Second National Communication to the United Nations Framework Convention on Climate Change

PHILIPPINES

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Acronyms and Abbreviations

A2C2	Albay in Action on Climate Change
ADB	Asian Development Bank
ADP	Ancestral Domains Program
AHP	Analytic Hierarchy Process
AO	Administrative Order
ASEAN	Association of Southeast Asian Nations
ASMC	ASEAN Specialized Meteorological Center
AWD	Alternate wetting and drying
BBL	Barrels
BPO	Business process outsourcing
BRT	Bus Rapid Transit
BSP	Bangko Sentral ng Pilipinas
BSWM	Bureau of Soil and Water Management
C	Centigrade CAI-Asia Clean Air Initiative Asia
CAR	Cordillera Autonomous Region
CBFM	Community-Based Forest Management
CBRED	Capacity Building to Remove Barriers to Renewable Energy Development in the Philippines
CCC	Climate Change Commission
CCIC	Climate Change Information Center
CDM	Clean Development Mechanism
CDR	Crude death rate
CEP	Coastal Environment Program
CER	Certificate of Emissions Reduction
CFL	Compact fluorescent lamp
CFP	Community Forestry Program
CGSD	Coast and Geodetic Survey Department
CH_4	Methane
CHED	Commission on Higher Education
CI	Conservation International
CLUP	Comprehensive Land Use Plan
CNG	Compressed natural gas
CO_2e	Carbon dioxide equivalent
COD	Center of development
COE	Center of excellence
CSO	Civil society organization
CSR	Corporate social responsibility
CTFIP	Clean Technology Fund Investment Plan
DA	Department of Agriculture
DA-BAR	Department of Agriculture-Bureau of Agricultural Research
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
DBM	Department of Budget and Management
DBP	Development Bank of the Philippines
DEA	Data Envelopment Analysis
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DFA	Department of Foreign Affairs
DILG	Department of the Interior and Local Government
DJF	December, January, February
DNA	Designated national authority
DOE	Department of Energy
DOF	Department of Finance
DOH	Department of Health
DOST	Department of Science and Technology
DOT	Department of Tourism
DOTC	Department of Transportation and Communication
DPWH	Department of Public Works and Highways
DRRM	Disaster risk reduction and management
DTI	Department of Trade and Industry
E3	Excellence in Ecology and Economy
ECC	Environmental Compliance Certificate
ECE	Early childhood education
EC-LEDS	Enhancing Capacities for Low-Emission Development Strategies
ECO-Asia	ECO-Asia Clean Development and Climate Program
EECP	Energy Efficiency and Conservation Program
EEL	Energy-efficient lighting
EEZ	Exclusive Economic Zone
EMB	Environmental Management Bureau
ENRC	Environment and Natural Resources Committee
EO	Executive Order

Acronyms and Abbreviations

ERC	Energy Regulatory Commission
ESMAP	Energy Sector Management Assistance Program
EST	Environmentally sustainable transport
ESTs	Environmentally sound technologies
EU	European Union
FFS	Farmers' Field School
FLMP	Forest Land Management Program
FPI	Federation of Philippine Industries
GCOS	Global Climate Observation System
GDP	Gross domestic product
GEF	Global Environment Facility
Gg	Gigagram
GHG	Greenhouse gas
GIS	Geographical Information System
GLOSS	Global Sea Level Observing System
GNP	Gross national product
GREET	Grassroots Entrepreneurship and Employment in Tourism Program
GTS	Global Telecommunication System
HEMS	Health Emergency Management Services
HFA	Hyogo Framework of Action
HID	High-intensity discharge lamp
HLURB	Housing and Land Use Regulatory Board
HSRA	Health Sector Reform Agenda
IACCC	Inter-Agency Committee on Climate Change
ICE CREAM	Integrated Coastal Enhancement: Coastal Research Evaluation and Adaptive Management
ICM	Integrated Coastal Management Program
ICT	Information and communication technology
IEC	Information, education and communication
IGES	Institute for Global Environmental Strategies
INC	Initial National Communication
IOC	Intergovernmental Oceanographic Commission
IP	Indigenous people
IPCC	Intergovernmental Panel on Climate Change
IPCPT	Integrated Program on Cleaner Production Technologies
IPP	Investment Priority Plan
IRRI	International Rice Research Institute
ISFP	Integrated Social Forestry Program
IT	Information technology
IWRM	Integrated water resource management
JICA	Japan International Cooperation Agency
JJA	June, July, August
JSMP	Job-Skill Matching Program
kTOE	Thousand tons oil equivalent
kW	Kilowatt
LCC	Leaf Color Chart
LCF	Local Calamity Fund
LEAP	Long-Range Energy Alternatives Planning System
LEED	Leadership in Energy and Environmental Design
LGU	Local government unit
LPG	Liquefied petroleum gas
LRT	Light Rail Transit
LTO	Land Transportation Office
LUCF	Land use change and forestry
LULUCF	Land use and land use change and forestry
M	Million
MAM	March, April, May
mcm	Million cubic meters
MDG	Millennium Development Goals
MDG-F	Millennium Development Goals - Fund
MILF	Moro Islamic Liberation Front
MMBFOE	Million barrels of fuel oil equivalent
MPFD	Master Plan for Forest Development
MRT	Metro Rail Transit
MT	Metric ton
$MtCO_2e$	Million tons carbon dioxide equivalent

