impact on forest ecosystems but is concerned about lack of research to determine the extent of impact. Under the recently adopted Strategic Plan for Climate Change Resilience, two of the five components directly relate to biodiversity conservation, one focused on enhancing climate resilience of

watersheds and the other being enhancing climate resilience of endangered species. Reference to the role of REDD+ in addressing climate change impacts in the country is also helpful.

3.1.5.3. Policy gaps and challenges

The disaster risk reduction challenges of Nepal include translating policies into practice; limited community-based projects in terms of technical quality, resource availability, operation and maintenance; inconsistency in data; high cost in acquiring data; wider areas and issues (hazards) to cover within limited resources, and reaching out to the poorest communities.

Reducing losses to disasters and implementing successful risk reduction measures are aims that can only be accomplished if they are undertaken in an integrated manner. Currently in the case of Nepal, policy responses to address disasters are integrated with other sectors such as environment, infrastructure and urban planning only in terms of the legal framework, but not in terms of enforcement and implementation. Conflicting and overlapping mandates and programmes of different institutions calls for rationalisation of these towards developing a more coherent framework that supports effective application of disaster risk reduction measures. So despite having the national policies, most of the disaster related measures are still addressed at the community level or local governance level such as village development committee, community-based organisations, etc.

This weakness can be attributed primarily to a lack of interaction and institutional overlap, calling for a review of the theoretical and policy linkages among disaster risk reduction, climate change and development plans in Nepal. The policy makers also need to understand that much can be learned and shared between sectors in order to ensure a move towards a path of integrated and more sustainable development.

3.1.6. Philippines

3.1.6.1. Policy framework related to DRR

The national disaster risk reduction and management plan 2011 to 2028 adheres to the principles of good governance within the context of poverty alleviation and environmental protection.

The policy related frameworks focus on partnerships – engaging the participation of CSOs, the private sector and volunteers in the government's DRRM programmes towards complementing resources and effective delivery of services to the citizens. It includes four distinct yet mutually reinforcing priority areas:

a) disaster prevention and mitigation;

b) disaster preparedness;

c) disaster response; and

d) disaster recovery and rehabilitation (NDRRMP, 2011).

Each priority area has its own long-term goal, which when put together will lead to the attainment of the Philippines' vision in DRRM.

The Plan highlights the importance of mainstreaming disaster risk reduction and management as well as climate change adaptation in the development processes such as policy formulation, socio-economic development planning, budgeting and governance. Particular attention is given to the sectors of environment, agriculture, water, energy, health, education, poverty reduction, land-use and urban planning and public infrastructure and housing.

Philippines' DRRM Plan also emphasises the authority of the central government in the disaster management programmes. The focus is often on developing proactive disaster risk reduction measures rather than response capabilities. With present regulatory environments concentrating on decision making and resources at the central level, local government action for disaster management is often given a lower priority.

National Climate Change Action Plan 2011–2018

The Government of Philippines adopted the National Framework Strategy on Climate Change in 2010 that envisions "climate-resilient Philippines with healthy, safe, prosperous and self-reliant communities and thriving and productive ecosystems". The goal of the Framework Strategy is to build adaptive capacity of communities and enhance resilience of natural ecosystems. In sum, the framework strategy adopts the principles of the Philippines Agenda 21 for Sustainable Development. The National Climate Action Plan has an overall goal of "building adaptive capacity of communities including women, increasing resilience of vulnerable sectors and natural ecosystems, and optimising mitigation opportunities towards gender-responsive and rights-based sustainable development". The NCCAP is a comprehensive action plan with mitigation and adaptation measures that has key actions related to "enhancing adaptive capacity and resilience of communities and natural ecosystems, adopting total economic valuation of natural resources while ensuring biodiversity conservation and recognising the competitive advantage of putting value on direct use, indirect use, option to use and non-use of environment and natural resources, as a short- to long-term sustainable development goal. The

priorities for the NCCAP include water sufficiency through conservation measures and ecological and environmental stability.

Intended Nationally Determined Contributions, 2015

The INDC refers to the importance of the country's natural ecosystems especially forests and marine resources in supporting efforts to address climate change impacts. It recognises the role marine ecosystems can play given their potential on blue carbon and has articulated these ecosystem contributions in the National REDD+ strategy as well as the draft NBSAP. In addition, the Government of the Philippines is committed to declaring 97 protected areas as national parks that can contribute to enhancing resilience against climate change.

3.1.6.2. Policy framework related to biodiversity conservation

The Fifth National Report to the Convention on Biological Diversity, 2014

The Report while identifying climate change as being a major driver for biodiversity loss also identifies that actions for biodiversity conservation need to be linked with disaster risk reduction, climate change adaptation and mitigation. The Report refers to biodiversity's true economic contribution not being fully accounted in terms of various ecosystem services including climate regulation and prevention of natural disasters, among others. The Government of the Philippines has adopted a Strategic Framework for Environmental and Natural Resource Sustainability Climate-Resiliency that is integrative in terms of the links between climate change, disaster risk reduction and biodiversity conservation. The Report refers to entry points for mainstreaming the Philippines NBSAP into the environment sector including through targeting national adaptation and mitigation action plans and policies and also into physical planning, emergency planning and response through targeting Provincial/City/Municipal Disaster Risk Reduction and Management Plans. The updated National Programme for UNCCD clearly identifies the focus being on generating synergies between the three MEAs related to climate change, biodiversity conservation and land degradation. Similarly, the Government of Philippines seeks to achieve synergies through implementation of most of their environmental programmes and policies.

3.1.6.3. Policy gaps and challenges

The disaster risk reduction challenges cover various facets of institutions and policies. Based on the review of the DRRM plans, institutional challenges are the following:

- Government capacity for proper resource management is wanting;
- Implementation is confused by overlapping and conflicting policies;
- Enforcement of environmental laws and policies is inadequate;
- A financing strategy for ecosystem, biodiversity and natural resources programmes and CCA is not yet available.

Additional gaps are in the development and transfer of knowledge, the low public awareness, and inadequate investments and financial resources for incorporating Eco-DRR solutions at the local level.

Despite the DRR and disaster management link with climate change adaptation in the policy formulation, no systematic linkage between disaster risk reduction (DRR) and climate change adaptation (CCA) has yet been established to advance sustainable development in practice and integrate biodiversity conservation specific aspects of Eco-DRR.

3.1.7. Thailand

3.1.7.1. Policy related to DRR and CCA

The Department of Disaster Prevention and Mitigation, Ministry of Interior, developed the Strategic National Action Plan (SNAP) on Disaster Risk Reduction 2010–2019, to address the implementation of the Hyogo Framework for Action (HFA) in Thailand.

The SNAP follows the strategic priorities of the United Nations Partnership Framework (UNPAF) developed by the Royal Thai Government and the United Nations Country Team. The UNPAF highlights disaster risk reduction as one of the top priorities in the next 10 years for the government. The objectives include:

a) Enhance safety and security of life and assets for Thai citizens and visitors as aligned with international safety standards

b) Mainstream disaster risk reduction into the national and sectoral development plans and programmes

c) Demonstrate clearly the intentions of the Royal Thai Government with regards to national disaster risk reduction

d) Develop and prepare a long-term Strategic National Action Plan for Disaster Risk Reduction for the country which is in line with the Hyogo Framework for Action 2005–2015

e) Establish a long-term action plan for all relevant agencies in the country, which will synchronise activities in a systematic and integrated approach in the same direction (DDPM, 2015).

Thailand has a National Strategy for Climate Change Management 2008–2012. The Office of Natural Resources and Environmental Policy and Planning (through the Office of Climate Change Coordination) is the national focal point for coordination with regard to the UNFCCC and the Kyoto Protocol (UNISDR, 2011). It is responsible for coordination with regard to climate change co-operation at state and international level.

Intended Nationally Determined Contributions, 2015

Thailand's INDC overall contribution is to reduce greenhouse gas emissions by 20% from the projected Business as Usual (BAU) scenario by 2030. The INDC refers to efforts by the Ministry of Natural Resources and Environment to determine the potential for reducing carbon emissions through implementing the REDD+ programme (which Thailand has not yet formally joined). The prioritised adaptation actions listed include implementing IWRM initiatives, increasing national forest cover to 40% through community participation focusing on mangrove and headwater forests to enhance EbA capacity, safeguard biodiversity and restore ecological integrity of protected areas, promote participatory integrated marine conservation and coastal rehabilitation initiatives to protect coastal and marine ecosystems among others.

3.1.7.2. Policy framework related to biodiversity conservation

Thailand Climate Change Master Plan 2012–2050

Thailand Climate Change Master Plan 2012–2050 is a framework of integrated policies and action plans relating to climate change. Its purpose is to support climate-change preparedness initiatives so that they are in line with Thailand's economic and socio-cultural contexts as well as sufficiency economy philosophy (ibid). The climate change master plan sets three horizons/time-frames, one being the short-term until 2016, the second being medium-term up to 2020, and the third being long-term up to 2050. One of the identified priority actions in the short-term is to increase the coverage of biodiversity conservation areas by 19% and to achieve an annual increase of 800 ha (5,000 rai) of additional mangrove areas. The medium-term priorities include 40% growth in forest cover and significant growth in protected area coverage. The long-term objectives include reduction in the threat to endangered species and improved conservation of biodiversity.

Thailand National Report on the Implementation of the Convention on Biological Diversity, 2014

The Thailand National Report clearly identifies climate change as a threat to biodiversity loss and especially degradation of coral reefs through climate-induced coral bleaching. The Report provides an update on the specific actions outlined in the NBSAP 2008–2012 with one specifically related to an action plan for understanding the changes in biodiversity components resulting from climate change and developing measures to mitigate the impacts of climate change on biodiversity. It refers to the Energy Conservation Plan 2008–2010 that includes a focus on applying biodiversity conservation specific measures for addressing climate change adaptation and energy conservation.

3.1.7.3. Policy gaps and challenges

The structure and frameworks in the plan have not yet been effectively implemented due to several limitations (UNISDR, 2011). The most challenging gap is lack of disaster awareness and understanding on the part of the public and even decision-makers.

Past experiences have shown that people are not well aware of hazards and disasters (DDPM, 2015) and there has been no specific biodiversity conservation-related aspects implemented at the national level. Knowledge and capacities are limited, and disaster management is not well organised. Good governance is another constraint for effective implementation of national policy and framework (ibid). Thus, the integration into local development processes of DRR and CCA based on the biodiversity aspects remains elusive.

3.1.8. Viet Nam

3.1.8.1. Policy framework related to CCA

The Law on Disaster Prevention and Control (the Law) was passed in June 2013 and took effect on 1 May 2014. The 47-article Law provides for disaster risk reduction, climate change adaptation and mitigation measures, from national to local and community levels. It outlines disaster prevention and control activities, including a national strategy and related plans, and stipulates the integration of disaster prevention into national and local socio-economic development plans.

The Law assigns roles and responsibilities among ministries and other key actors in preventing and responding to disasters, including the participation of international stakeholders. For example, the law on disaster prevention and control designates the Ministry of Agriculture and Rural Development as the provider of programmes of awareness raising and community-based

disaster management, and puts a special emphasis on vulnerable groups. The law also provides incentives for the provision of insurance against disaster risks.

National Strategy for Climate Change, 2011

The Prime Minister of Viet Nam approved the National Strategy for Climate Change in 2011 with the overall objective being to strengthen the resilience of human and natural systems to climate change. The Strategy contains strategic tasks of which 1/b relates to reduction of damage from natural disasters, with one of the identified actions on enhancing forest quality, forest cover, and forest functions, and to increase forest coverage to 45% by 2020. Strategic Task 2/b Water Resource Security has a specific action on formulating integrated water resource management plans for major river basins of the country. Strategic Task 4 is on protection and sustainable development of forests with identified actions including those focused on biodiversity conservation at all levels, reforestation and restoration of forests to increase carbon stocks.

