



**Status of Climate  
Change Management in  
Southeast Asia**

**Interim Report**

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**Cambodia Water Partnership  
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# Report on CLIMATE CHANGE ACTIVITIES IN VIET NAM





# The state of climate change management in Cambodia

Cambodia Water Partnership

December 2010

## ACKNOWLEDGMENT

This report was written by the CamboWP Expert Team. I would like to thank the Team for its efforts for writing this report on State of Climate Change (CC) Management in Cambodia. The contribution and inputs from the Team for reviewing of related papers and analysis of CC situation in Cambodia are useful and grateful. The report also shows other commitments of Cambodia to deal with International Organization such Mekong River Commission (MRC) in the adaptation of CC in the Lower Mekong Basin addressing the key challenges to applying the IWRM approach for CCA. Among the commitments of MRC member countries for CCA are to sustainably manage and develop water and other related resources in the LMB. The paper on the State of Climate Change Management in Cambodia was written by the CamboWP Expert Team under financial support of Global Water Partnership (GWP) to CamboWP as its activity in 2010. The Report is based on reviewing of existing policy and strategies of the Governments and related documents on CC in the country. The report is produced to contribute to the GWP for its review of countries in the World with relating to the Governments' commitment on CC Adaptation process and framework.

The report also introduces the main issues of CC occurred in the country and actions in place and some key challenges for adapting the CC. There are important water related actions as the key for intervention on CCA applied IWRM concepts. The Law on Water Resources Management in Cambodia is the main legal framework for application of CCA by integrating all sectors' aspects to the actions. These interventions were developed mainly by National Climate Change Committee (NCCC).

I would like to express my sincere acknowledgments to GWP for financial support to this activity. Taking this opportunity, I very much appreciate the strong supports of CNMC leaders especially **H. E Mr. Lim Kean Hor**, Minister of Ministry of Water Resources and Meteorology, the Chairman of Cambodia National Mekong Committee (CNMC) and Honorary Chair of CamboWP, **H. E. Mr. Sin Niny**, Permanent Vice-Chairman of CNMC Finally. In addition, I thank to other supporting staff for their kind efforts and being in good team co-operation before and during the preparation of this report and beyond.

H.E. Mr. Watt Botkosal,  
Deputy Secretary General  
Chair of CamboWP  
GWP SEA Steering Committee Member for Cambodia

December 2010



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## LIST OF ABBREVIATION



ADB	:	Asian Development Bank
APIP	:	Agricultural Productivity Improvement Project
BDP	:	Basin Development Plan
CamboWP	:	Cambodia Water Partnership
CCA	:	Climate Change Alliance
CCCA	:	Cambodia Climate Change Alliance
CCCO	:	Cambodian Climate Change Office
CDM	:	Clean Development Mechanism
CDRI	:	Cambodia Development and Research Institute
CMDGs	:	Cambodian Millennium Development Goals
CNMC	:	Cambodia National Mekong Committee
EIA	:	Environmental Impact Assessment
FAO	:	Food and Agriculture Organization
FMMP	:	Flood Management and Mitigation Program
FWUC	:	Farmer Water User Community
GDA	:	General Department of Agriculture
GEF	:	Global Environment Facility
GWP	:	Global Water Partnership
IDNA	:	Interim Designated National Authority
INC	:	Initial National Communication
IWRM	:	Integrated Water Resources Management
MoE	:	Ministry of Environment
MoH	:	Ministry of Health
MRC	:	Mekong River Commission
MRD	:	Ministry of Rural Development
NAPA	:	National Adaptation Program of Action to Climate Change
NCCC	:	National Climate Change Committee
NCDM	:	National Committee for Disaster Management
NEAP	:	National Environmental Action Plan
NPRD	:	National Programme to Rehabilitate and Develop Cambodia
PPCR	:	Pilot Program on Climate Resilience
RGC	:	Royal Government of Cambodia
SNC	:	Second National Communication
UNDP	:	United Nation Development Programme
UNFCCC	:	United Nations Framework Convention on Climate Change

## 1. INTRODUCTION AND BACKGROUND

The Kingdom of Cambodia is located in mainland Southeast Asia between latitudes 10° and 15° N and longitudes 102° and 108° E. Cambodia covers an area of 181,035 km<sup>2</sup> with a total population is about 13.4 million people in 2008 (NSDPU, 2009-2013). Approximately 80.5 percent of this population lives in rural areas. The population lives below the national poverty line fell from 34.7% in 2004 to 30.1% in 2007.

Administratively, the country is divided into 23 provinces and 1 municipality with a total of 159 districts and 1,417 communes for the provinces and 8 Khans (districts) and 204 Sangkats (quarters) for the municipality (NSDPU, 2009-2013). The climate is characterized by a dry season from mid November to mid May and a rainy season from mid May to mid November. The annual average temperature is 27°C, and rises to a maximum of 38°C in April or May and falls to a minimum of 14°C in January or December.

Cambodia is a least developed country, with a GDP per capita rising from US \$297 in 2002 (NIS, 2003) to US \$ 792 in 2010 (NSDPU, 2009-2013). On average, agriculture has accounted for more than 40% of GDP. Agricultural production is dependent on the annual flooding and recession of the Tonle Sap Lake and the Mekong River, which brings fertile alluviums to the central plains.

According to MRC (Sep 2009), in Cambodia, it is predicted that there will be an increase in mean annual temperature of between 1.4 and 4.3 by 2100. Mean annual rainfall is also predicted to increase, with the most significant increase experienced in the wet season. As with the other countries in the LMB, flooding and droughts are expected to increase in terms of frequency, severity and duration. The potential impacts of climate change include changes to rice productivity, with increases in wet season crops in some areas and decreases in others; acceleration of forest degradation including the loss of wet and dry forest ecosystems; inundation of the coastal zone and higher prevalence of infectious diseases.

The impact of climate change will be an unprecedented and increasing global threat to life, livelihoods and life-supporting systems. Cambodia's contribution to greenhouse gas emissions is negligible and the country is ranked number 109 by the World Resources Institute, with emissions of only 0.29 tonnes of carbon dioxide per head of population each year. However, Cambodia will suffer from the effects of global warming due to excessive emissions in other parts of the world. Like other countries in Southeast Asia, Cambodia is expected to experience higher and more intense rainfall. The effects are likely to include more severe water scarcity and more frequent floods, resulting in crop failures and food shortages. Accelerated loss of biodiversity will cause a decline in ecosystem services. Coastal communities and eco-systems are likely to be affected by rises in sea levels. Higher temperatures and humidity will create conditions for increased incidence of malaria and dengue fever. The poor and marginalized, particularly women and children, will be worst affected. The National Climate Change Committee (NCCC), established in 2006, comprises representatives of 19 ministries and government agencies.

The CamboWP has been working within Global Water Partnership (GWP) for promotion and facilitating the IWRM process in Cambodia by encouraging the different agencies which have concerns in the water and related resources development and management. With the aspect of sustainable development, the integration of Climate Change perspectives in these sector aspects is crucial. The NCCC is guiding policy and support the country for committing in applying the IWRM aspects for climate change adaptation in the country.



This is cooperative process of mainstreaming water aspects into the development policies and strategies of sectors will be ensured effectively and successfully projects implemented. There is consideration that the Governmental institutions have taken into account the CC concepts in their development activities.

### 1.1. OBJECTIVES

The major goal for writing this report was a suggestion of GWP for sharing the CC issues and actions to others countries in the SEA Region as well as in the World. The main objective is to gain insight on the experiences and lessons learned from Cambodian National Institutions and some key local communities' concerns to the CC and its adaptation.

This report would help these line agencies and communities to understand and get more knowledge on CC and its adaptation that applied IWRM approach. The Report provides recommendations on CCA specific interventions that improve inclusive integrated water resources management and development as well as building their capacity in these key sectors.

### 1.2. ACTIVITIES/TASKS

The following activities/tasks are predicated on items, specifically:

1. Identify and review of key existing documents related to water resource management that published by various organizations;
2. Identify and review the Governmental documents related to CC related policy and strategies by viewing the integrated aspects have been addressing by them;
3. Identify the knowledge gaps that require for improving the reviewed documents;
4. Identify challenges and opportunity to integrated holistic approach including IWRM mainstreaming in water and related resources management in specific sectors particularly agriculture, industry and water sector;
5. Propose comments and suggestion of those reviewed documents for CC sensitivities;
6. Provide recommendations for improving the related documents for CCA perspectives integrated;
7. Make specific recommendation for next activity.

## 2. SCOPES AND METHODOLOGY

The report was conducted in Cambodia by CamboWP -Expert Team which comprised of six persons: MOE (2), CNMC/CamboWP (2), freelance consultant (1) and ITC (1). The existing available documents were collected and have been reviewed and analyzed for report writing and based on those findings, expert team shares their views, comments and recommendations.

The report focuses only management concepts with limited technical supports (not deeply technically as MOE work), but reviewed key performance and commitment indicators in terms of policies and strategies and real action plan of the Government to CCA.

### 3. UNDERSTANDING OF CLIMATE CHANGE IN CAMBODIA AND IN GLOBAL CONTEXT

Recently, Cambodia facing various problems since there are increasing natural resources degradation due to forest, water, land and mineral resources have been overusing for economic development and pro-poor development activities in country-wide up to date. These problems are major for environment which appeared such as higher temperature, precipitation and sea level rise. It is to start a knowledge related to climate change in Cambodia.

The simple understanding on climate change, showed by Website chinaview.com, the word "climate change" is a change in the "average weather" that a given region experiences. Average weather includes all the features we associate with the weather such as temperature, wind patterns and precipitation. The earth's climate is dynamic, always changing. In the past few million years, there have been spells of Ice Age and warm periods. The causes of these changes in climate have been natural. What the world is more worried about now is the impact of human activities on climate change.

Website chinaview.com declared that CC also come from human activities, releasing greenhouse gases (GHG) into the atmosphere. Carbon dioxide (CO<sub>2</sub>) is produced when fossil fuels are used to generate energy or when forests are cut down and burned. Methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are emitted in many ways for example agricultural activities, change in land use, and other sources. A greenhouse is a house with transparent plastic or glass roof and walls that is built to grow vegetables, flowers or other plants in temperate and colder countries. A greenhouse protects and provides heat to plants: its roof and walls allow sunlight to enter and prevent heat from escaping. This effect is known as the "*greenhouse effect*".

IPCC defined clearly the definition of CC:

#### 3.1. IMPACT OF CLIMATE CHANGE IN CAMBODIA

With viewing of the climate change in global context, there are given in summary as below:

- a) Health sector: weather-related mortality, infectious diseases, air quality-respiratory illnesses;
- b) Agricultural sector: crop yields, irrigation demand;
- c) Forestry sector: change in forest composition, shift geographic range of forests, forest health and productivity;
- d) Water resources sector: change in water supply, water quality, increased competition for water;
- e) Coastal areas: erosion of beaches, inundate coastal lands, costs to defend coastal communities;
- f) Species and natural areas: shift in ecological zones, loss of habitat and species.

For specific Cambodia, this country contributes little effect to climate change, but the country shall be affected by climate change impacts as whole from the global. Recent study (Anshory Yusuf and & Fransisco, 2009) shows that Cambodia is not highly exposed to climate hazards (except the Mekong Delta on the border to Vietnam) all its provinces, but are vulnerable to climate change due to their limited and low adaptive capacity and dependence on climate-sensitive livelihood. Climate change adaptation in Cambodia is largely about water and health concerns and the strengthening of institutional capacity. There will be most climate change impacts in Cambodia be largely felt in Tonle Sap areas through changing water flows in the Mekong, altering the unique flood pulses system, and in coastal zones through sea level rise, increasing erosion and salinization. It is likely to be wetter, with higher water levels and more extensive flooded areas as well as longer flood duration; however the effects of climate change

on the monsoon system are not yet fully understood. Responding to climate change should start by linking efforts to reduce vulnerability to present climate-related disasters with those aimed at building longer-term resilience to climate change. It is important to note that climate change is not the only factor affecting the Mekong flows; planned large-scale hydropower dams are estimated to have a remarkable impact on the quantity and quality of the flow. The combined impact is a serious concern for the Tonle Sap areas.

The mean annual temperature is expected to increase by between 0.7 and 2.7 degree C until 2060, and between 1.4 and 4.3 degrees C until 2090 (McSweeney et al, 2008). The frequency of hot days and hot nights has increased by 13% and 17% since the 1960s. Projections for 2090 go up to a doubling of hot days and hot nights during summertime (ibid). According to the 2006 National Adaptation Program of Action to Climate Change (NAPA), agriculture, forestry, human health and coastal zones are most vulnerable against the impacts of climate change. The provinces with highest vulnerability against flooding risks are Prey Veng; Takeo, Battambang, Kampong Cham, Banteay Meanchey and Kampong Thom provinces show less vulnerability against floods. The remaining provinces show least vulnerability against floods. The provinces most impacted by climate change in terms of droughts are Battambang, Prey Veng and Banteay Meanchey, followed by Kampong Cham, Kampong Speu and other provinces. Floods have accounted for 70% of rice production losses between 1998 and 2002, while drought is responsible for 20% of the losses (MoE, 2006). Floods do not only destroy crops, but also kill many people and damage infrastructures. Weather extremes believed to be related to climate change cause a significant number of fatalities and considerable economic issues.

Cambodia's climate is governed by monsoon and characterized by two major seasons: rainy season from May to early October and dry season from November to April. The annual average temperature is 28°C, with a maximum average of 38°C in April, and a minimum average of 17°C in January. The country frequently experiences floods and droughts, that cause considerable economic losses and social and environmental impacts. Cambodia rarely suffers from extreme weather events such as typhoons or even severe storms because it is protected by the surrounding mountain ranges (MoE, NAPA, 2006).

According to IPCC, 2007, climate change impacts such as drought, floods, severe weather and sea-level rise are likely to result in food shortages, increases in vector-borne diseases, infrastructure damage, and the degradation of natural resources upon which livelihoods are based. The negative impacts of climate change will affect mostly poor people, who consider lower adaptive capacity.

Oxfam Cambodia (2005) also highlighted that Cambodia is one of the most disaster-prone countries in South East Asia with its vulnerability to annual floods and droughts. One of the reasons why it is vulnerable to natural disasters is that the livelihoods of the majority of people depend directly upon natural resources, with a large proportion of its population occupied in agriculture and related sectors, including animal husbandry. Extreme poverty, which limits access to food, water and other basic amenities, leads to the increasing of vulnerability. These characteristics heighten Cambodia's exposure to the impacts of climate change too.

The Ministry of Environment of Cambodia conducted the study on Cambodian Climate status by using two global warming scenarios (SRESA2 and SRESB1) and three models (GCM models CCSR and CSIRO) in 2002. The models suggested that by 2100 rainfall in Cambodia would increase by 3% to 35% from the current condition, while temperature increase would be in the range of 1.3oC-2.5oC. The occurrence of climate extremes may also increase.

This evidence of greater climatic extremes are both declining rainfall in the dry season and more violent rainfall in the wet season, causing flash floods. Increasingly powerful typhoons also appear to be occurring (Oxfam Cambodia). Projected changes in climate could have major consequences on hydrology and water resources, agriculture and food security, terrestrial and

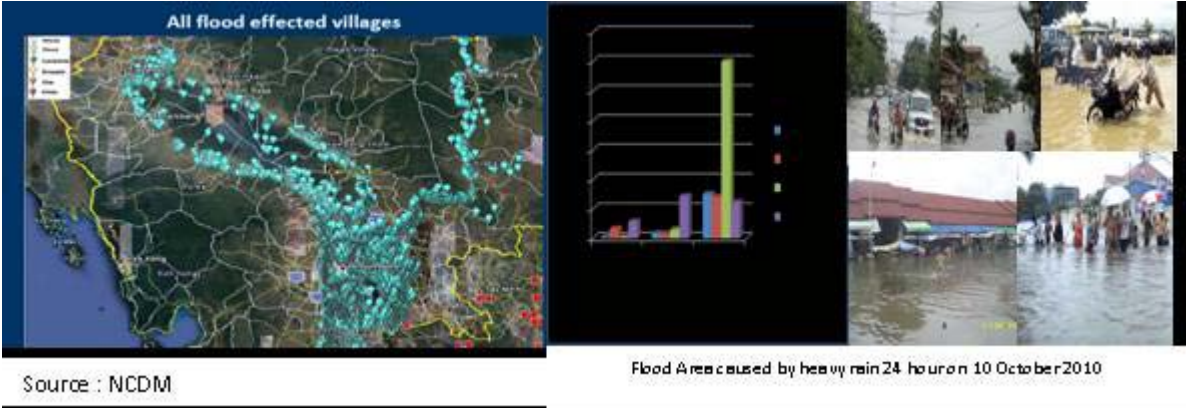
freshwater ecosystems, coastal zones and marine ecosystems, and human health. Adverse impacts include increased flood and drought magnitude and damages in temperate and tropical Asia, reductions in crop yields, decrease water availability, and increase in the number of people exposed to vector and water-borne diseases (MoE, NAPA, 2006).

There will be increasing the frequency and intensity of extreme weather events such as floods, droughts and windstorms as well as coastal inundation due to sea-level rise (Cambodia Environmental and Climate Change Policy Brief). The occurrence of drought, flood, and windstorm is getting more common in Cambodia. The risk of drought, flood and windstorm in Cambodia may increase as a result of global warming (TP, 2010).

**3.2. REAL CAUSES (NATURAL HAZARDS AND DISASTERS)**

**a) Flood**

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



**b) Drought**

According to the information from the National Committee for Disaster Management (NCDM) in 2002, the impact of drought in some regions in Cambodia can be evidenced through the following description. Prolonged drought was experienced in 1997 to 1998 and consecutive drought in 2001, 2002, 2004 and 2005. A short dry spell of 20 to 30 days during the rainy season (May – November) can result to extensive damage to crops. The most severe drought, which subsequently occurred in 2002, which caused by the lack of rainfall had been severely affected on more than 2 million people and destroyed more than 100,000 ha of paddy fields. The worst affected provinces were Prey Veng, Battambang, Kandal, Kampong Cham, Kampong Speu, Pursat and Takeo (CDRI, 2002). These facts indicate that the agricultural production centre of Cambodia is very vulnerable to extreme climate events. The productive impact could be classified as 134,926 ha rice crop, 41,490 ha transplanted and 15,441 ha seedling. Furthermore, the draught had been widely affected throughout the areas of 8 provinces consisted of 43 districts



and affected on 442,419 families (2,017,340 individual) and caused food shortage for 154,069 families. The estimated direct damages are at USD 9 M.

### c) Typhoons

Typhoons are rare in Cambodia and do not appear to be a serious threat to coastline integrity (EVS, 1996; GEC, WWF and Wetland International, 2000). Typhoons strike the Cambodian coastline every 2 to 5 years and normally occur at the end of the rainy season. In November 1997, Typhoon Linda hit the Gulf of Thailand. At the time, the wind speed in Sihanoukville reached 60 m/s. Over five days, approximately 400 mm of rainfall was recorded in coastal areas. Typhoon Linda destroyed 81 fishing boats, claiming some 100 victims and most of the paddy fields of the Sihanoukville area (MoE, 1998). Cambodia is among the four Southeast Asian Countries that were affected by **Typhoon Ketsana** between September 26 and October 5, 2009, causing incredible damage and loss, destroyed homes and livelihoods of some 49,000 families, or about 180,000 people, equivalent of 1.4 percent of Cambodia's total population, leaving 43 people dead and 67 severely injured and 14 out of 24 provinces were affected by the storm and subsequent flash flood. Most of the affected districts are among the poorest in the country (RGC, 2010). The typhoon hit the Northern Provinces of Cambodia, from the Northeast border (Stung Treng and Ratanakiri provinces) to the North (Kampong Thom, Kratie, and Kampong Cham) and the Northwest (Preah Vihear, Siem Reap, and Oddar Meanchey). The flash floods were followed by more moderate flooding in nearby provinces such as Mondul Kiri, Banteay Meanchey, Battambang, Kampong Chhnang, Preah Sihanouk, and Kampot (World Bank, 2010). The Post Disaster Needs Assessment (PDNA) estimated the total damage and loss caused by Typhoon Ketsana to be USD 132 million (damage: USD 58 million and loss: USD 74 million). The productive sector is the most affected (56% of all damage and loss), followed by the social sectors (26%), and infrastructure sector (18%). Damage and loss of the cross-cutting sectors (environment and public administration) can be considered as negligible when compared to the sectors (RGC, 2010). The initial Damage Assessment carried out by the Government indicated that up to 14 provinces with 73 districts and 336 communes had been affected by the storm and subsequent flash flood (NCDM, 2009).

### 3.3. SECTORAL IMPACT OF CLIMATE CHANGE (MINISTRY OF ENVIRONMENT, 2005)

Climate hazards occurring in Cambodia include flood, drought and windstorms. In coastal areas, underground water salinisation, and seawater intrusion are common problems. The following sections provide an overview of the impacts of climate hazards in Cambodia on various sectors.

#### d) Seawater Intrusion

Underground water salinisation and seawater intrusion are common in coastal lowland areas used for agriculture, particularly during the dry season. Salinisation of groundwater occurs in Kep and Kampot Provinces (MoE, 2002a and 2002b). Similarly, most streams in coastal areas experience seawater intrusion in the dry season (MoE, 2002a, 2002b; 2002c; and 2002d).

#### e) Malaria Incidence

Cambodia is geographically located in an area prone to vector and water-borne diseases, including malaria and dengue fever. Thus, changes in climatic conditions will have significant influence on the outbreak of these diseases. Cambodia already has the highest malaria fatality rate within Southeast Asia, with some 500 deaths per year (MoH, 1999 and 2004). The percentage of malaria inpatients is the highest among communicable diseases within the country. The Ministry of Health, especially the National Centre for Parasitology, Entomology and Malaria Control (CNM), has limited financial and human resources to fight malaria. Although malaria incidence has decreased since 1999, case fatality rate has increased from 3.2% in 1998 to 4.3% in 2002 (MoH, 1999 and 2004).

#### **f) Agriculture**

In the agriculture sector, only the rice production system was assessed in four major rice producing provinces. Based on data from the past five years, rice production loss in Cambodia was mainly due to the occurrence of flooding (more than 70% loss) and followed by drought (about 20% loss) and others such as pest and diseases (10% loss). Under elevated CO<sub>2</sub>, yields of wet season rice might increase above that of dry season rice. However, there is a chance that under changing climate, rice yield in some provinces would be more variable than under current conditions due to the increase in flood frequency and intensity, in particular in rice growing areas surrounding the Tonle Sap Lake and the Mekong River.

#### **g) Forestry**

According to the Holdridge Classification System, under the current climate conditions, Cambodia's forests are dominated by dry forest (60%), followed by wet forest (20%) and moist forest (20%). Under changing climate, the area of wet forest would decrease while moist forest would increase and dry forest would remain the same. This change indicated that forest productivity and biodiversity might also change. High rate of deforestation may accelerate the loss of forest biodiversity and reduce forest productivity.

#### **h) Health**

In the V&A study, only the impact of climate change on malaria has been assessed as this is the most serious vector-borne disease in Cambodia. The study showed that in the last four years the number of malaria cases is negatively correlated with dry season rainfall (6%), mean annual temperature (19%) and percent literate (46%), and positively correlated with wet season rainfall (29%).

#### **i) Coastal Zone**

Cambodia's coastal zone consists of two provinces (Kampot, and Koh Kong) and two municipalities (Sihanoukville and Kep). The total area covered by these provinces and the autonomous city is about 17,237 km<sup>2</sup>. In this study, only Koh Kong province has been assessed since this province covers most of the coastal zone (11,160 km<sup>2</sup>) and is the most vulnerable to the impact of sea level rise according to a preliminary analysis of the impacts of a 1 m sea level rise on Cambodia's coastal zone. This is due to the fact that most areas along the Koh Kong coastline are low-lying. The study indicated that if sea level rises by 1 m, about 0.4% of the total area of Koh Kong province would be permanently under water (MoE, CINC, 2002).

### **4. STRATEGIES, POLICIES AND LEGAL FRAMEWORK SUPPORT TO CLIMATE CHANGE ADAPTATION**

Responding to the urgent need for climate change issues and impact, Cambodia ratified the UNFCCC in 1995 and launched the first climate change project to help prepare the Cambodia's Initial National Communication (UNDP/GEF) in 1999. In addition, the environmental protection law which was approved by the national assembly in 1994 is also one legal document which is supporting the climate change.

In 2002, Cambodia has acceded to the Kyoto Protocol and at the same year, Cambodia has submitted the Initial National Communication (INC) to the CoP-8 in New Delhi, India. In addition, the MOE has conducted an analysis of policies and to address climate change impact of Cambodia (Final draft, MoE, 2005).

In 2006 the Government of Cambodia has developed the Cambodian National Adaptation Program of Action to Climate Change (NAPA) and in 2007 developed the second national communication. The National Strategy Development Plan, 2009-2013 is also a crucial

framework to support climate change. Finally, in 2010, the brief policy on Cambodia Environmental and Climate Change has also developed to support addressing the climate change impact of Cambodia.

#### 4.1. POLICY OF GOVERNMENT FOR CLIMAT CHANGE ADAPTATION

Cambodia ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 18<sup>th</sup> December 1995 and acceded to the Kyoto Protocol on 4<sup>th</sup> July 2002, which put into force on 22<sup>nd</sup> August 2002. The first formal communication with UNFCCC and Kyoto Protocol also took place at the same year as the Ministry of Environment was appointed to be the National Focal Point. On 23 June 2003 the Ministry of Environment established a Cambodian Climate Change Office (CCCO), which was upgraded to be department in October 2009, to be responsible for a wide range of climate change-related activities such as planning and policy formulation, implementation of the UNFCCC, assessment of new technologies to adapt to the adverse effects of climate change and to mitigate greenhouse gas emissions, and capacity building and awareness raising. The Office also serves as the Secretariat of the UNFCCC, the IPCC, the Kyoto Protocol and the CDM Focal Points for Cambodia. The National Climate Change Committee (NCCC), which was established by sub-decree in April 2006 with the representative of 19 Government ministries and agencies, serves as a policy-making body and coordinates the development and implementation of policies, plans and measures to address climate change issues within the country. Recently, the Ministry of Women Affairs has been included into this Committee. CCCO works closely with all relevant government agencies, nongovernmental organizations, the private sector, local communities, donors and international organizations to coordinate and implement national climate change policies, greenhouse gas mitigation and inventory, and climate change adaptation activities. In responding to the Climate Change issues, The National Adaptation Programme of Action to Climate Change (NAPA) was prepared and approved by Government in 2006. Even if the institutional framework is largely in place, it is considered that more could be done to address increasing risks caused by Climate Change, by both the Government and the donor community. It should be recognized that UNDP and DANIDA have and are still providing support to strengthening the Ministry of Environment and the Climate Change Department. Donor support to help Cambodia address the Climate Change challenge is however increasing - this EC Global Climate Change initiative being one example. In addition, Cambodia has been selected as one of 9 countries in the World Bank's Pilot Programme for Climate Resilience (PPCR).

The following legal, policy, planning and institutional efforts are directly linked to sustainable development:

- 1994-95 National Programme to Rehabilitate and Develop Cambodia (NPRD) (RGC, 1997);
- The "First Five Year Socio-Economic Development Plan (SEDP-I) 1996-2000";
- The "Second Five Year Socio-Economic Plan 2001-2005 (SEDP-II)";
- The National Environmental Action Plan (NEAP), 1998-2002;
- The Interim Poverty Reduction Strategy Paper;
- Article 59 of the Constitution of Cambodia;
- Establishment of the Ministry of Environment in 1993;
- A Royal Decree on the Creation and Designation of Protected Areas;
- The Law on Environmental Protection and Natural Resource Management;
- Sub-decrees on pollution control and Environmental Impact Assessment (EIA);
- Land Law, Mineral Law and Forestry Law.

Several government ministries have direct mandates related to sustainable natural resource management. These include the Ministry of Environment, Ministry of Agriculture, Forestry and Fisheries; Ministry of Water Resources and Meteorology; Ministry of Land Management, Urban

Planning and Construction; Ministry of Industry, Mines and Energy; etc. In addition, Cambodia has ratified a number of International Conventions related to the environment. These include:

- The Convention on Wetlands of International Importance (the Ramsar Convention);
- The Convention on Biological Diversity;
- The United Nations Framework Convention on Climate Change;
- The Convention on Marine Pollution: MARPOL 73/78;
- The United Nations Convention on the Law of the Sea (UNCLOS);
- The Convention on International Trade in Endangered Species (CITES);
- The Convention on Desertification;
- The Montreal Protocol; and
- The Convention on Persistent Organic Pollutants.

## 5. NATIONAL MECHANISM FOR CLIMATE CHANGE

### 5.1. INITIAL NATIONAL COMMUNICATION

In order to implement the relevant legal documents and policies to support climate change, the Royal Government of Cambodia (RGC), especially, MoE firstly has established the Initial National Communication (INC) in 2002 to implement the project funded by UNFCCC in Cambodia. The objective of INC is described below:

- a) To build capacity and facilitate the process of taking climate change related issues increasingly into account in Cambodia thus facilitating the country to deal with the climate change and its advise impacts;
- b) To contribute to the global effort to get better understanding on the sources and sinks of greenhouse gases, potential impacts of climate change, and effective response measures to achieve the ultimate objective of the UNFCCC.

### 5.2. NATIONAL ADAPTATION PROGRAMME OF ACTION TO CLIMATE CHANGE

The **National Adaptation Programme of Action to Climate Change (NAPA)** is supportive of the RGC's development objectives as outlined in The National Strategic Development Plan (NSDP), 2006-2010, adopted in May 2006. The NSDP stresses the need to improve agricultural productivity through the expansion of irrigation and the management of water resources to reduce vulnerability to disasters. Implementation of the Cambodian NAPA will contribute to the achievement of the Cambodian Millennium Development Goals (CMDGs). The latter includes CMDG 7 – 'Ensure environmental sustainability'. It aims to integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources in accordance with fourteen specific targets, including Target 7.9 – Reducing the fuel wood dependency from 92% of households in 1993 to 52% in 2015. **The Rectangular Strategy, Phase 2** stresses the RGC commitment to mobilise resources to address climate change.

In 2003, the Ministry of Environment (MOE) started to work with other concerned Ministries to develop a **National Adaptation Programme of Action to Climate Change (NAPA)**, endorsed by the Council of Ministers on 20 October 2006. The NAPA project is funded by the international donor community through its contributions to the Global Environment Facility (GEF). The NAPA process led to the identification of 39 adaptation projects in four key sectors, namely, agriculture, water resources, coastal zone and human health. These are primarily "no-regret" adaptation options focusing on capacity building/training, awareness raising/education and infrastructure development. Of these, 20 are proposed as high priority projects (16 non-health and 4 health), with total estimated budgets of US\$129. The Prime Minister Samdech Hun Sen urges *"All concerned ministries and agencies shall make their utmost effort to integrate the*



*priority projects identified (in the NAPA) into their respective sectoral plans*". However, Cambodia currently has a limited internal capacity to fund climate adaptation activities. As of to date, two project proposals developed based on NAPA, have received funding from donors: (i) "Building capacities to integrate water resources planning in agricultural development in Cambodia" (UNDP and LDC Fund), and (ii) "Vulnerability Assessment and Adaptation Measures for CC in the Coastal Zone of Cambodia" (UNDP, UNEP, LDC Fund and the EC Global Climate Change Alliance).

Beside these two NAPA follow-up projects, a number of small-scale projects on water resource management to adapt to climate change have been implemented under the UNDP/GEF Small Grant Programme by selected community-based organisations and local NGOs. (TP, 2010)

### **Objectives of the National Adaptation Programme of Action to Climate Change**

The Annotated Guidelines for the Preparation of National Adaptation Programmes of Action, based on Decision 28 of the 7th Conference of the Parties (CoP) of the United Nations Framework Convention on Climate Change (UNFCCC), provides the methodological basis for the development of NAPAs in least developed countries (UNFCCC, 2002). The identification of priority adaptation activities is the main goal of the NAPA formulation exercise. The formulation of the NAPA follows a participatory process that involves those who are most affected by climatic impacts, that is rural people and the poor. The NAPA builds upon existing coping strategies implemented by local communities in order to enhance their adaptation capacity. More specifically, the objectives of the NAPA project are: (1) to understand the main characteristics of climate hazards in Cambodia (flood, drought, windstorm, high tide, salt water intrusion and malaria); (2) to understand coping mechanisms to climate hazards and climate change at the grassroots level; (3) to understand existing programmes and institutional arrangements for addressing climate hazards and climate change; (4) to identify and prioritise adaptation activities to climate hazards and climate change.

### **5.3. NATIONAL CLIMATE CHANGE COMMITTEE (NCCC)**

Furthermore, in 2006 the Royal Government of Cambodia (RGC) has established the National Climate Change Committee (NCCC) (Sub-Decree No. 35 ~~អនក្រឹត្យ~~ dated 24 April 2006), which is chaired by the Senior Minister of Ministry of Environment with Prime Minister is the Honorary Chair.. The NCCC is based in the Ministry of Environment (MoE) and its secretariat is the Climate Change Office (CCO), which has been functioning since 1999 as a project unit although limited staff, financial resources and mandate has restricted its effectiveness. The NCCC comprises senior policy-makers from 19 ministries and serves as a policy-making body that coordinates the development and implementation of policies, plans, and measures to address climate change issues within Cambodia. The NCCC is set as the focal point for all engagement on climate change within the Government of Cambodia (PPCR, 2009). The committee consists of 19 ministries:

1. Ministry of Environment;
2. Ministry of Agriculture, Forestry and Fishery;
3. Ministry of Industry, Mines and Energy;
4. Ministry of Water Resources and Meteorology;
5. Ministry of Commerce;
6. Council of Ministers;
7. Ministry of Interior;
8. Ministry of Economy and Finance;
9. Ministry of Public Works and Transport;
10. Ministry of Planning;
11. Ministry of Foreign Affairs and International Cooperation;
12. Ministry of Education, Youth and Sports;
13. Ministry of Health;
14. Ministry of Land Management, Urban Planning and Construction;

15. Ministry of Rural Development;
16. Ministry of Information;
17. National Committee for Disaster Management;
18. Council for the Development of Cambodia;
19. Cambodia National Mekong Committee

The NCCC has its mandate as to prepare, coordinate and monitor the implementation of policies, strategies, legal instruments, plans and programs of the Royal Government to address climate change issues. The NCCC is responsible *inter alia* for (a) coordinating the implementation of climate change activities in Cambodia; (b) developing climate change policies, strategies, legal instruments, plans and programs; and (c) the integration of climate change concerns into relevant policies, strategies and legal instruments. It has been partly effective in carrying out its mandate but has only recently begun to meet regularly to address climate change issues. (PPCR, 2009)

#### 5.4. THE CAMBODIA CLIMATE CHANGE DEPARTMENT

Sequentially, the Royal Government of Cambodia (RGC), especially, the Ministry of Environment (MOE) has established the Cambodia Climate Change Office (CCCO) and later on it was extended to the Climate Change Department in 2003. The CCCO roles and responsibilities are:

- a) Implementing the UNFCCC and other climate change-related tasks;
- b) Providing information and advice to the Government on preparation of negotiation positions, establishment of national climate change policies, plans and legal instrument;
- c) Identifying and assess new technologies appropriate for Cambodia to adapt to climate change or to mitigate Greenhouse Gas (GHG) emissions;
- d) Promoting research activities and human capacity building;
- e) Developing new climate change-related project proposals;
- f) Acting as the Secretariat of the UNFCCC, the Kyoto protocol and the Clean Development Mechanism (CDM) focal point for Cambodia.

#### 5.5. CLIMATE CHANGE NATIONAL AUTHORITY

To ensure the issues of climate change have been addressed properly at the national and international level, in the same year the Royal Government of Cambodia has appointed MOE as the interim Designated National Authority (IDNA) for the Clean Development Mechanism (CDM).

#### 5.6. CAMBODIA CLIMATE CHANGE ALLIANCE

In order to perform its tasks in effective way, the Royal Government of Cambodia (RGC) has established the Cambodia Climate Change Alliance (CCCA) in 2010 which is launched on 25<sup>th</sup> February, under the initiative supported by the Climate Change Trust Fund of 8.9 million U.S. dollars which covers the period 2010- 2012 from the European Union, UNDP, SIDA, and DANIDA.

The CCCA has two aims:

- 1) To support capacity development and institutional strengthening in order to prepare for and mitigate climate change risks;
- 2) To directly help vulnerable communities by enhancing their resilience to climate change and other natural hazards.

The CCCA includes two working mechanisms as below:

- 1) A unified engagement point for development partners;

- 2) A multi-donor financial facility, the Cambodia Climate Change Alliance Trust Fund, which provides grant for projects that help Cambodia adapt to climate change.

In addition, the CCCA approach is based on three principles:

- 1) Climate change must be given higher priority by the Government and society;
- 2) Adaptation and mitigation must be addressed in a broad development context and linked to the government's poverty reduction agenda;
- 3) Climate change is about people and their livelihoods, therefore social efforts are needed to include women and youth in the response.

**The Main Activities of CCCA can be described as the following:**

The activities of the Cambodia Climate Change Alliance will be conducted through the CCCA Climate Change Support Programme. This will support capacity building and institutional strengthening and will manage the application and approval process for grants from the CCCA Trust Fund. The Climate Change Support Programme will screen and review requests for grant funding under the CCCA Trust Fund to ensure that they contribute to the objectives of the CCCA. The fund will be administered initially by UNDP, but it is envisioned that this arrangement will eventually be replaced by country systems, possibly a government-managed trust fund or direct budget support. CCCA grants will be implemented by the Government and civil society, with technical support by external development partners as required.

The Cambodia Climate Change Alliance has three main results:

- **Capacity development:** The National Climate Change Committee has stronger capacity to coordinate efforts on national policy making, capacity development and outreach/advocacy, and to monitor the implementation of the National Climate Change Strategy and Action Plan.
- **Awareness-raising:** A knowledge-management and learning platform operates to provide Cambodia with updated knowledge and opportunities to learn about climate change. This mechanism collects experiences and best practices from the region as well as Cambodia and disseminates them beyond the Government to civil society and the broader community of practice.
- **Grants:** Key line ministries, agencies and civil society organizations have access to financial and technical resources to design, implement and monitor climate change adaptation interventions.

The European Commission (EC) and RGC are currently preparing, with the assistance of UNDP and UNEP, a program of cooperation through the Global Climate Change Alliance (GCCA) initiative to support the RGC in implementing the National Climate Change Strategy and Action Plan (CCSAP). The proposal includes the establishment of a multi-donor trust fund to be managed by UNDP with initial pledges<sup>3</sup> of approximately USD9 million over 3 years. Component 1 of the program builds on the activities of UNDP and DANIDA and will focus on capacity building and institutional strengthening of the NCCC and CCO in order for them to support Government, academia, and civil society in mainstreaming climate change considerations into policies, strategies, plans and programs.

## **6. BEST PRACTICES FOR CLIMATE CHANGE ADAPTATION**

### **6.1. FLOOD PRONE MANAGEMENT**

A number of so far several programs have been implemented to reduce and mitigate the impacts of floods and droughts, which are the main climate hazards in the country. In the last five years, at least ten types of projects have been implemented to address floods. Most of these projects consisted of the construction of water culverts, and the rehabilitation of roads and bridges damaged by floods, while the construction of dams, pumping facilities, water gates and canals has been limited. Some roads were constructed as part of an effort to prevent or reduce the damages of floods in agricultural areas (MoE, 2005 and MRC/FMMP/BDP, 2007).

### **6.2. TRADITIONAL PLANT**

In addition, planting bamboo is a traditional method used by people who live along watercourses, water bodies to reduce the impact of excessive flooding, as bamboo can reduce erosion and sedimentation. Adequate funding to support traditional flood mitigation methods is still lacking (Final draft, MoE, 2005). Mangrove forest management will support to protect coastal erosion and to support biodiversity vital.

### **6.3. DROUGHT MANAGEMENT**

The impact of drought have similarly been addressed by a number of programs with aiming to improving the irrigation system, rehabilitation of pumping stations and water pump, water supply and sanitation and establishment of Farmer Water User Community (FWUC). For example, MOWRAM's objective for 2001-2005 have been achieved a total of 290 irrigation rehabilitation projects, covering 532,673 ha of wet season rice and 154,368 ha of dry season rice, at a total cost of about US\$ 607 million. Up to 2003, 315 irrigation projects had been implemented, covering 153,149 ha of paddy rice, of which 89,383 ha for wet season and 63,766 ha for dry season (MOWRAM, 2003).

### **6.4. OTHER SECTORS MANAGEMENT**

In 2009, the Food Facility Project was funded by European Union (EU) and implemented by the General Department of Agriculture (GDA) in cooperation with the Food and Agriculture Organization (FAO) in nine provinces in Cambodia. The results of the project include agriculture land improvement, better knowledge of local farmers on how to select a good rice crop variety aiming to improve the rice production, how to raise fish to support their livelihood, how to grow vegetable and how to store rice in a right manner for food and seed (ECO3 and SOGES, 2010).

In addition, the rice productivities were increased from 3 to 4 tons per ha in Svay Rieng and Kampong Thom provinces; and local farmers could grow vegetable not for household consumption, but also for selling at the local market during a shortage of food as compare to that before project.

The Ketsana project was funded by the World Bank and implemented by the Ministry of Rural Development (MRD) in six provinces, which affected by the Ketsana Typhoon in 2008, aimed to build and improve the rural infrastructure such as rural roads and rural water supply and sanitation facilities. However, the project has been started to make inventory and to build and



rehabilitate the rural roads and rural water supply and sanitation facilities later (the Ketsana project report, 2010). In addition, the project has also strengthened capacity of provincial staff of disaster management committee on how to prevent the natural disaster.

## 7. ADAPTATION CAPACITY TO CLIMATE CHANGE

### 7.1. UNDERSTANDING OF ADAPTATION

The definition of adaptation was made by IPCC (fourth assessment report IPCC, 2007): adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Other definition of adaptation as adjustments of a system to reduce vulnerability and to increase the resilience of system to change, in this case in the climate system (W. Neil Adger (UK), Shardul Agrawala (OECD/France), M. Monirul Qader Mirza (Canada/Bangladesh), 2007).

**Adaptive capacity** – The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2007). Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behavior and in resources and technologies.

**Coping Capacity** - The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards. (*UN/ISDR, On Better Terms: A Glance at Key Climate Change and Disaster Risk Reduction Concepts*)

The Copenhagen Agreement was adopted at COP-15 offers opportunities to significantly advance the climate change agenda and to establish a solid enabling environment for climate change adaptation (CCA). Yet ultimately success in adaptation must be measured in terms of impact on the ground at local level. Compared to climate change mitigation, climate change adaptation policy development is still in its infancy. Since adaptation was put on an equal footing with mitigation in the Bali Action Plan, significant progress in policy development can be observed. Yet the main focus of the debate is on the development of **national** adaptation strategies and programmes and the support by regional centres (UNFCCC, 2009) .

#### **Adaptation strategies:**

The adaptation is an important means of reducing climate-change impacts. Adaptation includes all activities that an individual, community, government, or institution does in response to climate stimuli. Adaptation can either be autonomous – reactive – or planned in advance. Autonomous adaptation refers to actions taken during or after experiencing the impacts of climate change. This kind of adaptation generally involves suffering losses and so is not ideal. Planned adaptation includes all those actions taken in anticipation of climate change impacts. These decisions are the most difficult to make, since climate change involves uncertainty, and human resources and financial investments may go to waste if the course of action decided on turns out to be wrong one. As decisions of this kind are important, we tried to identify both types of decision made at the community level. However, it is difficult to distinguish in practice between the two. For example, digging wells, planting new cropping systems, or storing rice or fodder may come under either category, depending on circumstances including intention, timing, and the degree of planning, and so on (Oxfam Cambodia).

## 7.2. ADAPTATION APPROACHES

First it must be clear understood about the approaches to climate change adaptation and disaster risk reduction activities and the need for a coordinated response between the disciplines. Climate change may increase disaster risk, both through an increase in extreme events and negative effects on society; and disaster can act to decrease social and environmental capacity to respond to climate change (O'Brien et al, 2008).

A holistic approach (Integrated Water Resource Management) is to be applied for disaster risk reduction management that focuses on prevention as well as emergency responses, and climate change adaptation acknowledges the importance to adapt with current vulnerabilities while building resilience to future climate change. There will be needed to reduce vulnerability, both communities focusing on capacity building and resilience to respond to natural hazards. These approaches are recognized for poverty reduction and sustainable resources management.

In many ways, adaptation is less to do with technical fixes such as dams, sea-walls and improved crop varieties, and much more about creating the institutional capacity to be able to monitor, assess, plan and implement policies and strategies which will build adaptive capacity across the different sectors of society. Technical solutions will be needed to certain problems, but without strong and effective institutions then adaptation will remain a set of disjointed projects rather than a jointed-up strategy which reduces the negative effects of climate change (Thomalla et al, 2006).

It is important to explore both national capacity and also regional capacity for IWRM as particularly for the issues raised by climate change are likely to be required at regional coordination and response. Particularly, the implementation of IWRM in the Mekong River basin has been in place including strong regional coordination and sharing of data and information among riparian countries, for example to flood prone management.

## 7.3. ADAPTIVE CAPACITY BARRIERS

In Cambodia, the NAPA (2006) highlighted the following barriers related to capacity for adaptation that will need to be addressed:

- a) Limited financial resources or funding for climate change related activities, especially in the health and agriculture sectors;
- b) Few climate change studies and little experience within the country;
- c) Lack of climate change research and/or training institutions in the country;
- d) Lack of data availability and reliability and , in particular, absence of a formal mechanism for information sharing;
- e) Limited cooperation and coordination among institutional agencies related to research or studies on climate change and climate variability;
- f) Relatively low technical capacity of local staff;
- g) Relatively low government salary and limited incentives from the climate change project;
- h) Non-comprehensive national climate change policies and/or strategy;
- i) Lack of qualified national experts in the country;
- j) Limited public awareness and education on climate change; and
- k) Limited technical, financial and institutional resources for adaptation.

## 7.4. ADAPTIVE CAPACITY CHALLENGES TO CLIMATE CHANGE ADAPTATION

Resulting from the importance and barriers of adaptive capacity for climate change in Cambodia, the several challenges for adaptive capacity to respond to climate change can be summarized are as follows:

- a) Awareness and knowledge on climate change must be mainstreamed to all sectors development aspect at local, provincial and national levels through media system, TV spots, radio and campaign;
- b) Establishment of data management system for collecting and sharing data and information on climate change issue and adaptation capacity to related stakeholders;
- c) Establishment of networks for meteorology and hydrology to manage and control for example temperature, rainfall, weather, level of agriculture, industry and health impacted by climate change;
- d) Staff capacity building on climate change through long term-studies, short course trainings and exchange study tours in and out of the country and the region;
- e) Development of long-term integrated planning of providing best chance of minimizing the sea-level rise's negative effects;
- f) Availability of financial resources must be secured for programs/projects, research and development on climate change adaptation from both the government agencies and development partners;
- g) Strengthening the cooperation and coordination mechanism among different sectors agencies at local, national, regional and international level applying IWRM aspects to response the climate change adaptation;
- h) Encouraging the decision makers to recognize the climate change issues and to commit their deals with issues;
- i) The appropriate capacity of local farmers on the selection of crop varieties, and the planning of crop system for climate change adaptation;
- j) Vocational skills for local farming to get the jobs in the communities for climate change adaptation.

## 8. CONCLUSION

In conclusion of the report, Cambodia is one of vulnerable countries to climate variability change. Natural resources are major for local communities to sustain their livelihood and development. The natural resources are degraded caused by natural and human activities. The climate change issues are ones of natural disaster hazards occurred in the country mainly flood and drought that affect mostly to socio-economic development and environmental problem. Lacking good practices in water and related management is the key that human activities are involved to climate change issues. The holistic approach and IWRM shall be incorporated to all sector aspects to response to climate change adaptation promoting capacity building and adaptive capacity of vulnerable people in affected areas. The sectors cooperation is appropriate though for this challenging process to support climate change adaptation.

The National policies, strategies and regulations have been set as national framework to response the climate change issues and challenges of climate change adaptation of related hazards. Cambodia supports the Protocol's CDM and commits her strong involvement in the Global Climate Change mechanism though establishment of NCCC, Climate Change Department within MOE, NAPA and CCCA. The National Plan for Development is being integrated with climate change aspects and IWRM perspectives as the tool for climate change adaptation in the country. The MRC program on climate change is provided to assist Cambodia and other member countries to cooperate on climate change in the Mekong River basin.

ASIAN Countries and MRC member countries have been working hard for CC in the region. The existing national mechanism response to CCA and Mitigation have been working and initiating at national and local levels. The Government Actions and interventions to CC are synergized, cohesion and integrated to national socio-economic development plan responding to CCA. Ministry of Environment is a key national agency leading CCA process with promotion and implementation of NAPA. Cambodia National Mekong Committee is leading in

coordination for water and related resources management and development in the Mekong basin by cooperation with national line agencies and other MRC member countries under MRC frameworks applying IWRM principles and also supporting CCA in the country. Climate change is a strategic challenge to the government of Cambodia to achieve the National MDGs.

## **9. RECOMMENDATIONS**

Based on these findings, the CamboWP expert team's recommendations are made as follows:

- a) Institutional and human resources capacity building for CCA should be improved and comprehensively capable to deal with CCA and Mitigation
- b) Improving policy and decision makers capacity to understand the climate change issues and capacity to deal with the climate change adaptation;
- c) Integrating Climate change aspects into the national policies, strategies and regulations to support enhancing the country capacity the climate change adaptation;
- d) Comprehensive raising awareness on climate change issues and CCA with relevant to IWRM as the tool for CCA among different stakeholders including governments, civil society, NGO, academic institutions and private sector etc; CamboWP is a national network for IWRM can play this key role.
- e) Enforcing the implementation of legal documents that support to climate change adaptation with appropriate tools, procedures, guideline etc;
- f) Development and improvement of networks for hydro-meteorology at rural communities in order to exchange and disseminate the weather and climate information to all;
- g) Developing the long term strategic roadmap and integrated plan for water and related resources management and development applying IWRM aspect for climate change adaptation;
- h) The government and other development partners have to secure fund for implementation of climate change adaptation programs/projects.