Acronyms and Abbreviations

MTOE	Million tons of oil equivalent
MTPDP	Medium-Term Philippine Development Plan
MW	Megawatts
MWh	Megawatt hours
NAMRIA	National Mapping and Resources Inventory Authority
NAP	National Action Plan for Climate Change
NCCAP	National Climate Change Action Plan
NCDPC	National Center for Disease Prevention and Control
NCF	National Calamity Fund
NCR	National Capital Region
NDCC	National Disaster Coordinating Council
NDRRMA	National Disaster Risk Reduction and Management Authority
NDRRMC	National Disaster Risk Reduction and Management Council
NDRRMP	National Disaster Risk Reduction and Management Plan
NEC	National Epidemiology Center
NEDA	National Economic and Development Authority
NEDO	New Energy and Industrial Technology Development Organization
NEECP	National Energy Efficiency and Conservation Program
NESTS	National Environmentally Sustainable Transport Strategy
NFP	National Forestry Program
NFSCC	National Framework Strategy on Climate Change
NGO	Nongovernment organization
NIA	National Irrigation Administration
N_2O	Nitrogen oxide
NOAH	Nationwide Operational Assessment of Hazards
NOH	National Objectives for Health
NOLCO	Net operating loss carryover
NPC	National Power Corporation
NREB	National Renewable Energy Board
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NSWMC	National Solid Waste Management Commission
NWRB	National Water Resources Board
NYC	National Youth Commission
ODS	Ozone-depleting substances
O&M	Operation and maintenance
PA 2020	Philippine Agriculture 2020
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAR	Philippine area of responsibility
PBE	Philippine Business for the Environment
PCAMRD	Philippine Council for Aquatic and Marine Research and Development
PCAPI	Pollution Control Association of the Philippines
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCB	Polychlorinated biphenyl
PCCI	Philippine Chamber of Commerce and Industry
PCW	Philippine Commission on Women
PD	Presidential Decree
PELMATP	Philippine Efficient Lighting Market Transformation Project
PEP	Philippine Energy Plan
PEPP	Philippine Environment Partnership Program
PhilRice	Philippine Rice Research Institute
PhP	Philippine peso
PIPH	Provincial Investments for Public Health
PNOC	Philippine National Oil Company
PO	People's organization
PRECIS	Providing Regional Climates for Impacts Studies
PSF	People's Survival Fund
PSSD	Philippine Strategy for Sustainable Development
PTFCC	Presidential Task Force on Climate Change
R&D	Research and development
RDE	Research Development and Extension

Acronyms and Abbreviations

RE	Renewable energy
REDD	Reducing Emissions from Deforestation and Forest Degradation
RIL	Rain-induced landslide
SARS	Severe acute respiratory syndrome
SIDA	Swedish International Development Cooperation Agency
SIFMP	Socialized Industrial Forest Management Program
SNAP	Strategic National Action Plan for Disaster Risk Reduction
SNC	Second National Communication
SON	September, October, November
SP	Sangguniang Panlalawigan
SSNM	Site-Specific Nutrient Management
S&T	Science and technology
SWIP	Small water impounding project
TOE	Tons of oil equivalent
TPES	Total primary energy supply
TVET	Technical vocational education and training
UN	United Nations
UNCDR	United Nations Centre for Regional Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UP	University of the Philippines
UP-NCTS	University of the Philippines National Center for Transportation Studies
USAID	United States Agency for International Development
USD	US dollar
V&A	Vulnerability and adaptation
VAT	Value-Added Tax
WB	World Bank
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WWF	World Wildlife Fund
WWW	World Weather Watch

Preface

Climate change is seen as one of the most pressing issues of the 21st century. It goes beyond being merely an environmental problem; it also has considerable social and economic impacts that threaten our survival. The Intergovernmental Panel on Climate Change has concluded in its assessment report that global warming is unequivocal. Addressing the impacts of climate change needs a concerted effort not just at the international level but also at the regional, national and sub-national levels.