Intended Nationally Determined Contribution of Viet Nam, 2015

The INDC mitigation component includes significant efforts made by the Government of Viet Nam in forest protection, afforestation and reforestation through implementing REDD+ and conservation and enhancement of carbon forest stocks initiatives. The INDC also mentions that GHG mitigation contribution in reference to LULUCF will result from improved management of grasslands and wetlands. The specific measures to achieve GHG mitigation include sustainable forest management, enhancing carbon sequestration and forest ecosystem services, conservation of biodiversity linked to the well-being of local, especially forest dependent, communities. Priority actions for climate change adaptation include: implementing ecosystem-based adaptation through the development of ecosystem services and biodiversity conservation with a focus on conserving biodiversity at all three levels; implementing sustainable forest management initiatives; protecting and restoring plants including coastal forests primarily mangroves in coastal estuaries and Mekong Delta areas; and implementing integrated coastal zone management.

3.1.8.2. Policy framework related to biodiversity conservation

Viet Nam's Fifth National Report to the United Nations Convention on Biological Diversity, 2014

This 5th National Report identifies climate change along with pollution and invasive alien species as new and emerging drivers of biodiversity loss in the country. As Viet Nam is one of the most climate vulnerable countries in the world, especially the Mekong Delta Region, significant adverse climate change impacts on ecosystems are expected, especially in coastal and marine ecosystems that will be affected by sea level rise, extreme weather phenomena, increases in average temperatures, etc. The Report refers to the increase in temperature likely to affect distribution and population structure of many species, habitats and ecosystems. Decision No. 45/QD-TTg, adopted by the Prime Minister of Viet Nam in 2014, calls for ensuring that ecosystems and their genetic resources are conserved to maintain ecosystem services that will support adaptation to climate change and promote sustainable development. The Report recognises the role of biodiversity corridors in not just connecting protected areas but also supporting EbA of the dependent communities.

Viet Nam National Biodiversity Strategy. 2015

The Overall Target for the NBSAP up to 2020 relates to the conservation of ecosystems and their component biodiversity to contribute to the development of the Green Economy and actively respond to climate change. The NBSAP refers to biodiversity conservation being one of the solutions to cope with climate change and specifically refers to the importance of sustainable forest management, EbA, and integrating biodiversity and climate change considerations into the poverty reduction and food security related strategies and plans. The Report also identifies biodiversity as being a fundamental element of the Green Economy including addressing impacts of climate change. One of the major tasks identified in the NBSAP is “biodiversity conservation in the context of climate change”, which has specific actions relating to understanding the impacts of climate change, development of biological corridors that would support adaptation to climate change and implementation of a forest regeneration programme to enhance carbon stock and support mitigation and adaptation to climate change.

3.1.8.3. Policy gaps and challenges

Research focused on Viet Nam policies on DRR found “a big gap between disaster and environment management policies and programs” (Shaw & Tran, 2012). The study also highlights the damage caused by disasters to natural resources reducing environmental quality, indirectly contributing to increasing poverty, which in turn adds to the vulnerability of both natural and human systems, so further increasing disaster losses.

Therefore, a first step towards more concerted and coordinated global action on disaster risk reduction must be a clear understanding of the depth and extent of hazard, vulnerability and disaster loss by integrating biodiversity conservation specific aspects of Eco-DRR in addressing the gap in understanding and then formulating plans and policies to implement the new approach.

This mirrors work on the key role to be played by municipal and local government as a champion for governance, linking public, private and civil society actors. The gap between different levels of actors like national level actors and community level including organisations also needs to be bridged.

4. Eco-DRR experiences in the region

Given the increasing importance of ecosystem services and management in adapting and responding to impacts associated with disaster risk, this section assesses the capacity for delivering and understanding Eco-DRR including biodiversity conservation and climate change adaptation within different sectors at selected national levels together with the gaps.

According to UNESCAP (2015), “one of the best defenses against many naturally occurring hazards and disasters is a healthy natural environment with robust ecosystems”. Unfortunately, much of this protection has been weakened. Over the past 50 years, humans have degraded the region’s forests, grasslands, deserts, tundra, mountains, and agricultural areas, as well as freshwater and coastal and ocean ecosystems − steadily reducing their capacity to protect people against hazards.

Climate change is posing significant challenges including its impending adverse impacts on ecosystems likely to be felt first in coastal areas, with risks of sea level rise, greater storm intensity, higher wind speeds, greater wave action and higher sea surface temperatures. The Asia region has many countries with significant coastal stretches of which this assessment is covering the People’s Republic of China, India, Viet Nam, Thailand, Bangladesh, Cambodia and Philippines.

This section will also present a complex sequence of events involving human activity, climate change and hazards then creating a vicious feedback loop to nature in terms of both ecosystems and biodiversity.

Box 2: Reinforcing Eco-DRR solutions: Coastal forest at Sanriku-Fukko National Park, Japan

Several studies of coastal forests along Japan's coasts determined that coastal vegetation provided some natural protection by catching large debris (such as boats) as tsunami waves advanced inland (Tanaka et al., 2012). Now, the establishment of the new Sanriku Fukko (Reconstruction) National Park is one of the measures by which the Ministry of the Environment, Japan (MOEJ) is implementing a programme of Green Reconstruction and establishing a linkage between forests, rivers, sea & *satoyama* (the area between mountain foothills and arable flat land), following the 2011 Great East Japan Earthquake.

Coastal disaster prevention forests are the forests that demonstrate these capabilities, mitigating the damage of tsunami as well (Onishi & Ishiwatari, 2012). For example, a maximum of 170 m of the coastal forest was mowed down by a tsunami in Hachinohe City, where the debris was trapped inside the fallen forest. In addition, it also offset the wave power of the tsunami, which mitigated the damage to houses and other infrastructure located on the land side beyond the coastal forest. The presence of coastal forests also presented some restriction to land use, keeping houses and other infrastructure away from the coast, consequently damages and flooding of houses, etc. were mitigated at some locations.

For this reason, the restoration of coastal disaster prevention forests that were affected in the Great East Japan Earthquake is under way in Japan now. On the other hand, reconstruction is also promoting enhanced social and cultural planning in the area with the provision for utilising local culture and lifestyle, studies and reviews of protocols for preparing for natural hazards, and mechanisms for dealing with the waste generated by these events.

The management plans, park boundaries and conservation policies will be revised to ensure the rich ecosystems remain intact, in accordance with the changes in the natural environment brought about as reconstruction proceeds.

In the future, as the reconstruction proceeds Eco-tourism characteristics will be considered as a part of the Green Reconstruction project including: the establishment of the Tohoku Coast Trail; public awareness campaigns – "Reconnecting the Forests, Rivers, Sea & *Satoyama*"; Education for Sustainable Development; environmental monitoring efforts; and the establishment of a Satoyama Satoumi Field Museum. (Source: MoE, Government of Japan,2013)

1. Implementation of Eco-DRR in the region

The sheer scale of risks posed by natural hazards, climate change and variability, in conjunction with globally widespread ecosystems' decline, requires solutions that are cost-effective but also locally accessible and applicable (PEDRR, 2010).

Ecosystem management/ Eco-DRR is not a new concept but further evidence is still needed to build the case and demonstrate how ecosystem management can be most effectively implemented for disaster risk reduction and thus facilitate uptake by communities, disaster management practitioners, policymakers and decision makers.

So this section of the assessment will assess hazards, applied approaches, empirical evidence-based experiences from different organisations, lessons learnt, and new plans/ policies with institutional designs for Eco-DRR initiatives in the selected countries of the Asia region.

The largest flagship programme of IUCN in Asia is the Mangroves for the Future Initiative, which was developed as a long-term response to address the impacts of the Indian Ocean tsunami by demonstrating that coastal ecosystems play a major role in buffering the impacts of coastal hazards and also provide vital ecosystem goods and services. This Initiative initially started as a multi-partner programme involving the affected countries of India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand and also three UN agencies and other regional partners. It has now expanded to include Bangladesh, Cambodia, Myanmar, Pakistan and Viet Nam. MFF has transformed in its third phase to focus on enhancing resilience of coastal zones, including their constituent communities, to the impacts of climate change.

IUCN is increasingly involved in supporting climate change adaptation programmes, with a specific focus on EbA. An initial rapid assessment of IUCN's project portfolio shows IUCN is implementing 45 EbA projects in 58 countries.

IUCN works to contribute towards an overall approach to the integration of climate sensitive planning for the conservation of biodiversity and sustaining ecosystem services for human well-being. In the Asia region, IUCN has ecosystem-based work in Bangladesh, Cambodia, People's Republic of China, India, Indonesia, Lao PDR, Maldives, Nepal, Pakistan, Sri Lanka, Thailand and Viet Nam. The ecosystems cover the whole range of IUCN's work. However, the countries mentioned below are restricted to the eight vulnerable countries selected for the Asia Regional Assessment:

- **Coastal and Marine Areas:** Bangladesh, Cambodia, India, Thailand and Viet Nam.
- **River Basins:** Thailand.
- **Mountain Regions:** Thailand and Nepal.
- **Agricultural Landscapes:** Thailand.

This section brings experiences and lessons learned from disasters in these countries to better understand the hazards, nature of vulnerability and approaches applied at the local as well as national level by integrating biodiversity conservation specific aspects of Eco-DRR.

This section also highlights the role of the local settings for the effective practice, support, adoption and implementation of the ecosystem and biodiversity inclusive approaches.

1. Bangladesh

1.1. Overview

Natural hazards such as cyclones and storm surges, floods, riverbank erosions, earthquakes, droughts, arsenic contamination of groundwater, tornados and landslides have caused significant damage to human lives and physical assets while creating long-lasting adverse effects on social settings, ecosystems and the economic well-being of Bangladesh.

According to EM DAT, “storms followed by floods have the highest event count. Storms include tropical cyclone and convective storms whereas floods include river floods, flash floods and coastal floods”.

Tropical cyclones from the Bay of Bengal accompanied by storm surges are one of the major types of disaster in Bangladesh, occurring mainly in April/May and October/November. The country is one of the world’s worst sufferers of all cyclonic casualties. Most of the damage done by cyclones is caused by the storm surges associated with cyclones, and not by the wind speed as is usually believed. Storm surges can rise up to 9 m and it is not uncommon in this region to experience severe damage from these surges up to 100 km inland following the river system (Zimmermann, et al., 2009).

The geographical setting of flood risk is heavily concentrated in Bangladesh, causing high human and material losses. An average of 844,000 million cubic metres of water flows into the country during the wet season (May–October) through the three key rivers, the Ganges, the Brahmaputra and the Meghna (Dewan, 2015).

1.2. Floating gardens as a means to sustainable livelihood (Haor region, southern floodplains of Bangladesh)

Floating gardening, a form of hydroponics, is an age-old practice of cultivation in the floodplains of the southern parts of Bangladesh.

Known locally as '*baira'*, the practice involves the use of plants to construct a floating platform, on which vegetables and other crops are cultivated. Seedlings are raised in the rainy season, and the platform residue is used in preparation of beds for winter vegetable gardening. Therefore, this cultivation technique is an environment-friendly means to utilise natural resources of the wetlands to grow vegetables and other crops almost all the year round. This form of hydroponics is a nature-based technology where water hyacinth and other plant materials are piled up to prepare long rafts and allowed to decay on which crop seedlings are raised and vegetables and spices are cultivated. The promotion of floating gardening in Bangladesh has led to socio-economic, agricultural and ecological benefits. An example is the significant positive impact on biodiversity, as the practice entails the removal and utilisation of water hyacinths, the primary invasive species affecting the wetlands of Bangladesh.