## REFERENCES

- Anshory Yusuf and & Fransisco. (2009).  
*Cambodia Environmental and Climate Change Policy Brief*.  
*chinaview.com*. (n.d.). Retrieved 2010, from <http://www.chinaview.com/>
- Final draft, MoE. (2005). *Analysis of policies to address climate change impacts in Cambodia*.  
*GEC, WWF and Wetland International*. (2000).
- IPCC TAR. (2001a). *Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third Assessment Report*. Cambridge University Press.
- McSweeney et al. (2008).
- Ministry of Environment. (2005). *Analysis of Policies to address Climate Change Impacts in Cambodia, Final Draft*.
- MoE, CINC. (2002). *Cambodia's Initial National Communication*.
- MoE, NAPA. (2006). *National adaptation programme of action to Climate Change (NAPA)*.
- MRC. (September 2009). *Management Information Booklet Series No.1 Adaptation to climate change in the countries of the Lower Mekong Basin*.
- NCDM. (2009). *National Committee for Disaster Management*.
- Neil Adger.W and al, IPCC . (n.d.). *Assessment of adaptation practices, options, constraints and capacity*. Retrieved December 18, 2010, from IPCC Web site: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter17.pdf>
- Oxfam Cambodai*. (n.d.). Retrieved 2010, from Oxfam Web site: [http://www.oxfam.org.uk/resources/policy/climate\\_change/downloads/cambodia\\_climate\\_change\\_report.pdf](http://www.oxfam.org.uk/resources/policy/climate_change/downloads/cambodia_climate_change_report.pdf)
- Oxfam Cambodia. *Oxfam Cambodia and Graduate School of Global Environmental Studies of Kyoto University, Japan, Drought Management Considerations for Climate Change Adaptation: Focus on the Mekong Region- CAMBODIA*.
- Oxfam. (n.d.). *Oxfam Cambodia*. Retrieved 2010, from Oxfam Web Site: [http://www.oxfam.org.uk/resources/policy/climate\\_change/downloads/cambodia\\_climate\\_change\\_report.pdf](http://www.oxfam.org.uk/resources/policy/climate_change/downloads/cambodia_climate_change_report.pdf)
- PPCR. (2009). *Aide Memoire Cambodia: Joint Mission for the Pilot Program on Climate Resilience (PPCR)* (Vol. 63).
- RGC. (2010). *Comprehensive Post Disaster Needs Assessment: Ketsana Recovery and Reconstruction in Cambodia*.
- RGC. (1997). *First Five Year Socioeconomic Development Plan 1996-2000*.
- Royal Government of Cambodia. (2010). *NATIONAL STRATEGIC DEVELOPMENT PLAN*.
- TP. (2010). *Climate Change Briefing – Cambodia*.

- UNFCCC. (2009). *Climate Change Adaptation Strategies for Local Impact Key Message for UNFCCC*.
- W. Neil Adger (UK), Shardul Agrawala (OECD/France), M. Monirul Qader Mirza (Canada/Bangladesh). (2007). *Intergovernmental Panel on Climate Change*. Retrieved 12 18, 2010, from IPCC Web site: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter17.pdf>
- World Bank. (2010). *Cambodia: Kh-Typhoon Ketsana Emergency Reconstruction And Rehabilitation Project - Project Information Document (Pid), Concept Stage*.

Prepared by  
Indonesia Water Partnership (Ina-WP)

# Climate Change Management in Indonesia

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## 1. Introduction

The climate change issue had grown from something regarded as a myth a few decades ago into a highly prominent issue. The issue's growing importance in the global stage sparked by the First Assessment Report of the IPCC, released in 1990, leading to the creation of United Nation Framework Convention of Climate Change. Despite of uncertainties of what will exactly happen in the future, scientists all over the world have produced a rapidly growing body of knowledge that provides evidences leading to a conclusion that the global climate is indeed changing, and it is predicted that the change will eventually be a significant threat to the continuity of life and humanity as we know it. Ever since, climate change entered the global political talks, commitments are stated in annually held conferences; policies are altered to better address the problem, affecting aspects of the way we live.

The IPCC's latest report, released in 2007, reported that eleven of the last twelve years (1995-2006) ranked among the twelve warmest years in the instrumental record of global surface temperature since 1850.<sup>1</sup> The warming temperature trend across the globe has lead to alteration of various physical and biological phenomena. Among it is the rising of global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and at an average rate of about 3.1 mm per year from 1993 to 2003;<sup>2</sup> changing agricultural patterns; disturbances to human health, such as prevalence of new diseases; and disturbances to development and other human activities. The same report stated that, specifically for South-East Asia region, global warming is potentially threatening by decreasing freshwater availability, increasing the risk of flood in highly populated mega delta region, compound the pressures on natural resources and the environment, and rising mortality rate from diseases due to changing hydrological cycle.

Indonesia is the world's largest archipelago, consisting of about 17,500 islands, that stretches from 06°08' North latitude to 11°15' South latitude, and from 94°45' to 141°05' East longitude. It includes 3.1 million square kilometers (km<sup>2</sup>) of territorial waters (62% of its total area), almost 2 million km<sup>2</sup> of land (38%), and 81,000 km of coastline and also home to over 237 million inhabitants, which makes it the fourth most populated country in the world. The population has more than doubled since 1970 and is estimated to grow to 262 million people by 2020. The urbanisation rate is very high (4.4%). Two-thirds of the total population and more than half of the poor (57%) reside on Java. Indonesia supports tremendous species diversity of both animal and plant life in its pristine rain forests and its rich coastal and marine areas. Nearly 60% of Indonesia's terrestrial area is forested. The landscape is also mountainous and volcanic with over 500 volcanoes out of which 129 are still active. Furthermore, Indonesia holds at its disposal deposits of petroleum, natural (fossil) gas, and metal ores. Indonesia's macro-economic development during the past 30 years is to a large extent based on its natural resources.

The combination of high population density and high levels of biodiversity, together with a staggering 80,000 kilometres of coastline and islands, makes Indonesia one of the most vulnerable countries to the impacts of climate change. Indonesia has to take up the challenge of climate change, putting climate adaption into the development agenda, promoting sustainable land use, as well as demanding support from industrialized nations.”

The Indonesian climate is tropical—hot and humid, but more moderate in the highlands. Climatic and weather conditions of the archipelago are characterized by an equatorial double rainy season. The dry season generally prevails from May to September, and the wet season generally prevails from December to March. These patterns do not always rigidly take place, however, since a large part of the archipelago is covered by sea and diurnal differences are not significant, which makes precipitation possible anytime. The mean annual relative air humidity ranges from approximately 80 to 90 percent. The mean maximum temperature can reach 33oC, whereas the mean minimum air temperature is 21°C. The geographic location of Indonesia is presented below.

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<sup>1</sup> IPCC, 2007

<sup>2</sup> IPCC, 2007

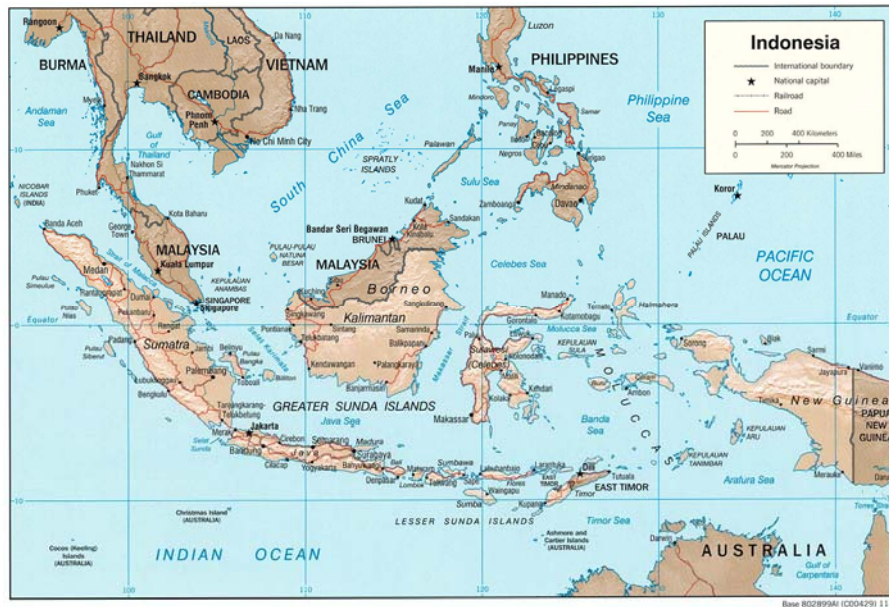
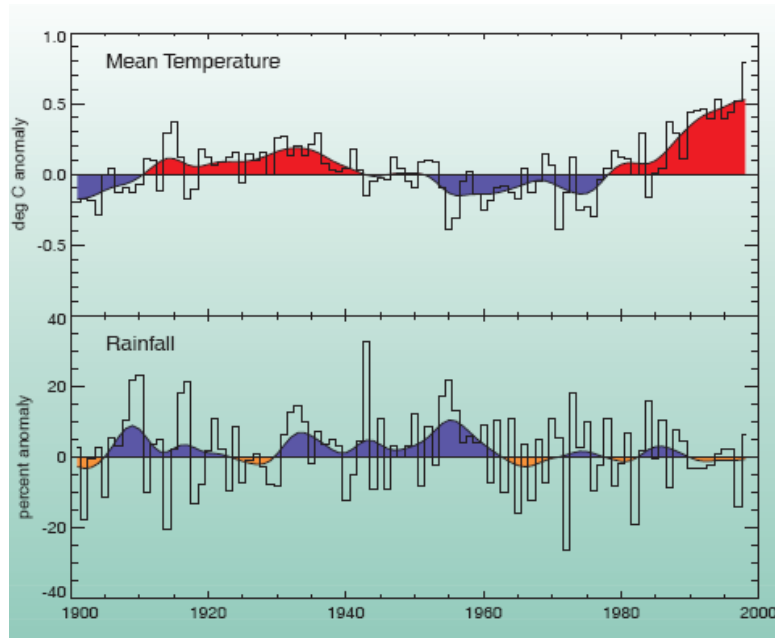


Figure 1. Overview of the Indonesian archipelago

## 2. Climate Change in Indonesia

While the overall observed surface air temperature in Asia has increased by approximately 1-3°C over the last century, the Intergovernmental Panel on Climate Change (IPCC) suggests that reliable historic temperature data in Indonesia is not available (Cruz et al., 2007). However, Hulme and Sheard (1999), find that Indonesia has become warmer since 1900 and that the annual mean temperature has increased by about 0.3°C (Figure 2). Annual precipitation overall has decreased by two to three percent across all of Indonesia over the last century (Figure 2). However, there is significant spatial variability; there has been a decline in annual rainfall in the southern regions of Indonesia (e.g., Java, Lampung, South Sumatra, South Sulawesi, and Nusa Tenggara) and an increase in precipitation in the northern regions of Indonesia (e.g., most of Kalimantan, North Sulawesi) (Boer and Faqih, 2004). There has also been a shift in the seasonality of precipitation (wet and dry seasons); in the southern region of Indonesia the wet season rainfall has increased while the dry season rainfall has decreased, whereas the opposite pattern was observed in the northern region of Indonesia (Boer and Faqih, 2004). It should be noted that precipitation in Indonesia (and many parts of the world) is strongly influenced by El Niño/ Southern Oscillation (ENSO) events and that some researchers suggest that there will be more frequent and perhaps intense ENSO events in the future because of the warming global climate (Tsonis et al., 2005). Because Indonesia typically experiences droughts during El Niño events (the warm phase of ENSO) and excessive rain during La Niña events (cool phase of ENSO), this global pattern will have regional impacts.



**Figure 2. Change in annual mean temperature, 1901–1998 (top) and annual rainfall, 1901-1998 (bottom), across Indonesia. Adapted from Hulme and Sheard (1999)**

### 3. Observed Evidences of Climate Change in Indonesia

Global warming is already affecting Indonesia's climate pattern. A report by the World Wildlife Fund cited observations that the annual mean temperature in Indonesia has increased by about  $0.3^{\circ}\text{C}$ <sup>3</sup> and in 1998 the increase was almost  $1^{\circ}\text{C}$ <sup>4</sup>. Precipitation patterns have changed (decreased by 2-3 percent across all of Indonesia over the last century); there has been a decline in annual rainfall in the southern regions of Indonesia and an increase in precipitation in the northern regions.<sup>5</sup> Some researchers suggest that there will be more frequent and perhaps more intense ENSO e El Niño/ Southern Oscillation (ENSO) vents in the future because of the warming global climate.<sup>6</sup>

### 4. Projected Climate Change Impacts in Indonesia

Under IPCC scenarios, it is projected that temperature may warm anywhere from  $0.72$  to  $3.92^{\circ}\text{C}$  and precipitation may decrease by two percent or increase by up to twelve percent the end of the century over all of Southeast Asia, including Indonesia<sup>7</sup>. For Indonesia, rate of warming will rise relatively uniformly across all of Indonesia from about  $0.1$  to  $0.3^{\circ}\text{C}$  per decade for the next 100 years<sup>8</sup>. (Fig. 3. A)

A more recent study suggests that the rate of warming for Indonesia will be slightly greater from  $0.2$  to  $0.3^{\circ}\text{C}$  per decade (Boer and Faqih, 2004). Modeled precipitation changes are not as uniform; it is projected that annual rainfall will increase across the majority of the Indonesian islands, with the possible exception of southern Indonesia (including Java), where it is projected to decline by up to 15 percent (Hulme and Sheard, 1999). (Fig. 3. B)

However, there is considerable variance in rainfall for different climate models, regions of Indonesia, and times of the years. For example, during the December-February season, parts of Sumatra and Borneo become 10 to 30 percent wetter by the 2080's. In contrast, rainfall changes during the June-August season

<sup>3</sup> Hulme and Sheard (1999) cited in WWF (2009)

<sup>4</sup> Yayasan Pelangi (2007)

<sup>5</sup> Boer and Faqih, (2004) cited in WWF (2009)

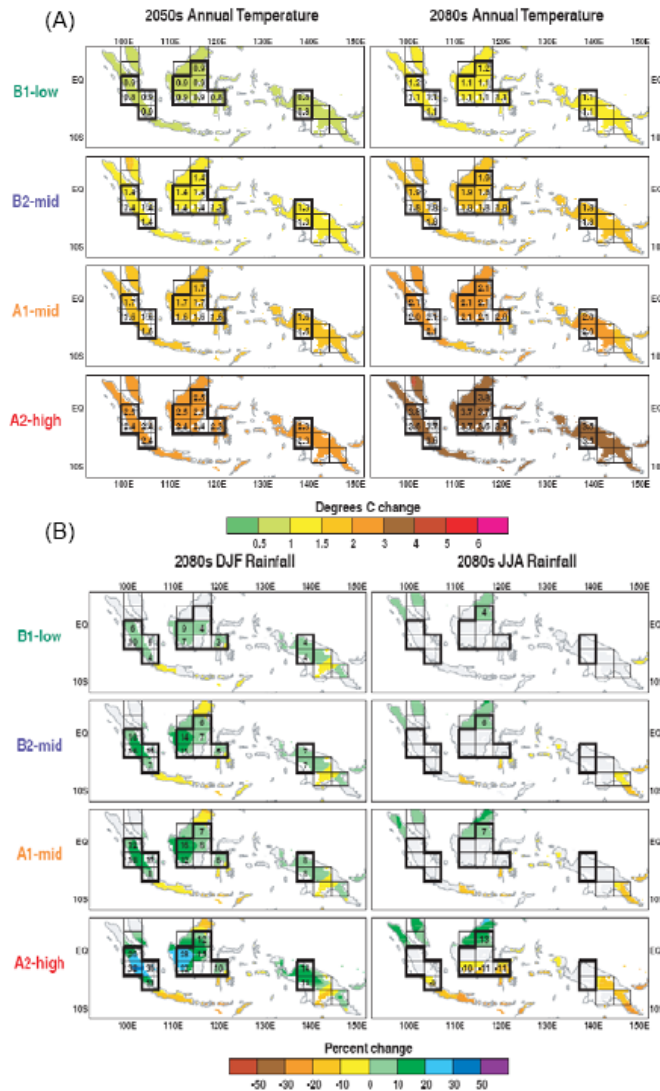
<sup>6</sup> Tsonis et.al (2005) cited in WWF (2009)

<sup>7</sup> Cruz et.al. (2007) cited in WWF (2009)

<sup>8</sup> Hulme and Sheard (1999) cited in WWF (2009)

are generally negative; Jakarta for example, is projected to become 5 to 15 percent drier depending on the emissions scenario (Hulme and Sheard, 1999).

Changes in the timing and seasonality of rainfall is also projected to change; a recent analysis suggests that there is an increased likelihood that the annual monsoon could be delayed by 30 days because of changes in regional climate and there may be a 10% increase in rainfall later in the crop year (April-June), but a substantial decrease (up to 75%) in rainfall later in the dry season (July–September) (Naylor et al., 2007)



**Figure 3.** Change in mean annual temperature (deg Celsius from the average 1961-90 climate) for the 30-year periods centered on the 2050s and 2080s for four IPCC emissions scenarios. The printed numbers show the estimated change for each model land gridbox over Indonesia. Changes are only shown where they are large in relation to simulated natural temperature variability on 30-year time-scales. (B) Change in December-February and June-August rainfall (percent change from the average 1961-90 climate). Adapted from Hulme and Sheard, 1999.

## 5. Projected Impacts on Indonesian Livelihood<sup>9</sup>

Indonesia is an archipelagic state located in the corner of Southeast Asia (6° N-11° S, 95°-141° E). It has five major islands (Sumatera, Java, Kalimantan, Sulawesi, and Papua) and comprises 17,508 islands in total, 6,000 of which are inhabited. It is the 16<sup>th</sup> largest-country in the world with total territory area of 1,904,569 sq km, of which the 93,000 sq km is water. It is the 4<sup>th</sup> most populous country after China, India, and United States. Population grew from 119 million in 1971 to 219 million in 2005. While the growth rate is slowing down from 1.49% (1990–2000) to become 1.34% (2001–2005), it is projected that Indonesia's population will reach 300 million in 2030.

During the New Order regime, development tends to be centered on Jakarta, the capital city, and other cities in Java, the island where the capital city is located. More than half of the entire population prefers to live in Java cities. Most of the Indonesian population is concentrated on Java and Madura (58.8 percent) while the two islands' area only makes 7 percent of Indonesia territory, making Java the most populous island in the world (Java has a population density of 940 people per sq km).

After having a centralized authoritarian government for more than three decades, Indonesia is now in a process of consolidating democracy. Decentralization of development is one of GOI's main concerns following the rise of urban related demographic problems. Administratively, Indonesia consists of 33 provinces, five of which have special status. Each province has its own political legislature and governor. The provinces are subdivided into regencies (*kabupaten*) and cities (*kota*), which are further subdivided into sub-districts (*kecamatan*), and again into village groupings (either *desa* or *kelurahan*). Furthermore, a village is divided into several citizen-groups (*Rukun-Warga (RW)*) which are further divided into several neighborhood-groups (*Rukun-Tetangga (RT)*). Following the implementation of decentralization beginning on 1 January 2001, regencies and municipalities have become the key administrative units responsible for providing most government services. The village administration level is the most influential on a citizen's daily life, and handles matters of a village or neighborhood through an elected *lurah* or *kepala desa* (village chief).

As a vast, highly populated archipelago, combined with financial constraints and decentralized government, the impact of climate change for Indonesian livelihood could be severe if not managed carefully.

### a) Water Availability

- Decreased rainfall during critical times of the year may translate into high drought risk, uncertain water availability, and consequently, uncertain ability to produce agricultural goods, economic instability, and drastically more undernourished people, hindering progress against poverty and food insecurity (Wang et al., 2006)
- Increased rainfall during already wet times of the year may lead to high flood risk, such as, the Jakarta flood on 2 February 2007 that inundated 70,000 houses, displaced 420,440 people and killed 69 people with losses of Rp 4.1 trillion (US\$ 450 million) (WHO, 2007)
- Stronger, more frequent El Niño events will exacerbate drying and/or flooding trends and could lead to decreased food production and increased hunger.
- Delayed wet season (monsoon) and a temperature increase beyond 2.5°C is projected to substantially drop rice yields and incur a loss in farm-level net revenue of 9 to 25% (Lal, 2007).

### b) Sea-Level Rise

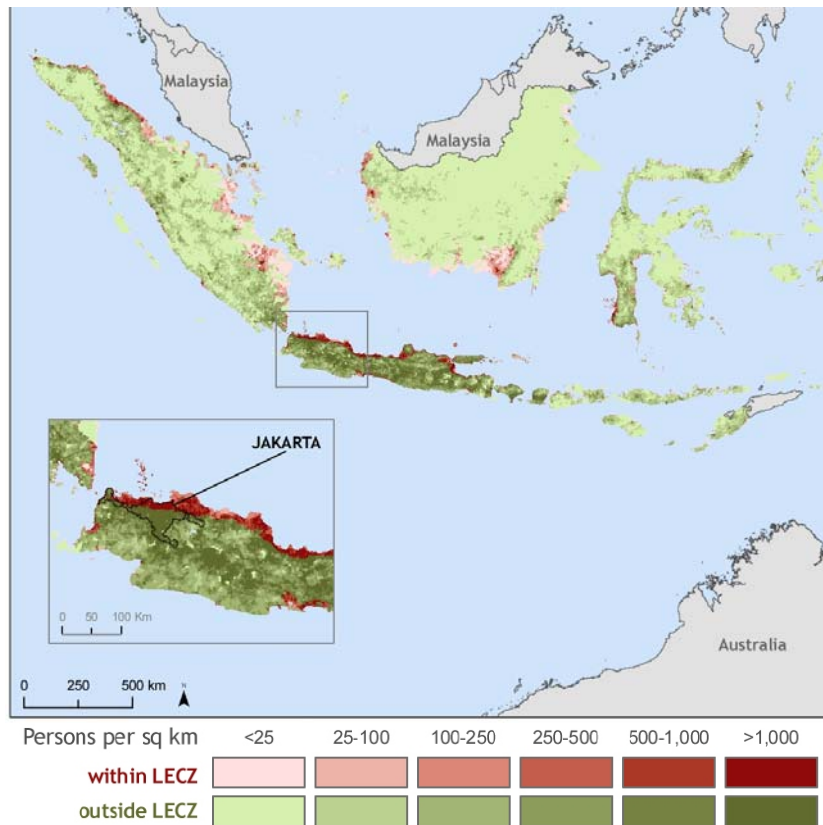
- Currently increasing at about 2 mm per year (1-3 mm/year in coastal areas of Asia) and is projected to accelerate to a rate of about 5 mm per year over the next century (Cruz et al., 2007).
- Increase from 13 million to 94 million people flooded annually in South Asia (under very conservative sea-level rise scenarios - 40cm by 2100) (Wassmann et al., 2004).
- One million at risk from flooding and sea-water intrusion due to sea-level rise and declining dry-season precipitation, negatively impacting the aquaculture industry (e.g., fish and prawn industries) and infrastructure along the coasts of South and South-East Asia, (Cruz et al., 2007).

Even moderate sea-level rise will result in significant physical and socio-economic impacts because much of Indonesia's population, industries infrastructure, and most fertile agricultural lands are concentrated in

<sup>9</sup> WWF (2009)



low-lying coastal areas (Figure 4). Approximately 60% of all Indonesians live in coastal areas and low-lying coastal cities like Jakarta and Surabaya. Sea-level rise when combined with the present subsidence or sinking that is being observed in Jakarta Bay will result in massive impacts on infrastructure and businesses. Groundwater near the coasts is also at risk due to saltwater intrusion, a result of higher sea levels, over-extraction of the resource (resulting in lower groundwater levels), and recharge with more saline surface waters. Further climate warming may also lead to more intense tropical cyclones (Emanuel, 2005), putting more people at risk and increasing damage losses.



**Figure 4. Population density within and outside of a 10 meter low elevation coastal zone (2000).** Adapted from CIESIN, Columbia University (2007). Available on line <http://sedac.ciesin.columbia.edu/gwp/lecz.jsp>

**c) Biodiversity and Ecosystem Services**

- Up to 50% of Asia's total biodiversity is at risk (Cruz et al., 2007)
- 88% loss of coral reefs in Asia in the next 30 years because of warming sea-surface temperatures, sea level rise, and other added stresses (Wilkinson, 2004)
- Significant declines in fish larvae abundance and large-scale changes in fish habitat, such as skipjack tuna, are projected in the equatorial Pacific (Cruz et al., 2007; Loukos et al., 2003)
- Massive coral bleaching leading to widespread loss of coral reefs and biodiversity, including the fish that many Indonesians rely on for food and livelihoods
- Sea-level rise, increased extreme weather events, warming temperatures, and changes in ocean circulation and salinity patterns impacting Indonesia's marine turtle populations (WWF, 2007a)
- More frequent forest fires having significant impacts on wildlife habitat and biodiversity and translating into serious economic and domestic and trans-boundary pollution consequences - the economic costs of the droughts and fires in 1997-1998 were about US\$ 9 billion (Applegate et al., 2002)

- Sea-level rise, reduced freshwater flows, and salt-water intrusion, in addition to the existing stresses primarily due to human activities threaten Indonesia's coastal mangroves (Tran et al., 2005)
- Changes in species distribution, reproduction timings, and phenology of plants (Cruz et al., 2005)

#### d) Human Health

- More frequent and severe heat waves, floods, extreme weather events, and prolonged droughts leading to increased injury, illness, and death
- Increased vector-borne infections (e.g., malaria and dengue), an expansion of water-borne diseases, such as diarrhea, an increase in infectious diseases, poor nutrition due to food production disruption, ill-health due to social dislocation and migration, and increased respiratory effects from worsening air pollution and burning
- Increased diarrhoeal disease and endemic morbidity and mortality (Checkley et al., 2000)
- Rise in severe respiratory problems following an increase in the frequency and spread of wildfires that release toxic gases such as carbon monoxide, ozone, nitrogen dioxide and hydrocarbons
- A rise in the number of dengue fever cases during the rainy season (PEACE, 2007)
- More phytoplankton blooms, providing habitats for survival and spread of infectious bacterial diseases, such as, cholera (Pascual et al., 2002)
- Increased water-borne diseases such as cholera and diarrhoeal diseases (e.g., Giardia, Salmonella, and Cryptosporidium) (McMichael et al., 2003)

## 6. Indonesia GHG Emission

### e. *Indonesia is among the top three GHG emitters in the world due to land use change and deforestation.*

Indonesia has become one of the three largest emitters of greenhouse gases in the world. This is largely due to the significant release of carbon dioxide from deforestation. Yearly emissions in Indonesia from energy, agriculture and waste all together are around 451 million tons of carbon dioxide equivalent (MtCO<sub>2</sub>e). Yet land - use change and forestry (LUCF) alone is estimated to release about 2,563 MtCO<sub>2</sub>e – mostly from deforestation, as estimated by the IPCC (Houghton 2003, cited in Baumert et al. 2005).

While data on the emissions from different sources does vary between studies, the overall conclusion is the same. Indonesia is a major emitter of GHGs.

Indonesia is host to vast forested areas. About 24 billion tons of carbon stock (BtC) are stored in vegetation and soil, and 80% of this (about 19 BtC) is stored in the standing forest (State Ministry of Environment, 2003). But out of the 108 million ha of forest area, almost half is in poor and degraded conditions (Departemen Kehutanan RI, 2006). Land use change and deforestation, estimated at 2 million hectares (ha) per year (World Bank 2000) results in the release of a large amount of Indonesia's carbon reservoir. Indeed, the emissions from LULUCF, notably deforestation, account for 83% of the yearly emissions of greenhouse gases in Indonesia, and 34% of global LULUCF emissions.

Emissions sources	United States	China	Indonesia	Brazil	Russia	India
Energy <sup>2</sup>	5,752	3,720	275	303	1,527	1,051
Agriculture <sup>3</sup>	442	1,171	141	598	118	442
Forestry <sup>4</sup>	(403)	(47)	2,563	1,372	54	(40)
Waste <sup>5</sup>	213	174	35	43	46	124
<b>Total</b>	<b>6,005</b>	<b>5,017</b>	<b>3,014</b>	<b>2,316</b>	<b>1,745</b>	<b>1,577</b>

Note: (1) The table excludes EU from the comparison as EU comprises 25 countries. If EU as a block enters the calculation, Indonesia stands 4<sup>th</sup>, and the ranking are US, EU, China and Indonesia. (2) The data for energy emissions are from 2005. The energy data used IEA's 2005 annual statistics except for Indonesia where PIE 2005 statistics are used. (3) The data for agriculture emissions are from 2005, from US EPA 2006. Biomass combustion is included in the calculation. (4) The data for forestry (LULUCF) emissions are from 2000, from Houghton 2005. (5) The data for waste emissions are from 2005, from US EPA 2006.

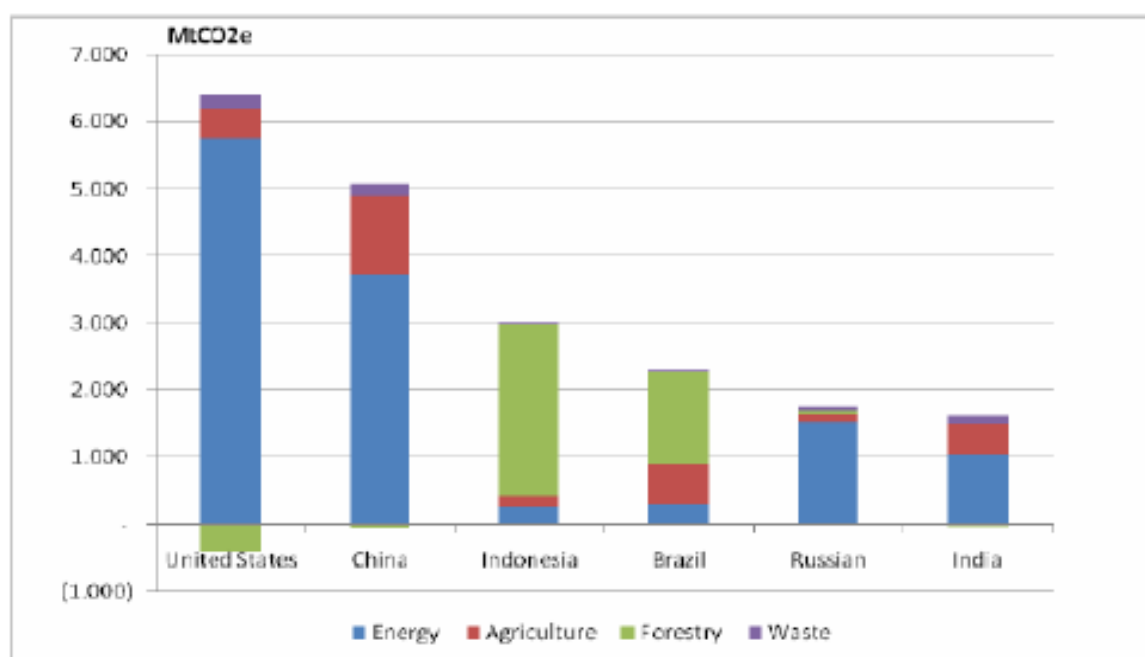


Figure 5. GHG Emission Summary (MtCO<sub>2e</sub>)<sup>1</sup>

f. *Deforestation and land conversion are the largest sources of emissions.*

The largest carbon dioxide emissions in the forestry sector, about three - quarters (75%), come from deforestation and land conversion, followed by forest - related energy consumption (23%), and the remainder is from forest - related industrial processes (2%). Forest fires are the main contributor of deforestation and land conversion, accounting for 57% of total deforestation and land conversion. In the 1997 forest fires alone, it is estimated that between 3,000 and 9,000 MtCO<sub>2e</sub> were released to the atmosphere. On average, around 1,400 Mt are released during the annual burning season and 600 Mt are released each year from decomposition of dry peat (Wetlands International n.d.). Global warming will likely cause a vicious cycle by drying up the rainforest and peat swamps, thus increasing the risks of even more intense fires.

g. *Emissions from the energy sector are small but are growing very rapidly.*

Emissions from non - forestry sectors are small, in absolute and per capita terms, but are growing very rapidly. Current emissions from the energy sector, about 275 MtCO<sub>2e</sub>, account for 9% of the country's

total emissions. But these emissions from industry, power generation, and the transport sector are growing very rapidly in the wake of industrialization and economic growth. It is expected that, with current governmental policies that promote the expansion of fossil fuels and the high barriers to clean and renewable sources of energy, the trend is that emissions from energy sector will continue to demonstrate a strong growth, tripling in the next 25 years from about 275 MtCO<sub>2</sub>e in 2003 to about 716 MtCO<sub>2</sub>e in 2030. Improvement in energy intensity of the economy, about 2% between 2000 and 2004, has been offset by strong economic growth as a whole. On a per capita basis, greenhouse gas emissions in Indonesia have grown 150% since the 1980s, or 67% since 1990 (World Resources Institute, 2007). The average growth rate of primary energy consumption since 1970 up to 2007 is  $\pm 7\%$  per year

Sources	1970 (%)	2007 (%)
Oil	88.0	49.7
Gas	1.0	19.2
Coal	1.0	27.0
Hydro	5.0	3.0
Geothermal	0.0	1.2

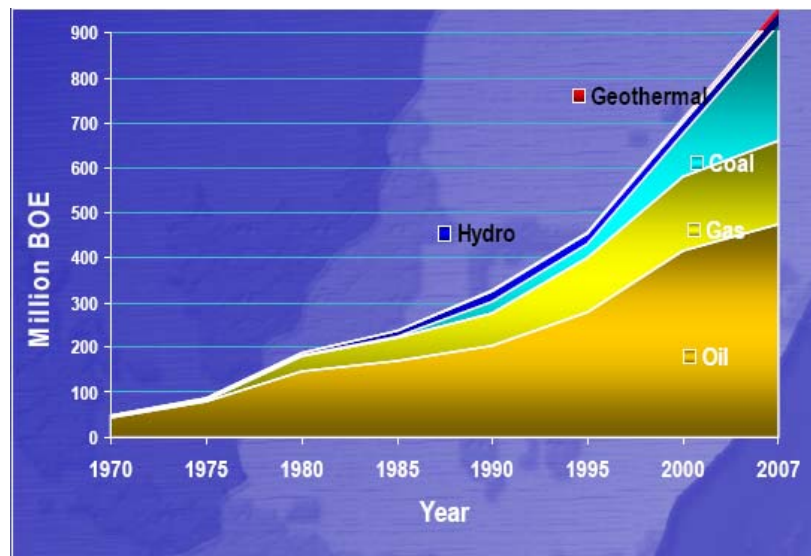


Figure 6. Average growth rate of primary energy consumption

#### h. Emissions from agriculture and waste are small.

Emissions from the agriculture and waste sectors are very small and insignificant globally, coming mainly from rice production. The sector is the main contribution of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions. Seventy% (70%) of the emissions from the agriculture sector are generated by rice cultivation. Albeit small, greenhouse gas emissions from the Indonesian waste sector in 2000 ranged from 32 – 60 MtCO<sub>2</sub>e. This ranks Indonesia as the sixth largest emitter in the waste sector (USEPA 2006).

## 7. Key Actors and Roles

GOI established a National Council on Climate Change (NCCC) in July 2008, to take on the task as the leading institution in addressing climate change. Before the establishment of NCCC, climate change issue was regarded as an issue falling under the jurisdiction of Ministry of Environment, often causing ineffectiveness due to lack of horizontal powers relating to other ministries.

NCCC is chaired by the President and composed of 17 Ministers. The task includes coordinating, monitoring and evaluating climate change mitigation and adaptation policies, including coordination in financing and technology transfers, as well as Indonesia's international positions in climate change talks.

NCCC is comprised of NCCC secretariat and seven working groups that act as think tanks in the fields of:

- Working group of Land Use, Land Use Change and Forestry (LULUCF)
- Working group of Mitigation
- Working group of Energy
- Working group of Adaptation
- Working group of Fund Mechanism
- Working group of Transfer of Technology
- Working group of Post 2012

The NCCC coordinates actions from particular related ministries as key actors in addressing climate change:

- Coordinating Ministry of Welfare
- State Ministry of Environment
- State Ministry of Research and Technology
- Department of Trade
- Department of Industry
- Department of Forestry.
- Department of Energy and Mineral Resource
- Department of Agriculture
- Department of Public Works
- Department of Social
- Department of Marine Affairs and Fisheries
- Department of Transportation
- National Development Planning Agency
- Agency for Assessment and Application of Technology
- Meteorological and Geophysics Agency
- National Coordinating Agency for Surveys and Mapping
- National Agency for Land Affairs

This indicates a positive mainstreaming of environmental, and especially, climate change issues by involving related technical ministries into coordination.

It should not be forgotten that after decentralization policy in 2001, Indonesia has been one of the most decentralization country in the world, with as much as one-third of central government expenditures transferred into regions<sup>10</sup>, making governance in regional level an important focus of attention to assure good vertical integration and implementation of policies.

## 8. Development Partners

Listed as a developing country, Indonesia is not obligated to reduce its emission under Kyoto Protocol and gain access to financing from Annex I countries via Clean Development Mechanism. By the time this report is compiled, Indonesia had received a total of USD 1.9 billion of Climate Change Development Policy Loans from Japan, French, and World Bank during the last three years, while ADB is projected to participate in 2011. The loans are all program- instead of project-based, which means that the loans are directed to national budget instead of specific activities. In regulating foreign financial assistance, Indonesia follows the 2008 Jakarta Commitment as effectiveness measures, with the principles contained in the Paris Declaration on Aid Effectiveness.

## 9. Domestic Climate Policies

In UNFCCC and Kyoto Protocol, Indonesia is listed as a Non-Annex I country, thus relieving it from obligations of reducing its GHG emission that might jeopardize economic growth. The government released a National Action Plan (NAPACC) in 2007, which focuses on:

- emissions reduction and the increase of carbon absorption capacity.

<sup>10</sup> World Bank, 2007



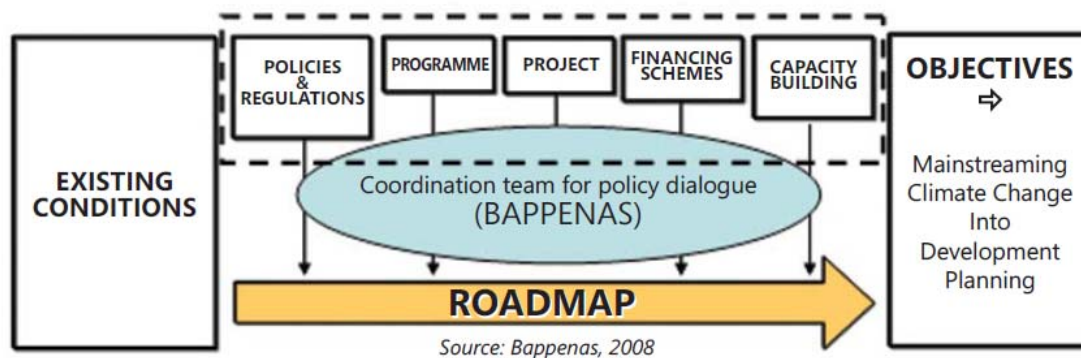
- the implementation of incentive mechanisms in the LULUCF sector.
- the development of supporting policies

While sustainable development had been a paradigm for environmental management under the old Environmental Protection and Management Act (No. 23/1997), climate change issue had only been discussed under specific provisions under the latest EPM Act (No 32/2009)

- Art. 10(2): Env. Protection and Management Plan (EPMP) should take into account the issue of climate change
- Art. 10(4): EPMP should include plans on adaptation and mitigation of climate change
- Art. 16: Strategic environmental study contain the vulnerability and adaptability to climate change
- Art. 21: criteria/parameters of environmental damage due to climate change based on the increased temperature, sea level rise, storm, and drought
- Art. 57 (4): preservation of atmosphere conducted through mitigation and adaptation of climate change
- Art. 63 (1): government has the authority to stipulate and implement policies on climate change and the protection of the ozone layer

The government approach in dealing with climate change is by incorporating climate change issues into development agenda, and exercising measures through development plans (RPJPM)

To achieve this, in 2010 the government releases Indonesian Climate Change Roadmap as a guidance of mainstreaming climate change issue into development.



**Figure 7. Process of Development of Climate Change Roadmap**

To support and accelerate the implementation of climate change programmes, the Government of Indonesia established a number of innovative ways to link international financial resources with national investment strategies. This Indonesian Climate Change Trust Fund (ICCTF; Bappenas, 2009) aims to be a showcase of alternative financing for climate change mitigation and adaptation programmes. At this stage, the ICCTF has five specific objectives namely

- a. to facilitate and accelerate investment in renewable energy and efficiency and simultaneously reduce GHG emissions from the energy sector,
- b. to reduce emissions from deforestation and forest degradation and stabilize carbon stocks through sustainable forest and peat land management,
- c. to reduce vulnerability in coastal zones, agriculture and water sectors, (iv) to bridge the financial gaps necessary to address climate change mitigation and adaptation and (v) to increase the effectiveness and impact of external finance for climate change programmes.

At the initial phase, the ICCTF will be created as an “Innovative Fund”, which involves grant funding from development partners that will help overcome barriers for early programme deployment. At the later stages, the ICCTF may advance by establishing a “transformation fund” mechanism, which would involve all available funding (public private partnerships, loan and world capital market sources). This

transformation fund also aims to assist with market penetration. As such, at the initial phase, the ICCTF will be dominated by public funding and at the later stages will draw predominantly on private funds. The ICCTF can be accessed by sectoral ministries and other stakeholders to support the implementation of climate change programmes. The coordination mechanism of the ICCTF is presented.

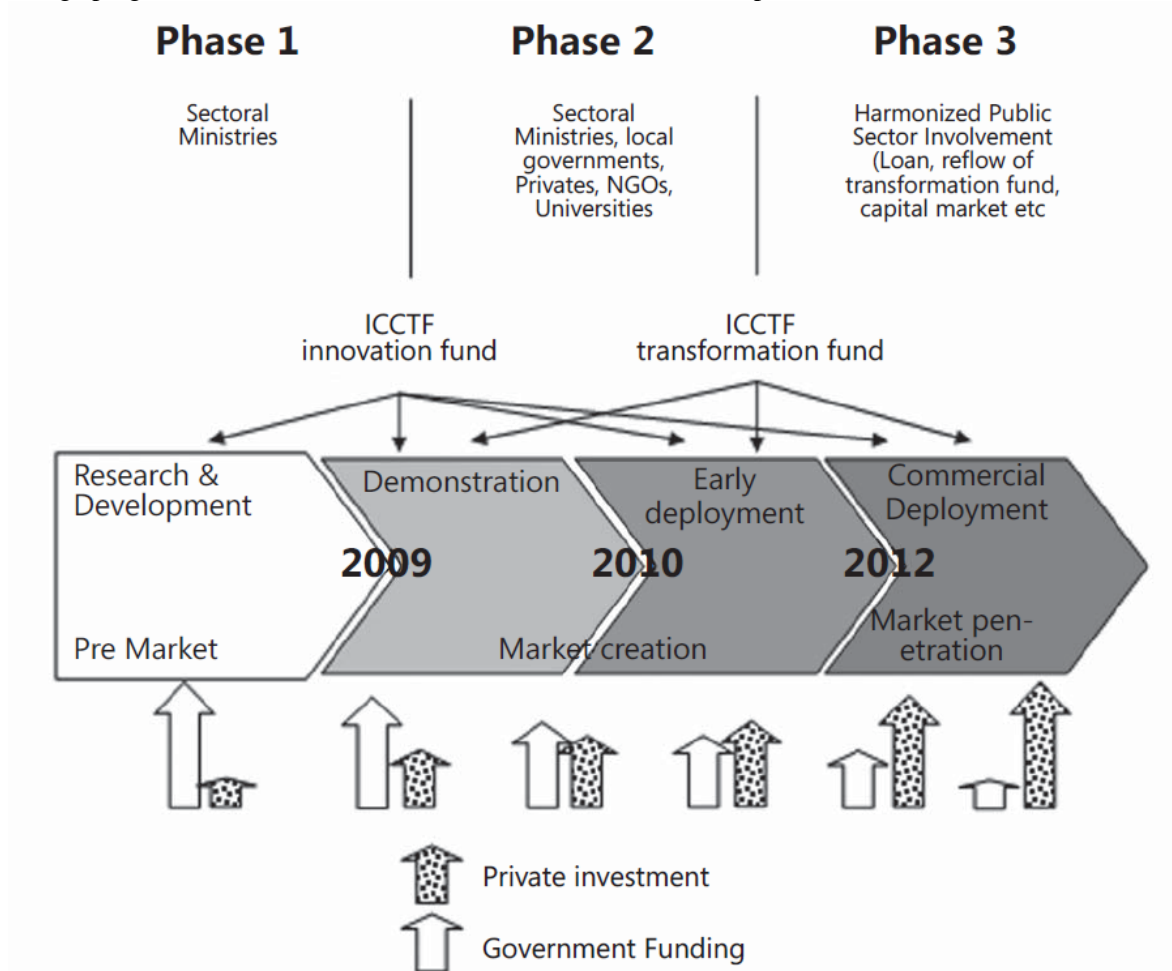
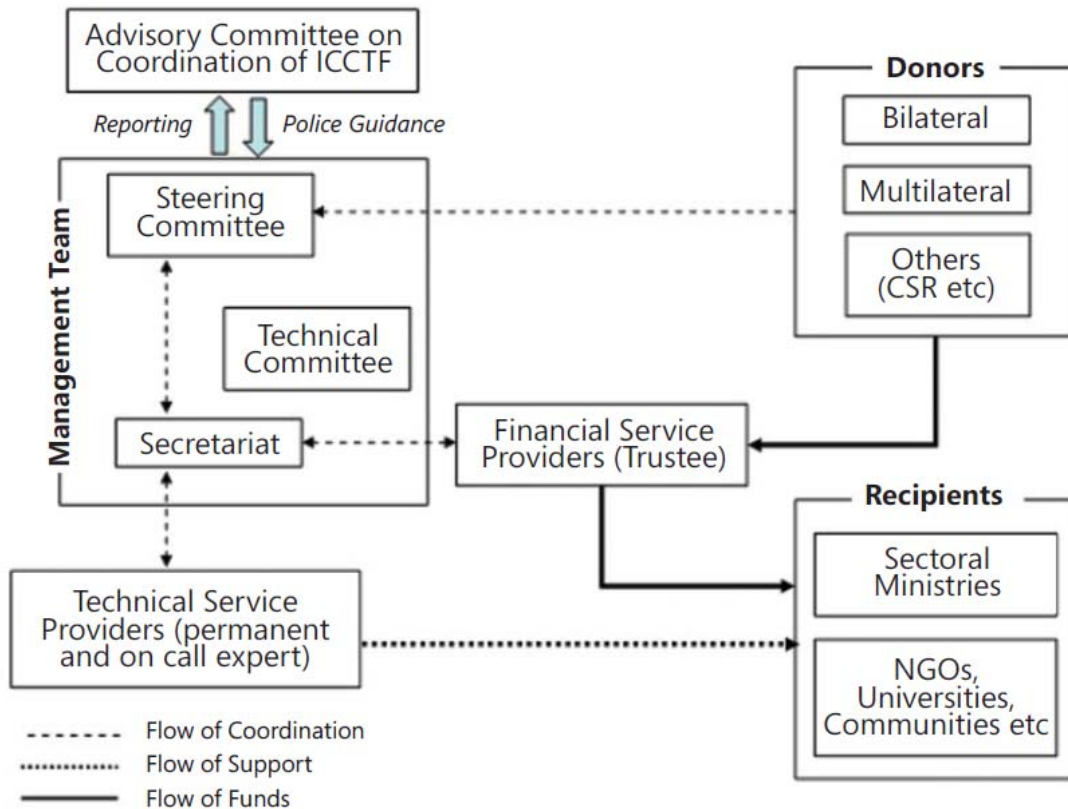


Figure 8. ICCTF Development (Bappenas, 2009)



**Figure 9. Coordination Mechanism of ICCTF (Bappenas, 2009)**

As stated in the Long-Term Development Plan (RPJP) 2005-2025, sustainability of development will face challenges of climate change. To anticipate these challenges the Roadmap sets several goals with regards to adaptation and mitigation of climate change to be achieved in the next 20 years, which will give comprehensive targets for all related sectors. The goals are as follows:

- a) Advanced research on the impact of climate change and the mapping of local vulnerability will be performed to strengthen the information system for adaptation in 2015. (b). Inventory of CO<sub>2</sub> emissions is refined and the target of emission reduction will be adjusted in 2015.
- b) As the institutional capacity of national ministries and agencies to anticipate climate change impacts has been strengthened in year 2015, the climate-proof policy-making process and regulation will be achieved in 2020. (b). The emission of greenhouse gas will decrease by 26% from the projected “business as usual” emission in 2020.
- c) National development goals will be optimized with the influence of adaptation actions in 2025. (b). Alternative sources for energy use will be significantly increased, while the use of nonrenewable energy sources will be proportionately reduced.
- d) The risks from climate change impacts on all sectors of development will be considerably reduced in year 2030, through public awareness, strengthened capacity, improved knowledge management, and the application of adaptive technology. (b). All sectors that contribute to greenhouse gas emission will operate using low-carbon development concept.

It is expected from this Roadmap that national programs of sectoral or cross-sectoral development will take into consideration future climate change, especially the sectors relevant for adaptation and mitigation. The sectors that need to plan adaptation actions are the following: water resources sector; marine and fisheries sector; agriculture sector; and health sector, while for mitigation principally consists of forestry sector; energy sector; industry sector; transportation sector; and waste sector.

As a nationally concerted effort to cope with climate change, the Roadmap sets up three categories of activities in each development sector as follows:

**Category 1. Data, Information and Knowledge Management (KNOW-MANAGE)**

This category consists of activities related to data collection, information development and knowledge management about the impacts of climate change and of the contribution of sectors towards climate change. This is to be achieved through scientific research, based on collaboration between universities, research institutions and the government.

**Category 2. Planning and Policy, Regulation and Institutional Development (PLANPRIDE)**

This category consists of activities related with formulation of plans for specific adaptation and mitigation actions that utilize the information resulting from activities in Category 1 and also capacity/institutional development. These programs are to develop plans, policies, regulations and institutional development, which will support the implementation of adaptation and mitigation actions.

**Category 3. Plans and Programs Implementation and Control with Monitoring and Evaluation (ICON-MONEV)**

This category consists of activities to implement plans for adaptation and mitigation of climate change. In addition to that control through monitoring and evaluation is embedded in this category to ensure effective implementation of those plans and programs. In order to allocate national resources efficiently and effectively for achieving several goals for the next twenty years, ICCSR develops programming strategy for each period of RPJM as follows:

- a. At the initial period of implementation of the Medium-Term Development Plan (RPJM) 2010-2014, activities are more concentrated on Category 1. Consequently, activities which are included in Category 2 and 3 will receive smaller portion of budget. This strategy aims to strengthen the capacity of institution in data and information management, climate risk assessment and greenhouse gas inventory. However, the proportion of activities in each category will depend on the capacity of each sector in responding climate change. Sectors that have already prepared for the climate change impacts may set up more advanced programs and activities.
- b. 2) At the later period, each sector will increasingly focus on activities which are classified into Category 2 and 3. The Roadmap sets a target that starting from the period of 2020-2025 each sector will be more concentrated on activities of Category 3 (Implementation of Program Actions for Adaptation and Mitigation).

The National Roadmap for mainstreaming climate change into development planning can be summarized as illustrated in the diagram below. Activities for adaptation and mitigation proposed in each sector are the elaboration of the three categories as illustrated by arrows. Thus the diagram below serves as a chart to read the Roadmap for climate change adaptation and mitigation as reported by the nine sectors.

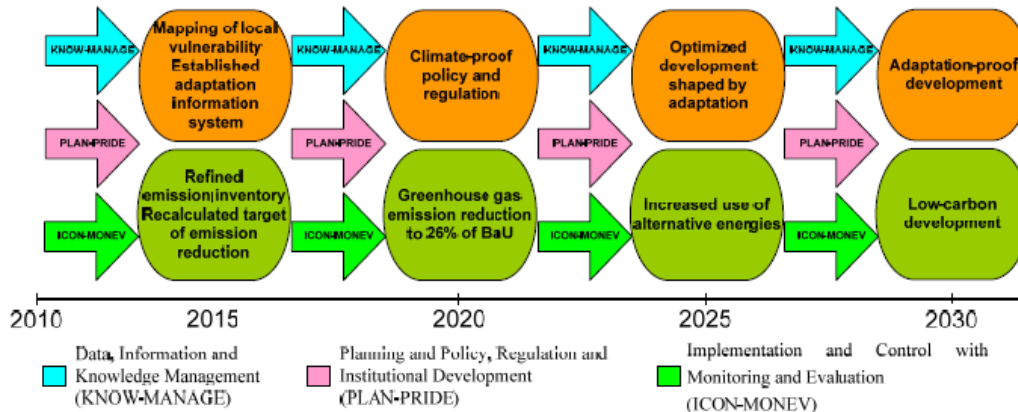


Figure 10. National Roadmap

## 9.1. Mitigation

Mitigation refers to anthropogenic actions to reduce the emissions of greenhouse gasses to the atmosphere, and thus reduce the magnitude of future climate change<sup>11</sup>, and is important in Indonesia due to its status as the 3rd largest emitter of greenhouse gasses, principally from large emissions from deforestation.

### a) Land Use Change and Forestry (LUCF)

Notable policies concerning LUCF:

- Act No. 41 of 1999 on Forestry
- Government Regulation No. 45 of 2004 on forest protection
- Government Regulation No. 4 of 2001 concerning control of environmental damage or pollution resulting from forest or land fires.
- Government Regulation No. 6 of 2007 (amended by the Government Regulation No. 3 of 2008) concerning forest planning and forest management plans, and the utilization of forest and forest area
- President Instruction No. 4 of 2005 concerning the eradication of illegal logging
- Regulation of the Minister of Forestry No. P.14/Menhut - II/2004 on CDM A/R projects
- Regulation of the Minister of Forestry No. P.30/Menhut - II/2009 on the procedures of REDD

### b) Energy Sector

In energy sector, notable policies are

- Government Regulation No. 5 of 2006 concerning energy policy
- Decree of the Minister of Energy and Mineral Resources No. 2 of 2004 concerning energy conservation and the utilization of green energy
- President Instruction No. 10 of 2005 and the Regulation of the Minister of Energy and Mineral Resources No. 31 of 2005 concerning the implementation of energy saving

In 2005 the Indonesian government reduced some of its fuel subsidies, which opened up space for additional spending and gave more environmentally sensible incentives. However, Indonesia's energy policy is to increase use of fossil fuels, in particular coal, with the result that emissions from the energy sector are expected to triple by 2030.<sup>12</sup> Policies are in place to support the use of renewables, but there is a lack of financial incentives to support these policies and encourage uptake. The government is also expanding the production of bio fuel for both domestic use and export. This is largely produced from palm oil, and will require an extra 200,000ha of plantations in 2009, driving deforestation.<sup>13</sup> Biofuel produced from *Jatropha* has the potential to rehabilitate degraded land and provide a source of rural livelihoods, but issues around deforestation and conflict over land remain to be resolved.

The energy-related sectors of the economy (i.e., energy industry, industry, transport and residential and commercial) will be responsible for most of the increase in GHG emissions over the next two decades. The CO<sub>2</sub> emissions, for instance, from the energy demand sectors are projected to triple between 2000 and 2020 (see Table 1). This is due, in part, to the projected composition of fuels that will be used to supply energy. The share of coal in energy supply is expected to increase by a factor of ten. Oil use doubles while the use of gas only increases by 50 percent.

<sup>11</sup> UNDP, 2007.

<sup>12</sup> PEACE, 2007.

<sup>13</sup> UNDP, 2007.



Table 1. Projection of Total CO<sub>2</sub> emission from the energy demand sectors in Indonesia to 2025

Sector	Total CO <sub>2</sub> emission (million t)						Growth Rate (%/year)
	2000	2005	2010	2015	2020	2025	
Industry	58	66	73	91	109	141	2.4
Households	21	22	23	23	22	25	0.4
Transport	55	61	76	99	128	168	3.4
Power plants	54	66	90	152	220	275	5.1
Energy Industry	40	30	35	27	48	63	1.9
<b>Total</b>	<b>228</b>	<b>246</b>	<b>298</b>	<b>392</b>	<b>526</b>	<b>672</b>	<b>3.3</b>

Source: SME-ROI, 1999 (t)

The criteria and standards used for the assessment of sustainability may also affect the global distribution of Clean Development Mechanism (CDM). It is likely that each country will be able to set its own sustainability standards, hopefully subject to universal minimum requirements. Countries opting for low standards may be able to implement relatively more CDM projects than those which set high benchmarks for local environmental and social benefits. The decision on sustainability standards is likely to involve a trade-off between increasing CDM volume and ensuring positive local impacts.

It is estimated that Indonesia has the potential for 235 million tons of CO<sub>2</sub> equivalent (mtCO<sub>2</sub>e) in emissions reductions through the Clean Development Mechanism (CDM), however there are currently only 8 projects registered with the Executive Board of the CDM, accounting for 13mtCO<sub>2</sub>e of reductions. GTZ and the Asian Development Bank have been building the capacity for CDM in Indonesia, however, compared to neighboring countries in Asia CDM is under-developed in Indonesia.<sup>14</sup> Indonesia is currently lobbying the UNFCCC to include the proposal on avoided deforestation (REDD), whereby developing countries would receive compensation for preventing deforestation, as part of the next international agreement on climate change. Forests provide key ecosystem services, including regulating climate, reducing flood risk by slowing run-off and maintaining habitat and biodiversity. The protection of these services can reduce the impacts of climate change (for example fewer floods) increase the ability of communities to adapt to climate change, and support livelihood activities thus aiding poverty alleviation efforts. As such, there is great potential in Indonesia for mitigation projects (CDM, and REDD if this becomes operational) which also have adaptation and poverty alleviation benefits, such as the afforestation of mangroves which also protect against rising sea-level and contribute to improved livelihoods.

Main elements of the Indonesian CDM strategy are the following:

1. Indonesia should play an active role in development of baseline methodologies, particularly standardised baselines for small scale projects.
2. A follow-up study would be helpful to give recommendations.
3. A national CDM manual and guidelines with a description of the project cycle, eligibility and sustainability criteria, the baseline rules, the forms to be filled by project proponents as well as contact details of government agencies and certifiers should be established and made available in print and via the internet.
4. Simplified procedures should be applicable to small-scale projects. Sustainability criteria should encompass economic, social and environmental criteria; the criteria on which comments has been solicited in the NSS questionnaire have to be refined.
5. Indonesian capacity to negotiate contracts that lead to a favourable sharing of benefits should be improved.

<sup>14</sup> PEACE, 2007.

Indonesia has a high potential for CDM projects in the fields of biomass (waste to energy), bio diesel, energy efficiency and transportation/infrastructure as well as on renewable energies. One of the most sustainable fields and very important for GHG are a forestation projects. CDM projects in Indonesia include:

1. Micro-hydro project - Renewable
2. Utilization of plantation waste and forest sequestration project - Fuel Switching
3. East Kalimantan plantation project - Sinks and sequestration
4. Sarulla geothermal project - Renewable
5. Yogyakarta urban bus project - Transport
6. Kansai wood waste recycling project - Sinks and Sequestration
7. Palm oil waste power plant - Renewable
8. Renewable agro-processing project - Fuel Switching, Renewable
9. Indocement project - Energy Efficiency, Fuel Switching
10. Darajat III geothermal project - Renewable
11. Biodiesel project - Renewable

## 9.2. Adaptation

Adaptation can be seen as adjustments in human or physical systems in response to current or expected climate changes in order to cope with the impacts of climate change and take advantage of any new opportunities.<sup>15</sup> To achieve its goals for economic development and poverty reduction, in particular amongst the poorest and most marginalized sectors of population, Indonesia will need to adapt to climate change. It is also clear that many Indonesians are already adapting to climate change, for example by building houses on stilts to respond to increased flooding, or responding to decreased reliability of fish catches by diversifying livelihoods, and that indigenous adaptation strategies should form the base for building adaptation to future change.<sup>16</sup>

Adaptation and Mitigation in Indonesia are strongly coupled, as continued rapid deforestation will not only exacerbate the impacts of climate change, but also constrain the adaptation options that are available to vulnerable communities. The priority sectors for adaptation are seen as agriculture, water, coastal and urban areas. There will be adaptation options that are specific for each of these sectors, for example faster growing crop varieties in the agricultural sector, however there are also general needs to be addressed which will build capacity for adaptation across sectors. These include the development of a system to provide climate information to actors at different scales, for example seasonal forecasts, and training in how to use this information effectively to manage climate risks. Training in vulnerability analysis and assessment of adaptation options would help to identify priorities for adaptation. Initiatives such as the development of community action plans to cope with flooding are being pursued in the field of disaster risk reduction (DRR), but are equally relevant in building community resilience to future climate change. Following this model of community engagement in projects would address one of the problems identified with several ongoing climate change initiatives in Indonesia, that of a lack of community ownership in projects.<sup>17</sup> Adaptation to climate change will be a long-term process, and as such will require long-term partnerships and cooperation between different actors at different scales. Encouraging dialogue between these different actors, in a similar way to the workshop convened to discuss the Climate Change Adaptation Programme (CCAP), will help to foster the relationships needed to enable adaptation to take place.

From a technological point, GHG emission reduction can be achieved through:

1. Energy efficiency and conservation measures and practices, namely through better energy housekeeping practices and by the deployment and functioning of more efficient energy technological systems
2. Shifting the energy mix towards higher shares of lower or zero GHG emitting fuels, for example, fuels having low C/H ratios, or zero carbon content, such as hydrogen
3. Increasing the deployment of renewable or near renewable, energy technology systems, such as solar photovoltaic, solar thermal, water turbines for mechanical energy and power generation, wind turbines,

<sup>15</sup> IPCC, 2007b.

<sup>16</sup> UNDP, 2007.

<sup>17</sup> PEACE, 2007.

geothermal base heat supply and power generation, biomass based system, waves and ocean thermal energy conservation system etc

Table 2. Technology options for greenhouse gas mitigation/abatement

No.	Sector and category	Technology Options	Base case or Reference Technology	GHG reduction potential, kg CO <sub>2</sub> eq./MWh	Incremental cost per unit output, US\$/MWh	Incremental cost per reduced GHG, US\$/kg
1.	Home water heating technology	* Solar Water Heater	LPG-fired water heater	1250	-22	-0.018
2.	Add-on and end-of-pipe technology for fired furnaces	* Combustion-Air Preheat	No air-preheating	133	-1.38	-0.010
		* Flue gas utilization for micro algae cultivation	Release to the atmosphere	1000	50	0.050
		* CO <sub>2</sub> recovery and disposal to reservoir	Release to the atmosphere	1000	50	0.050
3.	Improved technology for power generation	* Geothermal Power Plant	Pulv. coal power plant	946	-27.69	-0.029
		* Micro/small hydropower plant	Pulv. coal power plant	1000	-24.15	-0.024
		* Biomass Cogeneration Power Plant	Pulv. coal power plant	1000	-10.12	-0.010
		* Gas-Fired Combined-Cycle Plant	Pulv. coal power plant	550.4	-4.53	-0.008
		* IGCC* Power Plant	Pulv. coal power plant	61.5	6.73	0.11
		* Solar Photovoltaic Power Plant	Pulv. coal power plant	1000	149.39 (-24.74)**	0.15 (-0.025)**
4.	Improved technology for road transport systems	* Ethanol Vehicles	Gasoline car	1693.6	45	0.0266
		* Electric Cars	Gasoline car	967.8	151	0.156
		* Fuel Cell Vehicles	Gasoline car	2080.7	450	0.216
		* Compressed Natural Gas Vehicles	Gasoline car	483.9	120	0.248

## 10. WATER SECTOR

### 10.1. Current Condition and Projection of Water Sector

#### a. Water Shortage

The projected climate change in Indonesia will likely impose stress on water resources.. At present, the Java-Bali regions have already faced a deficit in its water balance, while for other regions like Sumatra, Sulawesi, Nusa Tenggara, and the Moluccas are projected in critical conditions. Based on climate projections, most regions in Indonesia will suffer from a gradual decrease of water supply due to temperature increase and rainfall changes that will affect the water balance as illustrated in the table below. Combined with estimated population growth rates, increased water demand will cause severe water shortages to occur, especially in Java and Sumatra for the period 2020-2030.

Table 3. Indonesia's current (2009) and projection of Water Budget (2015 and 2030)

No	Area	Supply (S)	Demand (D)	Balance 2009 (S - D)	Balance 2015s (S - D)	Balance 2030s (S - D)
1.	Sumatra	111,077.65	37,805.55	73,272.10	48,420.07	-67,101.34
2.	Java-Bali	31,636.50	100,917.77	-69,281.27	-118,374.36	-454,000.33
3.	Kalimantan	140,005.55	11,982.78	128,022.77	118,423.17	88,821.14
4.	Sulawesi	34,787.55	21,493.34	13,294.21	13,490.80	-21,021.99
5.	Nusa Tenggara	7,759.70	2,054.04	5,705.66	-17,488.89	-67,848.68
6.	Moluccas	15,457.10	540.23	14,916.87	12,648.91	9,225.75
7.	Papua	350,589.65	385.58	350,204.07	325,937.74	315,647.73

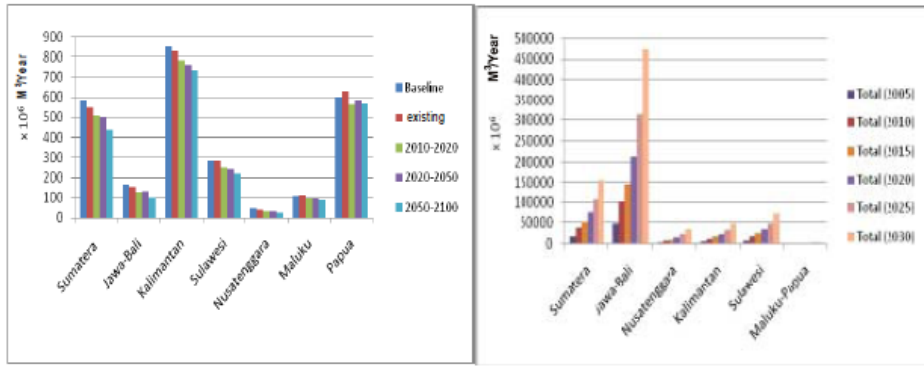


Figure 11. Water Supply (left) and Water Demand (right)

A risk analysis for projected water shortages has also been carried out under the framework of this study. Based on this risk analysis, the roadmap defines areas that have high risk or extremely high risk condition which need further attention for adaptation responses. For water sector, the priority areas are as follows:

- 1) **Extremely High Risk** is likely for parts of the Java-Bali region, especially in a few locations in the northern and southern of West Java, middle and southern of Central Java and East Java; as well as in the capital of the North Sumatra, West Sumatra, Bengkulu and Lampung (Sumatra), Nusa Tenggara Barat and South Sulawesi.
- 2) **High risk** is observed in about 75% of the Java-Bali region, in a small part in the northern, western, and southern, the island of Lombok (Nusa Tenggara) and South Sulawesi.

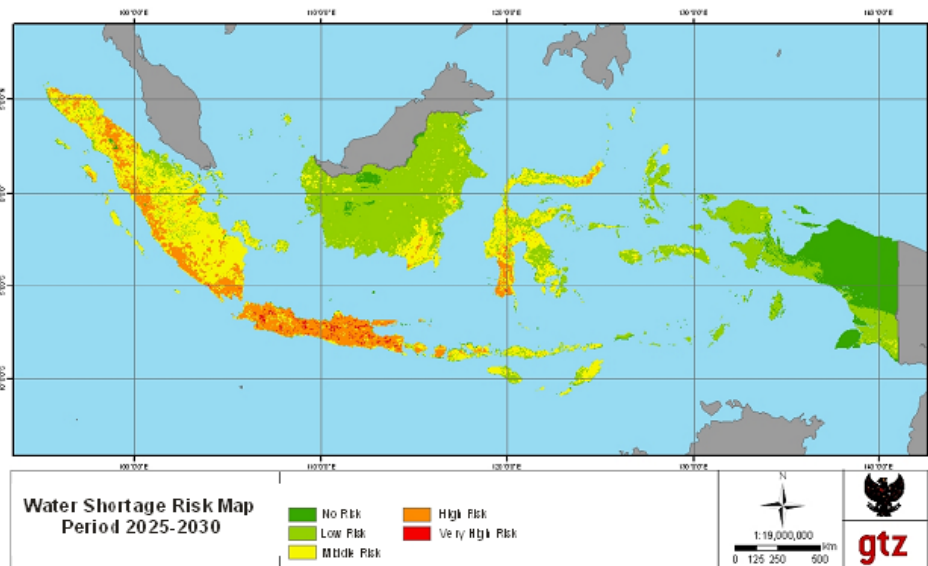


Figure 12. Water Shortage Risk Areas using IPCC’s SRA2 Scenario 2025-2030

**b. Flood**

Almost all parts of Indonesia are vulnerable to flood hazards. According to the Indonesian National Atlas (ANI, Bakosurtanal), Sumatra and Java-Bali have the largest vulnerable areas. Factors contributing to flooding are: the extreme rainfall of up to 400/mm/month (as per BMKG); overloaded surface water sources or water reservoirs, such as rivers, ponds, dams, etc; land characteristics and conditions in the upper reaches of the catchment area. In some cases, floods are related to landslides, as happened in Sinjai, Southern Sulawesi, in July 2006, causing hundreds of casualties.

Based on the analysis of flood risk, the areas which are classified as extremely high and high risks are as follows:

- a. Extremely **High Risk** of flooding is projected especially for areas along major rivers, particularly in downstream areas in Java, Eastern Sumatra; most parts of Western, Southern, and Eastern Kalimantan, Eastern Sulawesi and Southern Papua.
- b. Areas which will face **High Risk** are concurrence to those with extremely high risk mentioned above.



Figure 13. Flood Risk Areas based on Scenario SRA2 in 2025-2030

**c. Drought**

Drought can be defined in many ways such as from perspective of meteorological, hydrological, agricultural etc. The eastern part of Indonesia is vulnerable to meteorological drought. However, drought risk is particularly high in areas with high population numbers and density like Java-Bali. Drought can cause disaster, however, there is also potential for economic opportunities especially for the sea-fishery sector. Findings from the drought risk analysis are as follows:

- (1) **Extremely High risk** areas are stretched out over small areas of the Central Java, Northern Sumatra, and Nusa Tenggara;
- (2) **High risk** areas are found in large parts of Central Java, Sumatra, and Nusa Tenggara.

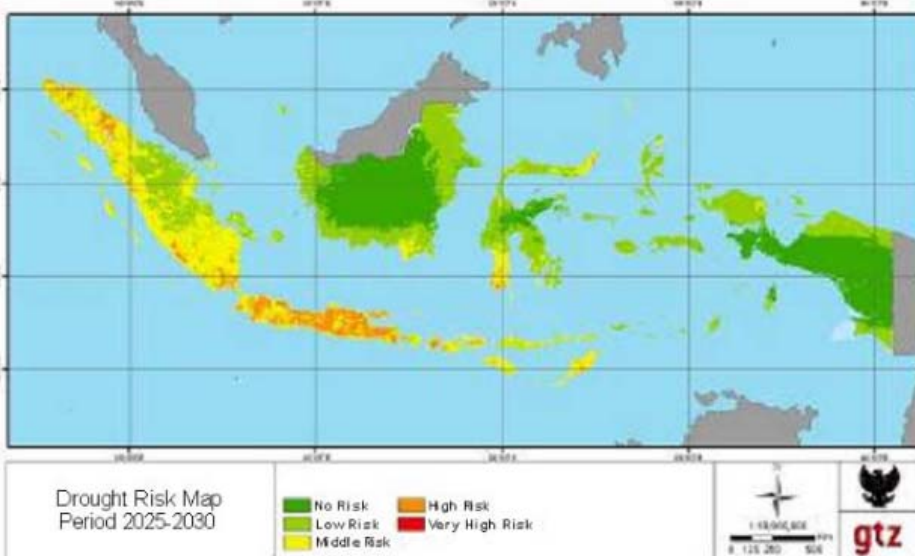


Figure 14. Drought Risk Areas based on Scenario SRA2 for 2025-2030



## 10.2. Strategic Issues for the Water Sector

As a result of the risk analysis, the following issues have to be addressed in order to successfully adapt the water sector to climate change:

1. Maintaining the balance between water availability and demand (water balance).
2. Sufficient water infrastructure and the provision of alternative water sources in certain areas.
3. Availability of data, technology and research as a basis for water resource management.
4. Reduction of vulnerability and risk from water shortage, flood and drought.
5. Finding of synergetic solutions for cross-sector issues with agriculture, forestry, health, energy, and industry sectors.
6. Integrated water resources management and flood control.
7. Water conservation based on innovation, community participation and local wisdom.

When addressing these key issues, the demands for water for domestic, urban and industrial use have to be balanced. In order to ensure this, the following approaches should be pursued:

1. Prioritizing water demand for domestic use, especially in regions with water scarcity and in regions of strategic importance.
2. Controlling the use of ground water and enhancing the use of surface water for water supply.
3. Intensifying the development of water storages for water supply and optimization and maintenance of existing resources.
4. Encouraging involvement of the private sector for financing the development of water infrastructure.

Moreover, the performance of water resource management must be improved by:

1. Encouraging the acceleration and completion of implementing regulations of the Law No. 7 of 2004.
2. Enhancing the capacity to communicate, cooperate, and coordinate between institutions involved in water resource management.
3. Building the capacity of institutions involved in water resource management and increasing community empowerment and participation at local level.
4. Nurturing initiatives and increasing community participation in water resource management.
5. Implementing water resource management by partnership between government and community.

## 10.3. Activities of Water Sector

From many activities that had been discussed during several focus group discussions and stakeholder consultations, five “champion” activities for adapting the water sector to climate change are recommended and illustrated in the table below. The details of the activities for water sector for the next 20 years by main Indonesian regions are available in the Roadmap for water sector.

Table 4. Activities of Long-Term Development Plan in Water Sector

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Vulnerability and risk assessment at regional level and strategic zone	Focus area: <i>BBWS</i> Sumatera I and Mesuji Sekampung in Sumatera, <i>BBWS</i> Bengawan Solo and Pemali Juwana in Java, <i>BWS</i> Kalimantan II in Kalimantan, <i>BBWS</i> Pempangan Jenebarang in Sulawesi, <i>BWS</i> Nusa Tenggara I in Nusa Tenggara, <i>BWS</i> Mahuku, and <i>BWS</i> Papua.	Focus area: <i>BBWS</i> Brantas and Ciliwung-Cisedane, <i>BBWS</i> Sumatera II dan V, <i>BWS</i> Kalimantan III, <i>BWS</i> Sulawesi II, <i>BWS</i> Nusatenggara II, Mahuku and Papua	Focus area: <i>BBWS</i> Serayu-Opak, Cimanuk-Cisanggarung and Bali; <i>BBWS</i> Sumatera IV and VI; <i>BWS</i> Kalimantan I; and <i>BWS</i> Sulawesi I	Focus area: <i>BBWS</i> Citarum-Citanduy and Cidanau-Cijung-Cidurian; <i>BBWS</i> Sumatera VIII and Sumatera III; Kalimantan I; and Sulawesi
Planning and Policy, Regulation and Institutional Development	Revitalization of local wisdom and building the capacity and participation of community in adapting to climate change	Focus area: <i>SWS</i> Musi in Sumatera, <i>WS</i> Citarum, Ciliwung and Citanduy in West Java and Jakarta, <i>WS</i> Mahakam in Kalimantan, and <i>SWS</i> Jenebarang in Sulawesi.	Focus area: <i>WS</i> Bengawan Solo, Pemali, Comal, <i>SWS</i> Krueng, <i>WS</i> Kapuas	Focus area: <i>WS</i> Brantas, <i>SWS</i> Batangharileko; <i>WS</i> Barito; and Tondano	Focus area: <i>WS</i> Opak; <i>SWS</i> Mesuji; <i>WS</i> Kahayan; and North Sulawesi
	Enhancement of water conservation and reduction of hazard and disaster related to climate change	Focus area: West Sumatera Province, Banten and West Java Province, West Kalimantan Province, Gorontalo Province, East Nusa Tenggara Province, Mahuku Province, and West Papua Province.	Focus area: Central Java; Bengkulu; South Kalimantan; East Sulawesi, West Nusatenggara	Focus area: DI Yogyakarta; Lampung; Central Kalimantan; and North Sulawesi	Focus area: East Java; Aceh; East Kalimantan; and Southeast Sulawesi
Implementation and Control with Monitoring and Evaluation	Enlargement of water supply using appropriate technology and development of local water resources	Focus area: <i>BBWS</i> Sumatera VIII in Sumatera, and <i>BWS</i> Kalimantan II in Kalimantan; Papua: <i>BWS</i> Western Papua	Focus area: <i>BWS</i> Kalimantan III, <i>BWS</i> Northern Papua	Focus area: <i>BWS</i> Kalimantan I; <i>BWS</i> Southern Papua	TBD
	Improvement of storage capacity and water infrastructure for safeguarding water balance and disaster prevention	Focus area: construction of dams in Deli Serdang, North Sumatera, in Ponorogo, East Java, in Waio, South Sulawesi, and in East Lombok, West Nusa Tenggara	TBD	TBD	TBD

Note: Thicker shade represents stronger weight

## 11. Capacity for Adaptation and Mitigation

There is much greater awareness of mitigation in Indonesia than awareness of adaptation, reflecting the broader international landscape but also Indonesia's status as the 3rd biggest emitter of greenhouse gasses, 85% of which come from deforestation.<sup>18</sup> The Ministry of the Environment (MOE) has been the focal ministry for climate change, which means that integration with development priorities has been a problem, and has created certain situations where government policies such as a push to expand the use of fossil fuels, work against legislation from the MOE.<sup>19</sup> The awareness created from hosting the 13th Conference of Parties to the United Nations Convention on Climate Change (COP13) may change this, as work is ongoing on a National Adaptation Plan on Climate Change (RANPI) and the ICCAP. It appears that Indonesia is building on the momentum from hosting COP13 to further develop these policies, for example through a multi-stakeholder workshop on the ICCAP held in March by the Ministry of Environment and UNDP which will hopefully create greater awareness on adaptation amongst different government departments.<sup>20</sup> Good policies exist to reduce the rate of deforestation and protect forests, but there is limited capacity to enforce these legislations at the local level due to institutional and financial constraints. There has been a degree of decentralization of government in recent levels, and local authorities are able to develop their own plans for forest conservation. However, the same issues still remain around the enforcement of these policies.<sup>21</sup>

Capacity constraints for adaptation include: (i) awareness of adaptation as an issue; (ii) ability to analyse and apply climate information; (iii) capacity to assess vulnerability to climate change; (iv) effective system for dissemination of climate information; and (v) technical assistance to assess and implement adaptation options.

## 12. Barriers, and Related Financial, Technical and Capacity Needs

The main barriers for the implementation of mitigation measures are the lack of available technology, low human resource capabilities in providing and operating such technologies, scarce government budget, and lack of information access. However, there are various options available to overcome these issues. The

<sup>18</sup> UNDP, 2007.

<sup>19</sup> PEACE, 2007.

<sup>20</sup> UNDP, 2008.

<sup>21</sup> PEACE, 2007.

abundance of resources for renewable energy in Indonesia and various government efforts, such as programmes and policies on the implementation of renewable energy and energy efficiency programmes, will accelerate the implementation of mitigation activities. In addition, the emergence and rapid growth of the carbon market may also accelerate the adoption and implementation of mitigation technologies that are not economically feasible and/or facing certain barriers. Nevertheless, to upscale the implementation of climate change programmes additional financial and capacity support will be necessary:

**Financial Needs.** Bappenas along with sectoral ministries has identified a number of climate change adaptation and mitigation programmes. There are about 54 climate change projects (26 adaptation, 18 mitigation and 8 integrated adaptation and mitigation projects) being proposed for implementation in the next five years (up to 2012). The programmes require about 897 million USD.

**Technical and Capacity Needs.** The agriculture sector has been considered the most vulnerable sector to climate change. In order to increase the resilience of this sector to climate change, a number of programmes are being considered:

- Development and implementation of a comprehensive communications strategy to increase the capacity of farmers to use climate information in managing their farming system and agribusiness activities (e.g. climate field school)
- Development and implementation of a comprehensive communications strategy to raise awareness of climate change impacts and the advantages of early attention to adaptation, including partnerships with key national professional and interest groups to develop best practice networks.
- Institutionalize the use of climate (forecast) information in managing current and future climate risks.
- Develop and promote tools for adaptation planning tailored to user's requirements that include:
  - Decision-support tools such as methods for assessing the costs and benefits of adaptation strategies, and guides for risk management;
  - methods for understanding social impacts;

A national 'one stop shop' website where decision-makers and their advisers can access information about climate projections, likely climate change impacts, tools, guides and approaches to adaptation planning.

To accelerate the development of mitigation and adaptation technologies, the Government of Indonesia has established the Research Consortium on Climate Variability and Climate Change. This consortium will play role in (i) coordinating each sector's adaptation research resources to more effectively support climate change decision-making, including by brokering research partnerships and providing a vehicle to commission new integrated research; (ii) Synergizing research programmes and activities on climate change and establishing a road map in mitigating and adapting to climate change, (iii) building the capacity of the Indonesia research community to generate information relevant to decision-makers; (iv) establishing an interface between researchers and decision-makers; (v) promoting coordinated programmes of work on impacts and adaptation across Indonesia, working in collaboration with stakeholders and other researchers in national, regional and sectoral contexts, (vi) delivering the information to support climate change adaptation decision-making at the national, regional and local levels through coordination, integration, synthesis and communication of research.

The consortium conducts research and development activities on inventories, mitigation and adaptation which include the following: (i) development of GHG emission and removal factors and methods for improving activity data, (ii) identification and development of mitigation technologies with the potential for CDM projects, the development of baseline and monitoring methodologies as required by the CDM Executive Board, and (iii) conducting policy research on maintaining food crop self sufficiency under changing demography, socio-economic, land use and climate (e.g. mapping vulnerable areas to climate change, strategies for coping with the climate changes etc)

In the forestry sector, the development of systematic forest and land use monitoring systems is also crucial to support the implementation of programmes for REDD. The Government of Indonesia is in the process of establishing Indonesia's National Carbon Accounting System (NCASI), based on Australia's system but tailored to Indonesia's unique circumstances. The NCASI will provide a comprehensive and credible compilation of Indonesia's land based emissions profile and sink capacity. It will support Indonesia's reporting requirements under the United Nations Framework Convention on Climate Change

(UNFCCC) and potential post-2012 Reduced Emissions from Deforestation and Forest Degradation global climate protection regime. Further, the NCASI will contribute significantly to Indonesia's carbon accounting, resulting in positive implications both domestically and internationally. It will allow Indonesia to develop a robust modeling and projection capacity for land based carbon accounting, and therefore robust emissions and removal estimates.

The INCAS will pull together information on deforestation, land use change and land use from Indonesia's forest lands and other lands (primarily agricultural lands) to:

Support Indonesia's position in the international development of policy and guidelines on sink activity and greenhouse gas emissions and their mitigation from land based systems.

Reduce scientific uncertainties (particularly regarding peat) of emission estimates and removals of both CO<sub>2</sub> and non-CO<sub>2</sub> greenhouse gases from land use change.

Provide monitoring capabilities for existing emissions and sinks, and scenario development and modeling capabilities that support greenhouse gas mitigation and the sinks development agenda through to 2010 and beyond.

Provide a scientific and technical basis for international negotiations and promote Indonesia's national interests in international forums.

Develop a comprehensive GIS that includes digital map-based information such as soil maps, remotely sensed images covering the whole of Indonesia and climate and vegetation data.

Support Indonesia's negotiations on REDD and provide the necessary inputs required for establishing a credible Reference Emission Level.

In relation to the forestry sector, Indonesia is developing Indonesia's Forest Resource Information System (FRIS). FRIS will be a comprehensive and transparent information management system to support effective planning and forest management decision making for forest lands in Indonesia. FRIS will allow the Ministry of Forestry to monitor forest productivity, yield and growth, harvesting rates, age class, species and forest area among other things. It will also compile critical information on deforestation, land use and land use change within Indonesia's forest lands to support a post-Kyoto climate protection regime that seeks to reduce emissions from deforestation and forest degradation (REDD). Combining this data within a single system will provide a good basis for planning and decisions on sustainable forest management.

The lack of reliable information on forest resources has been identified as a major impediment to sustainable forest management in Indonesia. Such information gaps are hampering efforts to monitor deforestation and forest degradation, sustainably manage forest resources, combat illegal logging, protect biodiversity and reduce carbon emissions from land use change. Improving forest information is crucial in the context of the emerging need for the Government of Indonesia to document carbon stocks in forests and greenhouse gas emissions related to land use change and to participate in carbon markets for avoided deforestation and degradation.

FRIS objectives:

- Provide spatial information on forest extent to support planning, management and decision making including improved tools for granting, monitoring and collating information on forest licenses.
- Provide an integrated and comprehensive system connecting data and statistics on forests with geographic maps and spatial data. The system will link the Ministry of Forestry with forest departments at the district and provincial level and interface with databases developed by other government departments, such as the Ministry of Agriculture and Ministry of Environment.
- Support transparency and disclosure of forest sector information.
- Support the regular reporting required of the Ministry of Forestry (for the FRA of FAO and others).
- To provide information that can be used to develop a Reference Emission Level for REDD.
- To provide estimates of the amount of carbon stored in above ground forest biomass, forest litter, tree roots and debris.

### **13. Possible Policy Instruments (Ministry of Finance and NCCC)**

The Indonesian Ministry of Finance has identified a list of possible policy instruments for influencing climate change mitigation and adaptation.

- Tax differentiation/Tax holidays can be used to encourage or accelerate investments toward national priority areas. Tax holidays are often used to promote economic development through foreign direct investment.
- Depreciation (part of tax policy). Accelerated depreciation for certain kinds of investments provides relief through the tax code affecting firms' cash flow and return on investment.
- Import tax breaks (or differential taxation) can be used to stimulate investment in clean technologies (already in limited use in Indonesia)
- Subsidies (or tax breaks) for technology adoption can promote specific types of products or technology investments, such as insulation or refrigeration upgrades.
- Tax treatment of carbon market revenue can help or hinder investments that seek to obtain Carbon Emission Reduction (CER) credits. Some uncertainty over carbon revenue taxation policy has been raised as an issue in the Ministry of Finance Focus Group Discussion Process (see FGD Report, March 2009).
- Emissions fees or user charges can be used to reduce emissions or change the mix of inputs used in production processes toward cleaner alternatives
- Risk guarantees can be used to lower the cost of capital (and provide an incentive for private banks to lend toward national priority areas). These could be targeted toward specific industries or technologies through special investment funds or lending windows.
- Transportation sector charges (fuel taxes per liter, road tolls, airline traffic taxes) would raise revenue and encourage greater efficiency in fuel use. Economic effect is similar to reducing fuel subsidies.
- Royalties/rent capture systems push the incentives upstream to the production of energy resources from the extraction industries.

However in reality, until now, no specific tax policy instruments have been applied to carbon finance related products. The Directorate General of Taxation has yet applied specific taxation rules on products and outputs related to carbon finance projects using CDM. There are several current tax facilities that can be used to this purpose: PPN (VAT), PPh (income tax), bea masuk (import duties), pajak bahan bakar kendaraan bermotor (fuel/gasoline taxes) and BPHTB (duty on land and building acquisition). Nonetheless, there is still the issue as to whether CERs themselves constitute a taxable product. There is also a view that CERs can not be categorized as a commercial paper, because it is regarded as an assistance from the developed countries to developing countries, which counts as delivery of non taxable goods. Thus no VAT is attached to it.

On the other hand, several specific tax exemption facilities for certain investment areas already exist, which could also be applied to carbon finance projects. The main examples are Government Regulations No. 1/2007 and No. 62/2008 which provide tax incentives for several industries. These incentives include: a 30 percent deduction of income tax for investment for a period of 6 years; granting a quicker depreciation and amortization rate for investment projects; a tax tariff treaty for foreign firms with a uniform income rate of 10 percent; and investment allowance (compensation for losses) based on certain conditions for 5 – 10 years.

Currently, there is zero tax for CDM which means an incentive for investors. Companies that have conducted green initiatives have received tax facilities, for instance in the case of waste management. Also, during the start up investment period, if a company is in loss they don't have to pay income tax. This is all part of the overall effort to promote investment and CDM projects can already benefit from this reasonable set of incentives.

In addition to that, the Ministry of Finance has also provided facilities to promote clean energy initiatives under Government Regulation No. 62/2008, which includes geothermal activities (Minister of Finance Regulation No. 178/ PMK.011/2007). Geothermal power generation is considered to be the long-term alternative to replace fossil fuel. However, so far the incentives and tax facilities already provided for geothermal development have not yet made it more competitive in the market. One key barrier to geothermal project development is pricing: State Electricity Company (PLN) offers to buy electricity at a price below the production cost for geothermal facilities, a gap of 2-2.5 cents per kilowatt hour. Existing tax facilities can reduce the gap by about 1 cent, so there is a need to cover an additional gap. The Ministry of Energy and Mineral Resources is considering using the Carbon Partnership Facility (a carbon purchasing fund) in a strategic manner to sell carbon credits, which would help to cover some of the remaining gap between the purchase price and the production cost of geothermal electricity.



Meanwhile, the Ministry of Industry has formulated a road map and strategy for greenhouse gas emission reductions for four key industries: Cement, Pulp and Paper, Steel and Textiles. The emission reductions projected for 2025 are as follows: Cement = 17%, Pulp and Paper = 20%, Steel = 32% and Textiles = 35%.

Other than the existing policies, the Ministry of Finance, in collaboration with the NCCC, has also identified possible policies to support emissions reduction in the manufacturing sector as shown in the table below:

Table 5. Emission Reduction in The Manufacturing Sector

Emissions Rank*	Industry Sectors	No. Firms/Plants	Min Industry Priority	Capital Stock/ Investment Options: (potentially eligible for carbon finance)	Regulatory Options: Energy/ Equipment Efficiency Standards	Fiscal Policy Enhancements: Incentive & Financial Assistance	Energy Management & Energy Efficiency Options
<b>Large, Concentrated Industries ( 50 firms or less)</b>							
1*	Cement	18	HI	Co-firing with biomass; blended cement; MOI plan implementation	Grinding equipment; motors	Encourage sectoral CDM; Faster depreciation or tax breaks for energy efficiency/ emissions reduction investment	All sectors with few, large firms can benefit from energy management practices and audits using in-house resources or through Energy Service Companies (ESCOs)
2	Steel Rolling	51	MED	MOI plan implementation; Ecotek options in rolling industry	arc furnaces; voluntary agreements	Tax breaks, soft financing for capital stock improvements;	
3*	Iron and Steel Basic Industry	16	MED	Alt fuels; heat recovery; MOI plan implementation	Furnace and drive efficiency	Access to international climate finance to lower cost of capital	
6*	Pulp	9	MED	Co-firing with biomass; heat recovery; cogeneration		Direct grant program or targeted tax policy for 9 pulp mills	
8*	Structural materials made of porcelain (ceramic tile)	30	HI	Process optimization; thermal efficiency	kilns; spray dryers	Gov't finance of ESCOs; incentives (or penalties) for underperforming firms; (e.g. low interest loans, change depreciation schedule)	
10*	Straight Fertilizer	15	HI	Optimize process controls; heat recovery	high efficiency process equipment	Direct grant program or targeted tax policy for 15 fertilizer/urea plants; Gov't finance ESCOs; low interest loans for investment	
<b>Textiles, Many firms, less concentrated target</b>							
4	Weaving mills	495	HI	Modernize equipment throughout industry (2700 machines at a cost of US\$1.7billion); co-gen & heating system reconstruction	CFLs; loom & mill efficiency	Tax policy to encourage foreign investment; low interest loans for efficiency investment; accelerated depreciation schedule	Consider a donor assistance project to provide ESCO-like advice for the Textile industry.
7*	Textile Fiber	78	HI		CFLs; loom & mill efficiency		
13	Finished textiles	167	HI		CFLs; loom & mill efficiency		
14	Spinning mills	68	MED		CFLs; loom & mill efficiency		
<b>Other Industries: Distributed, smaller firms, less concentrated target</b>							
9	Motor vehicle component and apparatus	168	MED	sector-specific analysis for electric equipment and process efficiency	motors, chain drive		Energy Management & Energy Efficiency Options
11	Crumb Rubber	146	HI			Gov't finance of ESCOs	Gov't assisted ESCO services
15	Cultural Papers	43	MED		CFLs		ESCO
16	Tire and inner tubes	33	MED		CFLs		ESCO
17 (& 20)	Crude vegetable (& palm) and animal cooking oil	295	MED/HI			Gov't finance of ESCOs	Gov't assisted ESCO services
19	Basic chemicals not elsewhere classified	37	MED				Energy Management & Energy Efficiency Options

Source: Ministry of Finance and NCCC, 2009

## BIBLIOGRAPHY

- Applegate, G., R. Smith, J. J. Fox, A. Mitchell, D. Pacckham, N. Tapper, and G. Baines. 2002. Forest Fires in Indonesia: Impacts and Solutions. Pp 293-306. In Coffey, C.J.P. and I.A.P. Resosudarmo (eds.) *Which Way Forward? People, forests, and policymaking in Indonesia*. Resource for the future, Washington D.C.
- Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.
- Government of Indonesia, *Indonesia Climate Change Sectoral Roadmap – ICCSR, Synthesis Report*, (2009)
- Hulme, M and N. Sheard. 1999. Climate Change Scenarios for Indonesia. Climatic Research Unit, Norwich, UK, 6pp.
- IPCC. 2007. Summary for Policymakers. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Lal, M., 2005. Implications of climate change on agricultural productivity and food security in South Asia, In Key vulnerable regions and climate change – Identifying thresholds for impacts and adaptation in relation to Article 2 of the UNFCCC, Springer, Dordrecht, in press.
- Loukos, H., P. Monfray, L. Bopp and P. Lehodey. 2003. Potential changes in skipjack tuna (*Katsuwonus pelamis*) habitat from a global warming scenario: modelling approach and preliminary results. *Fish. Oceanogr.* 12: 474-482.
- McMichael, A.J., D.H. Campbell-Lendrum, C.F. Corvalan, K.L. Ebi, A.K. Githeko, J.D. Scheraga and A. Woodward. Eds. 2003. *Climate Change and Human Health - Risks and Responses*, World Health Organization, Geneva, 333 pp.
- Ministry of Environment, Republic of Indonesia, 2009. *Indonesia Second National Communication Under The United Nations Framework Convention on Climate Change (UNFCCC)*
- Pascual, M., M.J. Bouma and A.P. Dobson. 2002. Cholera and climate: revisiting the quantitative evidence. *Microbes Infect.* 4: 237-245.
- PEACE (Pelangi Energi Abadi Citra Enviro). 2007. *Indonesia and Climate Change: Current Status and Policies*. 90 pp. Available online: [http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange\\_Full\\_EN.pdf](http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf)
- Tran, V.L., D.C. Hoang and T.T. Tran. 2005. Building of climate change scenario for Red River catchments for sustainable development and environmental protection. Preprints, Science Workshop on Hydrometeorological Change in Vietnam and Sustainable Development, Hanoi, Vietnam, Ministry of Natural Resource and Environment, Hanoi, 70-82.
- Tsonis, A.A., Elsner, J.B., Hunt, A.G., and Jagger, T. H. 2005. Unfolding the relation between global temperature and ENSO. *Geophysical Research Letters*, Vol. 32, L09701, doi:10.1029/2005GL022875.
- UNDP (2007) *The other half of climate change: Why Indonesia must adapt to protect its poorest people*.
- UNDP Indonesia Country Office, Jakarta. UNDP, 2007/2008, “*Human Development Report 2007/2008*”.
- Wang, X., F. Chen and Z. Dong. 2006. The relative role of climatic and human factors in desertification in semiarid China. *Global Environmental Change* 16: 48-57.
- Wassmann, R., N.X. Hien, C.T. Hoanh, and T.P. Tuong. 2004. Sea level rise affecting the Vietnamese Mekong Delta: water elevation in the flood season and implications for rice production. *Climatic Change* 66: 89-107.

Wilkinson, C., Ed. 2004: Status of Coral Reefs of the World: 2004, Volume 1. Australian Institute of Marine Science, Townsville, 302pp.  
WWF (World Wildlife Fund), Climate Change in Indonesia: Implications for Humans and Nature (2009)

# **Report of the Expert Meeting on Climate Change Management and Adaptation in Lao PDR**

## **Background**

The Meeting was held on 28-29 December 2010, at the Meeting room of Nakhonsack Hotel, which organized by DWR with financial support of GWP-SEA, and the chairman of this meeting was chaired by Mr. Phonechaleun Nonthaxay, Director General of DWR, Chairman of Lao Water Partnership.

This meeting aims to share experiences and knowledge regarding climate change adaptation involving water resources management and to raise awareness on the water management related the climate change among water sector.

## **Activities**

1. Dissemination of the Decision of the Minister to Prime Minister's Office on the members of Lao Water Partnership (LWP)
2. Presentation on the statue of water resources in the Lao PDR including critical problems/issues, challenge and opportunities in basin level regarding water resources management
3. Presentation on the result of climate change scenarios which calibrate/simulate by Modelling tools of the MRC
4. Presentation on issues and effect of climate change for sectors related water resources individually
  - Agriculture , Fishery and Irrigation
  - Navigation
  - Water Resources Management
  - Environment Management
  - Natural Disaster Prevention
5. Presentation on the international study on climate change adaptation and management regarding water resources management
6. Presentation on IWRM and RBC for climate change management

## **Participants**

There are 21 participants from line agencies attend this event

## **Outputs**

- Increased knowledge and understand on the situation of water resources and effects of climate change on it including the trend of water discharge issues in the future.

- Identified the critical problems, challenges and opportunities regarding the climate change adaptation and management through IWRM concept and other guide principles.



## **Brief Information**

### **Background**

Currently, accurate prediction of the potential change in climatic condition and resulting adverse impacts of such change have not been developed nationally by the Lao PDR but some indication can be taken from preliminary region level prediction. For example the Asian Development Bank (ADB) predicts that increasing temperatures and rainfall variability throughout Southeast Asia will cause a 2.5-10 percent decrease in crop yields by 2050 (Asian Development Bank, 2007). In this connection, Lao PDR is susceptible to the impact of climate change especially from floods and droughts. These have severe adverse impacts on livelihoods and in particular, the livelihoods of the poorest and most vulnerable groups with the lowest adaptive capacity. In overall, status of climate change in Laos has some serious problems such as flooded in 2008, drought in 2010 and it will be a significant issue in the coming years for better preparation and adaptation to climate change.

### **Problems/Weakness**

- Lack of Hydro-met stations that cause of inadequate data information
- Lack of experience, knowledge and data
- Limited local experts on the climate change management



- Lack of financials
- Inadequate capacity building
- Weak public awareness and communication
- Floods and Droughts
- Increase Water borne diseases
- Effectuated Food security especially fishery



## **Challenge and Opportunities**

Climate Change is popular issue in the world and as well as Lao PDR, the Lao government shown its interest throughout being a partner of United Nations Framework Convention for Climate Change (UNFCCC) in 1995 and the Kyoto Protocol in 2003, and participation on the varies activities and implementation regarding climate change management. In May 2008, the Prime Minister established the National Steering Committee on Climate Change (NSCCC) and the Climate Change Office (CCO) to coordinate the development of both a national strategy to manage climate change and its impacts, and an action plan that will details substantive programmes. The strategy for climate change in Lao PDR was also developed in 2010.

It is apparent that floods and droughts that occur almost every year have had significant adverse effects on Lao PDR's socio-economic development, especially agriculture, forestry, water and water resources public health, energy and people's livelihood (income, employment, food security and nutrition). In this respect the agriculture sector, which is a primary contributor to country's economy, has been most affected by the increasing severity of floods and droughts.

The opportunity that global and regional organizations/donors interested in this issue and provided technical and financial supports, which drove implementation in the Lao PDR such as integration of climate change concern in policy, expert study and technology research as per result discussed and shared in the Meeting.

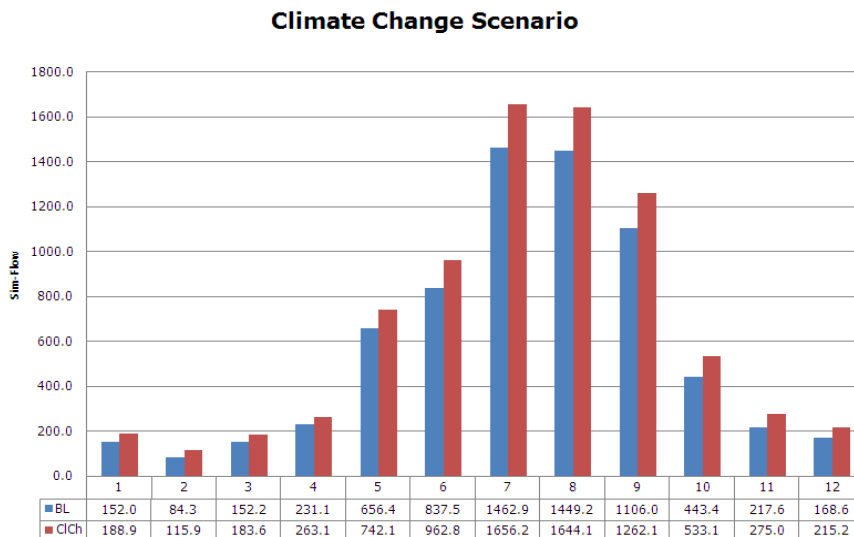
The new LWP organization was also setup in 2011 to continue sharing information and networking with other countries and organization that facing similar situation on climate change and other issues.

## Case Study of Water Resources and Environment Research Institute (WERI) on the Climate Change Scenarios

In this study, the weather variables were used for driving the hydrological balance such as solar radiation, wind speech, relative humidity and temperature. Climate data with time series period 1999-2008 were collected from two sources: MRCS and Department of Meteorology and Hydrology of the Lao PDR. Collected data for climate were used as parameters link with the stations locations for this analysis.

This hot issue has been widely discussed throughout the scientific world. This scenario is to exercise the simulation of climate change. Assumptions were based on country report on “National Adaptation Programme of Action to Climate Change on April2009”page 8 and 21 said that SEA start-BKK has been studying a climate change in Mekong river basin especially for Lao PDR .It will change a temperature 0.1-0.3 °C per decade during 1951-2000 in SE Asia and It is available 1-2 °C For the climate change scenario.