The agricultural benefits include additional space for vegetable cultivation and seedling raising in the wetlands; an increase in the supply of vegetables in the area and the surroundings; and the availability of the prime nutrient elements, namely N, P and K are available in water hyacinth comparable with cow dung whereas the ecological benefits include a good use of an invasive species like water hyacinth – a very effective way to control this notorious weed; using *baira* residues as organic fertiliser; cutting down pollution from chemical fertilisers, etc. In addition, *baira* provides apparently landless communities with parcels of land, thus increasing their land ownership in the rainy season to grow vegetables (Irfanullah, et al., 2011).

1.3. Challenges, gaps and opportunities

The case study of *baira* highlights how organisations are implementing projects through their programmes and services to realise the objectives of sustainable livelihood and food security and to overcome related challenges. CARE and IUCN together have reduced the challenging aspects of floating gardening. The challenges are: although floating gardening is widely prescribed as an adaptation option, hardly any study is available on whether it will adapt to changing climate and climate variability, and strong established markets for the produce were almost absent in the NGO-led scaling-up over the years, where household-level subsistence for poor project participants had been the core focus.

There are challenging aspects from the case-based perspective as well; it includes finding a suitable site and bringing different households together. However, the site selection considered only those houses where a sheltered site was present, water hyacinth were sufficiently

available, space was available for floating gardening by the homesteads, and land was available adjacent to the homesteads for subsequent winter gardening with floating garden residues.

The livelihood security aspects of the *baira* project and its upgrading cannot be overlooked. For the flood prone area, this cultivation practice helps to supplement people's income, which contributes towards the alleviation of poverty, and provides greater food security by increasing the landholding capacity of poor as well as landless people by allowing them to grow vegetables and crops with lower input costs, due to the minimal infrastructure and capital required. These characteristics can give an opportunity to many people living in the flood devastated and flood prone area to cultivate using this technique.

Recently the Government of Bangladesh has extended floating gardening in many waterlogged districts with 12,000 farmers through a Bangladesh Climate Change Trust-funded project (government's own fund), using the experiences from many past initiatives of organisations, like BCAS, IUCN, CARE, Practical Action and Inter-cooperation. Beyond its centre of origin – the southern coast of Bangladesh − this indigenous technology has clearly demonstrated its potential to be a very good tool for disaster management and climate change adaptation.

1.4. Conclusion

The overall experience of the *baira* project is positive. The participants managed to overcome the devastation of floods and practised floating gardening for the first time through intense motivation and willpower. Most of the vegetables grown on the floating gardens were consumed by the target families, with some given to relatives and neighbours; a good number of seedlings raised on these platforms were sold, but most were transplanted in available space in the homesteads and winter gardens.

Thus, a new technique like *baira* cultivation, if properly introduced, can help people devastated by a disaster to recover and develop a new and sustainable livelihood. This process involved effective support and constant monitoring to ensure that the beneficiaries benefited financially as well as heath- wise, with improved food security. .

2. Cambodia

2.1. Overview

As an LDC with many of its 14 million people directly dependent on biodiversity and ecosystems, Cambodia is highly vulnerable to the adverse impacts of climate change. The increasing development along the coastal areas of Cambodia has resulted in an exponential increase in the migration of people from areas not undergoing such development (Chong, 2014).

Due to this, pressure on the coastal natural resources and environment is increasing. This situation is further aggravated by the lack of facilities and coordination between the line agencies and departments responsible for coastal management in Cambodia (Rizvi & Singer, 2011).

Cambodia's coastal areas face sea-level rise and storm surges. Also, the highly valuable ecosystems of the Mekong River, which sustain fisheries and transport fertile soils vital for agricultural productivity, are faced with a more distinctive threat (Chong, 2014).

Lack of technical knowledge, poor infrastructure, and low socio-economic conditions along with coordination and budgetary constraints have been cited as major obstacles in the implementation of the NAPA (Rizvi & Singer, 2011). It is imperative for any initiative aimed at sustainable use of natural resources and enhancing climate resilience to recognise that conflict of mandates among agencies, lack of coordination and information sharing and limited technical capacity, are critical issues that will have to be tackled.

2.2. Ecosystem-based approaches to climate change adaptation (Koh Kong and Preah Sihanouk in south-western Cambodia)

Coastal wetlands, including mangroves, serve as carbon stores and sinks. Here mangrove restoration along the wetland and floodplain is providing a wide range of ecosystem services, including coastal defence, flood inundation, carbon sequestration, protection against extreme weather events, trapping sediment and providing nutrients and nurseries for coastal fisheries. Koh Kong and Preah Sihanouk in the south-western region of Cambodia are the site of projects designed to build the resilience of the coastal communities by incorporating mangrove

restoration and identifying other biodiversity conservation aspects in terms of fisheries in the same project (Chong, 2014).

These projects are supported by NAPA to deliver biodiversity conservation co-benefits, with the primary foundation to restore mangrove ecosystems as buffers against climate change hazards. These NAPA projects are implemented with the sponsorship of government agencies and donors organised by the Cambodian Climate Change Alliance [2] (CCCA) (ibid).

The projects are promoting biodiversity conservation with mangrove restoration for climate resilient water management as part of the agricultural practices among the communities of Koh Kong and Preah Sihanouk (D'Agostino & Sovacool, 2011) with a major focus on the intensification of fishery production as a direct benefit of the role of ecosystem services.

Consequently, the vegetation plantation project to build the resilience of the coastal communities in Koh Kong and Preah Sihanouk has great potential to incorporate the ecosystem-based elements of mangrove restoration and biodiversity conservation.

However, the success of the ecosystem-based approaches also depends on the amalgamation of the complexity and challenges to the effective biodiversity conservation and ecosystem management (Chong, 2014).

Cambodia has many institutional, political and socio-economic factors that hinder biodiversity conservation, including weak governance of natural resources, poor enforcement of laws, corrupt practices, and the exclusion of local people from participation in ecosystem management (D'Agostino & Sovacool, 2011).

Despite many barriers, EbA-based plans for the mangrove restoration and plantation in Koh Kong and Preah Sihanouk helped improve natural resource management in the specially designated zones. Such activities have helped local people understand the main issues including the role of biodiversity and its conservation affecting not only the coastal habitats but reducing the risk of disaster as well.

[2] The Cambodia Climate Change Alliance (CCCA) programme was launched in February 2010 led by the Ministry of Environment and supported (approx. US$ 10.8 million) by the European Union, Denmark, Sweden and UNDP. The CCCA aims at creating the enabling conditions for Cambodia's response to climate change through capacity building and institutional strengthening targeting key national institutions, sub-national authorities and civil society, and demonstrating pilot measures for adaptation to climate change.

Also from the IUCN web published article, the dolphin surveys in Koh Kong and seagrass survey in Kampot contributed to a better development of the integrated coastal management plan of these provinces. The IUCN-led research on coastal erosion and mangrove destruction in Koh Kong in 2013 helped concerned communities to understand the causes of mangrove devastation and large-scale coastal erosion, thereby acquiring new knowledge about the ecosystems, vulnerabilities to climate change, and impacts of projected beach barrier migration.

The government agencies, non-government organisations and communities in Cambodia have all increased their understanding of linking biodiversity and ecosystems to the goal of poverty reduction (Chong, 2014). Nevertheless, effective enforcement of legislation addressing water management, forestry, fisheries, wildlife, and protected area management is still lacking and needs to be developed with more integration of the biodiversity conservation specific aspects.

2.3. Challenges, gaps and opportunities

Although various ecosystem-based adaptation projects are identified in Cambodia's NAPA, the gaps and lack of integration in climate change issues and environment policy are not favourable to progressing effective implementation of EbA approaches.

Policies and strategies on climate change and disaster management are in place but are fragmented, and the focus of the latter is primarily focused on post-disaster emergency relief, with little integration with global or national climate change policies.

Critically, climate change policy and strategy development have been undertaken at the national level without engagement of vulnerable people and communities. Nevertheless, the civil society National Climate Change Network has had some success in providing inputs to key government climate change policy and strategy documents (Chong, 2014).

Many institutional, political and socio-economic factors hinder biodiversity conservation, including weak governance of natural resources, poor enforcement of laws, corrupt practices, and the exclusion of local people from participation in ecosystem management (Chong, 2014). It has also been determined that this has led to land alienation including increased commercialisation of forest and agricultural land, which complicates the implementation of effective disaster risk reduction measures (ibid).

Despite many barriers, governments, non-government organisations and communities have attempted to increase the importance of biodiversity and ecosystems including through the National Biodiversity Strategy and Action Plan (NBSAP), which does not address the climate

change link with biodiversity conservation. Nevertheless, such best practices at the community and the policy level should be identified and assessed to improve the effectiveness.

2.4. Conclusion

The success of biodiversity conservation and ecosystems-based adaptation for DRR therefore depends on enabling national political, socioeconomic and institutional conditions.

In Cambodia, local communities lack involvement in the disaster risk reduction initiatives using biodiversity related aspects, making the people and places more vulnerable. The weaker sections of the society are further exposed to natural hazards.

The examination of national policy and practice in Cambodia reveals that institutional and legal barriers at national level can pose significant challenges to achieving adaptation objectives.

Thus, institutional strengthening in Cambodia will contribute towards positioning relevant line agencies and stakeholders to better access global climate-related funding mechanisms. Along with addressing governance issues at the national and provincial levels, it is also critical to undertake strategic interventions aimed at developing and enhancing local communities' capacity to respond to climate hazards.

Strengthening ongoing commune level participatory engagement would be the most effective methodology in this context through integration of biodiversity conservation along with ecosystem-based adaptation approaches into overall mainstream development initiatives.

3. People's Republic of China

3.1. Overview

Increasing landslide occurrence has become a significant environmental concern in the People's Republic of China that has been attributed to human activities such as construction of roads, dams, mines, deforestation, intensive agriculture and over-grazing of livestock. The landslides also cause high economic losses.

In response to these events, the Chinese government created two large-scale, heavily funded ecological rehabilitation programmes: the Natural Forest Protection Program (NFPP) and the Sloping Land Conversion Program (SLCP).

The NFPP addresses soil erosion originating from deforestation by limiting or banning logging and closing large tracts of land for afforestation. The mission of the SLCP, also known as the "Grain for Green" programme, is to reduce soil erosion from sloped, degraded cropland by converting these areas to forest or grassland cover.

The goal of the SLCP is to convert a total of 32 million hectares of marginal sloped farmland and barren lands back to forest and grassland by 2010 (Xu et al., 2006). At least 25 provinces are involved in the programme, encompassing all of the People's Republic of China with the exception of the densely populated and developed eastern seaboard (Bullock & King, 2011). Initially the government subsidy to SLCP households was set to expire after eight years, but as of 2008, the national government has extended its compensation to farmers for eight more years (ibid).

Tianquan County, Sichuan Province, and Wuqi County, Shaanxi Province, are used here to analyse how rural areas with different economic patterns have responded to the SLCP implemented by the government.

3.2. *Sustainable transition of SLCP (Tianquan and Wuqi counties)*

The SLCP has been evaluated from a number of vantage points to investigate its diverse social and ecological effects. Several studies have addressed the effect of the SLCP on household income levels and determined that the programme has had mixed results. Farmers with low-yield, sloped farmland are receptive to the programme and experience a net income increase from the subsidy, while farmers required to convert high-yield farmland are negatively affected by a net income decrease (Xu et al., 2006).

For enhancing both environmental developments and economic benefits to farmers, the SLCP should focus on converting only low-yielding, degraded farmland, as is intended, instead of applying the policy uniformly regardless of land quality. However, the implementation and outcomes vary depending on the county, the followed steps of the SLCP guidelines and the local government implementation and supervision (Bullock & King, 2011).