Lao National Mekong Committee (LNMC) Modeling team in the WERI case study 2010 used a temperature for long term planning of climate change on Nam Ou River Basin, and selected 1.3 degrees for December-May and increase rainfall 10% for June –November as a basis for calibrate the model. The result is presented in the chart below.



The result of this study was also similar to a general conclusion from international climate change studies for the Mekong region is that the overall level of rainfall is not likely to change dramatically over the next 30-60 years, but that variability may increase, with longer, drier dry seasons and wetter, more intense monsoons. Predictions for the Western Himalaya suggest that

global warming could result in increased snow melt over the next 20-50 years, with resulting higher flows in rivers. In the long term, more specific strategies must be developed based on an improved understanding of the likely direction and magnitude of change.

### ***Climate Change Using SEA STAR***

According to data and statistics from the Department of Meteorology and Hydrology (DMH\WREA) from 1995 – 2005, drought conditions in recent years have been characterized by higher and irregular increases in temperature. In particular, high temperatures experienced in 1996 triggered the occurrence of drought in specific areas of the country. In 1998, a severe drought occurred during the dry season when the temperature became abnormally high, causing rivers, streams, lakes and ponds to dry up at a faster than normal rate.

In the Northern provinces of the Lao PDR some significant flooding has been frequent, having occurred in 1991, 1995, 1996, 2000, 2002, 2005 and 2006. Large floods also occurred in vast areas of the central and southern parts of the country. On 15 August 2008, the water level at Vientiane reached the highest recorded since records began in 1913. This flood caused water from the Mekong River to overflow its banks and inundate villages and farmland. The damage to roads and bridges was estimated at around 293 billion kip (300 million dollars). Flooding also affected 65,000 ha of agricultural production area, including 27,000 ha of paddy field. It afflicted some 150,000 people in seven provinces, including five deaths.

Regional studies at the SE Asian regional level and at the Mekong Basin level have been conducted in the past few years. For example, a preliminary study on potential climate changes in the Lower Mekong Basin under different scenario of atmospheric CO<sub>2</sub> concentrations was conducted between 2005 and 2006 under the sponsorship of the Bangkok-based Southeast Asia START Regional Center. The study concludes that:

- Future temperature change in the region will vary from baseline condition within the range of 1-2°C. The region will have longer summer with shorter winter time.
- The trend of increasing precipitation between 10% and 30% is projected throughout the region, with the highest increase to occur in the eastern and southern part of Lao PDR. Climate variability tends to be more extreme as the range of precipitation between dry and wet years will be wider in the future, especially in Lao PDR.

These observations of extreme climatic events in Lao PDR collaborate with the climate changes observed in Vietnam, an annual temperature rise of 0.10C per decade between 1931 and 2000.

### **Climate Change Management of Water Sectors**

1. Agriculture and Forestry: Programme implementation on Reducing of Emissions from Deforestation and Forest Degradation (REDD) has also develop some technology for increasing agriculture productions in order to adapt to the climate change. And also

promote on using new alternative energy such as bio gas instead of wood fuel to reduce CO2 emission.

2. Water Resources: Develop water policy to management water resources and using of IWRM. The recent setup RBCs will better manage water resources in the sustainable manner. In addition, setup more Hydro-met stations to collect data information and improve early warning system and weather forecast will strengthen capacity for technical staff to better plan for adaptation to the climate change.
3. Environment: Implementation of climate change strategy and action plan 2011-2015 including raising awareness on climate change, develop technology on bio gas and solar energy, thoroughly and continuously monitor the activities that will contribute to better management and adaptation to the climate change.
4. Health: Improving health system in Laos to deal the water and food diseases related climate change, including analysis and improvement the quality of potable water to meet acceptable standards in better management for sustainable use of good drinking water and sanitation.
5. Natural Disaster Prevention: Preparation of disaster prevention and cooperation with line agencies would continue strengthen for better preparation and adaptation to the climate change.

## **Conclusion**

The Meeting was successfully closed by the chairman of LWP with the statement that we will continue to work together for sharing knowledge and information on the issue of the climate change regularly.

# **Status Report on Climate Change and its impact on Water Management in Malaysia**

**By**

**Malaysian Country Water Partnership  
(MyCWP)**

**January 2011**



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## **1.0 INTRODUCTION**

This brief report on the current status of climate change and its impact on water management in Malaysia has been prepared by the Malaysian Country Water Partnership (MyCWP) as part of the program of activities supported by the Global Water Partnership (Southeast Asia). The information compiled in this brief report will serve as a useful reference document that will help to fill the gap in published and publicly available information on this subject.

The scope of this report covers three main subjects. They are:

- (a) Key policies related to climate change
- (b) Overview of the institutional framework for climate change management in Malaysia
- (c) Key climate change related studies

## **2.0 KEY POLICIES RELATED TO CLIMATE CHANGE**

A summary review of the following key policies related to climate change in Malaysia is given below.

1. The National Policy on Climate Change (2009)
2. The National Green Technology Policy (2009) (NGT)
3. The Tenth Malaysia Plan (2011-2015) (RMK10)
4. The Third National Agricultural Policy (1998 - 2010)
5. The National Physical Plan (2005) (NPP)
6. The National Policy on Environment (2002)
7. The National Policy on Biological Diversity (1998)

### **2.1 The National Policy on Climate Change (2009)**

The National Policy on Climate Change (2009) is based on 5 principles and 10 strategic thrusts. A total of 43 key actions have been identified to achieve the goals of the 10 strategic thrusts in the Policy.

The objectives of the National Policy on Climate Change are:

- (a) Mainstreaming climate change through wise management of resources and enhanced environmental conservation resulting in strengthened economic competitiveness and improved quality of life;
- (b) Integration of responses into national policies, plans and programmes to strengthen the resilience of development from arising and potential impacts of climate change; and

- (c) Strengthening of institutional and implementation capacity to better harness opportunities to reduce negative impacts of climate change.

The 5 Principles of the Policy are:

- P1: Development on a Sustainable Path  
Integrate climate change responses into national development plans to fulfil the country's aspiration for sustainable development.
- P2: Conservation of Environment and Natural Resources  
Strengthen implementation of climate change actions that contribute to environmental conservation and sustainable use of natural resources.
- P3: Coordinated Implementation  
Incorporate climate change considerations into implementation of development programmes at all levels.
- P4: Effective Participation  
Improve participation of stakeholders and major groups for effective implementation of climate change responses.
- P5: Common but Differentiated Responsibilities and Respective Capabilities  
International involvement on climate change will be based on the principle of common but differentiated responsibilities and respective capabilities.

The 10 Strategic Thrusts of the Policy are:

- **ST1-P1:** Facilitate the harmonisation of existing policies to address climate change adaptation and mitigation in a balanced manner.
- **ST2-P1:** Institute measures to make development climate-resilient through low carbon economy to enhance global competitiveness and attain environmentally sustainable socio-economic growth.
- **ST3-P1:** Support climate-resilient development and investment including industrial development in pursuit of sustainable socio-economic growth.
- **ST4-P2:** Adopt balanced adaptation and mitigation measures to strengthen environmental conservation and promote sustainability of natural resources.
- **ST5-P2:** Consolidate the energy policy incorporating management practices that enhances renewable energy (RE) and energy efficiency (EE).
- **ST6-P3:** Institutionalise measures to integrate crosscutting issues in policies, plans, programmes and projects in order to increase resilience to climate change.

- **ST7-P3:** Support knowledge-based decision making through intensive climate related research and development and capacity building of human resources.
- **ST8-P4:** Improve collaboration through efficient communication and coordination among all stakeholders for effective implementation of climate change responses.
- **ST9-P4:** Increase awareness and community participation to promote behavioural responses to climate change.
- **ST10-P5:** Strengthen involvement in international programmes on climate change based on the principle of common but differentiated responsibilities and respective capabilities.

## 2.2 The National Green Technology Policy (2009) (NGT)

The National Green Technology Policy was officially launched on 24 July 2009 with the following policy statement:

***"Green Technology shall be a driver to accelerate the national economy and promote sustainable development"***

The Policy objectives are as follows:

- (a) To minimise growth of energy consumption while enhancing economic development;
- (b) To facilitate the growth of the Green Technology industry and enhance its contribution to the national economy;
- (c) To increase national capability and capacity for innovation in Green Technology development and enhance Malaysia's competitiveness in Green Technology in the global arena;
- (d) To ensure sustainable development and conserve the environment for future generations; and
- (e) To enhance public education and awareness on Green Technology and encourage its widespread use.

The policy is based on the following four pillars:

- (i) Energy - Seek to attain energy independence and promote efficient utilization;
- (ii) Environment - Conserve and minimize the impact on the environment;
- (iii) Economy - Enhance the national economic development through the use of technology; and
- (iv) Social - Improve the quality of life for all.

## 2.3 The Tenth Malaysia Plan (2011-2015) (RMK10)

The Tenth Malaysia Plan (RMK10) is Malaysia's National Development Plan for the period 2011 to 2015. Its focus is on ten big ideas as shown in **Figure 2.1** below.

A systematic review of the contents in the RMK10 was carried out and the relevant points that refer to climate change or are relevant to the theme - adaptation to climate change were identified. The titles of the paragraphs and pages in the RMK10 report containing the relevant points are given below:

1. Idea No. 9 - Valuing our Environmental Endowments (page 26)
2. Looking Back: Achievements Under the Ninth Malaysia Plan (page 49)
3. Ensuring Effective Sourcing and Delivery of Energy (page 112)
4. Sarawak Corridor Renewable Energy (page 120)
5. Open Spaces and Green Corridors (page 257)
6. Waterfront Rejuvenation (page 257)
7. Strengthening Efforts to Deliver High Quality and Environmentally Sustainable Housing (page 279)
8. Managing Water Endowment and Supply (page 281)
9. Developing a Long-Term Strategy for Water Resource Management to Achieve Water Security (page 282)
10. Continuing Efforts to Restructure the Water Services Industry (page 283)
11. Protecting Rivers from Pollution (page 285)
12. Increasing and Diversifying Generation Capacity (page 287)
13. Restructuring the Electricity Supply Industry (page 287)
14. Valuing the Nation's Environmental Endowments (page 297)
15. Developing a Climate Resilient Growth Strategy (page 300)
16. Climate Adaptation: Protecting the Nation from the Risks of Climate Change (page 300)
17. Climate Mitigation: Reducing Malaysia's Carbon Footprint (page 301)
18. Creating Stronger Incentives for Investments in Renewable Energy (page 302)
19. Promoting Energy Efficiency to Encourage Productive Use of Energy (page 303)

# 10 BIG IDEAS

1	Internally driven, externally aware
2	Leveraging on our diversity internationally
3	Transforming to high-income through specialisation
4	Unleashing productivity-led growth and innovation
5	Nurturing, attracting and retaining top talent
6	Ensuring equality of opportunities and safeguarding the vulnerable
7	Concentrated growth, inclusive development
8	Supporting effective and smart partnerships
9	Valuing our environmental endowments
10	Government as a competitive corporation

**Figure 2.1 – The Ten Big Ideas of the Tenth Malaysia Plan (RMK10)**

20. Improving Solid Waste Management (page 303)
21. Conserving Forests (page 305)
22. Reducing Emissions to Improve Air Quality (page 305)
23. Enhancing Forest and Wildlife Conservation Efforts (page 306)
24. Ensuring Equitable and Sustainable Utilisation of Resources (page 307)
25. Whole-of-Government Approach (page 314)

## 2.4 The Third National Agricultural Policy (1998 - 2010)

The Third National Agricultural Policy (1998 - 2010) is based on 5 principles and 9 strategic thrusts. A total of 41 key actions have been identified to achieve the goals of the 9 strategic thrusts in the Policy.

The objectives of the Third National Agricultural Policy (NAP3) are:

- (a) The maximisation of income through the optimal utilisation of resources in the sector. This includes maximising agriculture's contribution to national income and export earnings as well as maximising income of producers.



(b) Specifically, the objectives of the Policy are :

- (i) to enhance food security;
- (ii) to increase productivity and competitiveness of the sector;
- (iii) to deepen linkages with other sectors;
- (iv) to create new sources of growth for the sector; and
- (v) to conserve and utilise natural resources on a sustainable basis.

The 5 Principles of the Policy are:

- 1. Meeting national food requirement
- 2. Enhancing competitiveness and profitability in agriculture and Forestry
- 3. Enhancing the integrated development of the food and industrial crop sub-sectors
- 4. Strengthening requisite economic foundation
- 5. Adopting sustainable development

The 9 Strategic Thrusts of the Policy are focused on the development of product groups and are as follows:

- 1. Food product group
- 2. Human resource development
- 3. Technology
- 4. Infrastructural development
- 5. Financing and incentives
- 6. Input Industries
- 7. Business support services
- 8. Institutions
- 9. Public-private sector collaborative mechanism

## **2.5 The National Physical Plan (2005) (NPP)**

The Department of Town and Country Planning, Peninsular Malaysia developed and released the National Physical Plan for Peninsular Malaysia in 2005 (NPP). The NPP consists of the following 6 sections:

- 1. National Development Planning Framework
- 2. Goal, Objectives & Principles
- 3. Plan Context

4. Development Strategy
5. Policies
6. Implementation Mechanism

The purposes of the National Physical Plan are:

- Enhancing the National Planning through spatial dimension in the country's economic policy.
- Coordination of sectoral agencies by introduction of the spatial policies
- Forming works for planning at the state and local level; and
- Formulation of the physical planning policies

The eight themes in the National Physical Plan are as follows:

1. Shaping national spatial framework
2. Improvement of national economic competitiveness
3. Modernization of agricultural sector
4. Strengthen of tourism development
5. Management of human settlement
6. Conservation of wildlife and natural resources
7. Integration of all national transportation network
8. Installation of appropriate infrastructure

A systematic review of the contents in the NPP was carried out and the relevant points that refer to climate change or are relevant to the theme - adaptation to climate change were identified. The titles of the sections in the NPP report containing the relevant points are given below:

1. Water Supply
2. Environmentally Sensitive Areas
3. Drainage
4. Sewerage
5. Hydropower
6. Major Granary Areas
7. Sensitive Coastal Ecosystems
8. Protection of Water Catchments
9. Water Resources Issues
10. Groundwater Resources
11. Flood Prone Areas

## 2.6 The National Policy on the Environment (2002)

The National Policy on the Environment (2002) is based on 8 principles and 7 strategic thrusts. The objectives of the National Policy on the Environment are to achieve:

- (a) A clean, safe, healthy and productive environment for the present and future generations.
- (b) Conservation of the country's unique and diverse cultural and natural heritage with effective participation by all sectors of society.
- (c) Sustainable lifestyles and patterns of consumptions and production.

The 8 principles are shown in **Figure 2.2** below.

<p style="text-align: center;"><b>PRINCIPLES</b></p> <p><i>The National Policy on the Environment is based on eight principles that harmonise economic development goals with environmental imperatives. These inter-related and mutually supporting principles are:</i></p> <p style="text-align: center;"><b>FIRST</b> <b>Stewardship of the Environment</b></p> <p><i>Exercise respect and care for the environment in accordance with the highest moral and ethical standards.</i></p> <p style="text-align: center;"><b>SECOND</b> <b>Conservation of Nature's Vitality and Diversity</b></p> <p><i>Conserve natural ecosystems to ensure integrity of biodiversity and life support systems.</i></p> <p style="text-align: center;"><b>THIRD</b> <b>Continuous Improvement in the Quality of the Environment</b></p> <p><i>Ensure continuous improvement in the productivity and quality of the environment while pursuing economic growth and human development objectives.</i></p> <p style="text-align: center;"><b>FOURTH</b> <b>Sustainable Use of Natural Resources</b></p> <p><i>Manage natural resource utilisation to sustain the resource base and prevent degradation of the environment.</i></p>	<p style="text-align: center;"><b>FIFTH</b> <b>Integrated Decision-Making</b></p> <p><i>Integrate environmental dimensions in the planning and implementation of the policies, objectives and mandates of all sectors to protect the environment.</i></p> <p style="text-align: center;"><b>SIXTH</b> <b>Role of the Private Sector</b></p> <p><i>Strengthen the role of the private sector in environmental protection and management.</i></p> <p style="text-align: center;"><b>SEVENTH</b> <b>Commitment and Accountability</b></p> <p><i>Ensure the highest commitment to environmental protection and accountability by all decision-makers in the public and private sectors, resource users, non-governmental organisations and the general public, in formulating, planning and implementing their activities.</i></p> <p style="text-align: center;"><b>EIGHTH</b> <b>Active participation in the International Community</b></p> <p><i>Participate actively and effectively in regional and global efforts towards environmental conservation and enhancement.</i></p>
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**Figure 2.2 The 8 Principles of the National Policy on Environment (2002)**

## 2.7 The National Policy on Biological Diversity (1998)

The National Policy on Biological Diversity (1998) is based on 11 principles and 15 strategic thrusts.

The objectives of the National Policy on Biological Diversity are:

- (b) To optimise economic benefits from sustainable utilisation of the components of biological diversity;
- (c) To ensure long-term food security for the nation;
- (d) To maintain and improve environmental stability for proper functioning of ecological systems;
- (e) To ensure preservation of the unique biological heritage of the nation for the benefit of present and future generations;
- (f) To enhance scientific and technological knowledge, and educational, social, cultural and aesthetic values of biological diversity;
- (g) To emphasize biosafety considerations in the development and application of biotechnology;

The 11 Principles of the Policy are:

1. The conservation ethic, including the inherent right to existence of all living forms, is deeply rooted in the religious and cultural values of all Malaysians;
2. Biological diversity is a national heritage and it must be sustainably managed and wisely utilized today and conserved for future generations;
3. Biological resources are natural capital and their conservation is an investment that will yield benefits locally, nationally and globally for the present and future;
4. The benefits from sustainable management of biological diversity will accrue, directly or indirectly, to every sector of society;
5. The sustainable management of biological diversity is the responsibility of all sectors of society;
6. It is the duty of Government to formulate and implement the policy framework for sustainable management and utilisation of biological diversity in close cooperation with scientists, the business community and the public;
7. The role of local communities in the conservation, management and utilisation of biological diversity must be recognized and their rightful share of benefits should be ensured;

8. Issues in biological diversity transcend national boundaries and Malaysia must continue to exercise a proactive and constructive role in international activities;
9. The interdependence of nations on biological diversity and in the utilisation of its components for the well-being of mankind is recognized. International cooperation and collaboration is vital for fair and equitable sharing of biological resources, as well as access to and transfer of relevant technology;
10. Public awareness and education is essential for ensuring the conservation of biological diversity and the sustainable utilisation of its components;
11. In the utilisation of biological diversity, including the development of biotechnology, the principles and practice of biosafety should be adhered to.

The 15 Strategic Thrusts of the Policy are:

- ST1 - Improve the Scientific Knowledge Base  
Survey and document the biological diversity in Malaysia, and undertake studies to assess its direct and indirect values, and identify the potential threats to biological diversity loss, and how they may be countered.
- ST2 - Enhance Sustainable Utilisation of the Components of Biological Diversity  
Identify and encourage the optimum use of the components of biological diversity, ensuring fair distribution of benefits to the nation and to local communities.
- ST3 - Develop A Centre Of Excellence In Industrial Research In Tropical Biological Diversity  
Establish Malaysia as a centre of excellence in industrial research in tropical biological diversity.
- ST4 - Strengthen The Institutional Framework For Biological Diversity Management  
Establish and reinforce the mechanisms for planning, administration and management of biological diversity.
- ST5 - Strengthen And Integrate Conservation Programmes  
Increase efforts to strengthen and integrate conservation programmes.
- ST6 - Integrate Biological Diversity Considerations Into Sectoral Planning Strategies  
Ensure that all major sectoral planning and development activities incorporate considerations of biological diversity management.
- ST7 - Enhance Skill, Capabilities And Competence  
Produce a pool of trained, informed and committed manpower in the field of biological diversity.

- ST8 - Encourage Private Sector Participation  
Promote private sector participation in biological diversity conservation, exploration and sustainable utilisation.
- ST9 - Review Legislation To Reflect Biological Diversity Needs  
Review and update existing legislation to reflect biological diversity needs and introduce new legislation where appropriate.
- ST10 - Minimise Impacts Of Human Activities On Biological Diversity  
Take mitigating measures to reduce the adverse effects of human activities on biological diversity.
- ST11 - Develop Policies, Regulations, Laws And Capacity Building On Biosafety  
Introduce measures for the incorporation of biosafety principles and concerns, especially in relation to genetic engineering, and the importation, creation and release of genetically modified organisms.
- ST12 - Enhance Institutional And Public Awareness  
Promote and encourage the understanding and participation of the public and institutions for the effective conservation and protection of biological diversity.
- ST13 - Promote International Cooperation And Collaboration  
Promote international cooperation and collaboration in order to enhance national efforts in biological diversity conservation and management.
- ST14 - Exchange Of Information  
Promote and encourage the exchange of information on biological diversity at local and international levels.
- ST15 - Establish Funding Mechanisms  
Identify and establish appropriate funding mechanisms for biological diversity conservation and management.



## **3.0 INSTITUTIONAL FRAMEWORK FOR CLIMATE CHANGE MANAGEMENT IN MALAYSIA**

### **3.1 Overview**

Malaysia ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 13 July 1994. As a developing nation Malaysia is classified under the category of Non-Annex 1 (N-A1) country. Under the UNFCCC's Article 12 all N-A1 parties must periodically prepare an inventory of Green House Gas (GHG) emissions and report on the implementation of the Convention. The term for the periodic report to the UNFCCC is "National Communications". A National Steering Committee on Climate Change (NSCCC) was established in 1994 to guide the national responses on climate change. As part of its commitment to the UNFCCC Malaysia completed its Initial National Communication (INC) in 2000. The Second National Communications (NC2) has just been completed in 2010.

In Malaysia, climate change has generally been considered to be an environment issue. Thus the Ministry of Natural Resources and Environment (NRE) is given the responsibility to respond to Malaysia's commitment to the UNFCCC. Prior to the establishment of NRE in 2004, climate change was under the purview of the Ministry of Science, Technology and Environment. The NSCCC is chaired by the NRE and comprised of members from various ministries. However, with the increasing concern on climate change both at the global and domestic level, a Cabinet Committee on Climate Change was established in 2008. This Committee has recently been succeeded by the Green Technology and Climate Change Council (GTCCC), which held its first meeting in 2010.

Both the Cabinet Committee and the GTCCC are chaired by the Prime Minister with members from the various ministries that are related to climate change. The NRE and the Ministry of Energy, Green Technology and Water are joint secretariat to both the Committee and the Council.

It can be seen that the institutional framework on climate change has evolved from a sectoral focus to a more integrated and higher level focus with the establishment of the GTCCC chaired by the Prime Minister. Also, a National Water Council chaired by the Deputy Prime Minister and comprising of all the State Chief Ministers has also been formed to address water management issues. Thus, the appropriate institutional framework to discuss water-related issues and climate change are in place, and to implement decisions to mitigate and adapt to climate change.

### 3.2 Green Technology and Climate Change Council (GTCCC)

In order to have high level coordination among Ministries, Agencies, the private sector and all other stakeholders to implement the Green Technology policy and also to respond to the challenges of climate change the GTCC has been created. The GTCC is chaired by the Prime Minister of Malaysia. It is supported by a Steering Committee and the following five Working Groups (WG).

- (a) Industry WG;
- (b) Research & Innovation WG;
- (c) Human Capital WG;
- (d) Promotion and Public Awareness WG;
- (e) Transportation WG

### 3.3 Organisational Framework for the preparation of the Vulnerability and Adaptation Section of the NC2 Report

In order to prepare the NC2 report a Project Management Group (PMG), led by the Undersecretary of Conservation and Environmental Division (CEMD) in the Ministry of Natural Resources and Environment (NRE) was set up in 2006 to co-ordinate the work of three main Working Groups (WG) that provide the inputs for the report. The three main working groups are as follows:

- (a) National Greenhouse Gas (GHG) Inventory WG
- (b) Vulnerability and Adaptation (V&A) WG
- (c) Mitigation WG

The WG that is important for water and adaptation to climate change is the V&A WG, which is chaired by the National Hydraulic Research Institute of Malaysia (NAHRIM). The V&A WG comprised seven sectors and two support groups. The sectors and the organisations involved are given in **Table 3.1** below.

**Table 3.1 Sectors and Organisations responsible for the V&A Section of the NC2 Report**

No.	Sector	Organisation
1.	Water Resources	<ol style="list-style-type: none"> <li>1. National Hydraulic Research Institute of Malaysia (NAHRIM)</li> <li>2. Public Works Department (JKR)</li> <li>3. Ministry of Energy, Green Technology and Water (KeTTHA)</li> <li>4. Minerals and Geoscience Department Malaysia (JMG)</li> <li>5. Department of Environment (DOE)</li> <li>6. Town and Country Planning Department (JPBD)</li> <li>7. Tenaga Nasional Berhad (TNB)</li> <li>8. Department of Irrigation and Drainage (DID)</li> <li>9. Muda Agricultural Development Authority (MADA)</li> </ol>
2.	Agriculture	<ol style="list-style-type: none"> <li>1. Malaysian Agricultural Research and Development Institute (MARDI)</li> <li>2. Malaysian Palm Oil Board (MPOB)</li> <li>3. Rubber Research Institute (RRI)</li> <li>4. Malaysia Cocoa Board (LKM)</li> <li>5. Department of Agriculture Malaysia (DOA)</li> <li>6. Department of Fisheries Malaysia</li> <li>7. Department of Veterinary Services</li> <li>8. Universiti Putra Malaysia (UPM)</li> <li>9. Ministry of Agriculture and Agro-Based Industry Malaysia (MOA)</li> <li>10. Ministry of Plantation Industries and Commodities</li> </ol>
3.	Biodiversity	<ol style="list-style-type: none"> <li>1. Forest Research Institute Malaysia (FRIM)</li> <li>2. Universiti Malaya (UM)</li> <li>3. National University of Malaysia (UKM)</li> <li>4. Universiti Malaysia Sabah</li> <li>5. Universiti Malaysia Sarawak (UNIMAS)</li> <li>6. Universiti Putra Malaysia (UPM)</li> <li>7. Department of Wildlife and National Parks, Peninsular Malaysia (PERHILITAN)</li> <li>8. Forestry Department of Peninsular Malaysia (JPSM)</li> <li>9. Maritime Institute Malaysia (MIMA)</li> </ol>

		<ul style="list-style-type: none"> <li>10. Malaysian Nature Society (MNS)</li> <li>11. World Wide Fund for Nature Malaysia (WWF)</li> </ul>
4.	Forestry	<ul style="list-style-type: none"> <li>1. Forestry Department of Peninsular Malaysia (JPSM)</li> <li>2. Universiti Putra Malaysia (UPM)</li> <li>3. National University of Malaysia (UKM)</li> <li>4. Universiti Malaysia Sabah</li> <li>5. Department of Wildlife and National Parks, Peninsular Malaysia (PERHILITAN)</li> <li>6. Sabah Forestry Department</li> <li>7. Sarawak Forestry Department</li> <li>8. Malaysian Nature Society (MNS)</li> <li>9. World Wide Fund for Nature Malaysia (WWF)</li> <li>10. Forest Research Institute Malaysia (FRIM)</li> <li>11. Universiti Malaysia Sarawak (UNIMAS)</li> <li>12. Science University of Malaysia (USM)</li> </ul>
5.	Coastal and Marine Resources	<ul style="list-style-type: none"> <li>1. Department of Irrigation and Drainage (DID)</li> </ul>
6.	Energy	<ul style="list-style-type: none"> <li>1. Malaysia Energy Centre (PTM)</li> <li>2. Tenaga Nasional Berhad Research (TNBR)</li> <li>3. PETRONAS</li> <li>4. Ministry of Transport</li> <li>5. Keretapi Tanah Melayu Berhad (KTMB)</li> <li>6. Department of Civil Aviation (DCA)</li> <li>7. MISC Berhad</li> </ul>
7.	Public Health	<ul style="list-style-type: none"> <li>1. Institute for Medical Research (IMR), Ministry of Health</li> <li>2. Science University of Malaysia (USM)</li> <li>3. International Islamic University of Malaysia (IIUM)</li> <li>4. Universiti Malaysia</li> </ul>
8.	Climate Change Projection (support group)	<ul style="list-style-type: none"> <li>1. National Hydraulic Research Institute of Malaysia (NAHRIM)</li> <li>2. Malaysian Meteorological Department (MMD)</li> <li>3. Department of Geography, Universiti Malaya (UM)</li> </ul>

		<ol style="list-style-type: none"> <li>4. Faculty of Science &amp; Technology, National University of Malaysia (UKM)</li> <li>5. Department of Irrigation and Drainage (DID)</li> </ol>
9.	Socio-economic Impacts and Response (support group)	<ol style="list-style-type: none"> <li>1. Institute for Environment and Development (LESTARI), National University of Malaysia (UKM)</li> <li>2. Malaysian Agricultural Research and Development Institute (MARDI)</li> <li>3. Forest Research Institute Malaysia (FRIM)</li> <li>4. Forestry Department of Peninsular Malaysia (JPSM)</li> <li>5. National Hydraulic Research Institute of Malaysia (NAHRIM)</li> <li>6. Graduate School of Management, Universiti Putra Malaysia (UPM)</li> <li>7. Institute for Medical Research (IMR)</li> <li>8. Institute for Health Management (IHM)</li> <li>9. Faculty of Social Sciences and Humanities, National University of Malaysia (UKM)</li> <li>10. Malaysia Energy Centre (PTM)</li> <li>11. Faculty of Economics and Business, National University of Malaysia (UKM)</li> <li>12. Department of Irrigation and Drainage (JPS)</li> <li>13. Faculty of Forestry, Universiti Putra Malaysia (UPM)</li> <li>14. Town and Country Planning Department (JPBD)</li> </ol>

## 4.0 KEY CLIMATE CHANGE-RELATED STUDIES

A number of key studies and reports related to climate change have been carried out. A brief description of the relevant contents and results from the following reports are given below.

- Malaysia's NC2 Report (2010)
- NAHRIM's Climate Change Projections with RegHCM-PM Model
- MMD's Climate Change Projections with PRECIS Model
- NAHRIM's Preliminary Study on the Impacts of Climate Change on the Water Supply and Irrigation Schemes in Selected Areas (2009)
- ASM's Study on the Status of Climate Change on Water-related Issues (2010)

### 4.1 Malaysia's NC2 Report (2010)

The NC2 Report (2010) was prepared as a follow-up to the Initial National Communication (INC) report completed in 2000. The complete NC2 Report contains the outputs of the deliberations from three key working groups. However, the content of the report that is relevant to water resources and climate change adaptation is that prepared by the Vulnerability and Assessment (V&A) Working Group.

The V&A WG's report presents the results of climate change projections studies carried out for Malaysia, highlights the possible climate change impacts and possible adaptation options to mitigate the impacts in the following seven sectors:

- (a) Water Resources
- (b) Agriculture
- (c) Biodiversity
- (d) Forestry
- (e) Marine and Coastal Resources
- (f) Energy
- (g) Public Health

For each of the sector, vulnerability assessments were carried out and adaptation options identified for each of its sub-sectors. The gaps and uncertainties as well as the capacity building requirements were also identified. The report concludes with recommendations to address the identified gaps and uncertainties.



## 4.2 NAHRIM's Climate Change Projections with RegHCM-PM Model

In order to assess the impacts of climate change on local rainfall patterns the National Hydraulic Research Institute of Malaysia (NAHRIM) has developed a dynamic down-scaled Regional Hydro-Climate Model for Peninsular Malaysia (RegHCM-PM) of 9km resolution that is capable of generating climate and hydrological projections up to 2050. A similar model for Sabah and Sarawak has also been developed in 2010. The RegHCM-PM model output is accessible from the following website (<http://www.futurehydroclimate.nahrim.gov.my>) for registered users.

The RegHCM-PM was developed to downscale the climate change simulations of the Canadian Center for Climate Modeling and Analysis general circulation model (CGCM1) at coarse spatial resolution (410km grid resolution) to the fine spatial resolution (9km grid resolution) so that a quantitative assessment of the possible change of climate on the hydrology and water resources of Peninsular Malaysia can be carried out. The positive feature of the model is that it can take into account the more refined topographic and land characteristics at regional and watershed scales. The model also includes a mesoscale atmospheric model component and a regional land hydrology model component, similar to the original IRSHAM for Japan.

The impact of changes in the climate for two ten-year future periods, 2025-2034 and 2041-2050, on the atmospheric conditions and hydrologic regime of Peninsular Malaysia was assessed. The future simulation of the hydroclimate over during 2025-2034 and 2041-2050 periods was compared against the CGCM1/RegHCM-PM simulated historical hydro-climate over Peninsular Malaysia during 1984–1993 in order to quantify the potential changes in atmospheric and hydrologic conditions over the region.

**Table 4.1** gives a summary of the results from the RegHCM-PM for some key hydrological variables for two future ten-year periods of 2025-2034 and 2041-2050.

**Table 4.1 – Summary of the results from the RegHCM-PM for some key hydrological variables for two future ten-year periods of 2025-2034 and 2041-2050**

		<b>PROJECTED (for the period 2025-2034 and 2041 - 2050 relative to 1984-1993 )</b>
(1)	<b>Averaged Annual Air Temperature</b>	+1.5°C
(2)	<b>Averaged Annual Rainfall</b>	+10% (Kelantan, Terengganu & Pahang) -5% (Selangor & Johor)
(3)	<b>River Flow (Monthly)</b>	+11% to +43% (Flood Flows) -31% to -93% (Low Flows)
(4)	<b>Evapotranspiration</b>	No significant changes
(5)	<b>Soil Water</b>	Seasonal oscillation for monthly storage

### 4.3 MMD's Climate Change Projections with PRECIS Model

The Malaysian Meteorological Department (MMD) has also developed a model to downscale GCM outputs to assess the impacts of climate change on rainfall patterns. The model's name is the "Providing Regional Climates for Impacts Studies" (PRECIS) and it gives outputs up to a resolution of 50km, unlike NAHRIM's finer resolution of 9km. The PRECIS model climate projections have been simulated for up to 2100. The Model uses the UK Hadley Centre's HadCM3 AOGCM lateral boundary data. The Model uses the SRES A1B climate change scenario for its regional simulations for the periods 1960 to 2100. The simulation results for 1961 to 1990 were used as the baseline. The results from 2001 to 2099 were used to generate climate change scenarios of the future climate.

**Table 4.2** and **Figure 4.1** give the PRECIS rainfall simulations driven by the HadCM3 AOGCM, for three decades for the first quarter (2020 – 2029), middle (2050 – 2059) and end of the century (2090 – 2099), relative to the 1990-1999 period.

Table 4.2– Annual Rainfall Changes (%) relative to 1990-1999

Region	2020-2029	2050-2059	2090-2099
North-West PM	- 11.3	6.4	11.9
North-East PM	- 18.7	- 6.0	4.1
Central PM	- 10.2	2.3	14.1
Southern PM	- 14.6	- 0.2	15.2
East Sabah	- 17.5	- 12.8	- 3.6
West Sabah	- 8.9	- 1.2	0.3
East Sarawak	- 9.1	- 1.3	6.2
West Sarawak	- 8.8	3.8	14.6

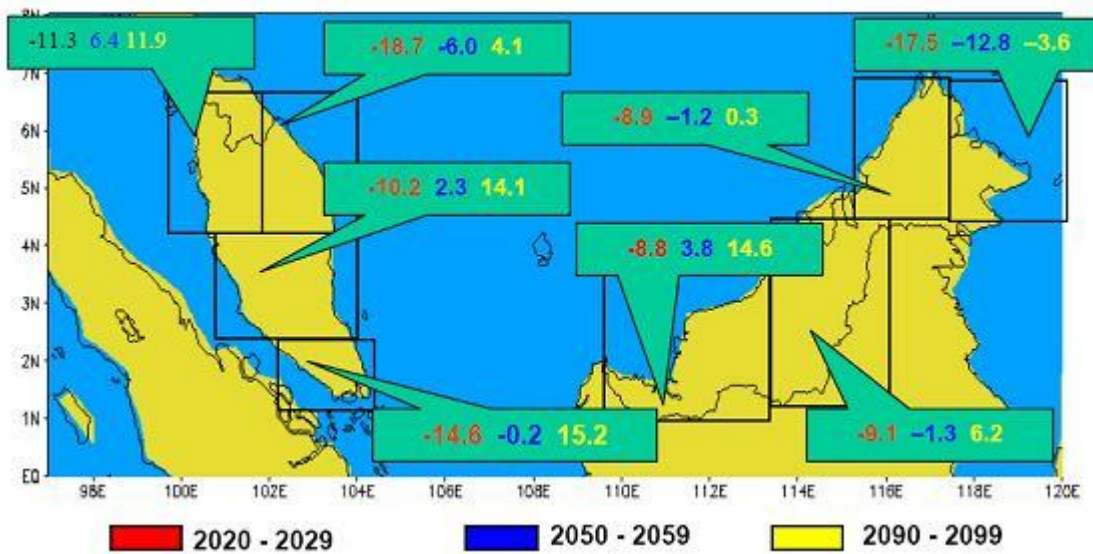


Figure 4.1 – Annual Mean Rainfall Anomaly (%) Relative to 1990 – 1999

#### **4.4 NAHRIM's Preliminary Study on the Impacts of Climate Change on the Water Supply and Irrigation Schemes in Selected Areas (2009)**

NAHRIM completed a study in 2006 entitled "Impact of Climate Change on the Hydrologic Regime and Water Resources of Peninsular Malaysia". The study simulated the possible impacts of climate change on the future rainfall and water resources characteristics in Malaysia. Following the Study NAHRIM completed a preliminary study in July 2009 to assess the impacts of climate change on the irrigation and water supply sectors for selected areas in Peninsular Malaysia based on the projected rainfall and runoff characteristics from the 2006 Study.

The main objective of the 2009 Study is to assess the impacts of climate change on the irrigation and water supply for the following selected study areas:

- Muda Irrigation Scheme
- Kemubu Irrigation Scheme
- Barat Laut Selangor (BLS) Irrigation Scheme
- Klang Valley Water Supply System

The study highlighted the fact that the simulated rainfall and runoff data are subject to a much higher level of uncertainties compared to the uncertainties in estimating the water supply and irrigation water demands for the selected study areas.

It must be emphasized that the conclusions from the Study are subject to the high uncertainties in the projected rainfall and runoffs arising from the climate simulation studies carried out in 2006.

#### **4.5 ASM's Study on the Status of Climate Change on Water-related Issues (2010)**

The Academy of Sciences Malaysia (ASM), under its Sustainable Water Management Programme, has established a number of Task Forces to address various matters of concern affecting the country's water sector. One of the Task Forces is on "Climate Change and Water Resources". The roles of the ASM Task Force on Climate Change and Water Resources (ATF-CCW) are:

- (a) To support the IWRM processes in adaptation to impact of climate change on water in a "No-Regret" agenda including to harvest low hanging fruits, and based on the precautionary principle; and

(b) To look at the extent of the issues and to propose a holistic framework for strategic actions in water-related issues, including the estimated cost and benefits, wherever possible and necessary, by:

- assessing potential issues and the gaps (e.g. but not limited to the following: information management/knowledge, R&D, capacity building, etc.) exacerbated by climate change;
- providing recommendations in each of the specific areas of, but not limited to, socio-economics (including floods), health (including pollution), agriculture, water supply, etc.

In order to fulfill its role the ATF-CCW is planning a series of stakeholder consultation workshops to identify and streamline the required strategic actions, and to develop the holistic framework, to address the water-related issues arising from the potential impacts of climate change in Malaysia. As part of the preparation for the stakeholder workshops the ATF-CCW has prepared a report, entitled *“Study on the Status of Climate Change on Water-related Issues”*.

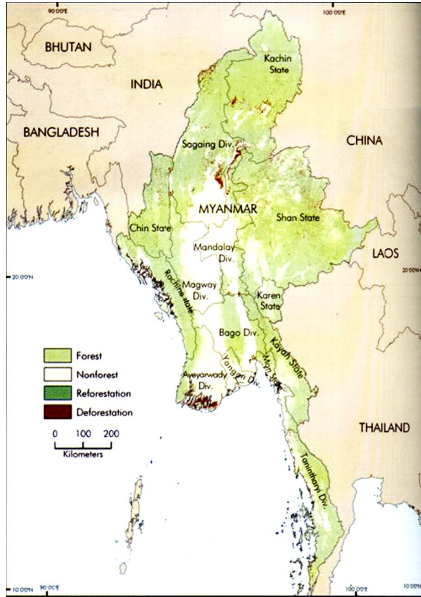
The content of the report is as follows:

- (a) A brief synopsis of some key local and international documents related to climate change adaptation were given.
- (b) A brief introduction to climate change modeling is given together with an overview of the current status of climate change projections in Malaysia.
- (c) A synthesized overview of the subject of climate change impact, vulnerability and adaptation for the water sector, based on the compiled extracts from the Stern Review on the Economics of Climate Change (2006) and the report on “The Economics of Climate Change in Southeast Asia: A Regional Review” (2009) by ADB.
- (d) A summary of the current status of water management in the country to address the impacts of climate change on water for the following seven thematic areas, together with highlights on the gaps and recommendations to address them.
  1. Governance and Institutional Capacity
  2. Climate Change Projections and R&D Capacity
  3. Information Management Capacity
  4. Stakeholder Awareness and Participation
  5. Water Bodies Management Capacity
  6. Water Use Management Capacity
  7. Water Management Capacity

# CLIMATE CHANGE MANAGEMENT IN MYANMAR

## 1. NATIONAL CIRCUMSTANCES

The Location of the Union of Myanmar is in both the eastern and northern hemispheres, and the southern edges of the country are just a few degrees north of the Equator. The total land area is 676,557 Km<sup>2</sup> bordered with China to the northeast and Laos and Thailand to the southeast. Myanmar has contiguous coastline along the Bay of Bengal and Andaman Sea to the southwest and the south. The population is about 57.5 million as per 2008 estimate.



Myanmar is rich in natural resources including water resources. Almost all the rivers and streams in the country rise in the northern highlands and follow into the southern sea. The river basin characteristics in Myanmar are quite variable to the difference in physiographic features. The principal water course flowing separately in Myanmar comprise four major rivers, the Ayeyarwady, Chindwin, Thanlwin, Sittaung and other major tributaries. All rivers with the exception of the Thanlwin River of trans-boundary nature can be considered national basins comprise about 737,800sq-km, those cover 90 percent of the country's territory. The average annual surface water and estimated ground water potential are 1082 km<sup>3</sup> per year and 495 km<sup>3</sup> per year respectively. Ayeayarwaddy river basin is 60% of Myanma total area. The upstream of the river basin is rich in natural resources such as forests, minerals, jades, gold, platinum and gas and others. The composition and distribution of Myanmar's land resources can be described as reserved forests and other forests, fallow land, cultivated areas,

cultivable wasteland and others. Out of the whole land area of Myanmar, about 50% is covered with forest. Hundreds of species of freshwater fish are wide-ranging, plentiful and are very important food sources.

Myanmar's climate conditions are defined as summer, rainy and winter season. Two third of Myanmar falls within the tropics and the remaining one third enjoys temperate climate conditions. Coastal regions receiving over 5000 mm and while average annual rainfall in the Dry Zone which is located in Central Myanmar is less than 750mm. Northern regions of the country are the coolest, with average temperatures of 21°C and mean temperatures of 32°C in the coastal area. During the hot seasons, temperature sometimes reach to 40°C and over in central dry zone areas.

Like other countries, Myanmar also suffers from climate change impacts on water cycle by sudden change of weather pattern such as flood and long drought and thus sustainability of water environment in some areas are facing difficulties. Due to the climate change impacts rainfall pattern and rainfall intensity are significantly changed occasionally in some parts of the country depending on the topographical condition. In the middle part of Myanmar, especially in dry zone area, sometime intervals of non-rainy days last more than two or three weeks and annual rainfall intensity is rather less than normal average. As a consequence, lesser inflows into the reservoirs, resulting in irrigation water shortage problems particularly in dry season. Due to the climate change impacts in delta and coastal areas, more severe storms often can occur at any time and moving of shore line and sea water intrusion. Although, changing climate pattern and potential impacts are of different scale, climate change impacts us directly through surface water utilization, more frequent floods and droughts but also indirectly through human activities which depend on water.

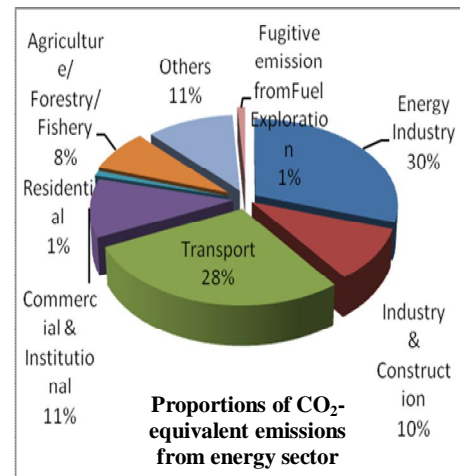


## 2. NATIONAL GREENHOUSE GAS INVENTORY

Myanmar ratified United Nation Framework Convention on Climate Change (UNFCCC) on 25 November, 1994 as a non-Annex I Party. Article 12.5 of the UNFCCC requires non-Annex I Parties to make their initial national communications. Thus, Myanmar sought Global Environment Facility (GEF) funding in 2006 to fulfill its commitments and obligations for preparing and reporting its Initial National Communication (INC). The National Commission for Environmental Affairs (NCEA) of Myanmar launched an INC project in 2008 with the financial assistance from GEF/UNEP. Setting the year 2000 as the base year, and prepared the database for each sector and predicted the GHG emission/reduction in inventoried sectors. The year 2000 greenhouse gas emissions were estimated from the information obtained from the following publications/sources:

- ❖ Statistical Year Book of the Ministry of National Planning and Economic Development
- ❖ Annual Report of the National Development Activities (1997-2000)
- ❖ Annual Production and Distribution of the Ministry of Energy (2000-2005)
- ❖ The Statistical Data from the Ministry of Transport, Inland Water Transportation, Civil Aviation of Myanmar
- ❖ Production Data from the Ministry of Industries
- ❖ Production Data from the Ministry of Mines
- ❖ Data from the Yangon City Development Committee

**2.1 Energy Sector** - The national Green House Gas (GHG) inventory in energy sector covers three major GHGs: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O). The main sources of GHG emissions examined are fossil fuel combustion, traditional biomass fuel combustion, fugitive emissions from coal mining activities and oil and natural gas system and the total GHG emissions fossil fuel combustion in Myanmar for the year 2000 was estimated to be 7,755.11 Gg in which energy industry and transport sectors shared the largest contributions. The per capita CO<sub>2</sub> emission from the energy sector is relatively low because Myanmar relies predominantly on hydroelectric power for industrial, residential and commercial uses. The increasing of urbanization and industrialization produce more of GHG.



HFC, PFC and SF<sub>6</sub> are not produced in Myanmar. Introduction of HFCs to replace ozone-depleting substances (ODS) to Myanmar commenced in 1997, but there are no records of import of these chemicals to Myanmar for the year 2000. CFCs and HCFCs have been used by refrigeration and air conditioning services technicians during the phase down period of ODS. Mobile air conditioners, locally manufactured and imported use HFCs as refrigerants. However, electrical equipment using SF<sub>6</sub> has been being imported to Myanmar since 1984.

**2.2 Agriculture Sector** – The *Irrigation Department* (ID) plays a major role as the prime water user, for the main purpose of supplying water for agricultural irrigation and protection of cultivable areas from floods, and has established 360 various kinds of facilities, capable of irrigating 1.7 million hectares, from the days of Myanmar Kings. The Irrigation Department is responsible for operating and maintenance of irrigation, drainage and flood control works. The management as well as the pace of construction becomes accelerated only after the 1980s when the Irrigation Department initiated bigger and more complex projects. New types of irrigation such as pumping irrigation and ground water irrigation were attempted apart from the introduction of storage reservoirs projects. The irrigated areas have been significantly increased by these projects. Some major irrigation works incorporating hydropower, flood control and domestic water supply are also included.

Agriculture sector contributes 34 % of GDP, 23 % of total export earnings, and employs 63 % of labor force. Seventy percent of the population reside in rural areas and are mainly engaged in agriculture, livestock and fishery for their livelihood. Majority of the farmers are small-scale landholders and the average size of land holding is approximately 5.6 acres. Most farmers traditionally grow rice as a single cropping system under the rain-fed condition. After 1988, the Government implemented the construction of dams and reservoirs and summer paddy program was introduced in 1992. In the year 2000, the total sown area reached 6,302,306 ha out of which 1,852,691 ha, or 29.4% were irrigated.

Prediction of CH<sub>4</sub> and N<sub>2</sub>O emissions in agriculture sector during 2000-2030 shows that both GHGs tend to rise until 2030 because of increased agricultural land and more inputs of fertilizers. Among the domesticated livestock, ruminant animals are the major emitters of CH<sub>4</sub> because of their unique digestive system. Methane emissions from the livestock sector from the year 1998 to 2002 increased by 1.25% annually. Because of the increased number of livestock, both CH<sub>4</sub> & N<sub>2</sub>O tends to rise until 2030.

**2.3 Land Use Change and Forestry Sector** - The forest resource assessment (FRA - 2000) conducted by the Food and Agriculture Organization (FAO) in cooperation with the Forest Department (FD) of Myanmar has indicated that Myanmar is still endowed with a forest-covered area of 52% of the country's total land. Deforestation and forest degradation processes may become the source of carbon emissions. If forest are manage to maintain properly, then this forest sector is one of the highest in the Asia-Pacific Region for carbon sink and the estimated total carbon sinks is equivalent to 160 tons of carbon per hectare in 2005.

The activities responsible for annual decrease in biomass carbon stocks in land use change and forestry sector are: (i) the activity which causes the annual decrease in carbon stocks but cannot be accounted for direct GHG emission (eg. wood removal); and (ii) the activity which can be accounted for direct GHG emission (eg. biomass burning). Net GHG removal in land use change and forestry sector is still a major carbon sink until 2030. CO<sub>2</sub> removal by land use change and forestry sector can compensate the total emission by different sectors. However the projection of net GHG removal in 2030 pointed out the constant decline because of decrease in natural forest area. Due to the biomass growth in natural forests, forest plantations, road side trees and home garden trees, land use change and forestry in the country is the only sector that can absorb of CO<sub>2</sub>. Therefore, the country's net emission figures show 67.8 million tons of CO<sub>2</sub> are being absorbed by forestry sector in Myanmar.

**2.4 Waste Sector** - CH<sub>4</sub> emissions from waste sector have been worked out from two different sources- (1) disposal of solid waste and (2) treatment of domestic and commercial wastewater. Solid waste includes Agricultural waste, Livestock waste, Industrial waste and Domestic waste. General amount of solid waste was about 0.278 kg per capita according to the YCDC data issued. In year 2000, urban population is taken as approximately 30% of the total country's population and by expert estimate, net methane emission from domestic and commercial wastewater is 1.257 Gg. The study in total methane emission from the Waste Sector shows that CH<sub>4</sub> and CO<sub>2</sub> emissions in this sector are increasing due to the increase of total population especially in urban areas.