From a broad perspective, the national statistics of the People's Republic of China portray the SLCP to be an environmental and economic success so far. In the course of this success, a vital role has been played by different factors that are barely discussed: (a) local government involvement; (b) local economic development; and (c) funding for projects. Without economic

development and local government backing within local economies, farmers will remain dependent upon continued subsidy assistance to meet the policy's ambitious environmental restrictions, thereby undermining the programme's long-term sustainability.

Tianquan County, Sichuan Province, and Wuqi County, Shaanxi Province, are geographically and economically distinct regions with different labour distribution and income sources (Bullock & King, 2011).

In Wuqi County eight years after the initial SLCP restoration efforts, farmers reported that the local environmental conditions have noticeably improved. Several positive environmental effects resulted from SLCP, including less severe and less frequent soil erosion from sloping land, less intense sandstorms, improved air quality, fewer landslides, a greener environment, and reduced water runoff and flooding after rainstorms.

In Tianquan County, farmers reported a decrease in landslide frequency and intensity. The reduced disasters and their effects were visible with the implementation of SLCP, with less erosion and landslide following heavy rain.

Local officials and farmers also confirmed visible and tangible problems with the environment prior to the SLCP, including issues with crop growth, soil erosion on sloped farmland, landslides, and flooding. Landslides caused damage to crops and houses below and blocked roads.

The positive transition in the environment also had social transition effects that were overlooked. Farmland is the primary source of income for both the counties, but Tianquan experienced a greater strain from SLCP compared to Wuqi based on land conversion. So Tianquan households faced occupational shifts to continue their livelihood, leaving many unemployed to a larger extent in comparison to Wuqi. On the other hand, the local communities became more dependent on the subsidy from SLCP provided by the national government. The dissimilarity between off-farm jobs in Tianquan and Wuqi also affected farmers' local economic conditions. Therefore, the well-being of the household or community also determines the adoption of policy measures.

For a sustainable transition it is important to note the social and economic aspects along with the physical ones.

3.3. Challenges, gaps and opportunities

SLCP implementation has had similar environmental effects but diverging economic impacts in Tianquan and Wuqi counties. Both the areas were reported to have noticeable environmental improvements from the SLCP implementation programme (Bullock & King, 2011).

The study also outlines the importance of involvement and technical support from local government for achieving the land conversion goals outlined by the SLCP, suggesting that the implementation and financing of the programme in a conventional top-down manner is not the most effective method . It may be better to enhance ownership at the provincial, township, commune and other local government levels towards enhancing the effectiveness of this important programme.

SLCP measures also need to be made local context specific and implemented through locally owned processes and also at the same time increasingly focus on restoration of natural vegetation rather than uniform plantations.

The SLCP does not give sufficient consideration to the ecological and economic functions of grasslands in semi-arid areas and the need to restore these ecosystems. However, in the broader picture, SLCP provides a good opportunity to restore biodiversity regions that have been destroyed or dramatically affected by human activity.

3.4. Conclusion

The guidelines designed within the national policy of the People's Republic of China for the implementation of SLCP could consider the longer social consequences along with the environmental benefits (fewer occurrences of landslides and erosion). It could emphasise the importance of regional and local government involvement, local economic development, and funding for local projects, for the long-term and sustainable viability of the SLCP.

The counties also need to focus on the challenges to determine the main needs of local farmers, to develop and deliver appropriate training on eco-DRR that corresponds to their needs, to disseminate information, and provide training to students on eco-DRR approaches.

4. India

4.1. Overview

India is vulnerable, in varying degrees, to a large number of natural disasters. About 58 % of the landmass is prone to earthquakes of moderate to very high intensity; 12 % of land is prone to floods and river erosion; of the 7,516 km coastline, close to 5,700 km is prone to cyclones and tsunamis; and 68 % of the cultivable area is vulnerable to drought, landslides and avalanches (NDMA, 2009).

According to the NDMA hazard profile and EM-DAT, floods followed by tropical cyclones have the highest events counts.

Considering the natural hazards in the Uttar Pradesh State of India over the years, floods have been causing severe damage and adversely affecting human, plant and animal life, property and environment.

Natural hazards that are of significance in Uttar Pradesh are floods, droughts, fires and earthquakes. Considerable efforts are made every year, both by the government and the public, to mitigate the losses encountered during a disaster.

4.2. Preserving traditional knowledge to help reduce risks in a protected area (Manas World Heritage Site and Biosphere Reserve, India)

Manas Biosphere Reserve in Assam, India is designated as a UNESCO World Heritage Site for its exceptional natural beauty, ongoing ecological processes and several endangered species. It spans across 2,837 km^2 of forest area. The Subankhata Reserve Forest, located along the eastern edge of the Manas Biosphere Reserve, falls under the Bhabhar region, characterised by rocky terrain as well as course-changing, seasonal Himalayan rivers. Due to the heavy rainfall (above 3 metres), the terrain and the loose soils are prone to floods and erosion along the Himalayan Rivers.

In response to the yearly occurring floods and erosion, the indigenous people living in the Manas Biosphere Reserve have successfully demonstrated the use of century old traditional knowledge for channelling seasonal Himalayan rivers. The community uses bamboo trees to protect river banks where a steep drop exists between the bank and the river bed. Residents generally feel that the trees are an advantage to protecting their land. This local technique is helping reduce soil erosion and floods by ensuring the availability of irrigation and drinking water

in an otherwise water deficient region (Dudley, et al., 2015). Further, they have also found that the use of bamboo provides resilience against imminent sand mining impacts.

The technique involved the construction of Dong Bundhs (small canals) on the river using locally available material such as timber, bamboo and boulders. It is known as the Dong Bundh system of Subankhata forest (DBSSF). These community-constructed micro-dams along the rivers helped reduce soil erosion and floods, and significantly contributed towards DRR in the downstream agricultural areas (ibid).

Building on their success, more schemes were gradually established and expanded to cover a significant portion of the catchment area. At present, there are 13 DBSSFs, with inhabitants from more than 95 villages managing the irrigation system, which benefits a population of over 36,000 people (ibid). The role of bamboo species for the purpose of DBSSF has been highly beneficial to the villagers in multiple ways which can be looked upon as opportunities for reducing the risks of disaster and most important during major floods, successfully avoiding erosion and landslides in the lower catchment .

4.3. Challenges, gaps and opportunities

Local governments have made many attempts to fully exploit the water potential and to use modern technology, such as check-dams (Dudley, et al., 2015). However, the community in Manas Biosphere Reserve has been able to develop and preserve an indigenous water management practice that has benefitted the Reserve immensely.

This practice of constructing micro-dams, channelising and regulating water following a systematic plan is almost a century old now, and this has ensured the protection of key water sources and its ecological processes within the protected area.

However, the evidence on such traditional practices is scarce and it is critical to identify such traditional practices surviving within the periphery of protected areas, and to encompass them in the overall management of protected areas (ibid).

On the other hand, villages along the rivers did not have to depend on an artificial source of water, and as a bonus they were able to harvest at least four different cash crops throughout the year, strengthening their socio-economic condition.

Based on the responses from the Wildlife Institute India under the UNESCO C2CON Natural Heritage Site Management and Training in the Asia Pacific Region, the project titled

“Conserving Wildlife Biodiversity and Ecosystem Services in Manas Tiger Reserve (MTR) for Regional Rural Development and Disaster Risk Reduction in Assam” involving PA in terrestrial ecosystems (forests, wetlands, etc.) has helped to develop and strengthen the partnership with national and state government institutions. The result is a science- and economics-based understanding of the ecosystem services that MTR’s wildlife biodiversity provides for agricultural development, poverty reduction and disaster mitigation at a regional level. This project lasted for four years with activities focusing on biodiversity conservation such as: valuing and assessing MTR’s ecosystem services for regional agricultural development and Disaster Risk Reduction and Climate Change Adaptation; analysing the role of biodiversity in supporting MTR’s ecosystem services through scientific research and raising societal awareness of ecosystem services; and developing projects for improving biodiversity conservation and ecosystem services through alternative livelihood support to the local community.

4.4. Conclusion

The practices based on local knowledge and experiences are inclusive of all the socio-economic and environmental parameters as mentioned above. Such practical traditional knowledge resulted in reducing the effect of disaster as well as enhancing the existing ecological process in Manas Biosphere Reserve.

Hence, the role of local knowledge needs to be recognised and blended with modern scientific knowledge to establish the knowledge base for reducing risk and enhancing community resilience. Further research and documentation is required, to provide solid documentation on the integration of environment conservation, ecological processes and local practices as very important in designing policies that are easily accepted and adapted by the people.

5. Nepal

5.1. Overview

Located along the Himalayan Arc, Nepal is highly susceptible to floods, landslides, glacial lake outburst floods and earthquakes. It is classified as a low-income country and a low human development nation, ranked 157 out of 187 countries in the composite Human Development Index (UNDP, 2013).

This combination of geophysical and social vulnerability (high levels of poverty and social inequality based on ethnic and caste-based discrimination) renders Nepal highly susceptible to any disaster, with Terai plains as an affected region prone to floods every year.

However, understanding the socio-cultural and political context in Nepal provides much needed insight into the ongoing governance and development challenges faced. According to UNISDR (2011), “the shortcomings in DRR are increasingly being regarded as a consequence of weak governance and lack of political will, which is also the case of Nepal”.

Annually, floods, erosion and landslides, on an average, cause about 300 deaths in Nepal and economic damage exceeding US$ 10 million. Most floods in Nepal occur during the rainy season, between June and September, when 80% of annual precipitation falls, coinciding with snowmelt in the mountains.

5.2. Role of bio-engineering plant species in DRR (Panchase area of Western Nepal)

Research is being undertaken in the Panchase area of western Nepal, as part of the Ecosystems Protecting Infrastructure and Communities (EPIC) project under IUCN to demonstrate the role of ecosystems – through low cost bio-engineering – as an effective way of stabilising roadside slopes and increasing resilience.

Three sites were selected in the Panchase region for the bio-engineering project. The purpose of the project was to reduce risks from landslides and flash floods in the region and quantify the role of ecosystem services, through the use of bio-engineering plant species, for slope stabilisation along earthen rural roads.

First, the activities were analysed with respect to EbA principles and indicators. Based on community suggestions and some EbA criteria, the priorities of the community and those important from the ecosystem resilience perspective were taken into consideration.

Any rural road project in Nepal must inevitably involve concerned communities, who are the de facto road engineers, maintenance crews and beneficiaries. They can also be considered local scientists, most often having very detailed knowledge of local conditions, plant species and general geological conditions of their locations.

The project was carried out with the local government partner, the District Soil Conservation Office (DSCO), and the selection of species was made by the community in collaboration with DSCO, which supplied the seedlings. The project involved participatory mapping of the site, community-based identification of problem areas and solutions; establishment of low-cost engineering structures for drainage; and selection of plant species with the communities that generally selected a combination of bio-engineering plant species. The plant species included:

Drepanosachyum falcatum, *Alnus nepalensis,* etc. fast growing fodder species and a variety of bamboo species, e.g. *Thysanolaena maxima* (Devkota, et al., 2014).

Despite this project research being at the initial phase, community observations and monitoring the effectiveness of vegetation for erosion control for different plant species for soil cohesion and drought resistance is very important.

5.3. Challenges, gaps and opportunities

As one of the poorest countries in the world, the Government of Nepal is struggling to provide many of the basic necessities to its population. Rural road construction continues to be a priority for rural development. However, these roads are being constructed without giving due concern to the long-term social and environmental implications, which in the longer run would also have significant economic impact as there would be need to adopt measures to address the adverse social and environmental implications.

Although the research by EPIC is in its initial stages, a comprehensive result can be obtained by combining different types of research methods, monitoring erosion and the effectiveness of different plant species to control erosion.