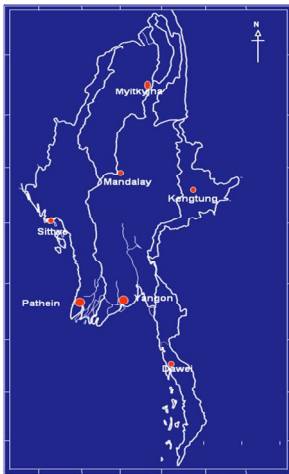
**2.5 The Trend of GHG emissions in Myanmar** - The trends for CH<sub>4</sub> and N<sub>2</sub>O emissions in agriculture sector clearly highlighted the sharp increase in the short term (2000-2005) as well as in the long term (1990-2030). Waste sector also showed an increase in CH<sub>4</sub> emissions due to the population growth. Land use change and forestry sector is the major emitter which comes from deforestation, shifting cultivation and land clearing. On the other hand, total annual CO<sub>2</sub> removals by natural forests are also declining steadily due to the decrease in the natural forest areas. However, it is estimated that GHG removals in Myanmar will still have outstanding surplus until 2030.

### 3. VULNERABILITY AND ADAPTATION ASSESSMENT

Agriculture, public health, water resources, forestry, and biodiversity are the sectors most vulnerable to climate change. Coastal zone is also vulnerable to climate-related hazards due to its geographical position.

**3.1 Climate change scenarios** - The “Model for the Assessment of Greenhouse gas Induced Climate Change / SCENario GENerator” MAGICC/SCENGEN model results on climate scenario were: (1) The temperature for 2001-2020 shows 0.5°C-0.7°C increase during the whole year in lower parts of Myanmar and record high maximum temperature may be expected. There is an increase in precipitation of about 4% during March- November in the whole country. (2) The temperature for 2021-2050 shows 1.4 °C -1.7°C increase in the months June-November in the whole country. From March to November there is an indication of about 10% increase of precipitation in the whole country. (3) The temperature for 2051-2100 shows the warming trend throughout the year especially in the cool season. The whole country will generally receive about 10% increase of precipitation during March to November and deficient rain of up to 80% is likely during the cool months from December to February.

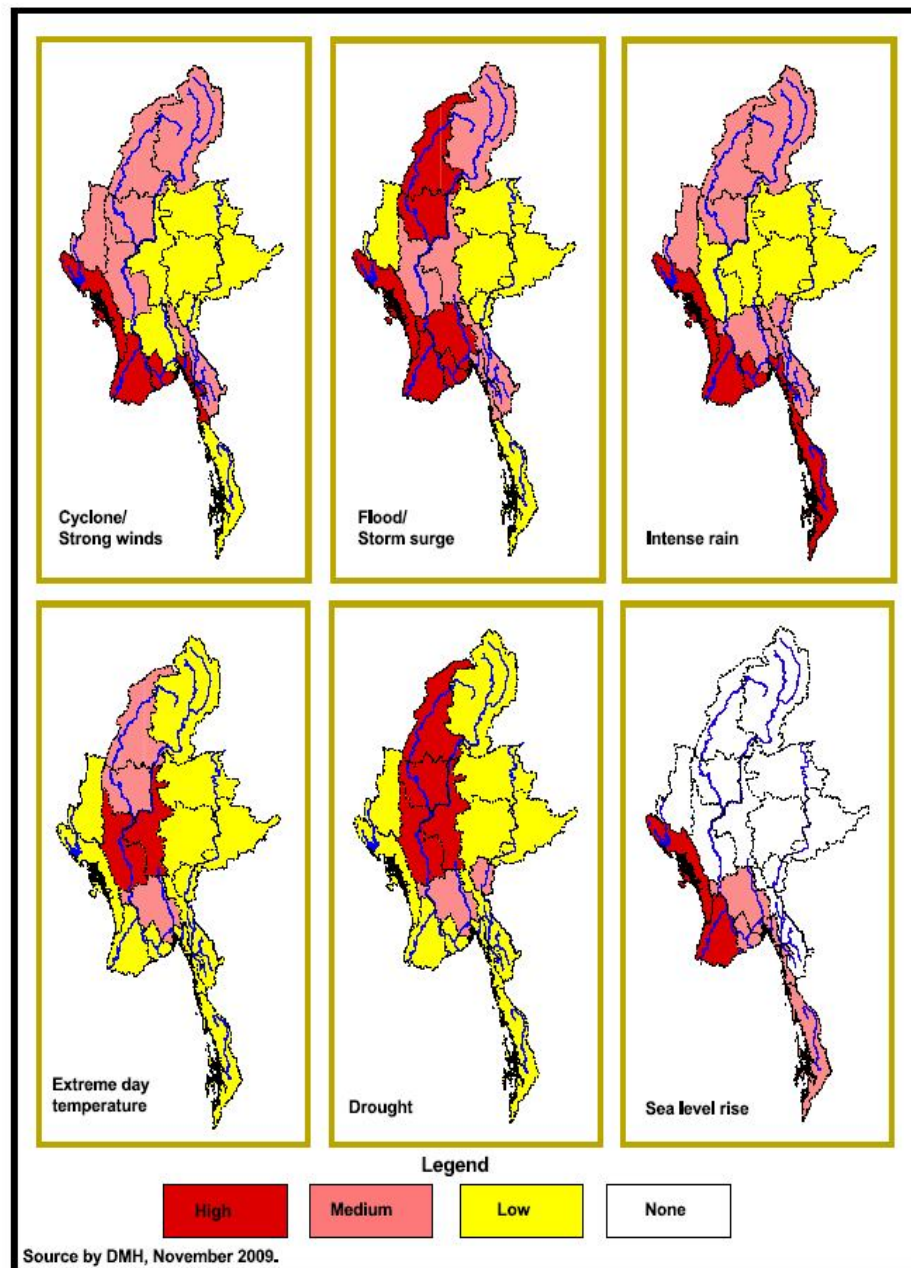
Regional Climate Impact studies the PRECIS model results on climate scenario were: (1) the standard deviation of mean temperature for 2001-2020 is generally less than 0.5°C in the whole country except Mandalay and Myitkyina. Annual rainfall will deviate more than 18% at Mandalay, Sittwe, Patheingyi and Dawei, more than 14% at Myitkyina, Kengtung and Yangon. (2) For 2021-2050, there is an increasing trend in temperature from 1°C to 1.4°C at Yangon, Patheingyi, Myitkyina, Sittwe, Dawei, Kengtung, and Mandalay. The standard deviation of temperature is 0.4 to 0.6°C in the whole country. A large standard deviation at Sittwe indicated 1130 mm, compared to 891 mm in 1971-2000. It shows that there is larger rainfall variability in the region. (3) For 2051-2100, the scenario indicates increases of 2.8°C to 3.5°C in many places from 1971-2000 baseline data due to decreasing cloudiness coverage. Maximum standard deviation is 1.0°C at Myitkyina and the lowest is 0.7°C at Dawei. Periods of drought are likely at Myitkyina, Mandalay, Sittwe, Patheingyi and Yangon where the standard deviation of mean temperature is generally about 0.9°C. Maximum standard deviation is 1358 mm at Sittwe, followed by 902 mm at Dawei and 485 mm at Patheingyi.



#### Location of selected stations for climate change scenarios in Myanmar

**3.2 Vulnerability and adaptation (V & A) assessment** - Potential hazard levels – Cyclone and strong winds, flood and storm surge, intense rain, extreme day temperature, drought, and sea level rise are the six natural hazards identified in Myanmar. The potential hazard levels for climate change impacts due to global warming may assume a pattern which is presented in Figure

There are six key socio-economic sectors, namely agriculture, public health, water resources, forestry, coastal zone and biodiversity of fish species. Vulnerability Level (VL) and its “Criteria and Scores” for States and Divisions were judged as three levels of High (H), Medium (M) and Low (L), numerically 3, 2 and 1. Indicators for each of the six key sectors were identified to evaluate vulnerability scores. The Confidence Level (CL) of the indicators from all sectors for the States and Divisions were then evaluated. The Affected Level (AL) is the last or 3rd basic factor of the climate change impact on the key socio-economic sectors for the calculation of vulnerability indices. It is derived from the 1st and 2nd factors of the Vulnerability Level (VL) and Confidence Level (CL) by the V & A Assessment team.



### The potential hazard levels for climate change features due to global warming

**3.3 Vulnerability Indices (VI) and maps** – Using the specified equation of the Vulnerability Index (VI), Sector scores (S) and their Mean score (SM) were worked out for the States and Divisions. The vulnerability index is obtained by treating the mean vulnerability score with population density level of State/Division. For Myanmar, highest sector score for Vulnerability is in the public health sector, followed by biodiversity, water resources, forestry, coastal zone and agriculture sectors. The Research programmes in the areas of (i) Climate variability, (ii) Climate change, (iii) Tropical storms, (iv) Drought and precipitation trends and (v) Extreme climates in relation to El Nino, among others, are to be targeted. Policy and Adaption options for agriculture, public health, water resources, forestry, coastal zone, biodiversity of fisheries were comprehensively considered.

## 4. MITIGATION OPTIONS ASSESSMENT AND STRATEGIES

**4.1 Mitigation Options Assessment for key Socio Economic Sectors** - Myanmar is under no obligation to quantify reduction of greenhouse gas (GHG) emission. However, GHG emission mitigation options assessment was made and strategies were developed for the key socio-economic sectors.

Energy Sector – Carbon dioxide CO<sub>2</sub> emission reduction from the energy sector can be focused on (i) energy conservation or efficiency improvements, (ii) replacing carbon-intensive energy sources with less intensive sources, and (iii) promoting new and renewable sources of energy. In Myanmar, it can be done by increased utilization of hydropower, increased use of solar power, use of electric vehicle, recycling of used engine oil through refining, and by recovering and recycling of HFCs. For transportation, primary mitigation options will include road maintenance, and fuel switching from petroleum to CNG.

Agriculture and Livestock Sector - GHG emission mitigation in agriculture can be effected through (i) mitigation of CO<sub>2</sub> emissions from crop lands, biomass, crop residues and by-products, (ii) mitigation of CH<sub>4</sub> emissions through fertilizer management, water management, and selection of high yielding rice cultivars, (iii) mitigation of NO<sub>2</sub> emissions from agricultural soils through the use of slow release fertilizer, sulphur addition and surface application of liquid manures, and also by developing organic farming, and (iv) mitigation by reducing field burning of crop residues via compost making and organic agriculture. Mitigation of methane emissions from livestock could be done by decreasing the number of ruminant animals, by improving manure handling, and by improving enteric fermentation process in ruminant animals.

Land Use Change and Forestry - Forestry mitigation measures include forest protection, afforestation, reforestation, improvement of tree species and stands, natural regeneration, conservation of natural forests, community forestry, agroforestry, dissemination of improved cooking stoves and use of forest products on sustained basis.

Waste Sector - In Myanmar, approaches such as waste disposal, waste recycling, and waste reduction are being employed in managing waste. Under the current domestic sewage system, waste water is discharged into sewer using huge amount of treatment water.

### 4.2 National Strategies for GHG Emission Reduction

Energy Sector - Emissions from the energy sector are not significant at present. Energy efficiency, reduced use of non-renewable energy resources, promotion of renewable energy and increased production level of energy are among the imperatives of energy policy laid down by the Ministry of Energy. In Myanmar, energy produced from hydropower and biomass shares about 67 percent of total energy consumption.

Agriculture and Livestock Sector - Ammonia (NH<sub>3</sub>) emission adversely affects environment, human health and crop nutrition. Any abatement strategies to reduce NH<sub>3</sub> emission support agro-ecosystem sustainability. NH<sub>3</sub> emission is considered not only as a serious environmental problem but as an agronomic problem of nutrient loss also. Deposition of emitted NH<sub>3</sub> can cause soil acidification, eutrophication and indirect enhancement of greenhouse gas, N<sub>2</sub>O. From side of agriculture ammonia emission is the primary loss of nitrogen from rice fields, which are fertilized with animal waste slurry. Keeping the flooded water table about 10cm high at the time of Anaerobically Digested Slurry (ADS) application, ammonia volatilization from ADS treated paddy soil will be significantly reduced. It could also be suppressed by adding organic waste and wood vinegar for neutralization. Use of genetically improved breeds, reduction of livestock numbers, increase in animal productivity, improved higher forage quality, and better nutrient composition are the mitigation options, currently



feasible at the farm level in Myanmar. Use of urea molasses mineral blocks (UMMB) was introduced by some projects in cooperation with international organizations.

*Land Use Change and Forestry* - In forestry sector, the mitigation strategies are usually not aimed at only to reduce carbon emission but also increasing carbon sequestration. Forest mitigation options will include mainstreaming climate change concerns into forest policy and legislations, improved forest management, habitat management for wildlife and wild plants, forest protection, afforestation and reforestation, and reduced firewood cutting. Promoting carbon trading is also a promising mitigation strategy.

### **Waste Sector**

*Development of Industries in Myanmar* - In Myanmar, both municipal waste and industrial waste have been increasing rapidly. By 2002, 83 main industries and 61 sub-industries under the six branches of the Ministry of Industry No.1 are producing 542 kinds of various goods including textiles, garments, foodstuffs, etc. There are nine major factories under the Ministry of Industry No.2 in 2002. The factories are also producing various kinds of goods, including tires and tubes, trucks, light vehicles, bicycles, etc. There are also several co-operatives and private-owned industries of various scales. Moreover, the government has established 27 industrial zones in year 2000. The total number of factories established was 60,513 in 2006.

*Greenhouse Gas Emission Reduction* - In waste management, waste production, waste distribution and waste consumption are involved. Recycling of plastic wastes, and reuse and recycling of wood and agricultural residues are being promoted in recent years.

*Appropriate Mitigation Strategies for Municipal Solid Waste* - Development with zero emission has been a growing concept of global acceptance. Use of “waste to energy” plants is also growing. With regards to the management of Municipal Solid Waste (MSW), there are four options and they are — (i) anaerobic digestion of bio-waste (ii) ‘Round-trip Paddling Fermenter (RTF)’, (iii) Refuse-Derived Fuel (RDF) system, and (iv) use of waste-to-energy power plant.

## **5. DEVELOPMENT AND TRANSFER OF ENVIRONMENTALLY SOUND TECHNOLOGIES**

Environmentally Sound Technologies (ESTs) are technologies that "protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they are substitutes". It can therefore improve environmental performance relatively better than other technologies.

Being a developing country depending mainly on the primary sector such as agriculture, livestock and fisheries, and forestry, Myanmar is vulnerable to climate change. At the same time, as the industrial sector has been expanding since the last two decades, Myanmar also has the potential for GHG emissions. Therefore, the transfer and development of ESTs are important for adaptation as well as for mitigation and prevention purposes. In order to identify ESTs need for mitigation of, and adaptation to climate change, Technology Needs Assessment (TNA) was carried out by the National Commission for Environmental Affairs (NCEA) under the Initial National Communication (INC) project.

It was observed that large segment of the industrial community in Myanmar are not aware of the industry related environmental problems and many factories are still using old machines, obsolete technologies and old trucks that mostly emit smoke and exhaust gases. Many factories have to keep and use power generators which emit hazardous gases due to lack of constant electric power supply. Waste water treatment and disposal systems are lacking in most industrial zones.



The survey revealed that there are many industries that have much interest in securing ESTs. Most of them mentioned that they required 3Rs, incineration and final disposal technologies. Most private and government owned industries do not have separate or special funds for environmental programs. From the present pilot TNA carried out in cooperation with the New Energy and Industrial Technology Development Organization (NEDO) of Japan, it was found that most ministries and the industries preferred renewable energy technologies, energy saving technologies, energy efficient technologies and cleaner technologies.

Based on the concern of the ministries and industries, the most appropriate and suitable ESTs could be identified. From the TNA survey, it is obvious that there is a great need for ESTs in Myanmar for both mitigation and adaptation purposes. Supports from the government as well as from the multilateral and bilateral sources are much needed for the transfer of ESTs to Myanmar. A technology information network and information clearing house on EST are being initiated by the NCEA. EST database is being developed at the NCEA using the information and data obtained through TNA. Network members from the ministries, departments concerned and all related organizations have been identified.

## **6. RESEARCH AND SYSTEMATIC OBSERVATION**

Department of Meteorology and Hydrology (DMH), Myanmar has been taking meteorological, hydrological and seismological observations since the late 19<sup>th</sup> century and became a member country to World Meteorological Organization (WMO) in 1951. Currently, DMH has 161 observatory stations across the country. According to the data collected since late 19<sup>th</sup> century, the long-term average annual rainfalls were 5011 mm in Sittwe, 912 mm in Mandalay, 2629 mm in Yangon and 4137 mm in Myeik,

For the period 1991-2000, annual mean temperatures in Sagaing, Magwe, Bago and Yangon Divisions had decreased by a range of 0.2°C-0.8°C while those of the rest of the States/Divisions had increased by a range of 0.1°C-0.6°C. The areas with higher latitudes in northern and central parts experience a trend of change from warming to cooling starting from 1977. Annual mean rainfalls of Shan State, Sagaing and Bago Divisions had decreased by 58 mm, 6 mm and 65 mm respectively, and the rest of the States/Divisions had decreased within the range of 2 to 339 mm.

### **6.1 Research on Climate Change**

Region-wise annual mean temperature - The lowest annual mean temperature of Myanmar is 15.8°C in Chin State followed by 19.1°C in Eastern Shan State, 27.4°C in Yangon Division and the highest 27.5°C in Magway Division for the WMO normal period 1961-1990. There is the general warming trend of mean annual temperatures in the whole country since the year 1979. For the longer term of 1951-2007, the highest warming rate per decade was 0.32°C in Kayin State, and cooling trends of -0.23°C and -0.16°C per decade were observed at Magway and Bago Divisions respectively.

Region-wise extreme mean temperature - During 1951-2000, annual mean frequency of heat wave occurrence in Myanmar was 15. The most extensive heat wave covering up to 60% of the country occurred in 1998, the ENSO year.

Region-wise annual mean rainfalls - The lowest mean annual rainfall of 768 mm is observed in Lower Sagaing. It increases eastward to about 1500 mm over Shan State, northward to about 2000 mm over Kachin State, westward to 4700 mm over Rakhine State and southward to 5400 mm over Taninthayi Division. Up till 2007, increasing rainfall trends were observed in many regions of the country, but decreasing rainfall trends observed in some.

Extreme rainfalls - Over the period 1991-2004, high extreme rainfalls with maximum frequencies of 5 years occurred at Nyaung-U station and low extremes occurred at Monywa with maximum

frequencies of 5 years. The stations with maximum frequencies of low to lower extremes were observed in the Dry Zone. During 1961-1990, about 94% of 24-hour heaviest rainfalls occurred in the "early to peak monsoon (mid-May to August)".

Cyclones - During 1887-2005, there were 1248 tropical cyclones in the Bay of Bengal. Of these, 80 cyclones crossed Myanmar coast, i.e. about one every other year. But, Myanmar coast was hit by cyclones every year after 2002 except for 2005. Low lying areas along the rivers are subject to normal floods during monsoon and multiple floods occur when monsoon is intensified at its peak. Dry Zone also experiences catastrophic floods when heavy rains occur for days.

Southwest monsoon - The onset of southwest monsoon into the country is becoming late and its withdrawal is advancing earlier. For 1988-2000, the monsoon duration was shortened by three weeks in Northern Myanmar and one week in other parts compared to 1951-2000 average. But post-monsoon rains can occur due to the influence of cyclonic disturbances in the South China Sea.

Drought can occur in a number of areas in the country. In the Dry Zone, 1954, 1957, 1961, 1972, 1979 and 1991 are the year most affected by drought. All the years, except 1988-89, were strong to moderate El Nino years.

ENSO, El Nino and La Nina - Over the past 40 years, all ENSO years resulted in large deficient rainfall in Myanmar. Recently, the ENSO years in Myanmar were 1982- 83 and 1997- 98. Maximum highest temperature records were set in 1998 ENSO year in almost the whole country except Sagaing Division and Kachin and Chin States.

During the period 1900-2008, Myanmar had strong El Nino events in 1901-02, 1913-15, 1918-20, 1972-73, 1986-88 and 1991-92. Very strong El Nino occurred in 1940-41, 1957-58, 1982-83 and 1997-98. In general, monsoon onsets are late and the withdrawals are earlier in El Nino years, compared to the normal. There have been records of highest maximum temperatures and lowest annual rainfalls in El Nino years.

The 1950, 1956, 1964, 1970, 1975, 1989 and 1999 were the La Nina years. Despite the widespread occurrence of temperature rise in the last two decades, record low minimum temperatures occurred at many stations in the cool season of 1999, a La Nina year.

**6.2 Warning Systems on Natural Disasters** - Cyclones in the Bay of Bengal usually accompanied by strong winds, heavy rainfall, floods and storm surges, can cause loss of lives and destruction of property and infrastructure. DMH has established five Meteorological and Early Warning Centers for the issuance of various hazard warnings as required. Myanmar is able to issue warnings on storms, flood and tsunami in advance of 5-7 days, 2-3 days and a few hours respectively.

**6.3 Networking** - Myanmar has been working with a number of organizations such as WMO, IPCC, UNFCCC, UNEP, UNESCAP, UNESCO, JICA, etc. to jointly undertake a wide range of projects and programmes. Myanmar has also been studying and investigating important issues on air pollution, oceanography, marine meteorology and climate change in cooperation with ASEAN, BIMSTEC, India, China, Korea Republic, Thailand and US.

**6.4 National strategies for promoting RSO** - National strategies for promoting Research and systematic observation (RSO) are identified and they are: (i) to strengthen climate change research, (ii) to upgrade facilities and technologies with the increased use of automation system and digitization, and (iii) to enhance capacity building.

**6.5 Research on Climate Change** - Climate research will particularly focus on the areas of climate variability, climate change, tropical storms, droughts and El Nino in Myanmar. Technological and

financial support and human resources development are in need of strengthening. The need for information networking at all levels is imminent.

## **7. REPORT OF EDUCATION, TRAINING AND PUBLIC AWARENESS ON CLIMATE CHANGE**

The 1997 Myanmar Agenda 21 has identified activities which are to be implemented to strengthen environmental education and awareness programmes. During the period of 2008-2010, a number of activities for Education, Training and Public Awareness on Climate Change (ETPA) were implemented in line with those identified in the Myanmar Agenda 21, 1997. The ETPA activities implemented focused on: strengthening education and training; and public awareness raising.

For strengthening education and training, three activities were undertaken:

- (i) Development of information, education and communication (IEC) material - Under this activity, a manual of WHO on climate change was translated into Myanmar version to be used as a reference by students and families in Myanmar; a pre-tested tool kit of climate change communication was developed for field extension agents; the climate change video "Inconvenient Truth" was translated into Myanmar version for use as a visual aid in trainings; and a calculation sheet for self-examination of ecological footprint was produced.
- (ii) Training of government officials on climate change - A six-day course, participated by 29 officials representing relevant but different government agencies from various regions across the country was organized.
- (iii) Training on environmental journalism and climate change communication - The training was organized for local media groups, and follow-on information-sharing meetings between the ETPA team and trained journalists had occurred, resulting in increased number of climate-related articles in weekly journals locally published.

For public awareness raising, four activities were undertaken:

- (i) Public awareness survey - One- page self-administered questionnaire was prepared and circulated to the public and NGOs via local media throughout the country. The survey indicated the need for establishing more of social networks to enhance the effectiveness in public awareness raising.
- (ii) Stakeholder awareness raising workshops - Two stakeholder workshops were organized to raise the awareness of private business sector, civil society and NGOs through consultative process. As a result, UNDP formed a tri-partite steering committee for setting up a small grant scheme, under which NGOs and CBOs could initiate grassroots-level climate change adaptation programmes.
- (iii) Nation-wide public awareness raising campaigns - Public awareness raising campaigns were organized at township, district and state/division levels across the nation, and the target audiences were local authority, government officials, non-state actors and community leaders at each level. During each campaign, participatory group discussions were made to analyze greenhouse gas emissions and extreme weather events.
- (iv) Climate Information Center:

Nearly 500 information materials on various aspects of environmental conservation and climate change were collected by the ETPA team and a Climate Information Center (CIC) that was established at the office of Forest Academy and Advisory Group in Yangon. The collected materials were made available to all stakeholders.

## **8. INTEGRATION OF CLIMATE CHANGE CONCERNS INTO DEVELOPMENT PLANS AND PROGRAMMES**

In Myanmar different ministries and organizations used to undertake development measures within their mandates to achieve their set targets very often in isolation. The coordinated efforts between the ministries have been insufficient to put the country in the right track towards sustainable development. As the National Environmental Policy stipulates, the development activities must integrate environmental considerations in order to achieve harmony and balance between national wealth, national cultural heritage and natural resources. In this context, line ministries and all other related organizations must cooperate with one another and work hand in hand closely so that national economic targets are met in harmony with environment, culture and natural resource development. This calls for a strong mechanism that could create and ensure inter-ministerial cooperation and coordination.

Regarding environment, the national Commission for Environmental Affairs (NCEA) was established in 1990 to act as a central body to coordinate and oversee environmental concerns. NCEA operating directly under the guidance of the National Cabinet of Ministers comprises a chairman, a secretary, and a joint-secretary. It has the following four subcommittees each headed by a deputy minister:

1. Sub-committee for Pollution Control
2. Sub-committee for Natural Resource Conservation
3. Sub-committee for Training, Research & Education, and
4. Sub-committee for International Relations NCEA had been able to develop National Environmental Policy which was adopted in December 1994, draft the National Environmental Protection Law (NEPL), which is still pending for adoption, and formulate Myanmar Agenda 21 (MA21) in 1997.

The current process of national development and planning in Myanmar does not provide a systematic means for the integration of environmental dimensions (MA 21 ).Climate change is one of the hottest environmental issue to-day and NCEA is well placed to undertake the task of coordinating line ministries and ensuring the integration of climate change concerns into the national and sectoral development plans and programmes.

There are in existence a number of legal frameworks and legislations. All of them deal with the general protection of the environment in one way or another. Some of the legislations date back to as far as the latter part of the 19th Century, during which the very first law on water pollution, the Penal Code, was enacted in 1860. Myanmar Environmental Protection and Conservation law has been drafted. The following are the Myanmar legal frameworks on environmental protection enacted during a span of about one-and-a-half centuries, listed in chronological order.

1. Penal Code, 1861
2. Yangon Waterworks Act, 1885
3. Canal Act, 1905
4. Yangon Port Act, 1905
5. Port Act, 1908
6. City of Yangon Municipal Act, 1922
7. Emergency Provisions Act, 1950
8. Factories Act, 1951
9. Territorial Sea and Continuous Zone Law, 1977
10. Law Relating to the Fishing Right of Foreign Fishing Vessels, 1989
11. Myanmar Marine Fisheries Law, 1990
12. Pesticide Law, 1990
13. Fresh Water Fisheries Law, 1992
14. Development Committees Law, 1993
15. Myanmar Hotel and Tourism Law, 1993
16. Protection of Wild Animals, Wild Plants and Preservation of Natural Areas Laws, 1994

17. Myanmar Mines Law,1994
18. NCEA Law for Myanmar Environmental Protection and Conservation Law has been drafted
19. Conservation of Water Resources and River Law, 2006

To integrate environment and development, the particular emphasis has been placed on key economic sectors for which GHG inventory was undertaken for the preparation of Myanmar's first Initial National Communication. These economic sectors are

1. Energy,
2. Industrial processes,
3. Agriculture including livestock,
4. Land use change and forestry, and
5. Waste.

Integration of climate change concerns (CCCs) into development plans and programmes is of vital importance to Myanmar in view of further enhancing its low-carbon economy and reducing its vulnerability to climate change challenge. Myanmar has been implementing low carbon economy, significantly contributing to the global efforts of stabilizing atmospheric CO<sub>2</sub> concentration below dangerous levels.

Sectors	Policy	Strategies	Actions	
			Mitigation Measures	Adaptation Measures
<p><b><u>Energy Sector</u></b> In the fourth Short-Term Five-Year Plan (2006/2007 to 2010/2011) of the national 30-year development plan for the energy sector placed its emphasis on environmental conservation while producing more crude oil and natural gas</p>	<p>1) to enhance energy conservation, efficiency and production and ensure energy security 2) to promote efficiency of national transportation system, regulation of imports of second-hand motor vehicles</p>	<p>1) perform energy audit 2) tap all potential power sources including renewable energy 3) improve traffic demand management 4) establish national ambient air quality standards</p>	<p>1) set energy efficiency standards and label efficiency grades on products 2) provide advices, inspection, incentives for energy conservation and efficiency 3) capture fugitive gaseous emissions 4) develop voluntary agreements for increased use of energy efficient products 5) invest more on and promote the use of cleaner and zero-emission energies 6) construct more hydropower facilities where EIA permits 7) upgrade existing power-generation and transmission systems 8) extract coal-bed methane 9) promote bio-energy production from available sources without compromising food security and viability of forests and soils 10) further promote and expand CNG-used vehicles and CNG pipelines and stations 11) improve all transport modes and traffic demand management, including cycling and containerized freight transport 12) install more light-emitting diodes for traffic lighting</p>	<p>1) adopt environmental standards for energy efficiency 2) construct buildings with designs to increase cross ventilation, prevent direct sunlight in the afternoon and reduce heat gains with shade covers 3) increase the use of fuel-efficient motor vehicles 4) make all public transports more attractive and affordable 5) raise public awareness on GHG emission reduction and energy conservation 6) build institutional capacity to monitor ambient air quality.</p>
<p><b><u>Industrial Processing Sector</u></b> Ministry of Industry 1 and Ministry of Industry 2, are producing various kinds of goods. The sector has some joint ventures with foreign companies. Between 1995-96 and 2005-2006, 18 industrial zones were established</p>	<p>1) to adopt energy efficiency standards and labelling system 2) to prohibit manufacture and import of GHG inefficient products 3) to promote energy efficiency and emission control technologies.</p>	<p>1) practice Green Certification System 2) introduce clean technologies 3) promote cleaner production.</p>	<p>1) set high energy efficiency and environmental standards 2) conduct at each industry, Efficiency Audit and provide green labels and tax benefits to the industry and product that meet the set standards 3) further promote the use of CNG, LPG and renewable energies by providing incentives.</p>	<p>1) encourage the use of more energy-efficient boilers, motors, furnaces and electrical equipment 2) introduce energy-saving, process-specific technologies 3) initiate the development of carbon capture and storage for energy-intensive plants 4) implement energy-saving regulations and improved energy management systems 5) provide energy efficiency-related</p>



				information services 6) conduct advocacy extensively on conservation of energy and utilization of cleaner energy
<p><b><u>Agriculture Sector including</u></b> For agricultural sector, Myanmar Agenda 21 has identified two programme areas, namely, 1) <i>Promote Sustainable Agriculture, Livestock and Fisheries Development; and</i> 2) <i>Enhance Food Security.</i> Irrigation coverage had increased from 12.5% in 1987-88 to 29.4% of the total rice land in the year 2000. Summer rice cultivation has been introduced since 1992 and rice production increased from 21 million tons in 2000-2001 to over 31 million tons in 2007-2008. In general, cattle and buffaloes are part of Myanmar farming system. However, feed resources are scarce and of poor quality especially during the dry season, resulting in low productivity. Emissions of CH<sub>4</sub> and N<sub>2</sub>O are likely to increase due to the expansion of agriculture with more fertilizer inputs and increasing population of livestock.</p>	<p>1) to follow Code of Good Agricultural Practice (CGAP) 2) to ensure increased food production in the climate friendly and resilient manner 3) to improve livestock management and livestock feed.</p>	<p>1) to improve paddy rice planting patterns and water management 2) to promote organic farming 3) to do research and development on crop varieties adaptable to climate change 4) to breed genetically improved strains of animals and regulate their population 5) to improve manure management and animal feed with quality forage and mineral supplements.</p>	<p>1) reduce tillage and practice intermittent irrigation, proper selection of rice varieties and crop rotation in rice fields 2) promote "Conservation Agriculture", "Sloping Land Agricultural Technology" and other climate friendly advanced technologies 3) improve water, crop and crop residue management 4) promote organic farming and bio-fertilizer use 5) reduce the use of mineral fertilizers 6) apply phosphor-gypsum with urea 7) apply slow release fertilizer 8) apply integrated pest management 9) improve and expand pastures, grasslands and forage and its quality 10) improve the use and management of animal waste to harvest producer gas and to use gasification effluent as bio-fertilizer 11) supplement poor quality roughage with minerals, urea molasses, legume or other agricultural bi-products.</p>	<p>1) adjust cropping systems, improve farm management including post-harvest treatment 2) use stress-resistant plant varieties and ensure climate-resilient agriculture 3) promote water use conservation and efficiency 4) expand water impoundment systems through clusters of smaller dams, ponds, etc. 5) promote organic farming and use of bio-fertilizers 6) popularize dry-land agricultural technologies, preserve soil moisture, foster soil fertility and further increase river water pumping and ground water harvesting particularly for dry zone agriculture 7) further strengthen weather forecasting and early warning system 8) make more investment to reduce climate change risks 9) protect grasslands and pasture against fires, over-grazing and soil and water erosion 10) add fermentation-control medicine, fermentation stabilizers and micro-organism repressors to animal diets 11) protect livestock against heat stress and strong winds 12) breed high-quality varieties for increased per head production.</p>

<p><b><u>Land Use Change and Forestry Sector</u></b>  Forest cover still constitutes about 50% of the country's land area. But annual deforestation rate was estimated at 466,420 ha during 1989-1998. To check and reverse this trend of forest depletion and degradation, reforestation has been sped up. Private companies and individuals have been actively establishing forest plantations since 2005. Both GHG inventories conducted in 1990 and 2000 had testified that Myanmar was a net CO<sub>2</sub> sequester.</p>	<p>1) to promote carbon sequestration through sustainable forest ecosystem development  2) Change of land use to be preceded by EIA in accord with broad National Land Use Plan.</p>	<p>1) to introduce private forestry  2) to manage state and non-state forest ecosystems in a sustainable manner  3) to intensify re-forestation programs  4) to promote community forestry and urban tree planting  5) to encourage manufacture of long lasting value added forest products  6) to develop national land use plan, to let EIA precede any major land use change.</p>	<p>1) protect existing forests effectively  2) expand forest extent, increase forest density and growth  3) maintain structural diversity of forest and species mixture  4) restore forests  5) conserve biological diversity and productivity with emphasis on genetic diversity  6) expand Protected Areas System  7) recover and conserve endangered species, and protect habitat loss and deterioration  8) avoid clear felling of forest in timber harvest, practice reduced impact logging and restore harvested areas  9) increase advocacy and educate public on community forestry (CF)  10) apply systems such as agro-forestry or aqua-forestry to establish CFs  11) continue the annual free distribution of tree seedlings for roadside and urban greening and consider incentives to ensure the survival of the planted trees  12) meet forest-related human needs  13) develop technologies for manufacturing superior quality end-use forest products for extended use  14) encourage the increased use of wood in place of fossil-fuel  15) strive for development and implementation of national land use plan to sustain permanent forest estate  16) conduct EIA and thorough cost-benefit analysis prior to deciding any major land use change</p>	<p>1) Enrich and sustain biodiversity  2) develop climate-resilient genetic strains  3) practice multi-culture and structurally complex forest ecosystems management  4) intensify mangrove re-forestation in coastal zones  5) establish an efficient fire fighting mechanism  6) promote private and community forestry  7) enhance public awareness and participation in managing the forests  8) educate public on climate change concerns</p>
<p><b><u>Waster Sector</u></b>  Since the inception of the market-oriented economic system in 1988, urbanization</p>	<p>1) to strengthen "Green and Clean Country" campaign to make the country</p>	<p>1) to minimize per capita waste generation  2) to recycle waste  3) to generate heat and electricity</p>	<p>1) reduce the volume of waste per capita  2) categorize waste and dispose it properly at designated landfills  3) collect fees for waste disposal</p>	

<p>and industrialization have accelerated in the country. Daily waste generation in Yangon increased three folds within 1990 to 2007. The emission will assume an upward trend with the improving economy coupled with increasing industrialization.</p>	<p>green and clean 2) reducing GHG emissions and environmental pollution</p>	<p>from waste 4) to advocate self-cleanliness and public hygiene 5) to enforce "Polluter Pay System"</p>	<p>4) fine heavily those who throw wastes recklessly 5) eliminate the use of polyethylene bags 6) expand waste treatment facilities 7) produce biogas for electricity generation at sewage treatment facilities 8) encourage waste recycle and waste reuse 9) promote market opportunities for recycled waste products 10) enforce regulations and standards for waste management 11) raise public awareness on waste generation and disposal.</p>	
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## 9. INFORMATION AND NETWORKING

Assessment and enhancement of information communication technologies - The existing ICT tools and communication facilities are not adequate in most of the government departments and other relevant organizations. Only a few experts in ICT are available, and more ICT trainings are needed. However, promotion of ICT has been undertaken jointly by the private computer associations and the government in recent years although many gaps and constraints such as financial and technical difficulties, poor infrastructure and frequent power failures still remain. Administrative restriction on the use of ICT is in existence and it could hinder ICT promotion. To this end, institutional strengthening including human resource development and skills and expertise on ICT are to be further enhanced in almost all the government organizations.

Establishment of information networks - The climate change information network has now been officially established at NCEA with initial 25 members from various government departments and local NGOs. NCEA has also established its own website [www.myanmar-unfccc-nc.net](http://www.myanmar-unfccc-nc.net). Training relating to the use of website has been provided for NCEA by a local company. In effect, Myanmar has laid down firm foundation further promoting climate change information sharing and networking within and outside the country.

## 10. CAPACITY BUILDING

Myanmar needs capacity building to be able to address climate change and its impacts and to satisfy their commitments to the Convention.

**10.1 Capacity-building Needs Assessment** - Myanmar undertook capacity-building needs assessment covering the areas of human resources, technology and environment. The assessment highlighted the needs of the institutions and organizations for man-power training, technology transfer and dissemination, institutional building, etc.

**10.2 Capacity-building Strategy** - The strategy involves three steps namely; capacity-building needs assessment, identification and formulation of priority capacity-building projects, and mobilization of resources for implementing the projects. Capacity building strategy could be applied on the national scale or on sector-wise basis. But implementation should be made on a continuous basis.

**10.3 Enhancement of International Negotiation Skills** - Capacity building to enhance the negotiation skills is largely needed in developing countries due to limited experience, limited expertise and knowledge and language barrier. In this respect, more seminars and workshops on climate change with the participation of relevant specialists and experts are to be organized.

## **11. OTHER INFORMATION CONSIDERED RELEVANT TO THE ACHIEVEMENT OF THE OBJECTIVE OF THE CONVENTION**

### **11.1 Programs and activities undertaken under various UN environmental conventions that are relevant to the achievement of the UNFCCC -**

United Nations Convention to Combat Desertification (UNCCD) related programs and activities - Myanmar acceded to the United Nations Convention to Combat Desertification (UNCCD) in January 1997. Even before acceding to the UNCCD, the Forest Department had implemented a special greening project for the nine districts in 1994. The project area was extended to 13 districts with the formation of a new Dry Zone Greening Department in 1997. Currently, there are 140 dams constructed in the Dry Zone with water shed areas of 4.5 million hectares. Rehabilitation and reforestation of mangroves is also being carried out in the Ayeyarwady delta region where large areas of mangrove forests had disappeared due to over-exploitation. Myanmar has also formulated a National Action Program (NAP) to combat desertification with 5 proposed projects particularly in the Dry Zone. The Dry Zone has now started to benefit from the greening activities thereby, achieving the objective of the UNFCCC.

Vienna Convention and Montreal Protocol related programs and activities - Myanmar also acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol in November 1993. The preparation of a Country Program which was supported by the UNEP and coordinated by the NCEA was completed during 1998 and 1999. Refrigeration Management Plan (RMP) was formulated in 2002 and was approved by the Multilateral Fund in 2005. A Memorandum of Understanding (MOU) on the Preparation of ozone regulations for the control of ODS, and monitoring implementation of the RMP was signed in 2008. The MOU on Provision of services and data collection for the formulation of the Hydrochlorofluorocarbons (HCFCs) Phase out Management Plan (HPMP) has also been signed.

Today, Myanmar has successfully phased out CFC consumption in all sectors. Awareness promotion activities on protection of the ozone layer, training programs for refrigeration and air conditioning service technicians, and training programs for enforcement officers have also been conducted.

Convention on Biological Diversity (CBD) related programs and activities - There is a loss of biological diversity due to social and economic pressures all over the world. Today, climate change is also posing threats to the biological resources. Conservation of biological diversity (CBD) is therefore being carried out by nations around the globe. Myanmar is making efforts for the conservation of biological diversity by, promulgating a Protection of Wildlife and Wild plants and Conservation of Natural Areas Law in 1994, formulating Myanmar Forest Policy in 1995, ratifying CBD in 1994, acceding to the Convention on International Trade on Endangered Species of wild flora and fauna (CITES) in 1997 and ratifying the Cartagena Protocol on bio-safety in 2008. NCEA is now initiating the development of National Biodiversity Strategy and Action Plan (NBSAP) with technical support from UNEP Regional Office for Asia and the Pacific (UNEP-ROAP). Conservation of biodiversity calls for protection of the habitats mainly forests, so that by

implementing the CBD, forests are being protected and conserved. In 2009, about 4.35% of the country area has been notified as protected area. Moreover, 34 protected areas, 3 zoological gardens, 1 botanical garden and a national herbal park have been established.

## ***11.2 Additional information considered relevant to the achievement of the objective of the UNFCCC-***

*Organizational improvement* - In addition to the NCEA which was formed in 1990 to manage and coordinate environmental matters in the country, and to act as the national focal point for environmental relations with other countries and international organizations, the Environmental Conservation Committee (ECC) was formed in 2004 to effectively carry out environmental conservation activities within the country. In recent years, there has been a substantial development in the formation of the non-governmental environmental organizations such as Forest Resources Environment Development and Conservation Association (FREDA), Biodiversity and Nature Conservation Association (BANCA), Wildlife Conservation Society (WCS), Ecosystem Conservation and Community Development Initiative (ECCDI), Renewable Energy Association Myanmar (REAM) etc; that are doing environmental promotion matters including climate change mitigation and adaptation related matters.

*International cooperation for addressing climate change* - After signing the UNFCCC in 1992, Myanmar ratified the convention in 1994. The country regularly participated in the COPs of the UNFCCC and its subsidiary bodies meetings. It was one of the 12 participating countries in the ALGAS project, and ratified the Kyoto Protocol in 2003. Regarding CDM projects, there has been some cooperation between Myanmar and Japan. The Designated National Authority (DNA) of Myanmar was established in 2006 for approving and providing information on proposed CDM projects. In order to make Myanmar safer and more resilient to natural hazards after the country suffered from a disastrous cyclone Nargis in 2008, the National Disaster Preparedness Central Committee (NDPCC) was formed in the same year. The Committee is chaired by the Prime Minister and has 38 members. Myanmar Action Plan on Disaster Risk Reduction (MAPDRR) 2009-2015 has been prepared. The Plan has identified projects and activities which are necessary to meet the Hyogo Framework for Action (HFA) and ASEAN Agreement on Disaster Management and Emergency Response Commitments.

## **12. CONSTRAINTS AND GAPS, AND RELATED FINANCIAL, TECHNICAL AND CAPACITY NEEDS**

### ***12.1 Development of national greenhouse gases inventory***

*Present efforts in national greenhouse gases inventory* - Very limited activities on climate change have been carried out in Myanmar apart from the preliminary greenhouse gases (GHG) inventory and mitigation options assessment undertaken in the ALGAS-study. Cooperative efforts of the United Nations, e.g. IPCC, UNEP, international organizations and Non-Government Organizations, are important to address the climate change issues and research activities. The challenge for Myanmar is to manage and reduce the risks to human health from development activities.

*Data availability constraints* - Lack of user-friendly database on ESTs, including endogenous technologies is an example of such constraints. Climate data quality needs to be further enhanced. Analysis of existing hydrological and meteorological data by local expertise must be immediately conducted. There are no forecasts of El Nino Southern Oscillation (ENSO) events in Myanmar. The methods used for the development of Vulnerability indices & maps need to be elaborated.

*Needs for GHG-inventory on a continuous basis* - CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O data need to be updated and extended based on the COP-8 Guidelines. Individual researchers in various sectors should be trained, and GHG-inventory needs to be conducted on a continuous basis.

Energy and Industrial Processes Sectors - constraints and needs - Greenhouse gas inventory for energy sector include CO<sub>2</sub> and N<sub>2</sub>O emissions from fossil fuel combustions, CH<sub>4</sub> emissions from fugitive coal mining and post-mining activities, fugitive oil and natural gas system, and NMVOC from fuel combustion. A wide variety of industrial activities produces greenhouse gases as a by-product. The total CO<sub>2</sub> emissions from the industrial processes in Myanmar were estimated at 248.59Gg in 2000.

Agriculture sector - constraints and needs - The misuses and excessive use of chemical fertilizers and pesticides, the production of CH<sub>4</sub> from paddy fields and ruminant animals, and of CO<sub>2</sub> from the burning of fossil fuel, land clearing and organic matter decomposition have often adversely affected the environment and created many problems. Promotion of a balanced and efficient use of plant and animal nutrients to intensify agriculture in sustainable manner is needed.

Waste sector - constraints and needs - GHG inventory for the waste sector mainly includes CH<sub>4</sub> emissions from MSW and domestic & industrial wastewater. In rural areas and small towns, there is no systematic collection of waste.

Land use, land use change and Forestry sector - constraints and needs - Countrywide, the annual deforestation was 0.3%, which is only slightly above the global average. Forest losses are greatest in the mangrove forests of the Ayeyarwady delta, where as much as 20% of mangrove forests disappeared in only 10 years. Agricultural expansion is driven by human population growth, and its effects on natural habitats are exacerbated by the lack of comprehensive land use policies and planning. Species-specific and ecological zone-specific data are still lacking. The dry matter (biomass)-based inventories for planted species should be carried out. Reliable data on types of fire, actual area burnt annually and greenhouse gases emission are still lacking.

**12.2 Financial Needs** - Lack of financial resources for climate change outreach programmes and activities is obvious in Myanmar at present. Myanmar's contribution to the mitigation of and adaptation to global climate change depends to a great extent on transfer of technologies and capacity building, as well as on funding support. Due to the lack of financial resources, not much has been done in Myanmar to raise the public awareness on climate change issues. The UN system has an important role to play in supporting and enabling developing countries to participate in the carbon market and prepare for future funding opportunities to catalyze climate action.

### **12.3 Technical Needs**

Technology needs for mitigation of climate change - Updated and improved cost-effective mitigation options assessment for CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, and new assessment of mitigation options for CO, NO<sub>x</sub>, Non-Methane Volatile Compound (NMVC), SO<sub>2</sub>, HFCs, PFCs and SF<sub>6</sub> for the year 2000, including appropriate mitigation technologies, are needed. Lack of legal and economic instruments for mitigation measures, lack of a national strategy for GHG mitigation, and lack of technical capacity in quantitative mitigation options analysis, including application of relevant methodologies as well as capacity-building are undoubtedly obvious. Technical capacity to effectively integrate V&A assessment and mitigation options analysis into sustainable development programmes, and hence to develop national adaptation and mitigation programmes of action is still lacking.

Technology needs for adaptation to climate change - No previous studies on the vulnerability of Myanmar to climate change have been undertaken, and hence no adaptation strategy or action plan has been developed. Thus, all selected priority areas will require participatory rapid appraisals (PRAs) with the aim of collecting information on vulnerabilities to climate change. Cost-effective technological and policy adaptation measures that are appropriate to Myanmar should be identified. Direct statement of policies on climate change adaptation is lacking

Systematic observation and research on climate system - Inadequate computers and internet access, limited climate change related information to function as a clearing house, and limited practice of sharing information among departmental personnel are most commonly obvious. Lack of training, lack of information and lack of experience on Environmentally Sound Technologies on Information System (ESTIS) are also constraints in this regard. The hydro-meteorological data sets provide a long-term baseline against which the impact of change in land use and land management on water quality and quantity can be measured. Such information is useful for other researchers, in particular, for understanding issues to do with global climate change. Traditional water management system can no longer meet the requirements of the market economy. Adaptation measures for water scarcity and drought include water supply and demand management, improved watershed management, water conservation and increased storage of water.

To enhance the systematic observation and research activities, technical/ financial/ expertise support will certainly be necessary from various international/ regional organizations. Research works of climate change will be particularly focused on El Nino, ENSO, tropical storms and associated hazards and droughts in Myanmar. Myanmar has signed some 30 international and regional environmental treaties and conventions.

#### **12.4 Needs for capacity building**

An overview of capacity needs - Limited capacities at all levels relating to climate change issues, namely (i) in climate change negotiation, (ii) in preparation of climate change projects for bilateral and multilateral funding, (iii) in assessing the impacts of both technological and policy measures for mitigation and adaptation, and (v) in effective implementation of various multilateral environmental agreements, including the UNFCCC, are prominent barriers. Climate change information network should be strengthened nationally/regionally and internationally. Capacity development in DMH, universities and related institutions is also another area of gap in the country.

Training needs for the development of greenhouse gases inventory - Capacity building in IPCC-methodologies for GHG-inventory and also in V&A assessment, urgently needed. Lack of human and institutional capacity in assessing, evaluating and verifying ESTs, and inadequate human and institutional capacity in climate data monitoring are gaps to be bridged. Myanmar has very limited capabilities that are required for the country to fulfill its commitments to the Convention.

Initiating programmes of school education and public awareness on climate change - There is a general lack of outreach materials, especially in Myanmar language on climate change issues for different target groups. In school level education, it is preferable to integrate environmental issues into existing subjects in the curricula, rather than attempting to introduce environment as a separate subject. Findings of climate change research carried out in universities and other institutions need to be continually made available in appropriate form for use by schoolteachers. It is desirable for practical activities on climate change and environmental studies to be based, on traditional conservation practices, and to involve interaction of schoolchildren with local villagers so that they can understand the issues. Public education, awareness, and training programmes need to be conducted on a large scale throughout the country with particular emphasis on pollution, natural resources depletion and global climate change.

Formulation of the communication network among researchers, institutions and policy-makers- Climate change policy, strategy and programmes, as well as the integration of this policy and strategy into sustainable development are needed. There is also a need to introduce and strengthen community education on climate change and disaster preparedness.

There is lack of policy measures to integrate climate change concerns into national long-term socio-economic and environmental planning. Building up a critical mass of human resources with required skills, is a basic need for any progress in the institutional framework. The formulated



National Environmental Policy calls for harmony and balance between environment and development through the integration of environmental considerations into development process and it forms the basis for developing environmental strategies, programmes and plans. However, Myanmar does not yet have a national environmental law though a draft of such law has been prepared.

Myanmar has undertaken a few activities relating to other Multilateral Environmental Agreements (MEAs). Although Myanmar has prepared its national Agenda 21, the issue on the integration of climate change concerns into sustainable development plans and programmes has not yet been addressed.