The communities, local government and national level stakeholders have been enthusiastic about EPIC Nepal and its focus on 'eco-safe' roads – a key issue throughout the country – rather than a more general focus on ecosystems and landslides. There were also uncertainties surrounding the carry-over of funds for bio-engineering with very little room for cutting back on the bio-engineering sites and costs without jeopardising the entire project and agreements with the local government. This budget issue also made it difficult for IUCN Nepal to ensure the signature of district level LOAs, without which bio-engineering implementation cannot start.

Therefore, awareness about eco-safe roads and how to make road construction more sustainable is still rather limited among governments, national level stakeholders and communities. It is expected that such study will contribute in shaping government policies and practices to reduce the impact of unplanned road construction. Also, according to IUCN country office Nepal, the 2015 Gorkha Earthquake disaster followed by blockade and political instability in the south bordering with India, doubled the transportation costs and re-orientation of priorities among Government partners in the demonstration sites.

5.4. Conclusion

The project is being implemented for two years and therefore, concrete results are still limited. However, it is clear that the participatory process adopted ensured the inclusion of various important institutions and other partners. As such, their input made important contributions to the action plans and the EbA strategy. The participatory process also helped to translate the EbA plan and strategy into awareness raising and capacity building activities for local partners and the community.

A major lesson learned is that the key driver of progress is efficient coordination among the partners. This needs effective mechanisms along with government endorsement. In addition, capacity development on ecosystems adaptation is crucial at all levels of implementation.

From the EPIC case study of Nepal, it is clear that the key drivers of ecosystem vulnerability are both climatic and non-climatic stress. Such stressors included poverty, poor land use practices, increases in temperature and more extreme events. Implementing EbA options that only consider climatic stress would not increase the resilience of ecosystem so the drivers of the ecosystem and the biodiversity aspects should also be taken into consideration.

6. Philippines

6.1. Overview

Due to its geographical location, the Philippines is exposed to high incidence of hazards such as typhoons, floods, storm surges, floods, tsunamis, earthquakes, volcanic eruptions, landslides and droughts. This, combined with poverty, leaves various communities throughout the Philippines in highly vulnerable situations.

Between 1997 and 2007, 84 tropical cyclones affected the Philippines, resulting in a total of 13,155 human casualties with more than 51 million families affected. Economic losses due to typhoon damages in agriculture, infrastructure and private properties are annual realities.

In 2010, out of the almost PhP 25-million-worth of damages to properties caused by natural hazards, tropical cyclones contributed to more than half. These affected more than 3 million people in that year alone (NDRRMP, 2011).

Because of the country's susceptibility to natural and human-induced disasters, efforts have been made for the past several years to build people's capacities and resilience to disasters by incorporating biodiversity specific aspects. Some promising initiatives are discussed below.

6.2. Restoration of degraded lagoon environment using coral M. digitata (Bolinao in Pangasinan Province)

Bolinao, in the northern Philippines, experiences several typhoons annually that affect the reefs along with the other anthropogenic disturbances such as sedimentation and blast fishing. The areas selected by Gomez, et al., (2011) for the restoration of coral reefs were covered with dead coral outcrops or "bommies". The coral species used was scleractinian coral *Montipora digitata,* which is a common reef flat species that thrives under high levels of light and water turbulence, and propagates successfully by natural fragmentation.

Populations of corals and other biota on the bommies were very limited at the time of transplantation of *Montipora digitata* (Gomez, et al., 2011). The transplantation was carried out in two different locations, Malilnep Ac and Binlab, with different habitable environments. For this experiment the lagoon area north of the island of Santiago that fronts the town of Bolinao (see figure 5) was selected for transplantation due to its year round accessibility and protection from extreme weather conditions.

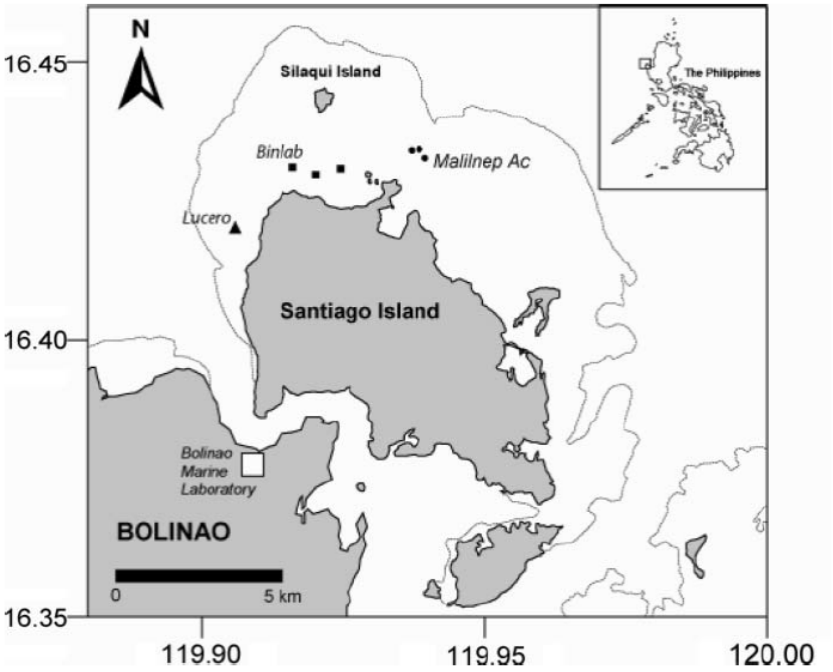


Figure 5: Location for the experimental transplantation in Bolinao.

Source: Gomez, et al., 2011

The existence of the many dead coral bommies distributed along the reef flat served as the experimental substrata for transplantation in the selected study area. For the procedure of the coral transplantation from one site to another, environmental parameters were taken into account. Regular monitoring of parameters such as sedimentation rate and water turbulence was carried out, while salinity, temperature and light were measured monthly..

The overall results were positive, indicating the potential for rehabilitation of degraded coral reef environments. However, the experiment's results varied in the two different locations, giving further encouragement to the coral restoration efforts and increasing awareness for designing the habitat's environmental parameters.

The species *M. digitata* demonstrated clear habitat preferences in terms of survival and growth, even when transplanted to areas where it did not occur naturally. The ecological conditions favourable for the establishment of the species were a combination of physical and biological factors. The species survived and grew significantly better where there were greater water

turbulence and higher light intensities. Here the lesson learnt was to be aware of the natural habitable environment and the choice of species in the rehabilitation of degraded habitats.

In the contemporary world, where many coral reefs have been damaged or destroyed, whether by anthropogenic stresses or by systemic climate change or tsunamis, coastal managers are continually challenged to find approaches, if not solutions, leading to the rehabilitation or restoration of ecosystem function. Passive restoration through the establishment of marine protected areas is a necessary approach, if only to prevent further damage to coastal ecosystems. In many situations, however, reefs that are included in the protected areas in developing countries are not in a pristine state, and conditions may not be ideal for rapid, natural recovery. In these situations, active restoration may be necessary and coral transplantation is an approach to be taken (Edwards & Gomez, 2007). Because of this need, new methods for reef rehabilitation are being continually developed (Edwards, 2010).

6.3. Challenges, gaps and opportunities

Coral reefs are among the most complex and biologically diverse ecosystems on earth, so the transplantations are still at experimental phases considering different environmental and contextual parameters. In this particular case of the *M. Digitata being* used for reef habilitation in the Philippines, water turbulence was found to be the most significant physical variable for the high survival rate and growth of the species It is also known that water motion is a major determinant of distribution patterns of coral species (Madin & Connolly, 2006).

Over the course of the experiment with monitoring and evaluation, a higher diversity of biota associated with the coral transplants also played an important role in the successful transplantation. Here Malilnep Ac was conducive to the development of a relatively more diverse community around the coral transplants.

The difference between the two environments was the nature of the substratum. The bommies at Malilnep Ac were generally monolithic, hard surfaces with few crevices, while those at Binlab were large outcrops consisting of matrices of truncated dead branching coral (*Porites cylindrica*). Conditions at Binlab appeared to favour the proliferation of turf algae and sponges, which contributed to the poor survival of the transplants.

Gomez, et al. (2011) add, “Enforcement of coastal laws and regulations to minimise destructive human activities is still the best way to ensure that restoration efforts are sustained”. In case of

transplantation, coastal community's participation and their measures for subsequent protection are important for successful transplantation and to gain the benefits from biodiversity.

6.4. *Conclusion*

In conclusion, *M. digitata* demonstrated relatively good survival and growth when transplanted to Malilnep Ac in the lagoon of Bolinao, Philippines (see figure 5), an area where it did not occur naturally. Its ability to adapt successfully to a completely new environment at a distance from its source site proved it to be a resilient species and demonstrated its potential to propagate.

Furthermore, the species is observed to flourish in shallow waters characterised by high levels of light, temperature and turbulence, demonstrating resilience to factors that could prove stressful when exceeding certain ranges. Thus, this very species can also be a candidate that coral reef managers and locals can use for replenishing coral cover in reefs increasingly stressed by climate change.

Coral transplantation is a promising management intervention if contextualised within the conditions of the target area (Gomez, et al., 2011). However, the sources and levels of anthropogenic disturbance as well as current reef state should be considered when drafting indicators for monitoring and evaluation (ibid). Therefore, coral transplantation is an effective management strategy/ approach integrating environment and livelihood in the contemporary world, where many coral reefs have been destroyed by anthropogenic stresses or climate change or tsunamis.

7. Thailand

7.1. Overview

Thailand's topography is naturally divided into four regions with the northern part being mountainous area and characterised by occurrence of hazards such as floods, landslides, earthquakes and forest fires. The Central part of Thailand is prone to floods and earthquake related hazards. The north-eastern arid part experiences floods and droughts, while the southern region has both mountains and coastal areas and experiences natural hazards such as floods, tropical storms, landslides and forest fires.

Natural hazards that frequently occur in Thailand include floods, droughts, tropical storms and forest fires whereas earthquakes and landslides occur occasionally. Generally, the sudden onset natural hazards cause the most damage to lives and property.

The rural area is the most vulnerable to disasters because of infrastructure underdevelopment. Moreover, the rural people are mostly poor agriculturists who are unable to invest in resources for reducing their vulnerability to disasters.

According to the Department of Disaster Prevention and Mitigation (DDPM), Ministry of Interior, Thailand, and EM-DAT, floods followed by storm have the highest events count.

7.2. Protective function of mangrove plantations (Koh Klang, an island in Krabi)

The International Union for Conservation of Nature (IUCN) through its partner, Mangrove Action Project (MAP) Thailand, is restoring mangroves in Koh Klang, an island in Krabi. The process centres on teaching the surrounding community about the benefits of mangroves as food sources, fish nurseries, and in terms of disaster risk reduction, and the ability of mangroves to protect nearby communities from floods, wind, salinisation and erosion.

The Community-Based Ecological Mangrove Restoration (CBEMR) methodology developed by MAP is being used to restore mangrove and wetlands ecosystems as natural infrastructures to help protect people against coastal hazards. It has a strong emphasis on correcting hydrological problems and dealing with natural or human-induced stressors in order to facilitate natural mangrove regeneration.

In this region, as in the rest of Asia, large areas of mangroves have been cleared for aquaculture, particularly shrimp production, which has often left coastal communities exposed to tropical storms, storm surges and salinisation of soils and fresh water supplies. Similarly, the CBEMR approach works with local people to restore the hydrology of former or degraded mangrove sites to facilitate the natural regeneration of mangroves.

These areas have the potential to be returned to functioning productive ecosystems that act as bio-shields, while providing important goods and services on which local communities rely for livelihood, as well as for the growing tourism industry (King, et al., 2015). MAP uses CBEMR methodology, which is far beyond the mere hand-planting of seedlings, as is typical of mangrove restoration projects, and increases the effectiveness of restoration of degraded mangrove forests by embracing and understanding the mangrove ecosystem as a whole.

The EPIC site in Koh Klang, Krabi has a few mangroves starting to naturally regenerate, some several metres tall. Other mangroves have been planted, mainly along the banks to reinforce the mud walls. But it is too early to measure significant economic or DRR benefits at the EPIC sites. Fish and other animals are populating the ponds, and owners are using the silvofishery as a place to deposit young fish for harvest at a later time, so food-related benefits are small but already measureable.

During the restoration, community meetings and workshops were conducted in which the interested people could learn about the benefits of mangroves and the CBEMR technique. At one of these meetings, silvofisheries became part of the intervention (King, et al., 2015). Throughout the implementation process, EPIC relied upon local labour, so additional training occurred on-site as the team encountered each new challenge and found its solution together. Also community involvement is much more than just participation, it is an empowering process that creates a sense of ownership of the mangrove restoration project.

Apart from the efforts from IUCN and the local community, the government's own environmental educational efforts include a sub-district Learning Centre that supports awareness creation among communities on climate change and mangrove restoration. The public schools in the area include local environmental education as part of their curriculum. The EPIC project has linked up with these aspects to create awareness on CBEMR.

Therefore, the CBEMR method is being implemented in Klong Kam village, to restore part of the protected area's coastline to a biologically diverse and resilient mangrove ecosystem. Restoring mangroves on the coastline of the Krabi offers a flexible, cost-effective and sustainable first line of defence from extreme climatic events and also brings valuable economic co-benefits, such as the net economic value of mangrove forests for the Krabi coastline protection and stabilisation (King, et al., 2015).

7.3. Challenges, gaps and opportunities

Events such as the December 2004 tsunami brought the importance of the mangrove ecosystem to the forefront, and motivated the government as well as international organisations to restore it.

However, complicating factors include unclear property ownership and rights to harvest in the mangrove. The Thai government officially owns mangrove areas, but in reality, they are open-access areas (King, et al., 2015).

Over time, local communities developed informal rules to manage and share the resources of a mangrove, but with little or no legal control, the sites became vulnerable to wealthy outside investors, and illegal encroachment by everyone. Similar problems appear now during attempts to restore mangroves.

King, et al., (2015) finds that “the failure of present laws and democratic institutions to support local involvement in administrative decisions may deter villagers in coastal communities from participating in mangrove replanting efforts”.

Yet most restoration efforts depend upon the participation of local communities in the planting and maintenance of the sites, while the shrimp pond owners (those most responsible for the destruction), are rarely called upon to replace the destroyed mangrove.

Other complications involve the difficulty in physically establishing a successful restoration; replanting fails because of hydrology or type of species planted, and natural regeneration rarely occurs because the terrain is so drastically modified for the shrimp ponds it is no longer hospitable to mangroves (King, et al., 2015).

7.4. Conclusion

With the increasing frequency and magnitude of natural disasters, protection from such events grows in significance. The protective function of mangroves on the Krabi coastline represents a form of climate change adaptation, as well as Eco-DRR. While mangroves are likely to be affected by climatic adjustments, their restoration and conservation could offer multiple benefits for communities in terms of mitigating and adapting to climate change.

IUCN is working with the Department of Marine and Coastal Resources (DMCR) under the Ministry of Natural Resources and Environment, Thailand in implementing the provisions of the recently adopted Coastal Zone Management Act, which provides for community management of coastal resources and recognises the role of communities as stewards of their natural resources.

8. Viet Nam

8.1. Overview

Viet Nam is prone to many types of natural hazards. They are mainly hydro-meteorological, such as recurring floods and storms, but also include low to moderate risks of droughts, earthquakes, tsunamis, forest fires, cold and heat waves, and animal disease epidemics.

The risk of floods and storms is extremely high in Viet Nam and they are almost certain to recur in the future. From 1980 to 2010, Viet Nam had an annual average of 4.46 disasters caused by floods and storms, while, in the same period, the occurrence of drought was just 0.16 and fires 0.03. In this period, no disasters were reported for earthquakes, tsunamis or diseases (UNDP & IFRC, 2014).

The risk of floods and storms is highest in the coastal and delta areas. The Mekong delta is often affected by the seasonal monsoon slow-onset floods, which can last for several months. The central coastal area is most prone to storms, and faces frequent sudden floods, which last less than a week.

The mountainous areas are particularly prone to flash floods and landslides caused by heavy rainfall. Storms and floods (including landslides caused by heavy rain) accounted for 87% of the disasters which occurred between 1980 and 2010, and these caused 100% of the disaster deaths recorded. Most of the legislation and DRR activities in Viet Nam deal with these two hazards.

8.2. Mangroves for disaster management (Nghe An Province)

Laws and regulations regarding DRR in Viet Nam remain diverse, extending over many different instruments. The new Law on Disaster Prevention and Control 2013 (New DRM Law) has brought more areas of DRR regulation under one umbrella law (UNDP & IFRC, 2014).

The Dyke Law has strengthened efforts in reinforcing structural measures against floods and storms, such as the upgrading of dykes, drainage systems and construction of water reservoirs, which are all areas within the mandate of the Ministry of Agriculture and Rural Development (MARD). Combined with the protection of mangrove forests in the Forest Law, this framework supports a key system of physical barriers of coastal communities against storms from the sea.

However, environmental protection laws do not currently make explicit reference to DRR or require the inclusion of DRR in environmental impact assessments, so there is an opportunity to enhance the legal framework in this regard.

Some of the challenges include limited resources at MARD for effective implementation of the Forest Law, especially for the protection of mangrove forests. Other policies however, such as the Climate Change Strategy, do make DRR a core activity.

On the other hand, Strategy 2020 has tailored itself based on the different geographical conditions. For example: In the Red River Delta, the priorities are strengthening the river and sea dyke system; planting mangrove trees to protect sea dykes; investing in flood drainage structures; upgrading water reservoirs; and increasing the safety of reservoirs (including the development of operation procedures, in particular for multipurpose water reservoirs regulating the water level for floods, drought and salt intrusion).

In terms of community awareness and propaganda, the local stakeholders were aware of the content of legislation and the relevant work. For example: they were well aware of regulations that prohibit the cutting of mangrove trees that protect dykes, the construction of buildings on dykes, or shrimp farming within 200 metres of dykes. They were aware of relevant regulations that affect their personal situations before or during disasters. Moreover, in terms of enforcement, numerous individuals have been prosecuted for violating the Law on Dykes. In the period of the study, three farmers in another province were brought to court for cutting mangrove forests, which protected a sea dyke, for the purpose of shrimp cultivation.

8.3. Challenges, gaps and opportunities

Mangroves play an important role in the protection against storms and floods along coastal areas. Mangroves break waves before they reach sea dykes and also contribute to the livelihood of coastal communities.

Despite the importance of mangroves for DRR, areas planted with mangroves have been destroyed for seafood farming and other economic developments.

In the 1990s, Viet Nam Red Cross Society (VNRC), with support from National Societies and other organisations, supported the planting of mangrove trees to protect the coast and provide an income source for poor households from aquaculture. The lack of legislation on the protection and management of mangrove forests, however, was an issue from the start of the mangrove planting programmes.

The Dien Ngoc and Dien Bich communes in Nghe An province have participated in Viet Nam Red Cross Society's mangrove planting programme with support from the Japanese Red Cross Society since 1997. The mangrove trees have reached a height of 2 metres or more and cover a wide area protecting the sea dykes.

The People's Committees are assigned to manage and protect the mangroves in their area. The People's Committees receive a small budget from the DARD to employ part-time forest guards to protect the mangrove forest in the commune.

The cutting or harvesting of mangrove trees is strictly forbidden in both communes. In one commune, all members are free to harvest the natural seafood, while in another, people were not allowed to enter the forest at all.

Dien Bich has 80 hectares of mangrove forest and the People's Committee has assigned four guards to protect it, however, they face the difficulty of overseeing this large area without watchtowers. While awareness in the community on the importance of mangrove forests is high, not everybody is yet convinced of the benefits.

Simultaneously, in Nghe An province, land-use planning is used to identify high flood-risk areas where no constructions are permitted to be built. These conditions also apply to high flood-risk areas in the communes of Dien Ngoc and Dien Bich, which have been identified by the People's Committee.

These communities are well aware that they are not allowed to construct houses in these areas. The land area surrounding sea dykes in the communes is reserved for mangrove forests and this is strictly enforced by the PCs. Therefore, the law on forestry contributes to the protection of forests, including mangroves and their sustainability, which protects sea dykes and coastal communities.

8.4. Conclusion

Legislation on forestry has played an important role in the protection of forests. The protection of mangrove forests, which were planted by VNRC, was a challenge before the introduction of the legislation.

There are still challenges such as limited resources at MARD for the effective protection of forests. DRR will have to be mainstreamed into land-use planning to ensure that economic development and prevention measures such as mangrove protection are properly balanced.

The new DRM Law has brought specific regulation of disaster risk management activities under one law, the legal framework pertaining to DRR remains spread over a range of laws, amendments, ordinances, decrees, decisions and circulars.

There has been continuous upgrading, which has resulted in the amendment of laws and ordinances, and the issuance of additional decrees, decisions and circulars providing further details for their implementation with the help of the People's Committee.

Another good practice is the law and regulation protecting mangrove forests. Before the introduction of the pertinent laws, planted mangrove forests were occasionally transformed into seafood farms.

Now the enactment of the Forest Law and the Decree on Handling Environmental Violations provide the instruments to stop the destruction of mangrove forests, which protect sea dykes and coastal areas.

Box 3: Strengthening decision-making tools for disaster risk reduction at Lower Neelum Valley, Northern Pakistan

The Kashmir earthquake of 8 October 2005, in northern Pakistan, triggered thousands of landslides, which was the second major factor in the destruction of the built-up environment, after the earthquake itself (IUCN-EMP, 2007). Such disasters in mountains require an understanding of the underlying causes in order to design effective risk reduction programmes. In the majority of such cases the underlying causes of landslides are not only associated with the economic development, poverty and resource degradation, but also with the vegetative cover, grazing, terraces, deforestation, roads, habitations, land ownership and management regime, terracing, road construction and debris flows.

A landslide susceptibility map incorporating a GIS-based tool including slope gradient, vegetative cover, active landslides and crack zones; along with land-use data and damage assessment with economic data on lost forest and agricultural land is important to strengthen the process of decision making.

According to (IUCN-EM) and Khattak et.al, (2010), "evaluating the impact based on the meteorological and anthropogenic factors on intensity and spatial distribution of earthquake-induced landslides are important to develop and implement the strategies for landslide management".

Policies to integrate resource management into DRR strategies, to raise awareness and provide incentives for private owners to plant and maintain more vegetation are a few of the proactive/ preventive measures.

An inventory of earthquake-induced landslides includes information about the location, spatial extent, source, type of mass movements, date of occurrences, number of landslides and other relevant characteristics (Guzzetti et al., 2012), which can be further used to formulate strategies for mitigating the impacts of landslide.

A landslide inventory was prepared using the imagery of the Neelum Valley, northern Pakistan (27 October 2005) and field observations. According to the research study by Kamp, et al. (2008), "79% of the earthquake-induced landslides are small and 9% are large in area". A landslide susceptibility map presents zones of varying susceptibility that is mainly used for developing and implementing landslide mitigation strategies. Consequently, the development of a lithological map of the region will help to better understand the mechanism of the landslides and accordingly develop strategies for their mitigation.

Of many studies evaluating earthquake-induced landslides in northern Pakistan, only Kamp et al. (2008) and Sudmeier-Rieux et al. (2006) have developed landslide susceptibility maps for the earthquake affected area. The susceptibility map has demarcated around one-third of the area as "high" to "very high" susceptibility to landslides and two-thirds of the area with "moderate" to "low" susceptibility.