*Activities for overcoming gaps* - Some attempt will be made to estimate the GHG emissions from slash and burn, especially in rural areas. The activity data of HFCs, PFCs and SF<sub>6</sub>, which are controlled by the Kyoto Protocol, will also, be collected for the same base year where available. An improved factor of CO<sub>2</sub> emission/sink from/to soils in Land-Use Change and Forestry in the region with similar conditions to Myanmar will be assessed and identified. CH<sub>4</sub> emission factor from rice fields and agricultural soils will also be assessed and identified.

As far as capacity-building is concerned, it would be appropriate to maximize the synergies for implementing the UNFCCC and other global environmental agreements, such as CBD and UNCCD. The National Capacity Needs Self-Assessment (NCSA) project for Global Environmental management would provide a good basis for such synergies.

### **13. CONCLUSION**

Myanmar is still rich in almost all kinds of natural resources both underground and above ground, and onshore and offshore. However, they have been depleting, some gradually and others drastically, due to illegal exploitation, legal but reckless harvests for national economic development, and most unfortunately mismanagement. To make the situation worse, the adverse impacts of the climate change have now come that will help speed up the resource depletion and disrupt the livelihoods of the grassroots poor, farmers in particular, who are dependent on agriculture, fisheries, livestock and forestry all of which are very vulnerable to climate extremes.

Myanmar has proved more than being a carbon sink nation, with a net removal of 67,863 Gg CO<sub>2</sub>e in 2000, which had been made possible by the vast forest resources. Adaptation to climate change, like promoting re-forestation and forest conservation programs, encouraging conservation agriculture, improving livestock management and enhancing livestock feeding with UMMB, fuel switching from petroleum to CNG, rapidly developing renewable energy sources such as hydro-, solar- and wind- powers. Still, a lot more remain to be done in the face of the changing climate. To successfully address this issue there are limitations in terms of finance, facilities, institutions, human capacities, public education and awareness.

### **14. REFERENCES**

- Preparation of the Initial National Communication under UN Framework Convention on Climate Change end of Project Review Workshop: National Commission for Environmental Affairs & United Nations Environment Programme, 2010 Yangon
- Myanmar Agriculture in Brief (2008), Department of Agricultural Planning, Ministry of Agriculture and Irrigation 2009. Nay Pyi Taw, Myanmar
- Ministry of Agriculture and Irrigation 2009: Water Resources Management in Myanmar

# **COPING WITH CLIMATE CHANGE IN THE PHILIPPINES WITH FOCUS ON THE WATER SECTOR**



May 2011

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Annex A - National Framework Strategy on Climate Change (NFSCC), 2010-2022

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## ACRONYMS

AccBio	-	Adaptation to Climate Change and Conservation of the Biodiversity in the Philippines
CCC	-	Climate Change Commission
CCO	-	Climate Change Office
DENR	-	Department of Environment and Natural Resources
DRRM	-	Disaster Risk Reduction and Management
GHGs	-	Green House Gases
INFRACOM-SCWR	-	Committee on Infrastructure / Sub-Committee on Water Resources
IPCC	-	Intergovernmental Panel on Climate Change
LGU	-	Local Government Unit
MTPDP	-	Medium-Term Philippine Development Plan
NEDA	-	National Economic and Development Authority
NFSCC	-	National Framework Strategy on Climate Change
NWRB	-	National Water Resources Board
PAGASA	-	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PSCCA	-	Philippine Strategy on Climate Change Adaptation
PWP	-	Philippine Water Partnership
PWSSR	-	Philippine Water Supply Sector Roadmap
SRES	-	Special Report on Emission Scenarios
UNFCC	-	United Nations Framework Convention on Climate Change

## EXECUTIVE SUMMARY

The global and local climate is rapidly changing. Along with the changes in the climate regime comes the realization that its impacts and magnitude will be felt differently at the global and local levels. Nevertheless, the message is clear: climate change is a reality and the government and its citizens need to be ready in terms of adaptation and mitigation measures such as policies and programs are firmly put in place to help address its adverse effects.

Recent weather events experienced by the Philippines prompted the government and all concerned sectors to come up with concrete plan of action to address impacts of climate change. As an archipelagic nation, the Philippines is considered as one of the highly vulnerable countries to experience negative effects of a rapidly changing climate regimes.

The passage of Republic Act 9729 together with the provisions of the Philippine Constitution provided the legal backdrop for the formulation of the National Framework Strategy on Climate Change (NFSCC) prepared by the Climate Change Commission (CCC) in coordination with concerned agencies and stakeholders. This was approved by the government in April 2010. The Framework envisions a climate resilient Philippines with healthy, safe, prosperous and self-reliant communities and thriving productive ecosystems.

Given the projected climate changes that the country is likely to experience based on data for the last 50 years, the Philippine Strategy on Climate Change Adaptation (PSCCA) was subsequently developed through a multi-stakeholder initiative. The Plan is considered a practical tool to assist the national and local institutions to manage the impact of climate change.

One of the sectors addressed in the Plan is the water sector, considered as the core of economic growth and development of the country as well as the social well being of its citizens. Current issues on climate change will inevitable have to tackle water as a key medium that will link the rise of temperature to the physical and human system.

Thus, the Water Sector Adaptation Strategy on Climate Change was developed to reduce the vulnerability of the water sector at the same time increase the resilience of communities highly dependent on the water sector. There were four strategic outcomes designed to be achieved and supported by ten strategic objectives and several key actions planned to be undertaken from 2010 to 2022 or in the next 12 years. Within the identified plan of action, specifically with respect to policy reforms, the Philippine Water Partnership (PWP) together with its active members are currently pursuing activities towards the attainment of policy changes responsive to climate change issues.

# **COPING WITH CLIMATE CHANGE IN THE PHILIPPINES WITH FOCUS ON THE WATER SECTOR**

## **1.0 Introduction**

Climate change is the most serious and most pervasive threat confronting the Philippines, in general and the water sector in particular. Water is the first element by which climate changes are manifested through the alternation of the hydrological cycle. The warming of the atmosphere and the oceans will change major weather systems and consequently alter the temporal and spatial patterns of rainfall with consequences for run off, surface and groundwater storage and river flow regimes.

As an archipelagic nation of more than 90 million people, it now faces threats from more intense tropical cyclones, drastic changes in rainfall patterns, sea level rise and increasing temperatures. All these factors contribute to serious impacts on the natural ecosystems — on river basins, coastal and marine systems and their biodiversity then cascading to impacts on food security, water resources, human health, public infrastructure, energy and human settlements.

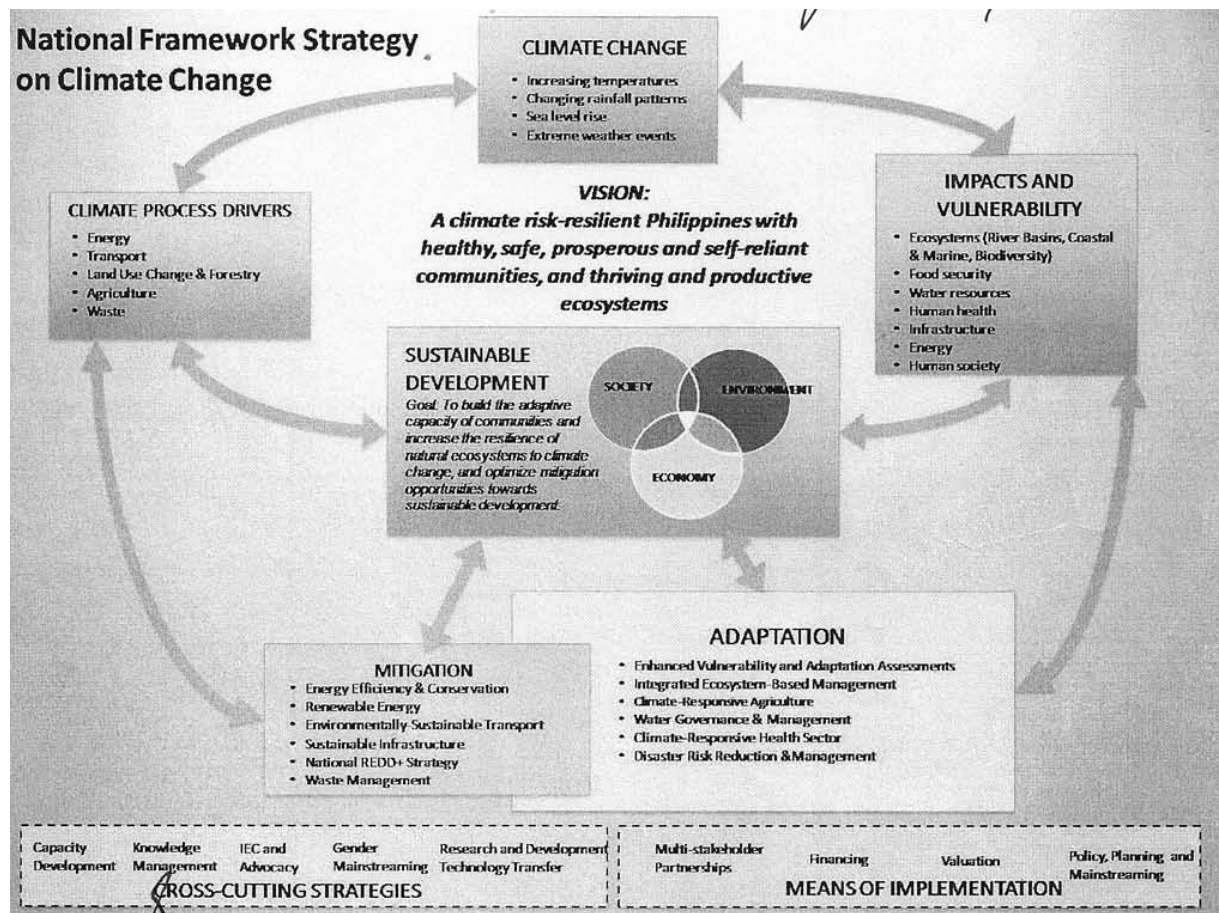
Cognizant of the impact of climate change and in anticipation of its more far reaching effects to the country in general, and to various sectors of development, the Philippines has formulated the National Framework Strategy for Climate Change (NFSCC) for 2010-2022. A major policy advance was achieved with the enactment of the Climate Change Act of 2009 whose mandate will be carried out by the Climate Change Commission (CCC). Furthermore, a parallel effort was also undertaken to come up with the Philippine Strategy on Climate Change Adaptation (PSCCA). This was made possible with support from the German Government through the Adaptation to Climate Change and Conservation of the Biodiversity in the Philippines (AccBio) Project in coordination with the Department of Environment and Natural Resources (DENR).

The development of such Plan of Action was a multi-stakeholder initiative with active participation of the government, and NGO representatives. There were eight (8) technical working groups dealing with nine (9) sectors namely: Agriculture, Biodiversity, Coastal and Marine, Energy, Fishery, Forestry, Health, Infrastructure and **Water**. This paper will deal only with the Water Sector portion.

## 2.0 Legal Basis and Framework

The Philippine Constitution clearly provides that the State shall protect and advance the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature (Section 16, Article II, the Philippine Constitution).

In addition, Section 2 of the Republic Act 9729 or the Climate Change Act of 2009 further provides that it is the policy of the State to afford full protection and the advancement of the right of the people to a healthful ecology to fulfil human needs while maintaining the quality of the natural environment for current and future generations. Below is the national framework strategy on Climate Change in general. The said document was prepared by the CCC in coordination with concerned agencies and stakeholder groups and approved on April 28, 2010 by President Gloria Macapagal-Arroyo. Details can be found in **Annex A**.





The State adopts the following Guiding Principles in the formulation of the National Framework Strategy for Climate Change (NFSCC):

- a. The Framework envisions a climate resilient Philippines with healthy, safe, prosperous and self-reliant communities and thriving and productive ecosystems.
- b. The goal is to build the adaptive capacity of communities and increase the resilience of natural ecosystems to climate change and optimize mitigation opportunities towards sustainable development.
- c. The Philippines as a State Party to the United Nations Framework Convention on Climate Change (UNFCCC), is committed to its core principles of common but differentiated responsibilities and respective capabilities.
- d. The precautionary principles guide the State's climate change framework and shall take precautionary measures to anticipate, prevent or minimize the causes of climate change and its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measure.
- e. The Framework is risk-based, and the strategies/activities shall be formulated, with decisions made based on the causes, magnitude and impacts of risks.
- f. Climate change knowledge is science-based, and shall draw from scientific contributions and best practices from communities taking into considerations local circumstances.
- g. The national priorities, and therefore, the pillars of the National Framework Strategy for Climate Change (NFSCC) shall be adaptation and mitigation, with emphasis on adaptation as the anchor strategy. Whenever applicable, mitigation actions shall also be pursued as a function of adaptation.
- h. Adaptation measures shall be based on equity, in accordance with common but differentiated responsibility; special attention must be given to ensure equal and equitable protection of the poor, women, children and other vulnerable and disadvantaged sectors.
- i. Even with inadequate scientific information, anticipatory adaptation measures should be undertaken to prevent or minimize the causes and potential impacts of climate change, whenever necessary.
- j. The Framework adopts the Philippine Agenda 21 for Sustainable Development, to fulfil human needs while maintaining the quality of the natural resources for current and future generations.

- k. The principle of complementation shall be observed to ensure that climate change initiatives of one sector do not restrict the adaptation of other sectors.
- l. The Framework recognizes the roles of agencies and their respective mandates as provided by law. The Framework also recognizes the principle of subsidiarity and the role of local governments as front-liners in addressing climate change.
- m. The Framework recognizes the value of forming multi-stakeholder participation and partnership in climate change initiatives, including with civil society, private sector and local governments, and especially with indigenous peoples and other marginalized groups most vulnerable to climate change.
- n. Policy and incentive mechanisms to facilitate private sector participation in addressing adaptation and mitigation objectives shall be promoted and supported.

### **3.0 Projected Climate Change Scenarios**

The Philippines being an archipelagic country is deemed highly vulnerable to the impacts of climate change. Data for the last 50 years dealing with climate showed a trend of rising temperatures by about 0.011° C annually; changes in rainfall pattern, and increasing number of extreme weather events such as cyclones, flooding and droughts. The Philippine Atmospheric, Geophysical and Astronomical Services Administration's (PAGASA) independent studies and climate models came up with the following changes in the climate regime for 2020 and 2050:

- *A rise in the country's mean annual temperature by about 0.9 °C to 1.4 °C for 2020 and 1.7 °C to 2.4 °C by 2050;*
- *Drier season of March to May will become drier and wet season of July-August and September-November will become wetter with time;*
- *Reduction in rainfall in most areas in Mindanao is seen for all seasons by 2050*
- *A much active and stronger southwest monsoon is projected as seen in the significant increases in rainfall in June-August become greater with time*
- *No significant trend in the number of tropical cyclones in Luzon;*
- *An increasing trend in the number of tropical cyclones in the Visayas; and*
- *A decreasing trend in the frequency of tropical cyclones in Mindanao*

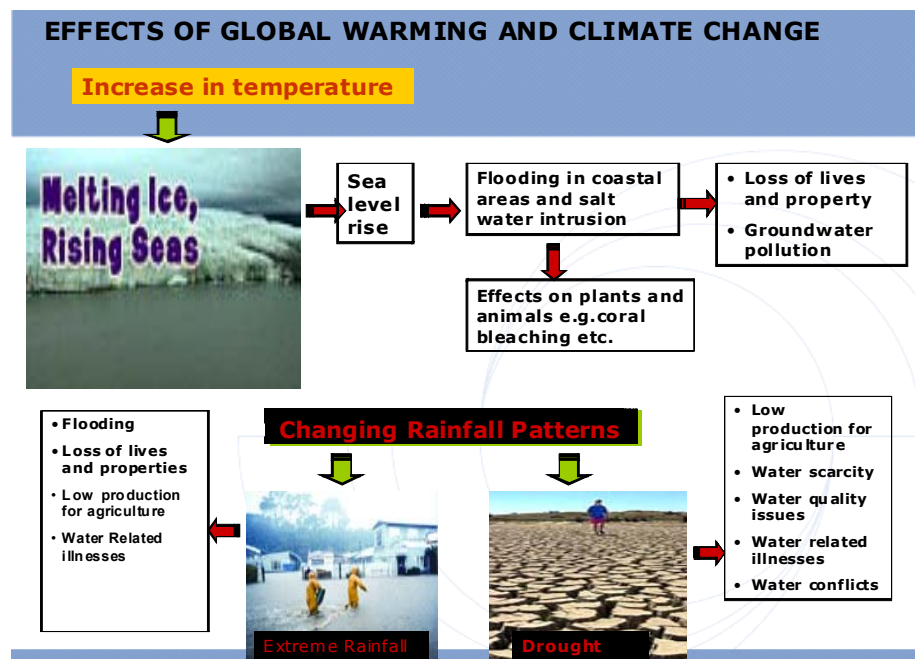
Globally, scientific studies indicated that even if the world makes a significant reduction in greenhouse gas emissions, the lag in the climate system means that the world is faced with decades of climate change due to the emissions already put into the atmosphere. Thus, despite the fact that the Philippines is not a major GHG emitter and a carbon sink, it will not be spared the negative effects of climate change. Therefore, adaptation is a necessary complement to measures that reduce greenhouse gas emissions. Adaptation is a mechanism to manage risks, adjust economic activity to reduce vulnerability and to improve business certainty.

Water is the first element by which climate changes are manifested through the alteration of the hydrological cycle. The warming of the atmosphere and oceans will change major weather systems and consequently alter the temporal and spatial patterns of rainfall with consequences for runoff, surface and groundwater storage, and river flow regimes. With changing climate and rainfall patterns, it is estimated that there will greater likelihood of extremes – droughts and floods – in different parts of the world.

The fact that the Philippines lies along the western rim of the Pacific Ring of Fire, which is a belt of active volcanoes, major earthquake faults, and tropical cyclones, makes the country more vulnerable to extreme weather disturbances brought about by climate changes. Recent climate change simulations by PAGASA and the Manila Observatory using global circulation models projected more intense rainfall events in the northern areas of the country, while the southern areas will face greater risk of drought from El Niño. The impact of climate change will be exacerbated by other socio-economic stresses (e. g., population growth, urban expansion, economic growth, globalization, etc.) that will have substantial effect on water resources in terms of scarcity (drought) and abundance (flooding). While the country’s vulnerability will increase in the future, the coping capacity of most of the population is limited due to poverty, lack of access to social capital, institutional fragmentation, and governance disconnection.

#### 4.0 Impacts and Challenges at the Country Level

Impacts of climate change to water as a resource and as a cross cutting sector is expected to be critical and apt to affect the economic development programs of the country. The water sector has been considered as the core of economic growth and development of the country, not to mention the social well being of the citizenry. Water is indispensable to human survival.



It is the quencher of thirst, a generator of power, a grower of crops and a basic natural resource for daily existence.

At the macro and global levels, as projected by the Intergovernmental Panel on Climate Change (IPCC), the climate change impact to water resources will be most pronounced in four (4) areas, namely:

- Temperature – for the next two decades a warming of about 0.2 °C per decade is projected for a range of Special Report on Emission Scenarios (SRES). Even if the concentration of all green house gases (GHGs) were kept constant at year 2000 levels, a further warming of about 0.1 °C per decade would be expected. Higher water temperature and changes in extremes including floods and droughts, are projected with very high probability to affect water quality and exacerbate many forms of water pollution – from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt as well as thermal pollution. The changes in water quality will have possible negative impacts on ecosystems, human health and water system reliability and operating costs.
- Precipitation and extreme event – increases in the amount of precipitation are very likely in high latitudes, while decreases are likely in most subtropical land regions by as much as 20% in 2100. Hot extremes, heat waves and heavy precipitation events will continue to become more frequent. Future tropical cyclones (typhoons and hurricanes) will likely become more intense, with larger peak wind speeds and heavier precipitation. The frequency of heavy precipitation events will consequently increase the risk of rain-generated floods. At the same time, the proportion of land surface in extreme drought at any one time is projected to likely increase.
- Water Availability – the melting of the ice caps will very likely reduce water availability during warm and dry periods through a seasonal shift in stream flow, an increase in the ratio of winter to annual flows and reduction in low flows in regions supplied by melt water from major mountain ranges. By mid-century, annual average river run off and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10 to 30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas.
- Sea level – global sea level is projected to rise by 0.19 to 0.59 meters between 1990 and 2100, due primarily to thermal expansion and loss of mass from glaciers and ice caps. Sea level rise is projected to extend areas of salinization of groundwater and estuaries, resulting in a decrease by 10-20% of freshwater availability for humans and ecosystems in coastal areas.

At the country level, and using 50-year data, PAGASA's observations point out to the following impacts on water resources:

- Climate changes will impact on stream flow, dam operation and water allocation, domestic water supply, irrigation, hydro power generation, tourism, depth of aquifer and aquifer recharge, water quality, forest resources/watershed, and fishery (Hilario, 2008)
- Changes in water quality and quantity due to climate change are expected to affect food production availability, stability, access and utilization which will consequently lead to decreased food security and increased vulnerability of the poor
- Extreme climate variability will affect the function and operation of the country's existing water infrastructure including hydropower, structural flood defences, drainage and irrigation systems.
- Water management practices which may not be robust enough to cope with the impacts on water supply reliability, flooding risks, health, agriculture, energy and aquatic ecosystem will also be affected. It will be further stressed by increases in water demand due to rising population, urbanization, industrialization and large changes in irrigation demand. Recent tropical storms and intense rain fall events demonstrated that current water infrastructures and disaster management structure cannot satisfactorily cope with climate variability.

## 5.0 The Water Sector Plan of Action

Current issues on climate change inevitably will have to adequately tackle water. It is the key medium that will link the rise in temperature to the physical and human systems. Through the alteration of the hydrological cycle, water is the first element by which climate changes are manifested. The warming of the atmosphere and oceans will change major weather systems and consequently alter the temporal and spatial patterns of rainfall, resulting in greater likelihood of extreme droughts and floods in different parts of the world.

### Increasing Frequency and Intensity of Climate Related Events

*Seven extreme tropical cyclone/southwest monsoon induced extreme events that occurred in 1991 to late 2004*

#### Floods

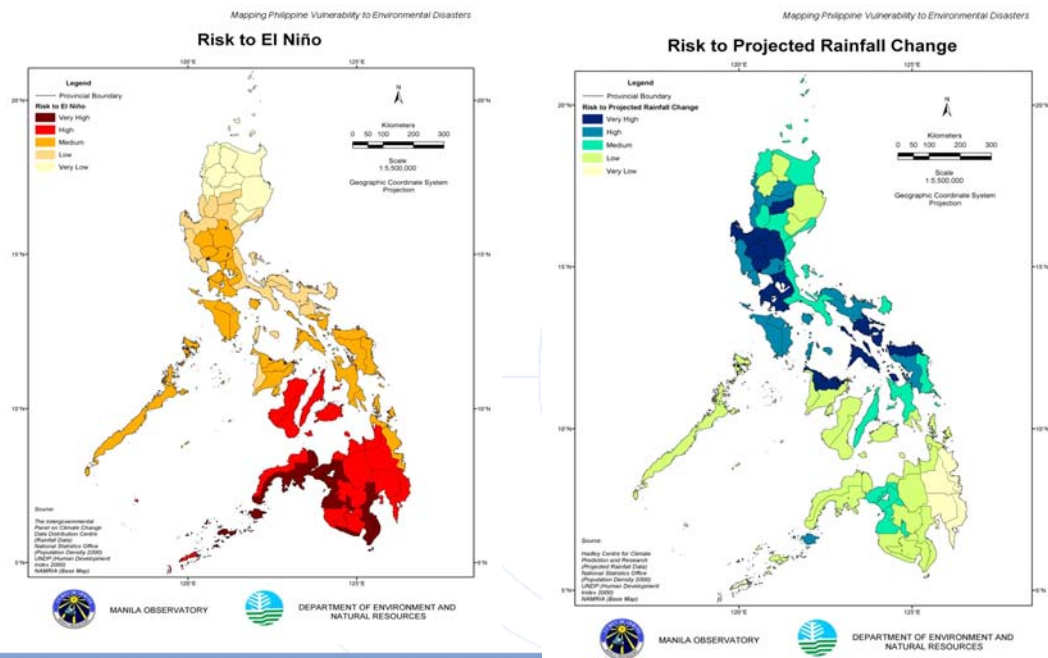
- ✦ Severe flooding occurs annually, affecting mainly lowland areas and high lying areas have experienced localized flooding
- ✦ Landslides and flash floods have taken place on a large scale in mountainous areas
- ✦ Areas most affected
  - Central Luzon
  - Parts of Metro Manila
  - Mindanao



DCC-OCD

A study done by the Manila Observatory in the Philippines projected more intense rainfall events in the northern areas of the country, while the southern areas will face greater risk of drought from El Niño. Central Luzon and the Bicol Region, for example, will face higher risk of typhoons, while Western Mindanao will face greater risk of drought due to increase in temperature and El Niño. The top 10 provinces most at risk to climate change-related disasters will include the following: Albay, Pampanga, Ifugao, Sorsogon, Biliran, Rizal, Northern Samar, Cavite, Masbate, and Laguna.

## Vulnerability to El Niño and Rainfall Changes



Given its geography and geographic location, Philippines has abundant freshwater resources obtained from three major sources: rainfall, surface water (rivers, lakes and reservoirs) and groundwater. Annually, the country gets an average of 965 to 4,064 mm of rainfall. There are 12 water resource regions and 421 river basins, of which 20 are considered major comprising about 990 sq. m. of basin area. The dependable surface water supply from rivers, lakes and reservoirs is estimated at 25.8 billion cubic meters. Groundwater potential, on the other hand, is approximately 20.2 billion cubic meters. Theoretically, therefore, the Philippines should have sufficient water supply. However, geographic and seasonal variations make water availability difficult in some areas at certain periods during the year.

In 2007, the National Water Resources Board (NWRB) data showed that agriculture and households were the largest consumers of water. Agriculture's share of the total water consumption was 52.22 percent while domestic water use was about 32.93 percent. The changes in water quantity and quality due to climate change, therefore, are expected to greatly affect food production, availability, stability, access and utilization, which will consequently lead to decreased food security and increased vulnerability of the poor. Moreover, extreme climate variability will affect the function and operation of the country's existing water infrastructure - including hydropower, structural flood defences, drainage, and irrigation systems. It will also affect water management practices, which may not be robust enough to cope with the impacts on water supply reliability, flooding risk, health, agriculture, energy and aquatic ecosystems. Recent tropical storms and intense rainfall events demonstrated that the current water infrastructure and disaster management structures cannot satisfactorily cope with extreme climate variability. The water management system and structure will be further stressed by increases in water demand due to rising population, urbanization, industrialization, and large changes in irrigation demand.

### **Issues and Gaps**

The national and local capacities in climate change adaptation and integrated water resources management remain inadequate for supporting a management framework and potential adaptation strategy. The gap in research on water resources supply and demand is also reflected in the lack of updated scientific information in the sector. This leads to conflicts in the implementation of water resources policy (e. g. awarding water use rights) and poor regulation of resource use and development. Inadequate awareness on water consumption efficiency and technological innovations lead to wasteful use of already scarce resources. Gaps in sector financing and investment also hamper the effective and efficient delivery of water services.

### **Sector Objectives and Plan of Action**

The *Water Sector Adaptation Strategy on Climate Change* was developed to reduce the vulnerability of the water sector and increase the resilience of communities and ecosystems to climate change utilizing a broad based participatory process of key stakeholders of the sector. Four strategic outcomes to be achieved by 2050 are identified supported by 12 strategic objectives and several key actions for 2010 to 2022.

The strategic outcomes for the sector include:

- Effective, climate change responsive, and participative water governance;
- Reduced water sector vulnerability and resilient communities and natural ecosystems
- Improved knowledge on water sector adaptation and climate change
- Sustainable and reliable financing and investment for climate change adaptation in the water sector.



Adaptive water governance includes the mainstreaming of adaptation in national and local policies and development plans. It will also entail some policy reforms to address institutional fragmentation in water resources management in the country and to climate-proof existing laws. Building resilient communities and ecosystems, improve their adaptive capacities, and reduce vulnerability will entail taking a serious assessment of existing water infrastructures to determine their vulnerability to extreme events, implementing modifications in the processes and demands for existing systems and water users, adopting low cost, “no regret” adaptation technology options, and enhancing the capability of communities and existing institutions for integrated water resources management.

The goal of building the adaptive capacity and resilience of communities of natural ecosystems to climate is being supported by 4 strategies namely:

1. Create an enabling environment for mainstreaming climate change adaptation based on a decentralized framework of good governance
2. Reducing climate change risks and vulnerability of human and natural ecosystems through ecosystems-based management approaches and appropriate technologies
3. Establishing knowledge management systems on climate change based on science and experiences of communities
4. Ensuring that the processes such as policy formulation, development planning, implementation and monitoring and evaluation are gender responsive and non-discriminatory.

There were ten (10) objectives under the Plan of Action with corresponding actions identified to be undertaken in the next 12 years.

**A detailed summary of the Water Sector Action Plan is contained in Annex B**

## 6.0 Status of Implementation and Recent Updates

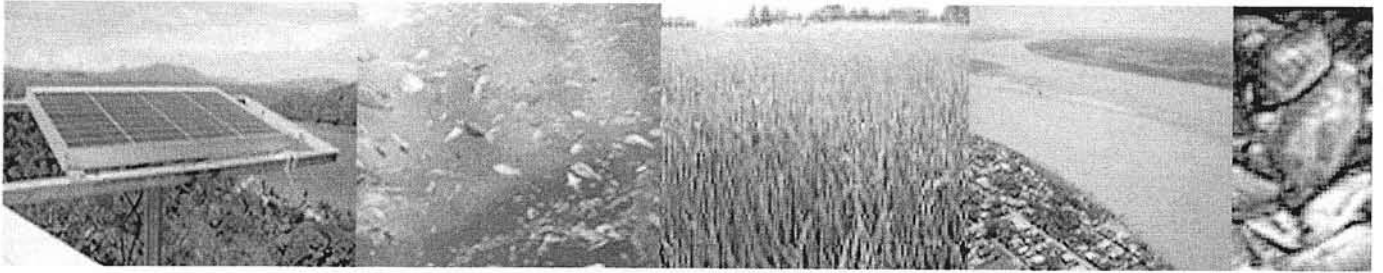
The Philippine Water Partnership and together with its 87 members, are actively pursuing the following recommended policy changes :

Policy Reforms	CCA ACTION	UPDATES
Amendment of the Water Code ( PD 1067)	<ul style="list-style-type: none"> <li>• Clarify authority and accountability in water resources management, including dam management</li> <li>• Harmonize various government agency functions on water resources management and CCA within the context of decentralization</li> <li>• Provide for the formulation of consumption standards in prioritizing water use in the light of climate change</li> </ul>	On December 2010, PWP has co-organized with the National Water Resources Board (NWRB) a consultative workshop on the proposed amendments of the Philippine Water Code, specifically to include a provision on IWRM and climate change
Integration of water sector CCA strategy in national and local development plans	<ul style="list-style-type: none"> <li>• Mainstream CCA and DRMM in 5 year LGU comprehensive development plan and investment plan</li> <li>• Enhance capability of oversight sector agencies, LGUs and private sector on how to mainstream climate change in policies, plans and programs</li> <li>• Review and integrate climate change adaptation and disaster risk reduction management concerns in the Philippine Water Supply Sector Roadmap (PWSSR)</li> </ul>	PWP has been working with the technical working group concerned on the integration of climate change aspects in the updated Medium-Term Philippine Development Plan (MTPDP) of 2010-2016
Enactment of a national land use legislation	<ul style="list-style-type: none"> <li>• Harmonize conflicting land uses</li> </ul> <p>Define areas not suitable for water infrastructure development and human settlements integrating scientific projections on climate change and extreme climate events</p>	PWP supports the proposed national land use legislation within the IWRM framework

<p>Formulation of a system of incentives for water resources CCA</p>	<ul style="list-style-type: none"> <li>• Design and implement proper valuation of scarce water resources to guide water pricing and tariff structures</li> <li>• Design system of incentives to encourage investments and mobilize private sector financing in CCA technologies</li> </ul>	<p>PWP is actively involved in the National Economic and Development Authority's Committee on Infrastructure / Sub-Committee on Water Resources (NEDA / InfraCom-SCWR), an oversight body responsible to overseeing the implementation of the Water Supply Roadmap and clearing house for policy recommendations prior to Cabinet approval.</p>
<p>Review of the Local Government Code</p>	<ul style="list-style-type: none"> <li>• Address short-term planning horizon of local executives to encourage long term CCA and DRRM investment</li> </ul>	<p>PWP is pursuing a strong advocacy within the IWRM framework</p>

**References:**

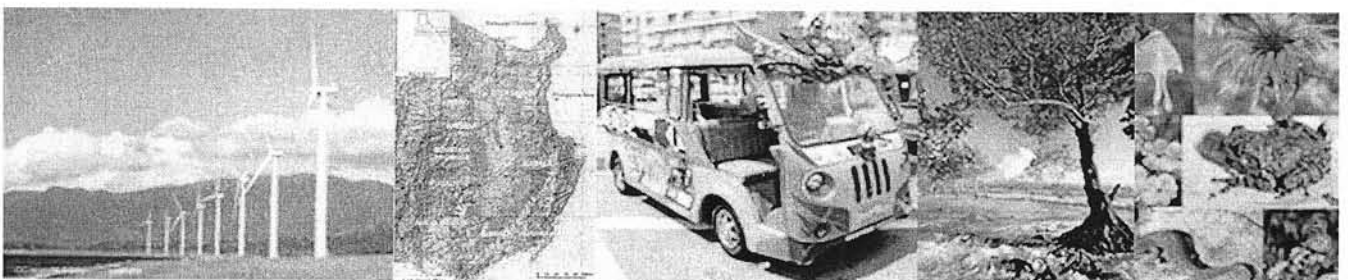
- National Framework Strategy on Climate Change (NFSCC), 2010-2022 by the Climate Change Commission (CCC)
- The Philippine Strategy on Climate Change Adaptation (PSCCA), 2010-2022 by the Climate Change Office (CCO), Department of Environment and Natural Resources (DENR)
- Slides from the presentation entitled: “Water for a Changing World” by Engr. Isidra Penaranda of NWRB during the Ayala Foundation, Inc. Water Forum on March 30, 2011



Office of the President of the Philippines  
Malacañang

Climate Change Commission

**National Framework Strategy  
on Climate Change  
2010-2022**





## Preface

Climate Change is the most serious and most pervasive threat facing humanity today. The Intergovernmental Panel on Climate Change (IPCC), the highest scientific body responsible for evaluating the risk of climate change, affirmed in its Fourth Assessment Report that the “warming of the earth’s climate system is unequivocal” and that this warming is attributed to the dramatic rise in human-induced greenhouse gas emissions since the mid 20th-century.

The Philippines, an archipelagic nation of over 90 million people, now faces threats from more intense tropical cyclones, drastic changes in rainfall patterns, sea level rise, and increasing temperatures. All these factors contribute to serious impacts on our natural ecosystems—on our river basins, coastal and marine systems, and their biodiversity—then cascading to impacts on our food security, water resources, human health, public infrastructure, energy, and human settlements.

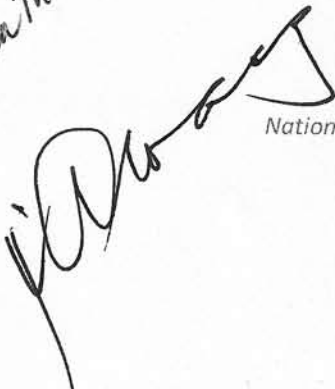
Indeed it is unequivocal that climate change will have serious implications on the country’s efforts to address poverty and realize sustainable development for current and future generations—ultimately making climate change an issue of intergenerational equity.

The National Framework Strategy on Climate Change is committed towards ensuring and strengthening the adaptation of our natural ecosystems and human communities to climate change. In the process, the Framework aspires to chart a cleaner development path for the Philippines, highlighting the mutually beneficial relationship between climate change mitigation and adaptation. As a matter of principle, the Framework aggressively highlights the critical aspect of adaptation meant to be translated to all levels of governance alongside coordinating national efforts towards integrated ecosystem-based management which shall ultimately render sectors climate-resilient.

As the world stands at the threshold of an important juncture in the history of the planet and the international community grapples for a lasting global solution to the climate crisis, the threats to humans and nature have become unprecedented.

The international community stands at a point where even the most aggressive and immediate actions to mitigate climate change will not stop the impacts at least for the next half of this century. While deep cuts in greenhouse gas emissions may buy time for human and natural systems to adapt in the decades ahead, human and natural systems have begun to reel from the unfolding impacts.

The aim of this national process is to build a roadmap that will serve as the basis for a national program on climate change and establish an agenda upon which the Philippines would pursue a dynamic process of determining actions through the National Climate Change Action Plan process.



National Framework Strategy on Climate Change, 2010-2022





## 1. LEGAL MANDATE

- 1.1 “The State shall protect and advance the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature.” – Section 16, Article II, The Philippine Constitution
- 1.2 “The Congress shall give the highest priority to the enactment of measures that protect and enhance the right of the people to human dignity...” – Section 1, Article XIII, The Philippine Constitution
- 1.3 “It is the policy of the State to afford full protection and the advancement of the right of the people to a healthful ecology... to fulfill human needs while maintaining the quality of the natural environment for current and future generations.” – Section 2, Republic Act 9729 (The Climate Change Act of 2009)

*Gloria M. Arroyo*

*Roberto S. Ochoa*

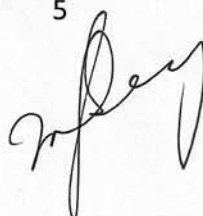
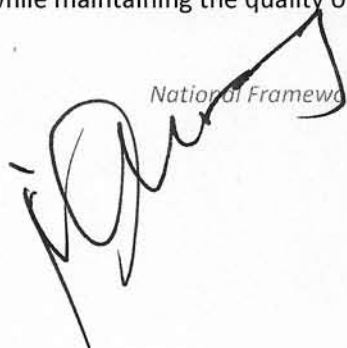
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## 2. GUIDING PRINCIPLES

The State adopts the following Guiding Principles in formulating the National Framework Strategy on Climate Change, referred to as the Framework:

- 2.1 The Framework envisions a climate risk-resilient Philippines with healthy, safe, prosperous and self-reliant communities, and thriving and productive ecosystems.
- 2.2 The goal is to build the adaptive capacity of communities and increase the resilience of natural ecosystems to climate change, and optimize mitigation opportunities towards sustainable development.
- 2.3 The Philippines, as a State Party to the United Nations Framework Convention on Climate Change (UNFCCC), is committed to its core principle of common but differentiated responsibilities and respective capabilities.
- 2.4 The precautionary principle guides the State's climate change framework and shall take precautionary measures to anticipate, prevent or minimize the causes of climate change and its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures.
- 2.5 The Framework is risk-based, and strategies/activities shall be formulated, with decisions made based on the causes, magnitude and impacts of risks.
- 2.6 Climate change knowledge is science-based, and shall draw from scientific contributions and best practices from communities taking into considerations local circumstances.
- 2.7 The national priorities, and therefore, the pillars, of the National Framework Strategy on Climate Change shall be adaptation and mitigation, with an emphasis on adaptation as the anchor strategy. Whenever applicable, mitigation actions shall also be pursued as a function of adaptation.
- 2.8 Adaptation measures shall be based on equity, in accordance with common but differentiated responsibility; special attention must be given to ensure equal and equitable protection of the poor, women, children and other vulnerable and disadvantaged sectors.
- 2.9 Even with inadequate scientific information, anticipatory adaptation measures should be undertaken to prevent or minimize the causes and potential impacts of climate change, whenever necessary.
- 2.10 The Framework adopts the Philippine Agenda 21 for Sustainable Development, to fulfill human needs while maintaining the quality of the natural environment for current and future generations.



2.11 The principle of complementation shall be observed to ensure that climate change initiatives by one sector do not restrict the adaptation of other sectors.

2.12 The Framework recognizes the roles of agencies and their respective mandates as provided by law. The Framework also recognizes the principle of subsidiarity and the role of local governments as front-liners in addressing climate change.

2.13 The Framework recognizes the value of forming multi-stakeholder participation and partnerships in climate change initiatives, including with civil society, private sector and local governments, and especially with indigenous peoples and other marginalized groups most vulnerable to climate change impacts.

2.14 Policy and incentive mechanisms to facilitate private sector participation in addressing adaptation and mitigation objectives shall be promoted and supported.



*Francis M. Araya*

### 3. FRAMEWORK CONTEXT

- 3.1 This Framework takes into consideration and complies with the commitments of the Philippines in multilateral environmental treaties, specifically the United Nations Framework Convention on Climate Change (UNFCCC).
- 3.2 Addressing adaptation needs, capitalizing on mitigation potential and complying with UNFCCC obligations require systematic analysis, strategic planning and determined implementation. Section 11 of Republic Act No. 9729 mandates the Climate Change Commission (CCC) to formulate the Framework Strategy and Program on Climate Change six (6) months from the effectivity of the Law. This Framework was developed based on the country's climate change vulnerabilities, adaptation needs and mitigation potential, all in accordance with international agreements.<sup>1</sup>
- 3.3 The Intergovernmental Panel on Climate Change (IPCC), in its Fourth Assessment Report (AR4), concluded that anthropogenic warming over the last three decades has affected many physical and biological systems all over the world. As a result, the resilience of many ecosystems is likely to be breached this century. As mean global temperatures rise and climate change impacts intensify, the Philippines will encounter serious stresses in food production, health, and economic security.
- 3.4 The Philippines is a country endowed with a plethora of species and ecosystems, making it one of the 18 mega-biodiversity countries in the world. However, there is currently an increasing threat to the country's wealth of biodiversity because of the pressure brought upon by human-induced threats, which are further compounded by the adverse impacts of climate change on terrestrial and aquatic plant and animal communities as manifested in increasing temperature and extreme variability in rainfall.
- 3.5 The country is ranked highest in the world in terms of vulnerability to tropical cyclone occurrence, and third in terms of people exposed to such seasonal events.<sup>2</sup> An average of 20 typhoons traverse the country yearly, causing physical and economic devastation. Climate variability increasingly induces drought during El Niño episodes and floods during La Niña. Consequently, the Philippines faces increasing disaster risks with geologic/seismic dangers closely interacting with such meteorological hazards.
- 3.6 Climate change also threatens the ability of the country's ecosystems to provide life-support services. In coastal areas, problems like flooding and inundation are expected to increase due to accelerated sea level rise, in addition to cyclones and storm surges. With coastal and marine ecosystems already suffering from anthropogenic problems like pollution, over-exploitation and uncontrolled development, the country can ill afford to cope with the additional stresses.
- 3.7 Climate change can provide opportunities that would allow the Philippines to capitalize on its greenhouse gases (GHG) mitigation potential for cleaner, indigenous and optimized energy and transport bases, as well as enhanced sinks. Leveraging recently-passed policies like the Renewable

<sup>1</sup> Refers to the obligations of the Philippines under the UNFCCC and other related international agreements.

<sup>2</sup> 2004 UNDP Global Report on Disasters

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Energy Act and the Biofuels Law, the Philippines could address its energy insecurity while providing much-needed co-benefits such as pollution prevention.

3.8 This Framework shall guide the national and sub-national development planning processes, specifically the formulation of the Medium-term Philippine Development Plan (MTPDP), Medium-term Public Investment Program (MTPIP) and sectoral plans; at the sub-national level, the Medium-term Regional Development Plan (MTRDP), Medium-term Regional Development Investment Program (MTRDIP), Provincial Development Plans (PDPs) and Provincial Physical Framework Plan (PPFPs); and at the local level, the Comprehensive Land Use Plans (CLUPs) and Comprehensive Development Plans (CDPs).

3.9 Within one (1) year upon the adoption of the Framework, the National Climate Change Action Plan (NCCAP) shall be developed to provide the details of the herein proposed strategies. The NCCAP shall then guide local government units in the preparation of their respective Local Climate Change Action Plans (LCCAP). A consultation process shall be initiated by the Climate Change Commission to seek the consensus of stakeholders on the provisions of this Framework, and seek their meaningful participation in the formulation of the NCCAP.



*Gloria M. Luzo*

#### 4. PHILIPPINE CLIMATE CHANGE SCENARIOS: 2020 and 2050<sup>3</sup>

The projected climate change scenarios are shown as bases for the indicative macro-level vulnerability assessment. Significantly, these scenarios are presented as a macro-analysis of changes in climate parameters: precipitation, temperature, and the use of statistical averages in the data presented. Prepared by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), these scenarios are culled from possible extreme events that would arise from average scenarios.

##### Changes in Annual Mean Temperature

Based on the downscaling made by PAGASA of the Hadley Center's global climate model PRECIS, significant warming will occur in the Philippines by the middle of the current century.

The country's average annual mean temperature is projected to increase by 0.9°C -1.2°C by 2020 and 1.7°C -3.0°C by 2050. Higher temperatures are generally expected for all regions of the country by 2050, the rates doubling compared to 2020 levels. Warming will be worst in Mindanao, supposedly the country's food basket. The changes in mean annual temperature by region relative to the baseline period of 1970-2000, are provided in Figure 1 below:

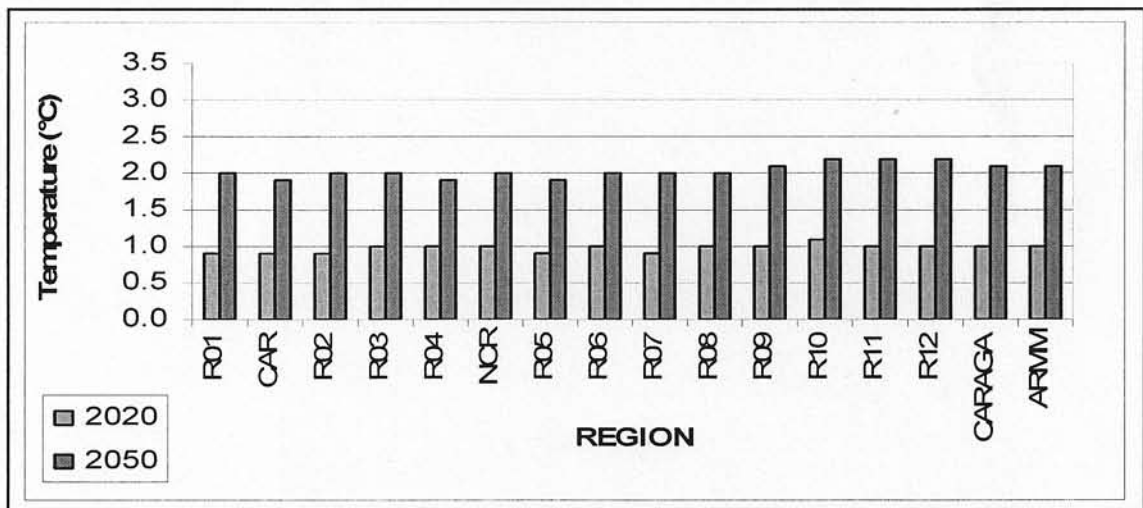


Figure 1: Projected Changes in Annual Mean Temperature for 2020 and 2050, relative to the Baseline 1971-2000 by Region (PAGASA, 2010)

<sup>3</sup> Prepared by PAGASA for the Philippines' Second National Communication on Climate Change (SNC), due for submission to the UNFCCC Secretariat as part of its commitments.

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*Gloria M. Araya*

### Changes in Annual Mean Rainfall

The PRECIS simulation exercise projects a change in annual precipitation from -0.5 to 17.4 % in 2020 and -2.4 to 16.4 % in 2050. Increases in rainfall are particularly evident in most areas of Luzon and Visayas, while Mindanao is projected to undergo a drying trend. Average annual rainfall increase over most parts of Luzon and the Visayas is expected to be 2 to 17 % by 2020 and 1 to 16 % by 2050. In contrast, there is a general reduction in regional annual average rainfall in Mindanao (~ 0.5 to 11 % by 2020; 2 to 11% in 2050).

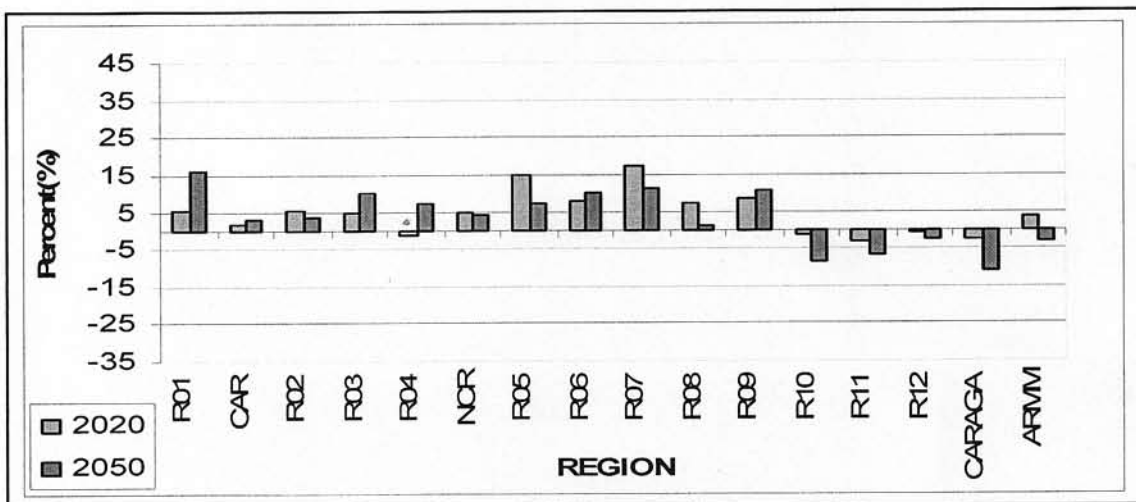


Figure 2: Projected Changes in Annual Mean Rainfall for 2020 and 2050, relative to the Baseline 1971-2000 by Region (PAGASA, 2010)

### Sea level Rise

Sea level rise will increase the risk of flooding and storm damage. Projected impacts of 1 meter sea level rise in many areas of the country show vast portions being inundated, affecting coastal settlements and livelihood.

According to estimates of the National Mapping and Resource Information Authority (NAMRIA), a one meter sea level rise can translate to an estimated land loss of 129,114 ha.

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## 5. IMPACTS AND VULNERABILITIES

### 5.1 Bio-Physical Vulnerabilities

For purposes of the Framework and its corollary action plan, what are considered of primary relevance are the natural meteorological or meteorologically-influenced hazards faced by the Philippines, which stand to be aggravated by climate change. Other physical vulnerabilities that are considered as underlying drivers of risks are likewise taken into consideration in assessing the country's indicative vulnerabilities. These are primarily the state of ecosystems such as the status of forest cover, the quality and extent of coastal resources, the overall state of biodiversity, the level of environmental pollution, etc., which are determinants of the extent of impacts from climate change and the magnitude of adaptation capacity that need to be put in place.