Moreover, the area located in close vicinity to the faults is also demarcated as highly susceptible for landslides. The landslide susceptibility map for the year 2001 developed by Kamp et al. (2009), is comparable with the landslides induced by the Kashmir earthquake, where 75% of the earthquake-induced landslides, have occurred in the "high" and "very high" zones of the 2001 susceptibility map. The landslide susceptibility map developed by Sudmeier-Rieux et al. (2006) using statistical regression shows that the forested areas are less susceptible for landslides than the less vegetated areas, if the terrain, slope and distance from fault are similar.

Therefore, based on the earlier studies and susceptibility map and on the landslides induced by the earthquake in northern Pakistan, the interdisciplinary approach to assessing landslides offers policy makers a more holistic picture of the underlying causes of landslides and an improved basis for designing a sustainable disaster risk reduction strategy.

For example: the role of protective forests, which are firmly established in some European countries, should be examined as cost effective natural barriers to disaster risk reduction in mountainous areas.

Also, the recommendations include the need to work with communities in establishing locally adapted monitoring, mitigation and early warning systems, and free or low-cost satellite images and GIS software, made readily available by donors and international organisations following natural hazards (IUCN-EMP, 2007).

5. Conclusions

Most of the countries studied in the Asia region have recent studies and assessment on the nature of the natural hazards, people's vulnerability and responses. Little is known about how other key stresses interact with climate change and biodiversity conservation at the national level for both government and non-government.

Identification and assessment of the biodiversity conservation specific aspects of Eco-DRR are very important. This assessment proposes a conceptual framework to understand not only the vulnerability but also the interactions and the consequent impacts on ecosystems of the region. It shows that inadequate attention in the national DRR agenda is given to biodiversity conservation specific aspects of Eco-DRR, leading to demands for including the new insights in the Asia region.

From the studies, it can also be said that the developing policies and strategies to tackle natural hazards risks and climate change risks are at individual levels and not associated with sustainability goals, ecosystem-based approaches and biodiversity specific aspects.

The DRR approach considers the heterogeneous behaviour of different levels of biodiversity, ecosystems and peoples, which is important to analyse the individual factors influencing respective ecosystems at the local and national level. It also helps to create the sustainability measures, in line with the existing understanding of the role of biodiversity and ecosystems for disaster mitigation and adaptation.

Also, the interest of funding institutions and investments in DRR related projects can add value to the sustainable development path by integrating ecosystem, climate change and biodiversity specific aspects to the DRR approaches. Thus, putting biodiversity conservation, ecosystems and people's welfare at the heart of the new strategy with awareness on the multidimensional benefits of Eco-DRR.

Besides funding, fostering collaboration at the project level would provide good lessons for future practice and facilitate integration of CCA and DRR through ecosystem-based approaches. This would then promote the development of much needed, integrated multi-level governance tools for CCA and DRR, integrated multi-hazard and climate change assessments, as well as community-based strategies.

5.1. Overall challenges and opportunities

5.1.1. At the policy level

Despite the many benefits that ecosystem-based solutions provide for DRR management, they still face **challenges** before they can be embedded permanently into government policy and practices:

- ***Inter-sectoral collaboration in improvement of policy and translating knowledge into action is required***. Implementing Eco-DRR and EbA calls upon the collaboration of different actors and expertise across various sectors. It is important for Eco-DRR and EbA to be prioritised into not only the national development plans/vision/strategy but also sub-national and local development plans at the state or local level. It is also vital to fill in various gaps in policy and awareness of hazards and disasters. This requires the policy linkages between Eco-DRR, agencies and PA creation and management to be further strengthened in order to develop comprehensive policies that do not conflict or overlap but instead clearly integrate the enforcement and implementation stages to address disaster management, which would facilitate translating knowledge into action.

- ***Inadequate in-depth understanding of hazard, vulnerability and disaster.*** A clear understanding of the depth and extent of hazard, vulnerability and disaster loss by integrating biodiversity conservation specific aspects of Eco-DRR must be created in order to develop a more concerted and coordinated global action on disaster risk reduction before addressing the gap in understanding and formulating plans and policies.

- ***Inadequate capacity to implement all aspects of policies and frameworks.*** The existing framework and policies do not accommodate biodiversity conservation related aspects directly. So the capacity challenges in the DRR and CCA measures include: inadequate staffing, financial bottlenecks and a lack of technical resources such as space-based technology such as Geographic Information Systems (GIS), Earth observation satellites, communication satellites, meteorological satellites and global navigation satellite systems (GNSS), which are key tools for comprehensive hazard and risk assessments, response, relief and disaster impact assessment. Space-derived and in-situ geographic information and geospatial data are extremely useful during times of emergency response and reconstruction, especially after the occurrence of major events such as earthquakes or floods (UNOOSA, 2013).

Development of Eco-DRR also has some promising **opportunities**:

- ***There is enormous scope for integrating DRR initiatives into biodiversity elements of risk reduction.*** Legislation and policies regarding biodiversity conservation for disaster risks have been developed and frameworks have often been put in place on a national scale. Implementing and managing the DRR framework at a local scale involving all stakeholders would need further action.
- **New government programmes offer opportunities for integrating Eco-DRR into climate change policies and priorities.** The recently developed INDCs of Asian countries clearly recognise the role of enhancing the management of natural ecosystems for reducing risks of populations to natural hazards including climate related hazards
- ***Local stakeholders are seeking increased engagement with DRR.*** There is a need to raise the currently low public awareness and understanding on hazards and disasters and on how ecosystem-based solutions have huge benefits for DRR. This can lead to the adoption of concerted bottom-up and top-down actions and applying scientific and local knowledge towards Eco-DRR.
- ***Growing interest in funding and investing in DRR related projects.*** This can add value to the sustainable development path by integrating ecosystem, climate change and biodiversity specific aspects to the DRR approaches, thus, putting biodiversity conservation, ecosystems and people's welfare at the heart of the new strategy with awareness on the multidimensional benefits of Eco-DRR.

5.1.2. At the implementation level

The case studies carried out in various countries in this assessment enabled the identification of **challenges** for the implementation of ecosystem-based initiatives:

- ***Incorporating all local stakeholders***. There is a clear recognition that there is a need to enhance collaboration at local governmental levels towards enhancing effectiveness in management and implementation of Eco-DRR and PA. Often times, when local communities lack involvement in the disaster risk reduction initiatives using biodiversity related aspects, it can bring about negative impacts making the people and place more vulnerable. The weaker sectors of society are commonly further exposed to natural hazards.
- ***Lack of integration with global and national climate change policy*****.** Disaster

management is primarily focused on post-disaster emergency relief, with little integration with global climate change policies. This gap in the policy environment is not favourable to progressing effective implementation of EbA approaches.

Several **opportunities** are also identified:

- ***The direct links between Eco-DRR measures and enhanced food security:*** As evident from the empirical cases provided in this report, there is a clear link between applying Eco-DRR measures and improved food security of communities, one example being mangrove restoration leading to improved fish spawning, which in turn benefits the food security and income prospects of the communities.

- ***Applying Eco-DRR measures can also indirectly help protect major ecosystems such as watersheds.*** The Nepal case study demonstrates that by adopting bio-engineering measures for slope stabilisation, soil erosion was checked as well as reducing the risk of landslides that would have affected the Phewa Lake ecosystem, which is a major watershed of the country.

- ***Use of indigenous and local technologies has less impact than applying structural technologies*****.** Applying Eco-DRR requires using sustainable and low intensity technologies that can either be obtained from existing indigenous knowledge systems based technologies or otherwise developed locally. These technologies have much less impact on the environment or on the social system in terms of leading to resettlement etc. than structural technologies such as dykes and dams which occasionally require resettlement of communities.

5.1.3. Strategic entry points

5.1.3.1. Entry point: Integrating sustainable development goals

It is very important to first understand the natural relationship among the ecosystem, disaster and sustainable development. In this multi-dimensional linkage, we only tend to understand the direct relationship between disaster and development; how disaster slows the pace of development and its goals. With a degrading ecosystem, climate change, increasing population (especially in the coastal cities) and increasing risk of disaster, it is time to realise the interdisciplinary linkages and effects of climate, disaster and ecosystem on achieving the goals of sustainable development.

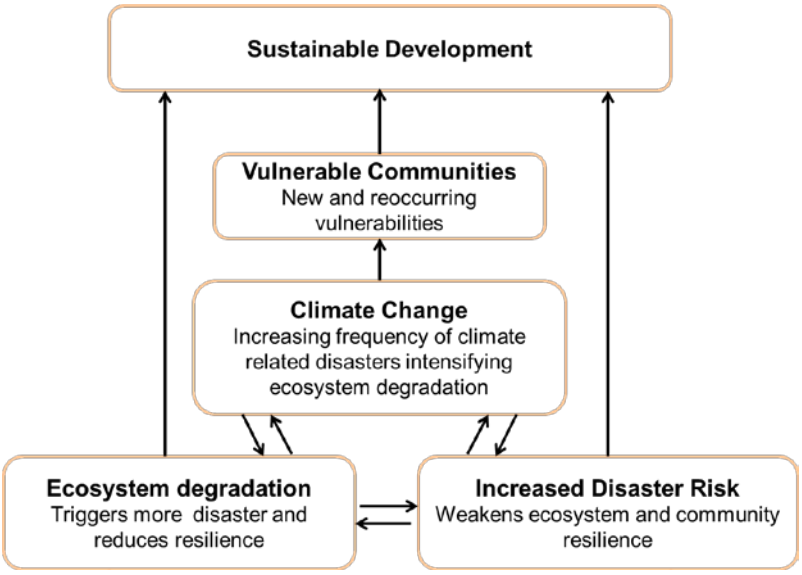


Figure 6: Interlinkages between ecosystem degradation, increased disaster risk and climate change

Source: Adopted & modified from Munang et al., 2013

The Global Assessment Report on Disaster Reduction identified ecosystem decline as one of four major drivers of increasing risk (PEDRR, 2010). It has also called for greater protection and enhancement of ecosystem services by reinforcing them in the Global Platform for Disaster Risk Reduction. It adds that appropriate management of ecosystems can therefore play a critical role in reducing vulnerability and enhancing resilience of local communities, as healthy socio-ecological systems are better able to prevent, absorb and recover from disasters (PEDRR, 2010) and enhance sustainable development.

5.1.3.2. Entry point: Reframing of DRR concepts with ecosystem-based approaches

There are a number of specific challenges to policy makers and mainly to the community residing along the hazards vulnerable areas in the Asia region and others as well.

Such challenges and risk are scaled up by climate change and ecosystem decline. There are different approaches to DRR. Both engineered and natural approaches have merits and demerits depending on the hazards (UNISDR, 2011) and population concentration.

The physical engineered infrastructure is limited by age, quality of materials, maintenance and location, whereas the natural infrastructure is limited by the relative degradation, ecosystem and hazard itself (Sudmeier-Rieux, et al., 2006). For instance, a wetland may be effective in absorbing excess floodwaters but only if accorded enough space to hold the additional water.

Natural infrastructure also provides benefits that cannot be quantified, such as aesthetics, recreational opportunities, a sense of well-being or fresh air, especially in densely populated urban areas besides their protective role.

However, there is a failure among policy makers at the national level and community at the local level to recognise ecosystem-based approaches as effective constituents of disaster risk reduction and climate change adaptation.

Today environmental degradation is identified as one of the main drivers of hazards-related risk, and investing in ecosystems is listed as a low regrets measure along with the current early warning system, disaster management, sustainable development and ecosystem management and restoration as well (UNISDR, 2011; IPCC, 2012). Also in 2009, the UNFCCC Conference of Parties (COP) in Copenhagen recognised ecosystem-based approaches for CCA strategies.