### Meteorologically-Influenced and Related Natural Hazards

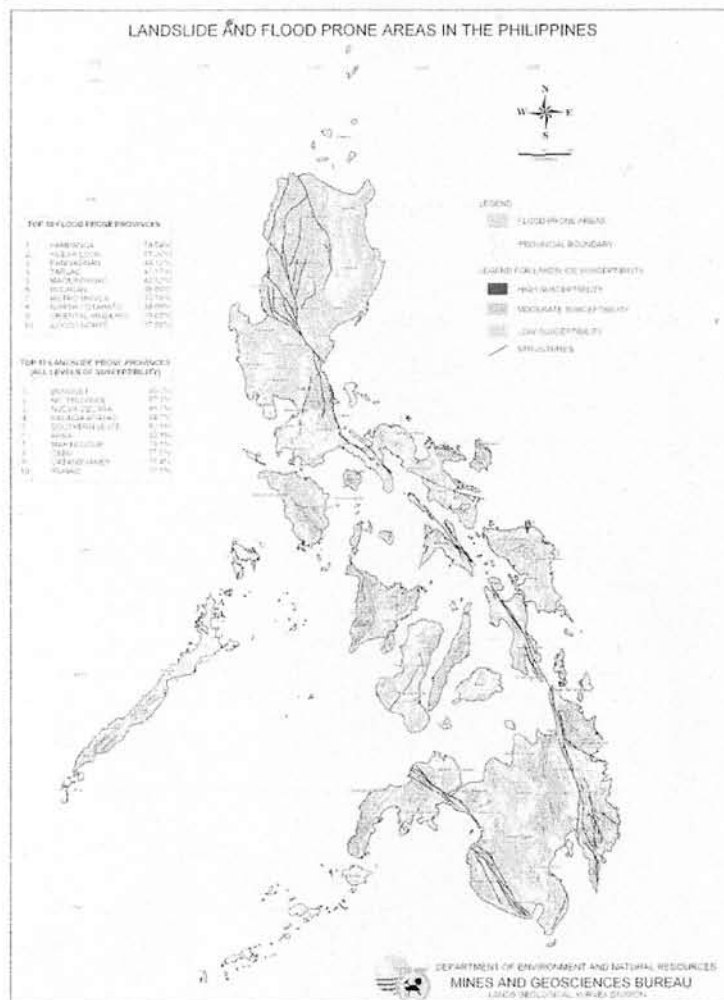


Figure 3: Map of landslides and flood prone areas

National Framework Strategy on Climate Change, 2010-2022

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*Glenn M. Arroyo*

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Figure 3 depicts the indicative landslide and flood prone areas of the Philippines that stand to be further impacted adversely by increased precipitation or rainfall brought about by climate change. The top 10 flood-prone and landslide-prone areas are also indicated. Overlaid with the climate scenarios for 2020 and 2050, the result would give the “first layer” of indicative physical vulnerability. It can be seen that a major portion of the country are susceptible to landslides as well as flooding.

## 5.2 Underlying Risk Drivers

### 5.2.1 Ecosystems Degradation

Two of the key underlying risk drivers of climate change are the loss of forest cover and degradation of coastal and marine resources.

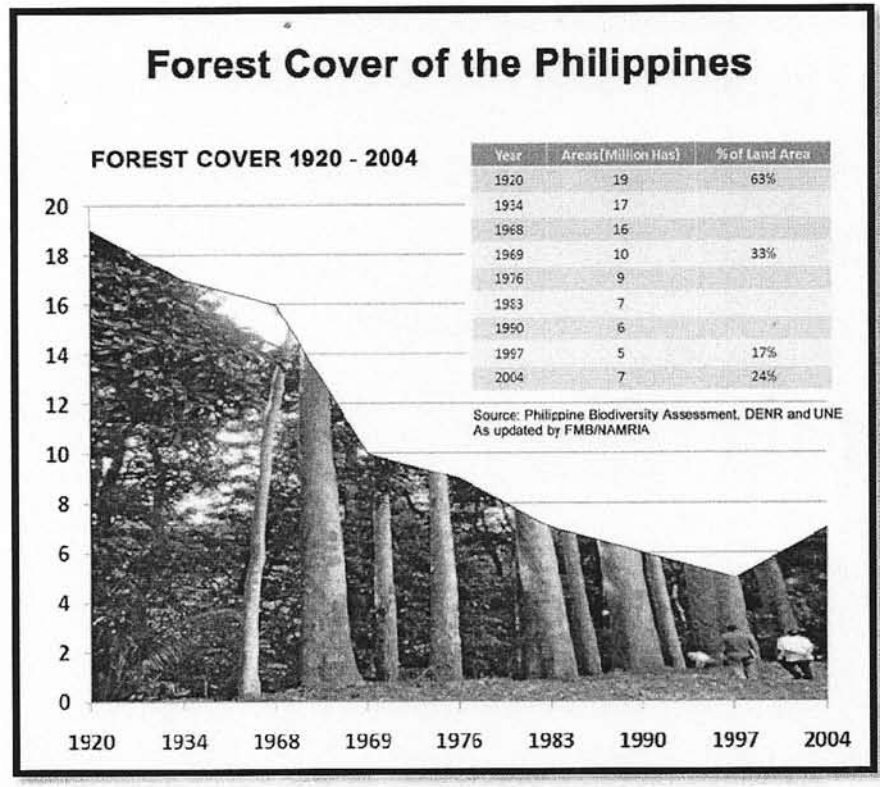


Figure 4: Area of forest cover, 1920-2004

Of the 27.5 million hectares in the late 1500s, the country’s forest lands currently stand at 7.2 million hectares or only 24.27 %t of the country’s total land area. This has been attributed to the combined ill effects of indiscriminate logging, inadequate forest protection, incoherent policies, expansion of upland agriculture, fires, pests and diseases, and unplanned land conversion. Of the current remaining forests,

*Glenn M. Araya*

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only 0.8 million hectares of primary forests remain. This is alarming as these remaining pristine areas are the repository of the country's gene pool. The Philippines is one of the 17 mega-diverse countries in the world with more than 65% of the species found nowhere else. Its being a critical hotspot with more than 800 of its plant and animal species threatened with extinction is of great concern because the Philippines is also globally important in terms of biodiversity-dependent adaptation.

The Philippines' diverse coastal zone comprise a variety of tropical ecosystems, including sandy beaches, rocky headlands, sand dunes, coral reefs, mangroves, sea-grass beds, wetlands, estuaries, and lagoons. Unfortunately, Over 80 percent of original mangroves in the country have been cleared, increasing sediment outflow onto reefs (Chou, 1998). Mangrove areas continue to be cleared and converted to fish ponds, a change that allows more sediment to reach reefs (DENR, 2001). Domestic and industrial wastes discharged into the sea further aggravate the vulnerabilities of the coastal ecosystems. The Philippine coral reefs, the second largest in Southeast Asia, are estimated to cover an area of 26,000 square kilometers and hold 2,177 species of fish. Much of these are significantly critical to the survival of the coastal poor. Fisheries account for about 4% of the country's GNP. The fisheries sector employs an estimated million people—26% in aquaculture operations, 6% in commercial fishing and 68% in marine and freshwater municipal fishing.

### 5.2.2 Agricultural

Agriculture represents 1/5 of the total economy (18 % of GDP) and generates 1/3 of the country's total employment and provides food and livelihood to our people as follows:

- Rice, 16.82 million mt;
- Fish, 4.97 million mt,
- Corn, 6.93 million mt,
- Other food and industrial crops, 57.75 million mt, and
- Livestock & Poultry, 4.04 thousands mt

*Gloria M. Arroyo*

Climate change in the country triggered the rise in temperature and the increases in variability and pattern of rainfall and super typhoon events, as well. The climate change and variability combined their weather modifying impacts with El Nino, which occurs in almost every two years and resulted into more complex and unpredictable changes in patterns and intensity of temperatures and extreme rainfall events close to their tipping points. The country has been traditionally exposed to the many hazards and risks from typhoons and droughts even before the on-set of climate change. The outstanding threat of climate change, however, is the undefined shifting of rainfall patterns and rising temperatures. Without proper scientific guidance, this creates confusion to many farmers in terms of when to plant and what to plant. Moreover, the concentration of climate-vulnerable dams and irrigation in Luzon, which is the location of 60 percent of national irrigated rice production, will definitely weaken the overall resiliency of the country's national food security and self-sufficiency to climate change, including the increasing problems of water allocation and prioritization for water supply for irrigation, domestic water and energy.

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### 5.2.3 Biodiversity

The existing human-induced threats to biodiversity are compounded by the adverse impacts of climate change on terrestrial and aquatic flora and fauna communities. Even slight increases in temperature would affect the survival of plants and animals with narrow tolerance range for temperature and those which are presently living at the upper limit of their tolerance level. Most vulnerable are those species that have difficulties in migrating as a form of survival. A substantial increase in temperature in the range of 30°C to 40°C may possibly cause the migration of plant and animal species with narrower temperature tolerance to other more suitable areas as their form of adaptation. Such temperature level rise may also disrupt species interactions like plants and pollinators relationship that may affect the survival of plant species. Further increase in temperature to 50°C or 60°C may cause a number of animals and plant species to die out and become extinct while critical habitats may be lost.

### 5.2.4 Infrastructure

Infrastructure facilities are threatened by climate change as they are directly exposed to oftentimes prolonged and frequent rainfall, strong winds, and higher waves; temperature variations - that can lead to accelerated structural fatigue and materials failure for example in power transmission structures, and road pavements; and places greater demands on the construction and operation and maintenance of flood control and drainage structures, seawalls and port structures; and public buildings such as schools, and health care facilities. The impacts could be severe in areas where infrastructures are not designed to fully cope with the effects of climate change. Thus, these impacts have potential implications for where we locate and how we build our new infrastructures, as well as make existing infrastructure robust or resilient to the effects of climate change.

### 5.2.5 Energy

Energy technologies, particularly on power generation from renewable sources, rely greatly on the climate for its resource. With projected changes in precipitation, humidity, wind speed and cloudiness, energy technologies will be affected, resulting in changes in the quantity and timing of the renewable resource, in its operational performance and energy production. Changes in the mean potential and altered variance of a renewable resource will result in the changes in the resource, with climate change seemingly enhancing seasonal differences. In general, the relationship between the renewable resource potential and the driving climate variables such as precipitation and wind speed will dictate the extent of changes.

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## 5.2.6 Population, Health and Demography

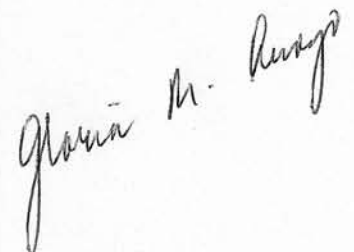
Population growing exponentially and migrating into areas where they should not be contribute to the overall vulnerability of the country to additional external threats like climate change. The latest national population count by the National Statistics Office (NSO) placed the Philippine population at 88,574,614 persons as of August 2007.

Of the total population, 62.7% live in urban areas (2005) with an urban annual growth rate of 3.45%, much higher than the annual population growth rate of 2.28%. Since 1995, there has been more migration towards urban areas with increasing population numbers. Urban growth rates peaked in the late 1980s to early 1990s. From 2000 onwards, there has been a negative growth rate in rural areas. These trends have contributed to the increasing deteriorating conditions in the urban centers and upland areas where migrants have tended to drift to.

Age distribution and economic status also influence level of vulnerability of people which, in turn, determine the overall level of vulnerability of the country. More young and older people in the population would be critical in disaster situations. Poverty limits the concerned population's capacity to bounce back immediately in the face of disasters or to shift rapidly to new adaptation modes that require financial resources to materialize.

Rural poverty incidence was estimated at 41.5% in 2006, accounting for about 75% of total poverty in the country. It is also a driver of rural-to-urban migration. Rural poor in lowland agricultural areas have also been migrating upwards to forest lands for better agricultural opportunities. This has further contributed to the precarious situation of the forests in the country's watersheds.

The health sector also stands to bear the brunt of climate change, brought about mainly by the country's high vulnerability to climate change-related hazards. As diseases, disabilities and deaths are consequences of these hazards, the health sector is usually left to handle the management and rehabilitation of victims. Among the most likely impacts of climate change on the health sector include increases in endemic morbidity and mortality due to diarrheal disease, exacerbation of the abundance and/or toxicity of cholera due to increases in coastal water temperature, and an expansion of the natural habitats of vector-borne and water-borne diseases.





## 6. PHILIPPINE CLIMATE CHANGE FRAMEWORK

The State hereby promotes the following **Vision and Goal** for Climate Change, the achievement of which is operationalized in the succeeding Framework diagram:

### Vision

*"A climate risk-resilient Philippines with healthy, safe, prosperous and self-reliant communities, and thriving and productive ecosystems."*

### Goal

*"To build the adaptive capacity of communities and increase the resilience of natural ecosystems to climate change, and optimize mitigation opportunities towards sustainable development."*

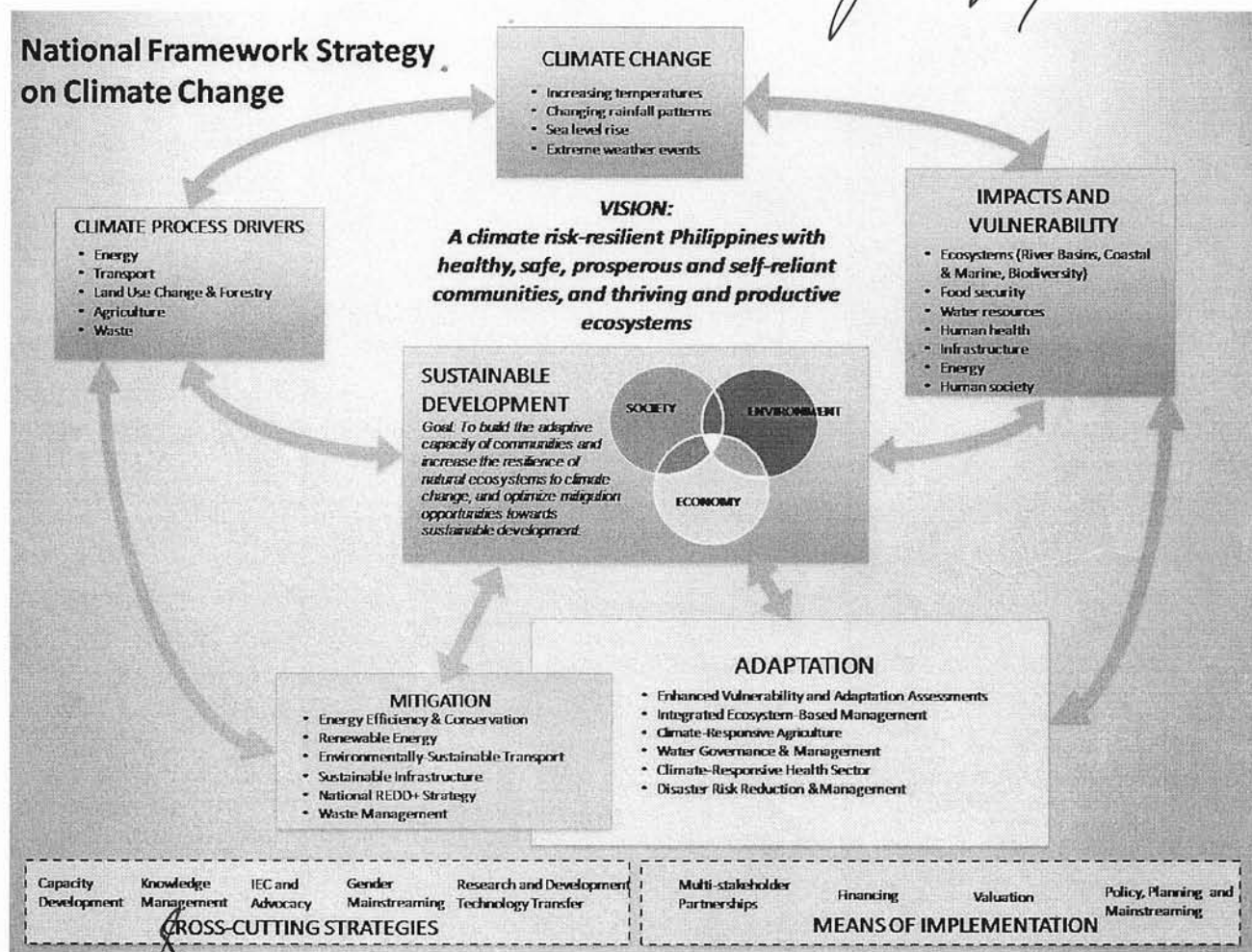


Figure 5: Climate Change Framework

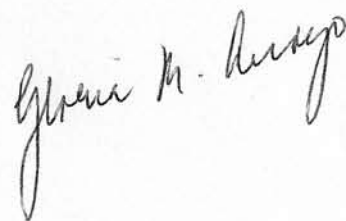
National Framework Strategy on Climate Change, 2010-2022

The national framework is formulated within the context of the country's sustainable development goals and governance/institutional factors that affect the country's ability to respond to climate change. The changing climate conditions will have a myriad of impacts and underscore the vulnerabilities in all sectors of society and the economy. Adaptation will require resources and the cooperation of all sectors. Addressing climate change, therefore, moves beyond the environmental challenges and will have to be closely linked with economic targets and social sustainability.

This Framework Strategy provides a basis for the national program on climate change. It identifies Key Result Areas to be pursued in key climate-sensitive sectors in addressing the adverse effects of climate change both under adaptation and mitigation. The framework is based on the fundamental principles of sustainable development and treats mitigation as a function of adaptation, cognizant of the vulnerability of key sectors that include energy.

Increasing temperatures, changing rainfall patterns, sea level rise, and extreme weather events form the backdrop upon which the Philippines endeavors to pursue its development goals. Such factors affect key sectors such as ecosystems, food, water, human health, infrastructure, energy, and human society. The ability of the country to address such impacts and vulnerabilities of these sectors affect the facility by which sustainable development is pursued. Sustainable development, on the other hand, greatly impinges on the capacity of the country to adapt to the impacts and address vulnerabilities to climate change.

In order to achieve the key result areas, it is important to ensure that cross-cutting strategies are likewise given attention. As means of implementation, the framework puts forward multi-stakeholder partnerships, financing, valuation, and policy planning and mainstreaming.





The following diagram illustrates a more specific aspect of the Climate Change Framework, taking into account how climate change impacts and vulnerabilities shall be addressed by adaptation, mitigation and cross-cutting strategies and supported by the means of implementation—which would eventually lead to achievement of the National Goal.

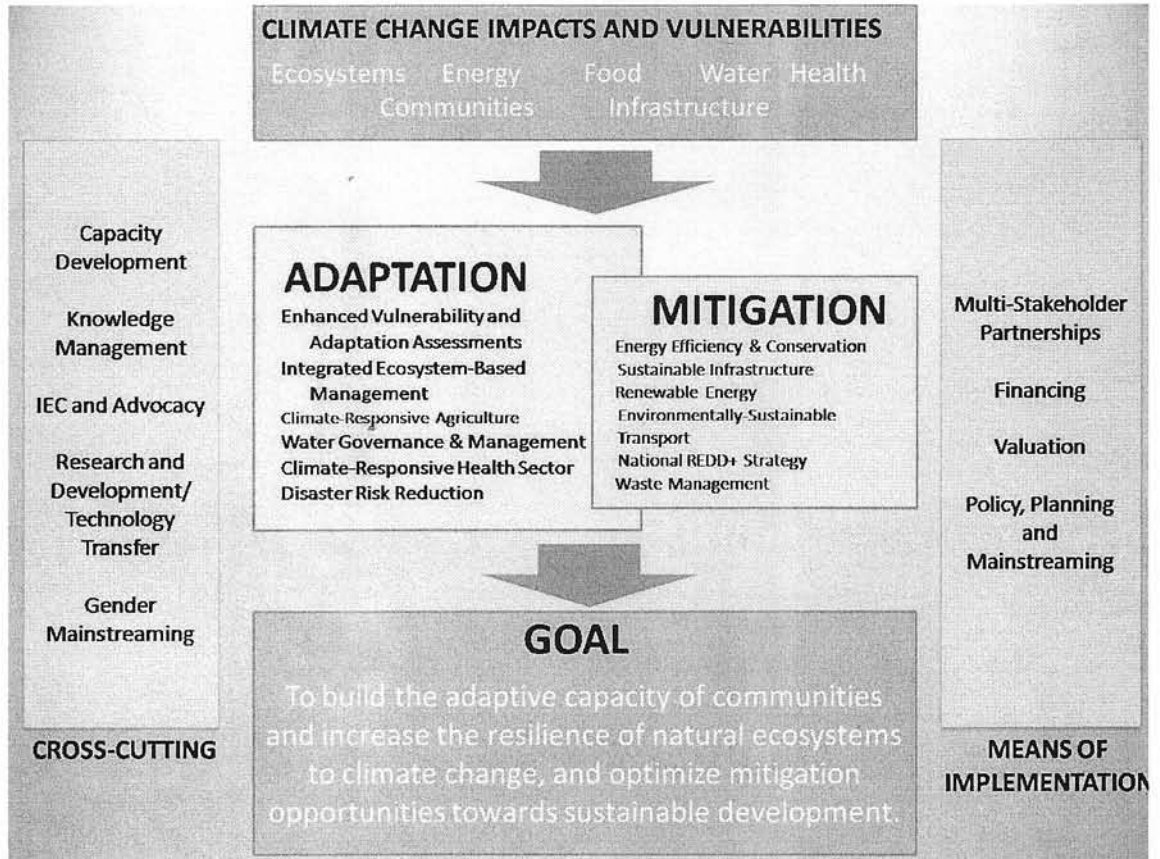


Figure 6: Operational Diagram

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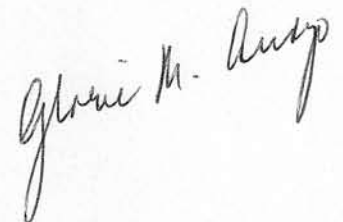
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## 7. SYNERGY OF ADAPTATION AND MITIGATION

The increasing concentration of GHGs in the atmosphere has started to and will continue to influence changes in the global climate system in the coming decades. The Fourth Assessment Report (AR4) of the IPCC and the international imperatives drawn in the Bali Conference in 2007 establish the urgency of adaptation especially for developing and vulnerable countries like the Philippines. This Framework recognizes the mutually beneficial relationship between climate change mitigation and adaptation, particularly in the context of Philippine development. Cognizant of the impacts of a changing climate on sectors that are also sources of GHG emissions, which include energy, transport, agriculture, and industry, this framework endeavors to integrate mitigation with adaptation and take into account the circumstance

Mitigation strategies in the Philippine development context offer opportunities for enhancing development and boosting the adaptation capacity of communities. In the same vein, adaptation is as much a development concern as mitigation. With the context of global-scale shifts in the climate system, development can only succeed if mitigation strategies such as energy efficiency and conservation, renewable energy development, environmentally-sustainable transport, sustainable infrastructure, and Reduction of Emissions from Deforestation and Forest Degradation (REDD+) are undertaken in the context of adaptation. The development of a framework that integrates adaptation within the development process is deemed to ensure sustainability and success (WRI, 2007).

An integrated approach builds on mitigation measures as a part of adaptation in order to provide necessary mechanisms to respond to the realities of climate change and contribute to attaining the twin objectives of the UNFCCC and create an enabling policy environment for strengthening the country's pursuit of sustainable development and the fulfillment of its Millennium Development Goals (MDG) targets.


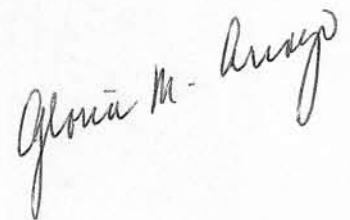


## 8. THE MITIGATION PILLAR

The principal objective of the UNFCCC is the stabilization of GHG concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference of the global climate system. Mitigation as a response plays a key role in pursuing the UNFCCC objective, particularly in the context of historical emissions of industrialized countries. Achieving this objective would involve limiting or reducing anthropogenic GHG emissions by sources and preserving or, as appropriate, enhancing sinks and reservoirs of GHGs. However, the complexity of prevention and mitigation stems from the fact that the atmosphere is part of the global commons and as such, no single country, region, or economic sector can, reverse the trend of increasing GHG emissions by itself.

Like most developing countries, the Philippines' contribution to the total global GHG emissions is insignificant compared to the rest of the world. Nonetheless, the Philippines embarks on a mitigation strategy to contribute to the global effort to reduce emissions, pursuing cost-effective measures to reduce GHG emissions, including increased energy efficiency and conservation, development and increased utilization of appropriate low carbon and renewable energy technologies, and reducing emissions from deforestation and forest degradation. The strategy shall take the form of nationally-appropriate mitigation actions, which reflects the recognition of the key role that developing countries play in ensuring that the global community can achieve the long-term objectives of mitigation, taking into account the rising emissions growth rates of developing countries including the Philippines. Such an approach to mitigation, anchored on the pursuit of sustainable development, gives the country the opportunity to leapfrog into the future and avoid harmful emissions as the economy grows.

It is important to understand the mitigation potential of the Philippines although greenhouse gas mitigation will not be the primary driver of the country's mitigation strategies as enshrined in this Framework and the subsequent Action Plan. This potential should be transformed strategically into mitigation options that will offer the most co-benefits to fuel sustainable developments.



## The Philippines 2000 Greenhouse Gas (GHG) Inventory

The Philippine's mitigation potential can be gleaned from the GHG inventory, which is summarized in the following figure and table:

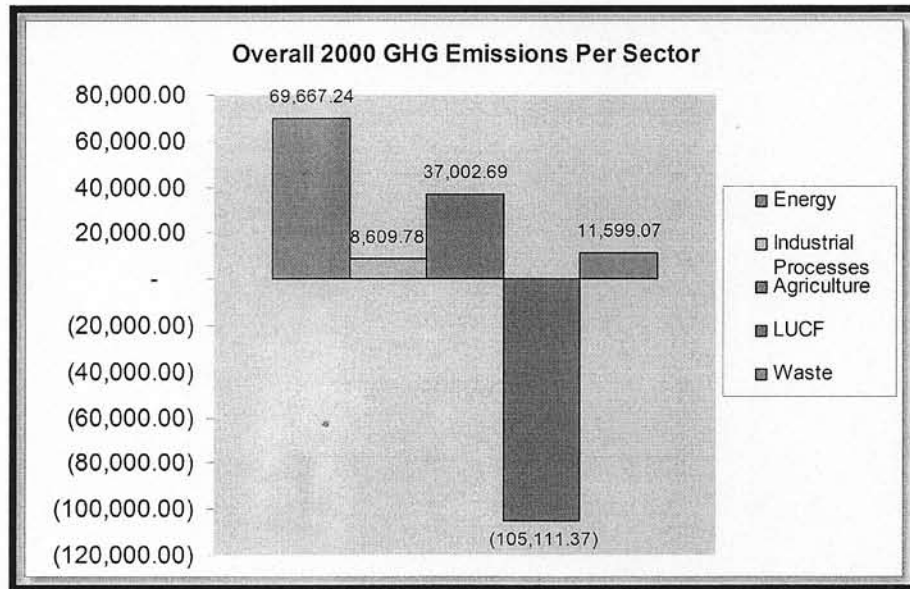


Figure 7: Overall 2000 GHG Emission per Sector

Table 1: Overall 2000 GHG Emission per Sector (in Gg CO<sub>2</sub> e)

Sector	CO <sub>2</sub> , Gg	CH <sub>4</sub> , Gg	N <sub>2</sub> O, Gg	*CO <sub>2</sub> e Emission, Gg
Energy	62,499.10	304.14	2.52	69,667.24
Industrial Processes	8,604.74	0.24	-	8,609.78
Agriculture	-	1,209.79	37.41	37,002.69
LUCF	(104,040.29)	(46.28)	(0.32)	(105,111.37)
Waste	-	500.67	3.50	11,599.07
<b>Totals</b>	<b>(32,936.45)</b>	<b>1,968.56</b>	<b>43.11</b>	<b>21,767.41</b>

$$\text{CH}_4 \text{ GW Potential} = 21; \text{N}_2\text{O GW Potential} = 310; * = \text{CO}_2 + (\text{CH}_4 * 21) + (\text{N}_2\text{O} * 310)$$

This is the second GHG inventory conducted by the Philippines, to be contained in its Second National Communication (SNC) on Climate Change for submission to the UNFCCC Secretariat. This inventory and the first one have been adjusted in view of new information on the LUCF. Based on the inventory conducted for the different sectors, the Philippines emitted 21,767 Gg of GHG in the year 2000, net of sequestered carbon by LUCF Comparing the 1994 Initial National Communication (INC) and the 2000

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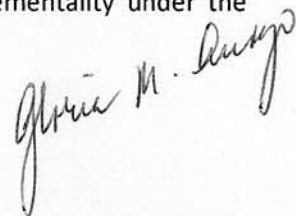
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GHG Inventory for the SNC, a decrease of 78% in GHG emissions for the Philippines has been registered, notably due to the adjustment in the amount of emissions sequestered by the LUCF sector.

Total emissions from non-LUCF sectors amounted to 126,879 Gg CO<sub>2</sub>e as seen in the above figure and table. The energy sector still contributed the highest at 69,667.24 Gg CO<sub>2</sub>e or 55% of the total. This was followed closely by the Agriculture sector with 37,003 Gg or 29% of the total. Emissions from industrial processes was registered at 8,610 Gg or 7% of the total, while the waste sector released 11,599 Gg or 9% of the total GHG emissions for 2000.

These total can be further adjusted based on sectoral refinements of estimations. These then can be translated into possible mitigation measures, which should emphasize the co-benefits of pollution prevention, energy security and improving the stability & productivity of ecosystems containing the country's sinks like its forests. The translation into specific mitigation measures in the various sectors can guide mitigation opportunities that can be pursued in the context of incrementality under the Convention and its Kyoto Protocol processes.



### Key Result Areas (KRAs) for Mitigation

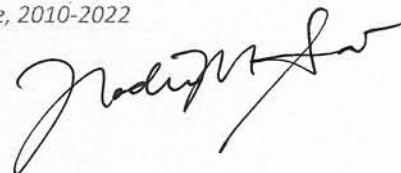
**Long-term Objective:** *Facilitate the transition towards low greenhouse gas emissions for sustainable development.*

To achieve this long-term objective, the following KRAs, from which the national, sectoral and local action plans shall be drawn, are adopted. A list of strategic priorities is provided under each KRA to serve as initial guide for action planning:

#### 8.1 Energy Efficiency and Conservation

The energy sector is considered as one of the most vulnerable sectors that need to adapt to changing demand and supply conditions resulting from climate change. One major challenge for energy is the adaptability of infrastructure such as power plants, refineries, depots, power transmission and distribution systems, and fuel distribution systems to cope with these changing climatic conditions. Most energy infrastructure are located along coastal areas, where the direct impacts of sea level rise and coastal storm surges will be felt.

**Objective:** *Develop and enhance clean energy sources, uses and other efficiency measures towards a low carbon economy in the energy sector.*





Strategic Priorities

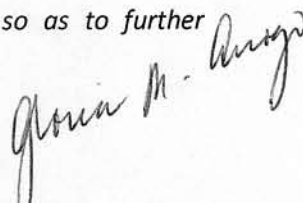
- a. Enhance energy efficiency and conservation, and put in place long-term reliable power supply through reinforcement of energy infrastructure, diversification of energy sources and research and development (R&D) in new technologies.
- b. Maintain a competitive energy investment climate.
- c. Reduce GHG emissions from the energy sector, particularly those that contribute or forecast to contribute the most, through increased use of alternative fuels and other energy conservation programs.

**8.2 Renewable Energy**

While the country is promoting the use and development of renewable and alternative energy sources, the Philippines still relies heavily on thermal electric power generation, particularly gas-fired, oil-fired and coal-fired power plants. Thermoelectric generation is water-intensive. If changing climatic conditions alter historical patterns of precipitation and runoff, they may complicate operations of existing thermoelectric power plants.

About 56 percent of the country's energy demand is met by indigenous resources including coal, natural gas, hydropower and traditional biomass energy. The Philippines is one of a few countries in the world where renewable energy (sourced from geothermal and hydropower plants) accounts for the largest share (43 percent) of total primary energy supply. The Philippine government targets to double its current renewable energy capacity from 4,500 MW to 9,000 MW in the next 20 years.

Objective: *Realize the full potential of the country's renewable energy capacity so as to further contribute to energy security and promote low-carbon growth in the energy sector*



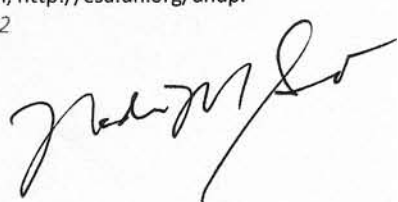
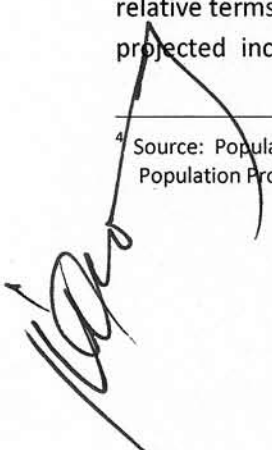
Strategic Priority

- a. Intensify the development and utilization of renewable and environment-friendly alternative energy resources/technologies.

**8.3 Environmentally Sustainable Transport**

The transport sector's contribution to GHG emissions has increased significantly both in absolute and relative terms since 1990. Based on the current growth rates in motorization of about 6 percent, and the projected increase in urban population by 35 million by 2030,<sup>4</sup> emission contributions from road

<sup>4</sup> Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2007 Revision, <http://esa.un.org/unup>.  
*National Framework Strategy on Climate Change, 2010-2022*



transport, estimated at 24 MtCO<sub>2</sub>e in 2007, are projected to increase to 37 and 87 MtCO<sub>2</sub>e by 2015 and 2030 respectively under a business as usual (BAU) scenario. This would result in a rapid enlargement of the country's carbon footprint, further exacerbating pollution in urban areas.

A low-carbon path in the transport sector is thus essential. This Framework promotes models to improve the transport sector's efficiency and modal shifts as compressed natural gas (CNG) and liquefied petroleum gas (LPG) becomes the primary fuel of the public transport, and support the expansion/shift to more efficient mass transport systems such as metro rail transit (MRT), light rail transit (LRT) and bus rapid transit (BRT).

*Objective: Improve the efficiency of the transport sector through increased uptake of alternative fuels and expansion of mass transport systems*

#### Strategic Priorities

- a. Promote models to improve the transport sector's efficiency and modal shifts
- b. Convert of public utility vehicles to LPG and renewable energy sources, and the expansion of/shift to more efficient mass transport systems.
- c. Integrate climate change to the formulation of energy and transport policies, e.g., formulation of a national Environmentally Sustainable Transport (EST) strategy.

#### **8.4 Sustainable Infrastructure**

The Philippines' residential and commercial sectors - human settlements – are major producers of GHG. They consume 50% of primary electric energy: 27% is consumed by households, while 23% is consumed by the business sector. Of all structures built for various human activities, high-rise buildings consume most (72%) of electric supply and 17% of fresh water.

Moreover, buildings contribute 33% of the carbon dioxide emission of human settlements. Making these buildings energy- and water-efficient would, therefore, be critical component mitigation. The full implementation of a standard for green buildings would minimize the release of GHGs by as much as 2,400,000 tons a year.

*Objective: Reduce carbon footprint through energy-efficient design and materials for public infrastructure and settlements*

*Gloria M. Araya*



### Strategic Priorities

- a. Institutionalize guidelines for the construction of innovative climate-resilient and energy-efficient human settlements.
- b. Promote green infrastructure practices through climate-smart technologies, climate proofing processes and construction of energy-efficient buildings.
- c. Install energy-efficiency and climate-proofing mechanisms for public infrastructure, cultural facilities, and socio-economic infrastructure (including telecommunications facilities) through appropriate standards and inventory mechanisms.
- d. Develop energy-efficient and climate-resilient human settlements through government and private sector housing programs, and public awareness campaigns.

### **8.5 National REDD+ Strategy**

The Philippines' Second National Communication to the UNFCCC highlights the potential of the country's forestry sector to serve as a "carbon sink," effectively mitigating the country's overall greenhouse gas emissions via the absorption of carbon dioxide by the sector. However, an assessment of the country's forestry sector reveals several gaps in governance, extension services, research and development, capacity building, and financing, among others.

A National REDD+ Strategy does not only leverage the country's participation in a prospective international REDD+ mechanism, but also boosts domestic efforts towards the reduction of emissions from deforestation and forest degradation and the enhancement of forest carbon stocks in the country. It can also create an opportunity to strengthen the forestry sector's capacity to adapt against the impacts of climate change by enhancing ecosystem services and establishing safeguards towards the realization of multiple environmental and social benefits.

*Objective: Reduce emissions from deforestation and forest degradation through the sustainable management of forests and the protection and enhancement of carbon stocks in watersheds, forests and other terrestrial ecosystems*

### Strategic Priorities

- a. Review, harmonize, and where necessary formulate, enabling policies towards enhancing the forestry sector's ability to reduce emissions from deforestation and forest degradation and enhance forest carbon stocks, in the process, identifying and ensuring social and environmental safeguards are observed in the implementation of REDD+.
- b. Strengthen governance mechanisms in REDD+ coordination and implementation by establishing appropriate institutional arrangements with which to meaningfully engage stakeholders and ensure equitable benefit sharing with local government units and communities.

- c. Promote a watershed approach towards REDD+ planning, implementation, and enforcement, pursuing options to improve the protection and sustainable management of forests, and the enhancement of forest carbon stocks and biodiversity.
- d. Collaboratively establish a broad science-based REDD+ research and development (R&D) agenda which, among others, identifies relevant national baselines, the drivers of deforestation and degradation in the country, and the social, policy, and carbon-cycle aspects of REDD+ in the Philippines.
- e. Establish and implement a subnational REDD+ measurement, reporting, and verification (MRV) system, scaling up to a national-level system commensurate with the improvement of capacities and resources.
- f. Formulate and implement a national REDD+ communication plan and capacity building program with which to facilitate engagement, dialogues, and training for stakeholders towards REDD+ development.
- g. Explore and capitalize on opportunities for financing REDD+, establishing long-term financial sustainability and resilience by seeking multiple funding sources, establishing contingencies and investing in self-sustaining local-level programs.

## 8.6 Waste Management

Acknowledging that unmanaged waste aggravates the emission of methane, a greenhouse gas 20 times more lethal than carbon dioxide, it is imperative that the Philippines paves a way towards the more effective implementation of waste management laws of the Philippines.

Objective: *Full implementation of proper waste management*

### Strategic Priorities

- a. Enhanced implementation of the Ecological Solid Waste Management Act
- b. Promotion of best practices in waste management, involving all categories of waste
- c. Strengthen the advocacy of proper waste management as a tool towards better communicating and mobilizing the public to address climate change

*Gloria M. Araya*

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## 9. THE ADAPTATION PILLAR

Adaptation refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. The Delhi Declaration on Climate Change and Sustainable Development highlights the importance of adaptation as “high priority for all countries.” With the Philippines’ geophysical and socio-economic characteristics, more emphasis is given on adaptation to risks associated with current climate variability and extremes.

### Key Result Areas (KRAs) for Adaptation

Long-term Objective: *To build the adaptive capacity of communities and increasing the resilience of natural ecosystems to climate change.*

To achieve this long-term objective, the following KRAs, from which the national, sectoral and local action plans shall be drawn, are adopted. A list of strategic priorities is provided under each KRA to serve as initial guide for action planning:

#### 9.1 Enhanced Vulnerability and Adaptation Assessments

The development of a science-based approach to climate change adaptation requires the establishment of a comprehensive knowledge system which has, as its components, the rigorous collection, warehousing, and publishing of country-specific data towards the generation of methods, tools and assessments for better decision-making. Vulnerability assessment is the process of identifying, quantifying, and prioritizing (or ranking) the vulnerabilities in a system. It means assessing the threats from potential hazards to the population and to existing infrastructure.

Vulnerability and adaptation assessments need to be generated to serve as the country’s scientific basis towards quantifying and prioritizing climate-related vulnerabilities and refining adaptation strategies in both national and local settings. As a matter of principle, such assessments shall be iterative as they will be subject to constant methodological and data enhancement.

Objective: *Enhance the availability and quality of vulnerability and adaptation assessments to serve as the country’s scientific basis for formulating appropriate climate change adaptation strategies.*



#### Strategic Priorities

- a. Ensure the formulation of effective and efficient vulnerability, impact and adaptation assessment tools that are relevant to target sectors and implementers.
- b. Improve mechanisms for addressing gaps and limitations of existing assessment and vulnerability approaches, in relation to the needs and objectives of climate change plans.
- c. Increase access to climate change adaptation knowledge products and support services for the purpose of guaranteeing that the needs of the marginalized and vulnerable sectors are addressed.

National Framework Strategy on Climate Change, 2010-2022



## 9.2 Integrated Ecosystem-based Management

Addressing the country's multiple vulnerabilities to climate change requires an integrated ecosystem-based management approach which not only acknowledges the interrelationships across the country's ecosystems, but also strengthens the integrity of decision-making processes towards the formulation of comprehensive adaptation strategies from ridge-to-reef.

Integrated Ecosystem-based Management in the Philippines shall be achieved through, but not limited to, the following approaches and systems:

### 9.2.1 River Basin Management

Objective: *Manage watershed ecosystems and multi-polar environments through the River Basin Management (RBM) approach.*

#### Strategic Priorities

- a. Rehabilitate and develop watershed resources through resource use improvement and governance improvement.
- b. Enhance vulnerability and adaptation assessments.
- c. Enhance ecosystem services to control droughts, floods and landslides.
- d. Institute a comprehensive river basin management governance strategy.
- e. Establish appropriate and participatory institutional arrangements with local government units, private sector, and civil society organizations.
- f. Reduce climate change risks and vulnerability of watershed ecosystems and biodiversity through ecosystem-based management approaches, conservation efforts, and sustainable ENR-based economic endeavors such as ecotourism.

### 9.2.2 Coastal and Marine Systems

Objective: *Build up and improve the resilience of coastal and marine ecosystems and communities, including tourism industries, to climate change.*

#### Strategic Priorities

- a. Establish marine reserve networks through active participation of local communities to serve as sources of marine propagules to replenish biodiversity in shallow water habitats.
- b. Determine optimal clustering and locations of marine reserves according to "source and sink".
- c. Prioritize protection/management of mangroves, estuaries, sea grasses, coral reefs and beaches as a management unit to derive maximum benefits from synergistic interactions of these five ecosystems that result in enhanced marine productivity.

*Gloria M. Arroyo*



- d. Strengthen sustainable, multi-sectoral and community-based coastal resource management mechanisms and ecotourism endeavors.
- e. Manage and expand the sink potential of marine ecosystems such as coral reefs and mangroves. (Mitigation)

### 9.2.3 Biodiversity

Objective: *Mainstream biodiversity adaptation strategies to climate change in policies, plans and programs of national and local government agencies.*

#### Strategic Priorities

- a. Establish national baselines, standards and indicators for monitoring progress in implementing biodiversity conservation programs.
- b. Strengthen vertical and horizontal coordination among government agencies, civil society groups, academe and other organizations in implementing biodiversity conservation and adaptation strategies to climate change.
- c. Protect vulnerable ecosystems and highly threatened species from climate change impacts;
- d. Develop institutional capacities in biodiversity conservation and climate change adaptation at the national, regional and local levels.
- e. Establish scientific basis for measuring the impacts of climate change scenarios on ecosystem and species diversity.
- f. Mobilize sustainable funding support to climate change adaptation programs

## 9.3 Water Governance and Management

The success of the country's adaptation efforts are seriously dependent on how the country's water resources are governed and managed. Therefore, appropriate mechanisms must be established towards protecting and enhancing the integrity of our water resources towards environmental flows for biodiversity, agriculture, energy, and consumption of settlements and industries.

Objective: *Reduce water sector vulnerability to climate change through participative water governance, resource management and sectoral policy reform.*

#### Strategic Priorities

- a. Reduce climate change vulnerability of water resources through improved water governance and resource management mechanisms.
- b. Mainstream climate change adaptation in water resources policies and development planning
- c. Promote water sector reforms that will address the weak and fragmented institutional and regulatory framework



- d. Study, design, and implement innovative financing and incentive systems to stimulate water sector climate change adaptation investments and encourage community participation in water resource management
- e. Climate-proof water-related infrastructures such as dams and impoundments for domestic water supply, irrigation, and energy generation.
- f. Test and adopt “low-cost, no regrets” water sector climate change adaptation technologies
- g. Enhance institutional and community capacity for Integrated Water Resources Management (IWRM)
- h. Establish science-based water resources information, climate projections, climate change impacts on major water resources and infrastructure, and adaptation technologies at scales relevant to communities, decision makers and water resources managers.

#### 9.4 Climate-Responsive Agriculture

The sensitivity of the country’s agricultural sector to the impacts of climate change cannot be overstated. The increasing frequency and intensity of extreme weather events affecting the country continue to devastate and threaten the country’s food and water resources. Addressing these vulnerabilities in both the short and long-term requires building the resilience of our food production systems through the mainstreaming of sustainable agriculture and aquaculture and related developments in the sector.

*Objective: Protect and enhance ecosystems and ecosystem services to secure food and water resources and livelihood opportunities.*

##### Strategic Priorities

- a. Reduce climate change risks and vulnerability of natural ecosystems and biodiversity through ecosystem-based management approaches, conservation efforts, and sustainable ENR-based economic endeavors such as ecotourism.
- b. Increase the resilience of agriculture communities through the development of climate change-sensitive technologies, establishment of climate-proof agricultural infrastructure and climate-responsive food production systems, and provision of support services to the most vulnerable communities.
- c. Improve climate change resilience of fisheries through the restoration of fishing grounds, stocks and habitats and investment in sustainable and climate change-responsive fishing technologies and products.
- d. Expand investments in aquaculture and in other food production areas.
- e. Strengthen the crop insurance system as an important risk sharing mechanism to implement weather-based insurance system.
- f. Strengthen sustainable, multi-sectoral and community-based resource management mechanisms.

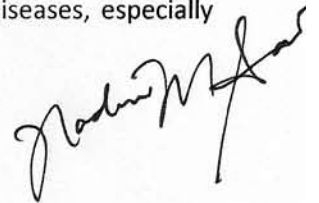
## 9.5 Climate-Responsive Health Sector

The global climate is now changing faster than at any point in human civilization, and one of its main impacts on human health is increasing morbidity and mortality rates especially due to vector-borne diseases. Climate change profoundly impacts communicable index diseases as its vectors adapt, resulting in greater vulnerability of the marginalized sectors. The health sector must formulate proper climate-sensitive interventions in ensuring a healthy citizenry, and a disease-resilient community.

*Objective: Manage health risks brought about by climate change.*

### Strategic Priorities

- a. Assessment of the vulnerability of the health sector to climate change.
- b. Improvement of climate-sensitivity and increase in responsiveness of public health systems and service delivery mechanisms to climate change.
- c. Establishment of mechanisms to identify, monitor and control diseases brought about by climate change; and improve surveillance and emergency response to communicable diseases, especially climate-sensitive water-borne and vector diseases.



## 9.6 Climate-Proofing Infrastructure

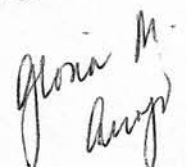
The impacts could be severe in areas where infrastructures are not designed to fully cope with the effects of climate change. Thus, these impacts have potential implications for where we locate and how we build our new infrastructures, as well as make existing infrastructure robust or resilient to the effects of climate change.

Infrastructure in the country has not kept pace with the requirements of a growing economy, and the increase in population and urbanization. The Philippines has not provided infrastructure that is sufficient in quantity and quality to meet global economic challenges as well as poverty reduction goals under such international commitments as the Millennium Development Goals (Llanto, 2007). This will be further exacerbated by climate change and the need for urgent adaptation actions is increasing by the day.

*Objective: Render the infrastructure sector resilient to the escalating impacts of climate change*

### Strategic Priorities:

- a. Establish baseline data and benchmarks for climate change as basis for adaptation actions in the infrastructure sector
- b. Collaborate and integrate climate change adaptation plans for infrastructure with other stakeholders.
- c. Rationalize climate change adaptation in infrastructure policy, planning and programming.





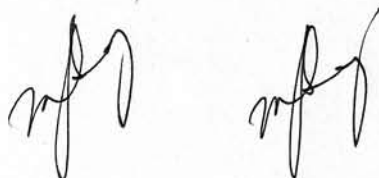
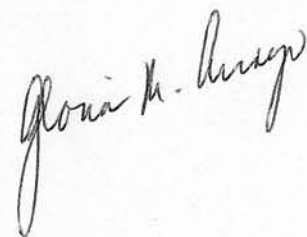
## 9.7 Disaster Risk Reduction

In the overall effort of combating the effects of climate change, disaster risk reduction (DRR) shall be the first line of defense. Thus, beyond normal relief operations, the Framework Strategy shall expand and upgrade the country's capacity to address and anticipate disasters such as typhoons, floods, and landslides. This would bring a renewed focus on science-based early warning systems and capacity-building for local government units and organizations for disaster preparedness and risk management. This would also entail vulnerability assessment of communities as well as prioritized disaster planning and management for areas in the typhoon-path and flood-prone areas.

*Objective: Reduce disaster risks from climate change-induced natural hazards.*

### Strategic Priorities

- a. Adoption of a responsive policy framework to serve as an enabling environment for reducing losses from natural disasters, including climate change-related risks.
- b. Use of the best available and practicable tools and technologies from the social and natural sciences as decision aids and support systems to stakeholders in preventing, reducing and managing disaster risks.
- c. Enhancement of institutional and technical capacity to facilitate the paradigm shift from disaster response to disaster preparedness and mitigation.
- d. Enhancement of national monitoring, forecasting and hazard warning systems; and improve effectiveness of early warning systems available to communities.
- e. Mainstreaming of climate and disaster risk-based planning in national and local development and land use planning thru the application of disaster risk assessment and by further supporting capacity development, including the preparation/ gathering and dissemination of appropriate data and maps necessary for national, regional, provincial and city/municipal planning.



## 10. CROSS-CUTTING STRATEGIES

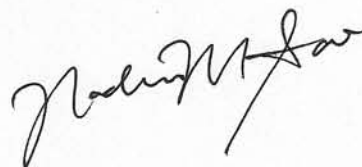
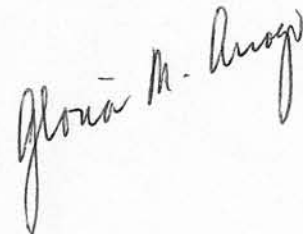
Several cross-cutting areas are identified by the Framework as crucial to the achievement of the National Goal: Capacity Development, Knowledge Management, Information, Education and Communication (IEC), Research and Development (R&D), and Technology Transfer. The succeeding sections outline the priority strategies that would be undertaken under these critical areas of concern.

### 10.1 Capacity Development

Capacity development objectives in the area of policy formulation, organizational development and systems improvement shall be pursued for national government agencies, local government units and stakeholder groups. At the individual level, specialized capacity (training) needs in the areas of adaptation and mitigation have to be addressed to enable the full, effective and sustained implementation of the Framework and Action Plan. Overall, these strategies are aimed at strengthening the capacity of local, regional and national institutions and individual stakeholders for undertaking climate change initiatives.