Therefore, at the individual country's national decision-making level, there is a need to reframe the conceptual framework of DRR and its perspective by including ecosystem-based measures to achieve DRR and CCA related priorities.

With the inevitable and increasing vulnerability, ecosystem management is now a familiar concept and disaster risk is not a standalone issue. So reframing, based on experiences from events and ecosystems, of the concepts that comprise the current DRR perspective is a valuable contribution to closing the policy–practice gap.

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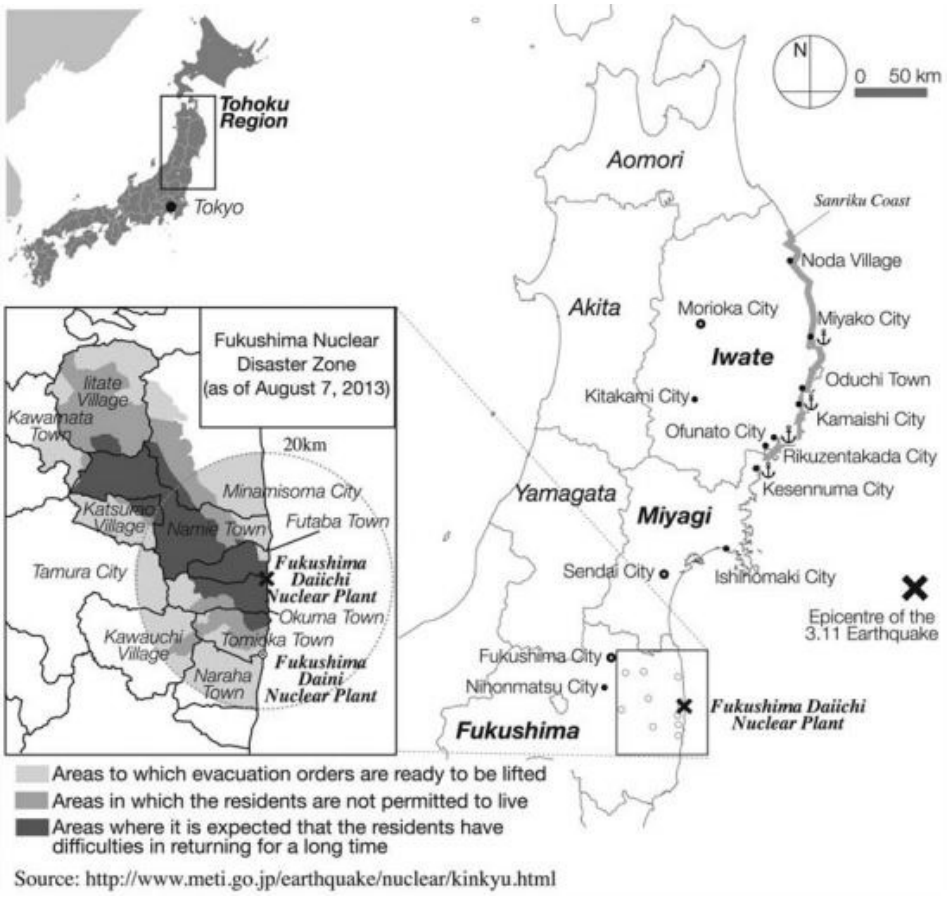
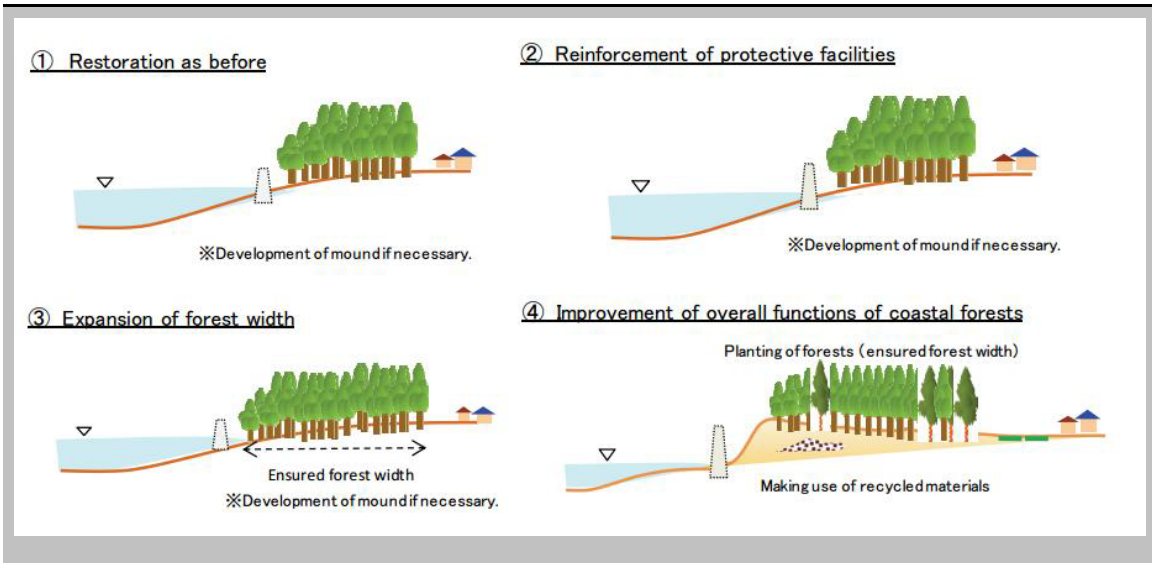
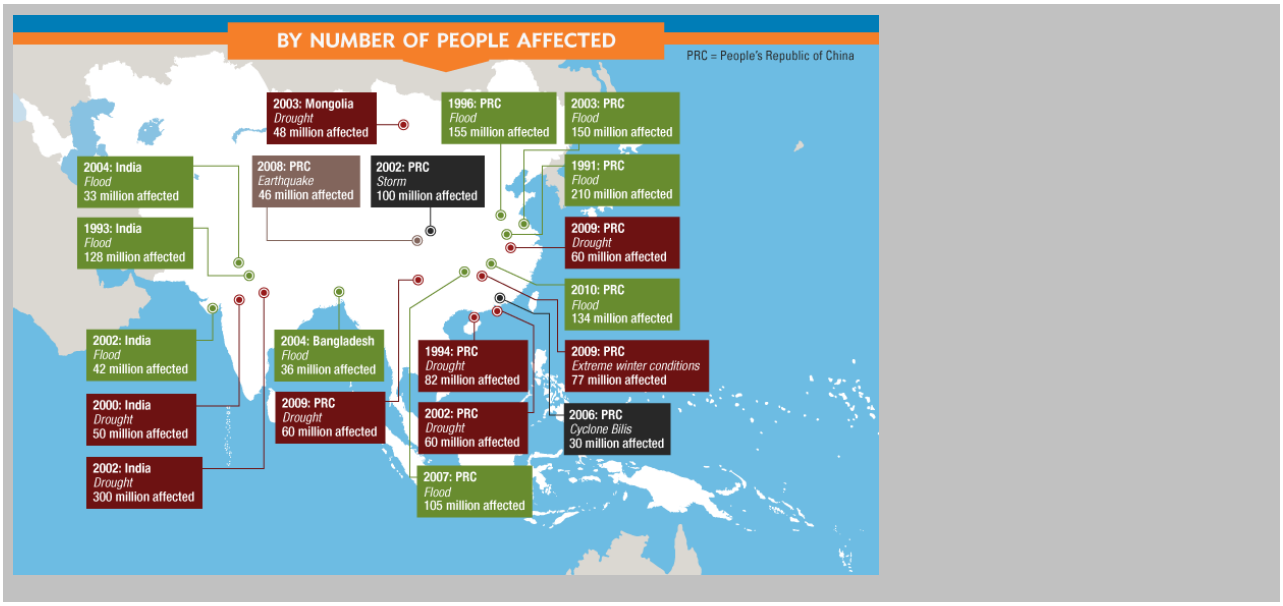
7. Annexes





Map of the Tohoku region and the four strategies for the restoration of the coastal forest.

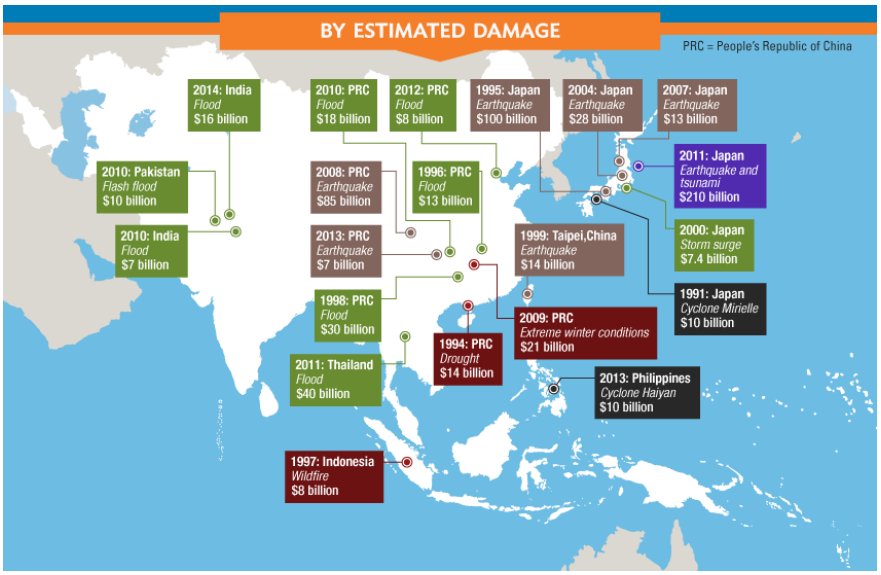
Source: (Renaud et.al, 2013)



Disasters in terms of numbers of affected.

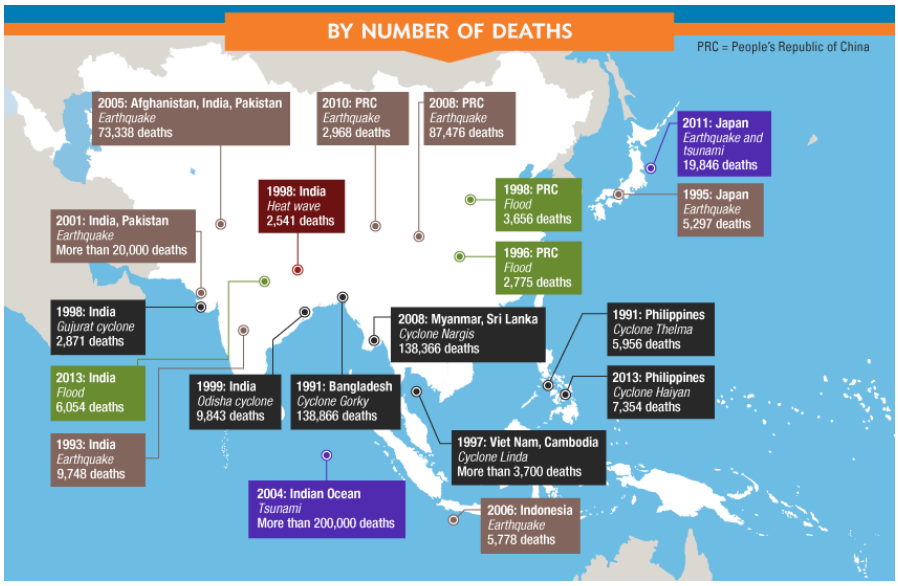
Source: 3rd UN World Conference on Disaster Risk Reduction ADB, 2015

8.



Disasters in terms of numbers of damages.

Source: 3rd UN World Conference on Disaster Risk Reduction ADB, 2015



Disasters in terms of numbers of deaths.

Source: 3rd UN World Conference on Disaster Risk Reduction ADB, 2015

High economic losses in the Asia region.

Source: UNESCAP, 2014