#### Strategic Priorities

- a. Review and develop policy instruments at all levels of government to facilitate the implementation of the National Framework Strategy on Climate Change.
- b. Enhance the capacity to plan, prepare, implement, monitor and report on climate change actions, including the integration of such actions into relevant national strategies and plans;
- c. Enhance systematic observation, research and knowledge management, which includes strengthening and using data for systematic observation, early warning, national and regional downscaling and modelling, disaster preparedness, vulnerability assessment and other climate services.
- d. Strengthen climate change communication, education, training and public awareness at all levels, including at the local and community levels, taking into account gender issues;
- e. Encourage and strengthen participatory and integrated approaches taking climate change considerations into account to the extent feasible in relevant social, economic and environmental policies and actions.
- f. Enhance systems and procedures to strengthen institutional arrangements in addressing climate change mitigation and adaptation.
- g. Develop appropriate assessment tools such as carrying capacity assessment incorporating an appropriate environmental valuation methodology to inform decision-making, policy development, research and development (R&D), payment and incentive mechanisms, and other climate change-related endeavors.



## 10.2 Knowledge Management and Information, Education and Communication (IEC)

Under knowledge management, mechanisms and protocols shall be installed for a well-coordinated climate change information and data management and reporting system. The information management system includes distillation and dissemination of country experiences and lessons in addressing climate change adaptation and mitigation, including assessments/evaluations. This knowledge management mechanism shall then feed into the development of communication materials and the introduction of innovative tools and approaches for increasing public awareness on Climate Change.

### Strategic Priorities

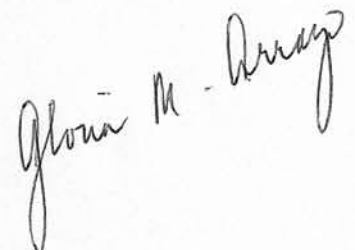
- a. Educate the public and private sectors to secure broad public awareness, support and cooperation in disaster risk-reduction, mitigation and adaptation programs.
- b. Mainstream climate change into all levels of formal education.
- c. Provide socio-economic and cross-sectoral climate change impacts and vulnerability assessment and decision-making tools at all levels of development.
- d. Maximize utility of forecasts, research, and climate change knowledge through a nationwide behavior change communication (BCC) and IEC campaigns.
- e. Establish a functioning network of government and non-government specialist institutions and professionals to provide the country with necessary tools, observations and information in dealing with climate change.

## 10.3 Research and Development (R&D) and Technology Transfer

Currently, three of the five sectoral councils of the Department of Science and Technology (DOST) have formal statements of varying depth and scope concerning climate change – related to Research and Development as well as Technology Transfer. It is observed that some activities cut across sectors and could benefit from the participation of multiple disciplines to ensure success from basic research to development to application. The seeks the rationalization and enhancement of the existing sectoral R&D and Science & Technology agenda to ensure mainstreaming of the country's climate change requirements.

### Strategic Priority

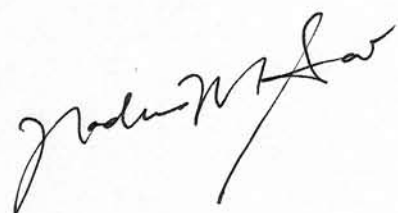

- a. Develop and implement a national, comprehensive, multi-sectoral climate change research and development (R&D) and science and technology (S&T) agenda based on the initial inputs of research and science agencies and institutions.



## 11. MEANS OF IMPLEMENTATION

The following Strategies in the areas of governance, coordination, financing, valuation and partnerships are adopted to facilitate the implementation of the Framework. Other mechanisms that may be appropriately identified during the formulation of the Action Plan shall be included.

- 11.1 Establish appropriate management and institutional arrangements and coordination mechanisms for climate change at the national, sub-national and local levels.
- 11.2 Maximize government financing instruments at the national and local levels as source of funds for the National Framework Strategy.
- 11.3 Install policy and incentive mechanisms to facilitate and leverage private sector investments in climate change.
- 11.4 Provide and access scaled-up, new and additional financial resources to support the requirements of the National Framework, including sectoral and local financing requirements.
- 11.5 Development of appropriate assessment tools such as carrying capacity assessment incorporating an appropriate environmental valuation methodology to inform decision-making, policy development, research and development (R&D), payment and incentive mechanisms, and other climate change-related endeavors.
- 11.6 Establish partnerships among national and local government agencies, business, professional and other private groups, community-based organizations, academic and scientific organizations, and civil society organizations.



## 12. MONITORING AND EVALUATION OF THE FRAMEWORK

The Climate Change Commission, in coordination with concerned agencies and stakeholder groups, shall install a monitoring and evaluation (M&E) system to track the implementation progress of the provisions of this Framework and the resulting National Climate Change Action Plan and Local Climate Change Action Plans.

As per Rule VIII, Sec.1 of the Implementing Rules and Regulations of the Climate Change Act of 2009, review the provisions of this Framework every three (3) years using a participatory evaluation process.

*Gloria M. Acosta*

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### 13. TRANSITORY PROVISION

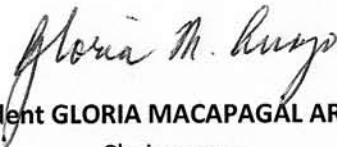
The National Framework Strategy on Climate Change is a dynamic and living document that shall continue to evolve as new challenges and opportunities emerge and as the level of consensus continues to develop among stakeholders in all sectors of Philippine society. All stakeholder groups shall pursue more concrete strategies and actions and work towards enhancing the Framework, as national government agencies and local government units continue to refine the processes, as Filipinos endeavor to deepen and enrich their understanding of the consequences of climate change, and as the nation matures in its understanding of the interdependence of individuals, groups, cultures, and ecosystems to pave the way for new modes of collaboration—all in a concerted national effort to realize the Vision of *“a climate risk-resilient Philippines with healthy, safe, prosperous and self-reliant communities, and thriving and productive ecosystems.”*

*Gloria M. Araya*

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**President GLORIA MACAPAGAL ARROYO**

Chairperson



**Secretary HEHERSON T. ALVAREZ**

Vice Chairman



**Undersecretary MARY ANN LUCILLE L. SERING**

Commissioner



**Undersecretary NADEREV M. SAÑO**

Commissioner



## SUMMARY OF WATER RESOURCES SECTOR CCA OBJECTIVES AND PLAN OF ACTION

<b>GOAL</b>									
To build the adaptive capacity and resilience of communities and increase the resilience of natural ecosystems to climate change.									
<b>Strategy 1</b>			<b>Strategy 2</b>			<b>Strategy 3</b>			<b>Strategy 4</b>
Creating an enabling environment for mainstreaming climate change adaptation based on a decentralized framework of good governance.			Reducing climate change risks and vulnerability of human and natural ecosystems through ecosystem-based management approaches and appropriate technologies.			Establishing knowledge management systems on climate change based on science and experiences of communities.			Ensuring that the processes, such as policy formulation, development planning, implementation, and monitoring and evaluation, are gender responsive and non-discriminatory.
Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6	Objective 7	Objective 8	Objective 9	Objective 10
To mainstream CC adaptation in water resources policies and development planning at the national, regional and local levels	To promote water sector reforms that will address the weak and fragmented institutional and regulatory framework.	To study, design and implement innovative financing mechanism and economic instruments to stimulate water sector CCA investment and encourage private sector and community participation in water resource management	To climate-proof water-related infrastructures, including water supply infrastructures, dam and impoundments for domestic use, irrigation and energy generation	To adopt "low cost," "regrets" and advanced adaptation technologies	To enhance institutional and community capacity for IWRM	To strengthen key government and academic institutions at the national and local levels to provide climate change projections and impacts on water supply and demand vulnerability assessments (including social and economic), updated scientific and technical information, and tools on integrated water resources management at scales relevant to decision makers	To establish science-based water resources information, climate projections, CC impacts on major water resources and infrastructure, and adaptation technologies at scales relevant to communities, decision-makers and water resources managers	To develop and implement comprehensive communications strategy to raise awareness on climate change impacts on water resources and the advantages of early attention to adaptation of R & D on climate projections, impacts, and adaptation technologies	To ensure the active participation of women in IWRM and CCA decision-making processes at all levels

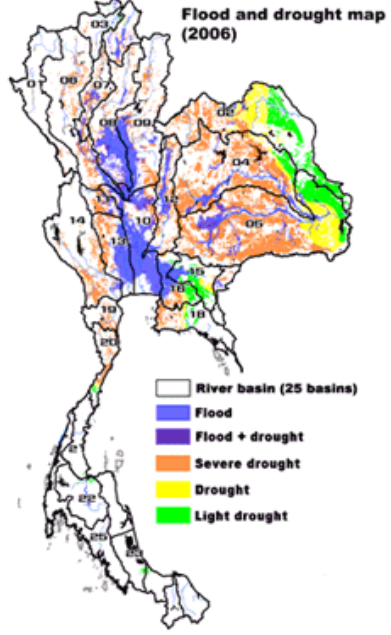
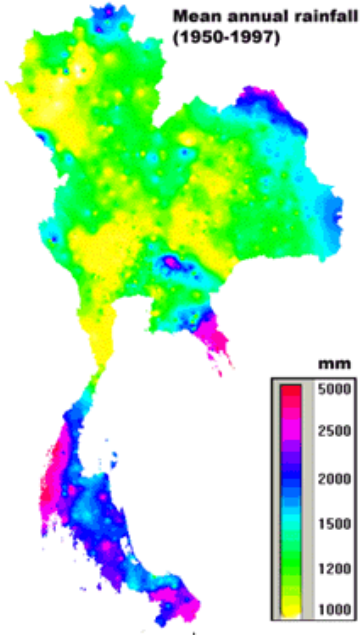
PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION	PLAN OF ACTION
Integrate climate change in the development and design criteria of water sector infrastructures, such as water supply distribution systems, dams and water impoundments, and community and LGU-managed rainwater harvesting infrastructures	Review and amend the Water Code (PD 1067) to be responsive to climate change risks	Develop public-private sector and community partnerships in IWRM and CC adaptation to encourage shared responsibilities in financing adaptation measures	Conduct vulnerability assessment of existing dams and water supply infrastructures to extreme weather variability and accelerated sea level rise brought about by climate change for major river basins or smaller units	Design and implement alternative management mechanisms of existing water resources, such as (i) small water impoundments vs. large dams, (ii) rainwater harvesting, and (iii) (integrated water resources management through either watershed, river basin and small island management units.	Integrate IRWRM principles and methods in government plans and programs to (i) secure water for people, (ii) secure water for food production, (iii) protect vital ecosystems, and (iv) address gender disparities.	Improve the capacity of key government institutions to provide scientific and technical leadership: (i) PAGASA-DOST, (ii) DENR-National Water Resources Board; and (iii) key academic institutions at the national and local levels	Generate scientific knowledge and knowledge products on adaptation technologies and impacts of climate change risks to water resources through R&D and database infrastructure accessible to a broad set of users through partnerships with key national professional and interest groups to develop best practice networks on water resources management and adaptation technologies	Formulate water sector CCA communication strategy on: (i) IWRM approach; (ii) best practices and technologies, including rainwater harvesting; and (iii) simple water balance and water quality models for watersheds	
Integrate water resources climate change vulnerabilities and adaptation in EIA guidelines	Enact a national land use legislation	Design and implement full-cost water pricing and tariff structures that encourage recycling, conservation and efficient water consumption and generate resources to assist in financing adaptation measures	Retrofit, rehabilitate and implement operational changes of existing water-related infrastructures, when necessary and cost effective	Study the appropriateness of decentralized water systems for certain communities	Provide technical assistance to vulnerable communities on IWRM practices that will demonstrate how these practices are linked to CC adaptation and disaster risk reduction at the community to the national level	Integrate climate change and IWRM into education and training for key professions, including engineering, economics, architecture, planners, natural resources / environmental managers, and local governance	Create partnerships with key national professional and interest groups to develop best practice networks on water resources management and adaptation technologies	Develop knowledge hubs and web-based information sites where decision-makers and their advisers can access information about climate projections, likely climate-change impacts on water resources and infrastructures, tools, guides and approaches to adaptation planning	Review IWRM plans and programs to ensure that there are no barriers to women's participation at all levels in CCA design, planning and programming

<p>Integrate water sector climate change adaptation and DRRM in the MTPDP, sectoral plans, water supply roadmap, and local comprehensive development and investment plans</p>	<p>Review the Local Government Code to integrate climate change concerns.</p>	<p>Provide regular budget allocation for water sector CCA of national agencies and local government units under the General Appropriations Act</p>	<p>Integrate climate change and disaster risk reduction in the design criteria for new water-related infrastructure development</p>	<p>Study the appropriateness of rainwater harvesting technologies for groundwater recharge. Irrigation, flood control, and water supply.</p>	<p>Assess the environmental, social and economic impacts of climate change adaptation measures to provide decision-makers at various levels as well as communities to provide a menu of adaptation options. The assessment should include (i) gender impacts, and (ii) economic valuation of impacts</p>		<p>Promote tools for adaptation planning, which may include: (i) decision support tools, (ii) environmental, social and economic assessment and decision tools for watershed, river basins and small islands.</p>		<p>Conduct research on the impacts of water-climate change, CCA technologies and climate-related disasters on women and men.</p>
<p>Adapt integrated water resources management (IWRM) principles and strategies in national, regional and local development plans, and programs</p>		<p>Study, design and implement appropriate public finance mechanisms and incentive systems to mobilize a diverse financing source and leverage investments in CCA measures and technologies</p>	<p>Integrate climate change in the life cycle management of aging water infrastructures</p>	<p>Assess the environmental, economic and social implication of adaptation technologies</p>	<p>Enhance skills of key government agencies (particularly NWRB, NEDA, LGUs, and DILG-LGA and Local Government Resource Centers) to provide technical assistance on IWRM and mainstreaming CCA to LGUs and communities</p>		<p>Assess and promote new efficient technologies (desalting, biotechnology, drip irrigation, wastewater reuse, recycling, solar energy)</p>		<p>Review financing policies in the water sector to remove barrier for women's access to loans and credit facilities</p>

<p>Harmonize water sector CCA action plan and programs, with international agreement</p>			<p>Improve forecasting methods for reservoir and emergency operations</p>		<p>Study and design effective structure of collaboration between LGUs and stakeholders (water users) for IWRM to include conflict resolution</p>		<p>Update information and database on the country's water resources and best practices through the: (i) conduct of assessment and mapping of groundwater resources; and (ii) development of tools for the conduct of water balance assessment in watersheds to assist management of water supply and quality, and their impacts on domestic agriculture and coastal areas.</p>		
<p>Conduct socio-economic analysis of adaptation plans and programs</p>			<p>Implement modifications in the processes and demands for existing systems and water users through: (i) water conservation, (ii) forest, catchment and groundwater protection, (iii) flood plain management and flood hazard / damage reduction, (iv) water quality management, (v) monitoring networks</p>						



# Report on Status of Climate Change Management in Thailand



## Abbreviation

ADB	:	Asian Development Bank
ANU	:	Australian National University
CCA	:	Climate Change Alliance
CDM	:	Clean Development Mechanism
DNA	:	Designated National Authority
ECPA	:	The Energy Conservation Promotion Act
FAO	:	Food and Agriculture Organization
GEF	:	Global Environment Facility
GWP	:	Global Water Partnership
ICEM	:	International Center for Environmental Management
IUCN Asia	:	International Union of conservation on Nature and Natural Resources, Asia
IWMI	:	International Water Management Institute
JBIC	:	Japan Bank for International Cooperation
MoNRE	:	Ministry of Natural Resources and Environment
MoPH	:	Ministry of Public Health
NEB	:	National Environmental Board
NGO	:	Non-governmental Organization
ONEP	:	Office of Natural Resources and Environmental Policy and Planning
Oxfam	:	Oxford Committee for Famine Relief
SEI	:	Stockholm Environmental Institute
TSPCC	:	Thailand Strategic Plan on Climate Change
UNDP	:	United Nations Development Program
UNEP	:	United Nations Environmental Program
UNFCCC	:	United Nations Framework Convention on Climate Change
UNIDO	:	United Nations Industrial Development Organization
UNITAR	:	United Nations Institute for Training and Research
WB	:	World Bank
WWF	:	World Wild Fund for Nature

## **Background**

The report on the status of climate change in Thailand was composed for the sharing of the climate change issues and its national plan on adaptation and implementations to line agencies and NGOs representatives working on environment and water issues. The documents on climate change issues, reports and draft of the master national plan were reviewed and presented. The review has helped the group discussion on the lesson learned from the participants. However, adaptation to climate change is still a relatively new problem domain for Thai Government policy-making. Most policy, therefore, remains exploratory and generic or in form of individual projects.

### **Existing knowledge of national climate change situation in Thailand.**

Though Climate Change is the most challenging situation which impacts almost all aspects in people's livelihoods, the knowledge on climate change at the country level is quite limited. Most of Asian countries based on the prediction from experts in Meteorology or Geography. The existing information on climate change is mostly derived from the global level knowledge, not specific knowledge and information to the country. Thus, the data on climate change is in generic of the potential trends on the climate conditions.

There has been the prediction on the increase in mean annual temperature with the longer period of summer and more days of higher temperature than 33°C. The number of cold days will be decreased, but with higher rainfall intensity. Water shortage and increasing in drought and flood frequency in some river basins are predicted. There is also expectation of climate change impacts on rice productivity change. Wet season crop might increase in some areas and might decrease in other areas. Water quantity decrease will damage the wetlands areas, while the coastal zones will be damaged by the increasing severe coastal erosions and changes in the accretion patterns. The current severe coastal erosion has been reported that 23 coastal provinces in Thailand have lost 599 square km or 21% of 2,667 km. Bangpakong and Maeklong coastal ecosystems are the most at risk. ( more than 25 m. per year)

### **Responses to climate change**

Responses to climate change at national level include policy, institutional and adaptation responses. The Lower Mekong Basin countries (LMB: Cambodia, Laos, Thailand, and Vietnam) have ratified the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.



The adaptation activities have mostly been undertaken more on the natural disaster prevention rather than management of climate changes. There are technical and financial supports from international organizations like the MRC, UNDP, and the ADB in relation to climate change. 'Study on Climate Change Impact Adaptation and Mitigation in Asian Coastal Mega Cities' is being carried out with financial support from the ADB, World Bank, JBIC. The investigation on climate change issues in Bangkok and Ho Chi Minh City is being carried out. Other international organizations working on climate change issues include SEA-START, IUCN Asia, FAO, WWF, ICEM, Oxfam, SEI, CARE, ANU, IWMI, and the GWP.

### **National policy responses to climate change**

Thailand's economy relies heavily on its natural resources. A large number of its population is engaged in agriculture. In addition, several of its manufacturing and service industries, such as food processing and tourism industries, require agricultural and natural resources input. Therefore, Thailand is likely to be strongly affected by changes in the climate variables. As a consequence, taking actions to build up preparedness and the ability to adapt to cc should be high on the country's agenda.

Thailand ratified the UNFCCC in December 1994 and the Kyoto Protocol in August 2002. From 1997 to 2000 Thailand developed the initial National Communication to UNFCCC, funded by Global Environment Facility (MOSTE, 2000). In 2004, Thailand has designated the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Ministry of Natural Resources and Environment as the national climate change focal point. It was followed by the establishment of the National Board on Climate Change Policy and the Climate Change Coordinating Unit under ONEP in 2007. The Green Gas Management Organization (TGO), a public organization was also established as the Designated National Authority (DNA) for Clean Development Mechanism (CDM) projects.

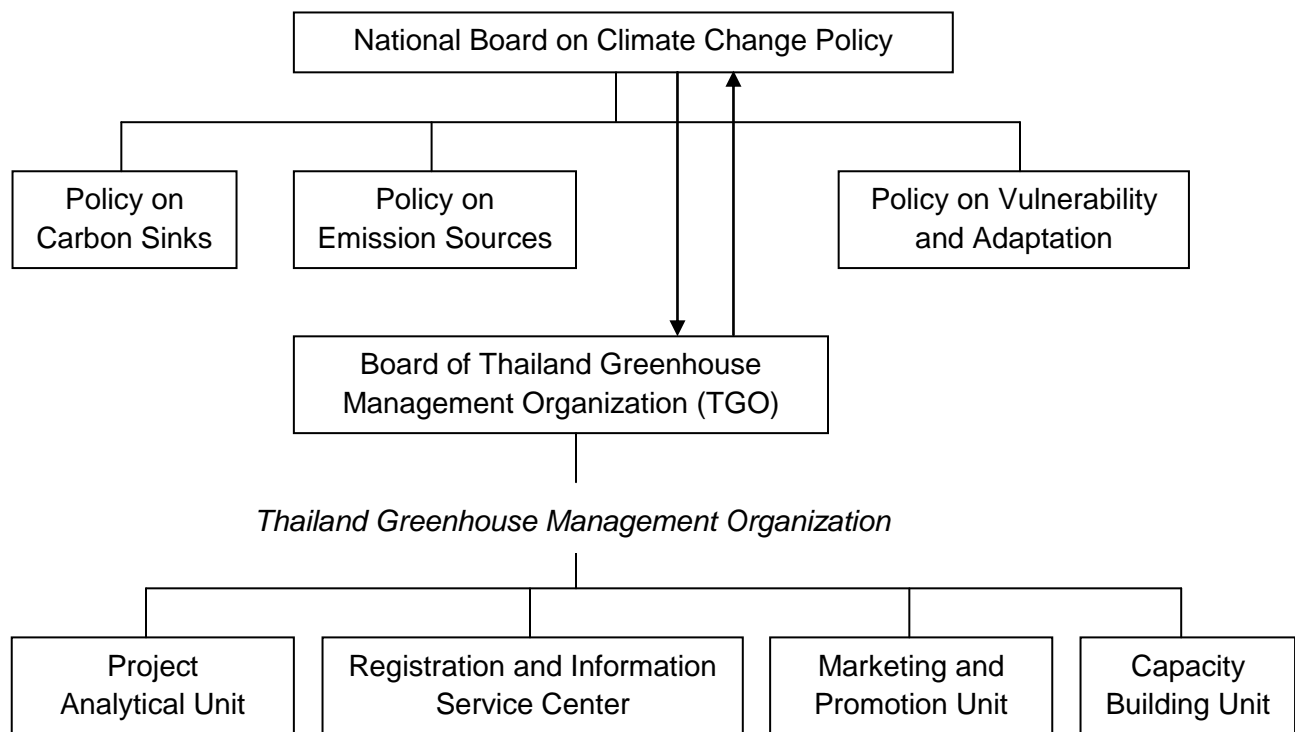


Figure 1. Thailand's institutional arrangements for climate change

Source: Thailand NET, 2009

The National Board on Climate Change Policy includes representatives of line agencies, research institutes and is chaired by the Ministry of Natural Resources and Environment (MoNRE). The Strategic Plan on Climate Change (TSPCC, 2008-2012), formulated by the MoNRE and approved by the Cabinet in 2008 is with the aims to remove existing barrier to Climate Change implementation in Thailand. There are six strategies in the Strategic Plan on Climate Change (2008-2012), set as a comprehensive guideline for the relevant national and local level agencies to develop their action plans in responses to climate change challenges. Six strategies are as follow.

1. To build capacity to adapt and reduce vulnerabilities to climate change impacts;
2. To promote greenhouse gas mitigation activities based on sustainable development;
3. To support research and development to better understand climate change, its impact and adaptation and mitigation options;

4. To raise awareness and promote public participation;
5. To build capacity of relevant personnel and institutions and establish a framework of coordination and integration;
6. To support international cooperation to achieve the common goal of cc mitigation and sustainable development

Three main laws which facilitate the national implementation of measures to address climate change are following:

1. The Enhancement and Conservation of National Environmental Quality Act (NEQA) B.E 2535 (A.C 1992) authorizes the National Environmental Board (NEB) to set environmental quality standards and to strengthen the rules of governing the monitoring and control pollution, including emission standards (ONEP, 1997)
2. The Energy Conservation Promotion Act B.E 2535 (A.C 1992) or so called ECPA. ECPA complies to
  - (2.1) identify general measures that factory owners should reduce energy uses
  - (2.2) the mandates energy audits and monitoring of energy consumption by owners of large buildings
  - (2.3) establish energy conservation promotion funds for energy efficiency, renewable energy projects, etc.
3. The National Energy Policy Council Act, B.E 2553 (A.C 1992) promotes a study and analysis of energy policies, management and development plans of the country (Thai Government, 1992).

The other policy documents involved but with no specific reference to climate change include National Water Policy, Thailand National Forestry Policy, and the Land Development Department Policy.

### **Adaptation Activities**

Main activities for climate change adaptation in Thailand were the promotion of better management and conservation of natural resources in various sectors; and the promotion in energy security. They are summarized as follow.

#### **Water Resource Management and the Agricultural Sector:**

1. The Royal Projects on the development of water resources for agricultural activities, and the drainage of water in low-lying areas in order to expand agricultural areas; topsoil preservation by the vetiver grass; to support the research on plant and animals species suitable for local areas.
2. The projects by the Ministry of Agriculture to promote market access for agricultural products; to enhance the capacity of local agricultural communities; to research on drought-resistant plant and animal species; to improve and build the irrigation system;
3. The projects by the Ministry of Natural Resources and Environment on integrated water resource planning for surface and ground water; water resources management at river basin level by the TAOs and local communities; capacity building for water resource use and conservation in agricultural sector.

### **Natural Disaster Management**

1. The Royal Projects on floods mitigation, decrease of drought (Royal Artificial Rain Projects); topsoil protection by vetiver grass; water resources management by dams and reservoirs construction.
2. The establishment of the National Committee on Water Policy for flood mitigation and the relief of drought crisis.
3. The establishment of the Information Center on Environmental Disasters under the Ministry of Natural Resources and Environment.
4. The establishment of the National Disaster Relief Center under the Ministry of Information, Communication and Technology.

### **Restoration and conservation of biological diversity and forest resources**

1. The Royal Projects to renew forested land in key areas in upstream and reservoir areas; to expand moist forests to be as buffer zone for forest fires prevention.
2. The projects by the Ministry of Natural Resources and Environment on Integrated natural resources and environmental management plan; Integrated management of biological diversity and forest resources for resources conservation and sustainable resource use.

### **Management of carbon sources**

Ministry of Energy has taken the priority in the greenhouse gas mitigation with active measures to promote supply and use of renewable and alternatives energies in electrical generation and transport and to promote energy efficiency in the residential, commercial and industrial sectors.

The activities include:

1. Establish market mechanisms to promote the use of alternative energies from biogas, biomass, solar energy, etc in electricity generation.
2. Provide the supply of renewable and alternative energies like biodiesel, gasohol and improve infrastructure to support the use of those energies in the transport sectors.
3. Undertake the Clean Development Mechanism (CDM) to promote greenhouse gas mitigation in various sectors (by Ministry of Natural Resources and Environment).
4. Incorporate Climate Change Adaptation into Bangkok's Strategic Plan and promote energy efficiency use in the urban residential and commercial sectors.
5. Develop legal instruments to promote for energy-efficient machine in the industrial sector;
6. Campaign to decrease the slash and burn practice in the agricultural sector
7. Promote 5Rs principle (Reduce/Reuse/Recycle/Refill/Repair) ,and sanitary landfills to replace open garbage dump.

#### **Promotion of carbon sinks**

1. Ministry of Natural Resources and Environment (MoNRE) has undertaken the projects on afforestation and reforestation,
2. Bangkok Metropolitan has put the increment of urban green space in its Strategic Plan on Climate Change (TSPCC).

#### **Clean Development Mechanism (CDM) Projects**

1. Biomass Power Projects.
2. Biogas Projects

Most of the adaptation activities are small-scale and concentrate on agriculture, water and natural disaster relief. They emphasized on diversification of agriculture, conservation of water, awareness raising to change practices which impacted people's livelihood of the impacted community. However, there has not yet the systematic climate change adaptation at local level.

#### **International organizations supported the national activities**

The summary of the international organizations involved in the climate change activities in Thailand is as follows:

Sector	Est. no. of projects	Partners Agencies involved
Capacity Building for Climate Change	9	ADB, GEF, IUCN, JBIC, MFF, UNDP, UNEP, World Bank (WB)
Green House Gas Mitigation	20	ADB, Canadian Corporation Fund for Climate Change, Danida, FAO, Finnish Technical Assistance Grant Fund, GEF, Netherlands Government, UNIDO, World Bank
Research on adaptation and mitigation	26	ADB, British Council, GTZ, Hadley Center UK, MRC, SEI, SEA-START, UNEP, UNITAR, World Bank, World fish Center
Awareness raising and public participation	12	FAO, UNDP, UNEP, World Bank
Building institutional capacities and coordination	8	ADB, SEA-START, UNDP, UNEP, World Bank

### Gaps on Climate Change

The meeting participants identify gaps or the insufficient agendas on climate change as follows:

- Thai people in general still lack awareness on climate change.
- Awareness and Institutional strength and capacity on climate change.
- Adaptation capacity.
- Technical knowledge among government agencies and NGOs working on environment and impacts of climate change.
- Reliable climate change data and Analytical studies on climate change impacts.

The gap analysis derived from the forum on Regional Climate Change on the MRC CCAI held in Bangkok in February 2009, and the current workshop can be summarized as follows.

*Institutional strength, capability and availability of reliable data are key issues for generating reliable climate scenarios:* In Thailand, line agencies, universities, and research institutes are working on climate change and try to have technical knowledge in this area. They also receive support from international agencies to carry out the advanced research on climate change, as well as the assessment on vulnerability and adaptation alternatives. However, there is still

limitation on the experts' capacity and funding to support the learning in time for the emergence of the climate change threats.

*Baseline data:*

There is no concrete baseline information on the potential changes in climate and human systems in different ecosystems and agro-climatic systems. Though there might be baseline data on climate changes researched and analyzed by different organizations, there was no systematic information sharing. At the national scale, the livelihoods aspects and inter-sectoral relationships have not been incorporated into the assessments. Thus, with no firm background by the good baseline data and national assessments, the design and plan for adaptation policies will not be effective for implementation.

*Capacity in developing adaptation activities:*

It is very critical that the effects of climate change be understood at the local and national levels. As it will enhance the ability to select or apply appropriate methods and tools prepared for adaptation. In addition, technologies development and the integration of traditional and local knowledge are still needed. Technology transfer and communication to both local people and policy makers are very necessary for the effectiveness in the adaptation activities. The adaptation process of the successful schemes, sharing mechanism should be recoded and documented to disseminate to the public.

*Awareness of climate change issues:* It is very crucial to raise awareness on potential impacts of climate change among involved groups. Moreover, all stakeholders should recognize and accept that climate change is real and the impact is already experienced. There is a real need to develop and disseminate good quality information. Different climatic parameter' impact assessments should be studied systematically.

**National Master Plan on Climate Change (2010-2019)**

Climate Change is an environmental problem of global concern. The international community has agreed to take serious actions through the conclusion of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol as the forum for collaboration to solve and cope with the problems and threats posed by climate change. In recognition of the need to participate in these efforts, Thailand has ratified the UNFCCC in 1994 and the Kyoto Protocol in 2002, and assigned the Office of Natural Resources and Environmental Policy and Planning (ONEP) as the national focal point on climate change since 2004.



ONEP has worked continuously to prepare policies and plans to support Thailand's actions on climate change. In order to meet the challenges of climate change effectively, Master Plan on Climate Change was prepared with the participation of all sectors: public and private, academic institutions, and common citizens. The Plan of 10 year period to cover 2010-2019, is intended to provide long term development directions to all sectors to cope with climate change challenges in the coming years.

### **Recommendations**

The Master Plan has been prepared while the data on climate change is being updated for more accurate projections. It is recommended that there should be the review of the national master plan on its strategy for climate change, when Thailand's international commitments in 2012 are clear. The recommendation suggests that the review of the national plan should cover four issues as follows:

1. the indicators, and process to achieve the targets which will reflect the implementation of the core line agencies at the ministerial level,
2. the set indicators of the local authorities which will reflect their readiness and preparedness for climate change adaptation,
3. the knowledge and understanding in relation to climate change of the media and the NGOs,
4. the curricula on climate change in the education system at all levels.

In addition, the participants have discussed about further recommendations as follow:

1. Improved adaptation strategies and assessment
2. Develop and implement the capacity building programs
3. Develop and implement the awareness raising programs
4. Mainstream the adaptation to climate change in national policy development processes
5. Develop mechanisms for fund raising for climate change adaptation
6. Investigate the linkages between poverty and climate change
7. Develop and disseminate the improved modeling tools
8. Increase the scientific research

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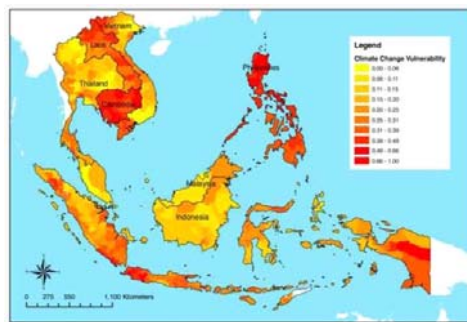
**Vietnam Water  
Partnership**



**Global Water  
Partnership  
Southeast Asia**

# Report on **CLIMATE CHANGE ACTIVITIES IN VIET NAM**

Prepared by  
**The Vietnam Water Partnership**



**Hanoi, December 2010**

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## Abbreviation

IPCC	:	Inter-governmental Panel on Climate Change
MONRE	:	Ministry of Natural Resources and Environment
MARD	:	Ministry of Agriculture and Rural Development
MPI	:	Ministry of Planning and Investment
MOF	:	Ministry of Finance
MOFA	:	Ministry of Foreign Affairs
MOIT	:	Ministry of Industry and Trade
MOLISA	:	Ministry of Labour, War invalids and Social Affairs
MOT	:	Ministry of Transport
MOC	:	Ministry of Construction
MIC	:	Ministry of Information and Communications
MOET	:	Ministry of Education and Training
MOHA	:	Ministry of Home Affairs
MOH	:	Ministry of Health
MOST	:	Ministry of Science and Technology
MOCST	:	Ministry of Culture, Sports and Tourism
MND	:	Ministry of National Defence
MPS	:	Ministry of Public Security
VC	:	Vice Chairman
NTP-RCC	:	National Target Program to response to Climate Change
	:	The Support Program to respond to Climate Change (SP-RCC)
NGO	:	Non Government Organization
CDM	:	Clean Development Mechanism
IWRM	:	Integrated water resource management
ICM	:	Integrated Costal Management

## I. Introduction

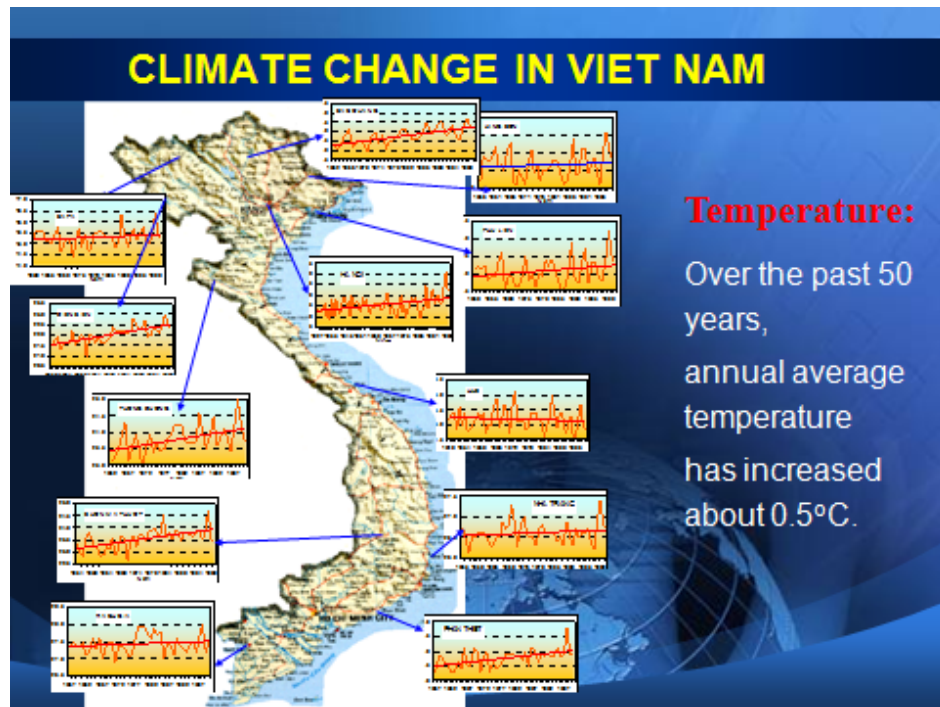
Climate change is one of the most significant challenges facing human beings in the 21<sup>st</sup> century. Climate change impacts almost aspects of Society and the economy, including food production and security, water supply and sanitation, health, energy, tourism, industry and the functioning of ecosystems.

Climate change manifested mainly by global warming and sea level rise, is caused substantially by human activities that emit excessive greenhouse gases into the atmosphere.

According to the IPCC (Inter-governmental Panel on Climate Change) Fourth Assessment Report in 2007, the global average temperature has risen about  $0.74^{\circ}\text{C}$  for the period 1906-2005 and the warming trend over the last 50 years is nearly twice that for the previous years. The observed sea level data of 1961-2003 showed an increasing rate of the average global sea level of about  $1.8\pm 0.5\text{mm/year}$ . The satellite data from TOPEX/POSEIDON in the period of 1993-2003 showed an increasing rate of the average global sea level of about  $3.1\pm 0.7\text{mm/year}$ , considerably faster than that of 1961-2003 (IPCC, 2007).

In Vietnam, results of analysis of observed data indicated that during the last 50 years (1958-2007), the annual average temperature increased about  $0.5\text{ to }0.7^{\circ}\text{C}$ . Sea level rise was at the rate of about  $3\text{mm/year}$  during the period of 1993-2008 which is comparable with the global tendency. In the past 50 years, sea level at Hon Dau station rose about  $20\text{cm}$  (MONRE, 2008).

Climate change is a major challenge for poverty alleviation activities and for sustainable development of Vietnam. Climate change responses should create environmental, social, and economic resilience.



## **II. Sustainable Development and Programs to response to Climate change**

Recognizing potential impacts of climate change, the government of Vietnam has created a legal framework on sustainable development and climate change including Viet Nam Agenda 21, the Law on Environmental Protection, disaster risk mitigation policies, and energy efficiency policies. Recently Government issued important programs as follow:

### ***2.1. Climate change , sea level rise scenarios for Viet Nam*** (MONRE, 2009 June):

Based on the results of studies made by IPCC working groups 1, 2 and 3 on the green house gas emission, sea level rise in the 21<sup>st</sup> Century. With the collected data of temperature variability, rainfall of 7 climatic zones of Vietnam and sea level rise:

- By the end of 21<sup>st</sup> century, temperatures in Vietnam would raise 2.3°C related to the average of 1980-1999. The increase in temperature would be in the range of 1.6-2.8°C in different climatic zones;
- Both annual rainfall and rainy season's rainfall would increase. For the whole country, annual rainfall by the end of the 21<sup>st</sup> century would increase by 5% compared to that of the period 1980-1999;
- By mid 21<sup>st</sup> century sea level is expected to increase about 30 cm and sea level would rise about 75cm by the end of 21<sup>st</sup> century compared to the period of 1980-1999.

MONRE developed climate change scenarios with the different green house gas emissions options, namely, low (B1), medium (B2) and high (A2, A1FI). Due to the complexity of climate change and the limited understanding of climate change, both in Vietnam and in the world, together with the psychological, social, economical factors, uncertainties of green house gas emissions scenarios, the most harmonious scenario is the medium scenario and recommended for ministries, sectors and provinces to use as an initial basis in climate change and sea level rise impact assessments and in the development of action plans to respond to climate change.

### ***2.2. National Target Program to response to Climate Change (NTP-RCC)***

The National Target Program to response to Climate change has been created by the Government of Vietnam by decision 158/2008/QD-TTg dated December 2008 of the Prime Minister.

The strategic objectives of NTP-RCC are to assess climate change impacts on sectors and regions in specific periods and to develop feasible action plans to effectively respond to climate change in the short term and long term to ensure

sustainable development of Vietnam, to take opportunities to develop towards a low-carbon economy, and to join the international community's efforts in mitigating climate change and protecting the climatic system.

The main tasks of NTP-RCC are:

- a) To identify the extent of climate change in Vietnam due to global climate change and assess climate change impacts on every sector, area and locality;
- b) To identify measures to respond to climate change;
- c) To promote scientific and technological activities to establish the scientific and practical basis for climate change response measures;
- d) To consolidate and enhance the organizational structure, institutional capacity and the development and implementation of policies to respond to climate change;
- e) To enhance public awareness, responsibility and participation, and develop human resources to respond to climate change;
- f) To promote international cooperation to obtain external support in response to climate change;
- g) To mainstream climate change issues into socio-economic, sectoral and local development strategies, plans and planning;
- h) To develop and implement action plans of all ministries, sectors and localities to respond to climate change; to implement projects, and first of all pilots projects to respond to climate change.

The NTP-RCC is opened for participation of all stake holders: Government, Civil Society, NGOs and private sector.

### ***2.3. The Support Program to respond to Climate Change (SP-RCC)***

In order to support the implementation of NTP-RCC, the Government and donors decided to formulate SP-RCC. The main objective of SP-RCC is to promote climate change adaptation activities and GHG reduction, through policy dialogues, to ensure sustainable development in Vietnam in terms of economic, social and environment aspects. SP-RCC is also supporting aid harmonization and coordination for policy related activities, technical and financial assistance provided by Government, donors, NGOs and private organizations for climate change response in Vietnam.

Scope and content of program activities are sectors and groups of tasks indicated as follows:

#### **Group A: Mitigation:**

- a) Energy;
- b) Transport and construction;
- c) Forestry and agriculture;
- d) Solid waste management;



- e) CDM;

**Group B: Adaptation:**

- a) Water and water resource management;
- b) Integrated Coastal Management (ICM);
- c) Disaster Risk Management;
- d) Biodiversity, agriculture and forestry;
- e) Transport and construction;
- f) Health;

**Group C: Cross cutting issues:**

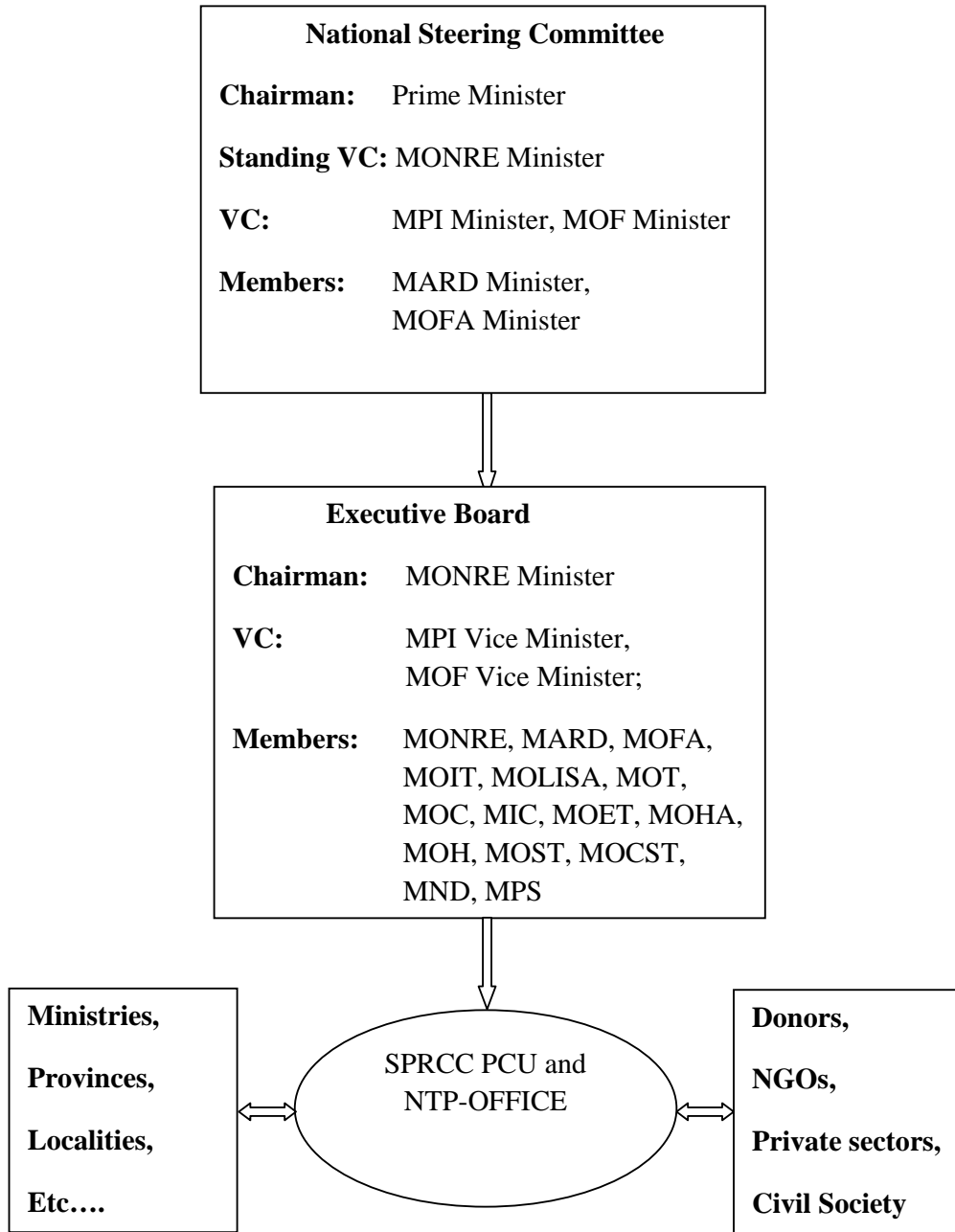
- a) Assessment and monitoring implementation of program activities;
- b) Financial mechanism for the program implementation;
- c) Coordination and management of resources to respond climate change;
- d) Awareness raising, capacity building, organization improvement and human resource development.

### **III. Implementation arrangement**

- The Ministry of Natural Resources and Environment (MONRE) is assigned to coordinate all activities related to climate change in Viet Nam with the following main tasks :
  1. Develop policies ,strategies and manage the activities related to climate change in all sectors and localities in Viet Nam;
  2. Guiding sectors and provinces to set up the Action Plans to deal with climate change;
  3. Monitoring and evaluation of the progress of implementation of action plans of the sectors and provinces;
  4. Coordination in Public awareness, Policy dialogues and International cooperation
  5. To set up Climate Change, sea level rise scenarios for Viet Nam;
  6. Take leadership in climate change finance by working with donor community, NGOs and private sector. Coordination of CC ODA;To support MONRE for implementation above-mentioned tasks is the Department of Meteorology, hydrology and climate change.
- Line ministries and provinces :
  1. Set up the sector/provincial action plans and manage the implementation of the CC activities within sector/provincial areas;

2. Integrate the CC activities into social-economic development;
  3. Mobilize participation from NGOs, civil society and private sector for implementation CC activities;
  4. In all provinces and line ministries there is one focal point for CC activities. The main tasks of this office are to prepare action plans and coordinate for the implementation of CC activities in their Provinces/Ministries;
- Establish the National Steering committee, Executive Board and the NTP-RCC office:
    - a) The national Steering Committee
      - The Prime Minister – Chairman;
      - Minister of Natural resources and Environment – Standing Vice Chairman
      - Minister of Planning and Investment – Vice Chairman;
      - Minister of Finance – Vice Chairman;
      - Minister of Agriculture and Rural Development – Member;
      - Minister of Foreign Affairs – Member;
    - b) Executive Board
      - Minister of Natural resources and Environment – Chairman;
      - Vice Minister of planning and Investment – vice Chairman;
      - Vice Minister of Finance – Vice Chairman;
      - Representative s of ministries of Agriculture and Rural development; Foreign Affairs; Industry and Trade; Labour, invalids and Social Affairs; Home Affairs; Transportation; Construction; Information and communication; Education and training; Health; Science and Technology; Culture, Sport and Tourism; Defense ; Public Security - Members;
    - c) The NTP Office is located at Department of Hydrology, Meteorology and Climate change, MONRE. It is an assisting agency of the Executing Board to coordinate activities of the NTP. This office is the focal point for all activities related to the implementation of NTP-RCC and SP-RCC.
      - Line ministries are in charge for setting up their sector climate change Strategy and Action Plan. They will coordinate with Civil Society, NGOs and private sector for implementation of sector plan.

ORGANIZATIONAL CHART OF NTP-RCC AND SP-RCC  
IMPLEMENTATION



## **IV. Activities being implemented from 2010-2013**

The following activities are being implemented:

### 1. Mitigation :

#### a) Energy:

- Renewable energy: Formulate Strategy and Master Plan for renewable development; establish Renewable Development legal framework and fund;
- Develop bio-fuel for use as an alternative to partially replace conventional fossil fuels; Set-up a sustainable policy for bio-fuel development, with consideration of environmental and food security issues;
- Energy Efficiency and Conservation;

#### b) Transportation and construction:

- Develop the plans and activities of energy conservation and buildings to save energy consumed nationwide ; Reduce GHG emission from transportation and construction;

#### c) Forestry and Agriculture:

- Afforestation and reforestation; forest management, REDD;

#### d) Land use and land use change:

- Develop appropriate land use planning in the context of climate change;

#### e) Agriculture:

- Develop sustainable agricultural ecosystems to mitigate climate change and to secure the livelihood of farmers;

#### f) CDM:

- Develop mechanisms and policies to encourage investment into clean development mechanism, emission reduction, and environmental protection;

### 2. Adaptation:

- Assess climate change impact to water;
- Strengthen governance of water resources based on the IWRM and river basin management principles;
- Increase efficiency of agricultural water usage and safety of irrigation facilities;
- Enhance drinking water supply ;
- Integrated coastal management;
- Disaster prevention.

### 3. Cross Cutting issues:

- Assessment, Monitoring and evaluation on climate change impacts and development the mitigation and adaptation measures;
- Financial mechanism;

## **V. Suggestions**

Climate change is so far a scientifically established fact. To respond to climate change, Vietnam Government is shifting to a taking- action approach with the involvement of Ministries, Provinces and Localities.

Considering water as a finite resource and a vulnerable factor to Climate Change, we, the VNWP's experts would like to raise the following suggestions that should be addressed:

1. It's necessary to raise awareness on IWRM and Climate Change for stakeholders, specially focus on the community.
2. Conducting case studies to review the status of IWRM application in Vietnam and propose suitable solutions for IWRM practices in the context of climate change.
3. Enhancing the roles of civil society in climate change adaptation activities.

## References

1. *IPCC, 2007*, the fourth Assessment report;
2. *Vietnam Government, 2008*, Decision No. 158/2008/QD-TTg dated 2nd December 2008 on approval of the National Target Program to respond to climate change.
3. *MONRE, June 2009*, Climate change, Sea level rise scenarios for Viet Nam;
4. *Vietnam Government, Ha Noi November 2010*, Support Program to respond to climate change;
5. *Consultative Group Meeting, Ha Noi, December 2010*, Sustainable Development and Climate Change Financing Joint Donor Statement;
6. *Summary of the Cancun Climate Change Conference: 29 November-11 December 2010*.

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