The Philippines is one of countries most vulnerable to the impacts of climate change. The country is visited by an average of 19-20 typhoons annually. The increasing frequency and severity of extreme weather events pose challenges on how we will meet our development goals.

Responding to the need to address the detrimental impacts of climate change, the Philippines has undertaken several initiatives and introduced some policies highlighting its importance. The government has put premium on this through the enactment of the Climate Change Act. This set the roadmap towards the formulation of a comprehensive climate change framework with the subsequent release of the National Framework Strategy on Climate Change and the National Climate Change Action Plan.

We are pleased to submit our Second National Communication (SNC) to the Secretariat as part of the Philippines' commitments under the United Nations Framework Convention on Climate Change. The SNC contains pertinent information on the vulnerability of the Philippines to climate change and outlines the concrete steps it has taken and will be taking to increase the country's resilience. It also identifies the needs and provides recommendations to ensure that the country is adequately equipped to address climate change.

Executive Summary

The Philippines is one of the countries in the world that are most vulnerable to climate change, ranking only No. 3 globally. This means that the country is not only more exposed by virtue of its geographical setting and environmental situation. It is also less able to cope with the extreme events and natural calamities brought about by climate change. This report – the Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC) – explores the conditions in the country that may have been affected by climate change, and the factors that may have contributed to the country's high vulnerability. The report also looks into the mechanisms that have been employed to adapt to and mitigate the effects of climate change, as well as policies and actions that have been taken to promote and improve the country's ability to cope with climate change. Finally, the report identifies the gaps and needs that need to be addressed to enhance adaptation and reduce vulnerability.

National Circumstances

The Philippines lies in a region where tropical cyclones and high temperatures are common, but in recent years, the country has been experiencing even warmer temperatures at certain times of the year, and typhoons with greater amounts of rainfall causing floods, landslides and other calamities. It is also projected that climate change will trigger a more active southwest monsoon, bringing significant increases in rainfall, during the rainy season in the coming years.

One aspect of Philippine development that seems critical in the country's vulnerability to climate change is population, which now numbers 92 million and is growing at an annual rate of 1.90%. The large number of people and their migration patterns have led to crowded cities, waste and housing problems, pollution, and encroachment of upland forests and watersheds leading to denudation and, consequently, significant reduction of carbon sinks.

The Philippine economy has been growing positively over the past few years, posting one of the highest gross domestic product (GDP) growth rates in the region in 2012. In spite of this, the Filipino people are still highly vulnerable to, or unprotected from and unprepared for, natural hazards that befall them, especially those brought on by climate change.

As the population and the economy grew, energy consumption increased, as well as transport use, and industrial activity in all the production and services sectors. All of these meant greater use of the country's agricultural, forestry and marine resources and increasing pressure on the natural environment. The implications of these to the health and well-being of the people, and national development, are complicated even more by climate change. The consequences of climate change, in fact, become more damaging because of the poor state of the environment and the people's socioeconomic conditions.

Greenhouse Gas Inventory

An inventory of greenhouse gas (GHG) emissions conducted in year 2000 showed that the Philippines emitted a total of 21,767 Gg of carbon dioxide equivalent (CO_2e), net of the amount of carbon sequestered by land use change and forestry (LUCF), that year. The biggest contributor to the GHG emissions was the energy sector, followed by agriculture, and to a lesser degree, waste and industrial processes. Within the energy sector, most of the emissions came from transport. Rice cultivation was the most significant source of emissions in the agricultural sector, while processing of mineral products made up the bulk of the emissions from industrial processes. Wastewater handling and solid waste disposal shared the GHG emissions from the waste sector.

There is now a proposal to institutionalize a national GHG inventory, with the past inventories having been done mostly by individual sectors.

Vulnerability and Adaptation Assessment

The vulnerability to climate change and the adaptation mechanisms employed by four major sectors were assessed: (1) agriculture and food; (2) watersheds, including forestry, biodiversity, and water resources; (3) coastal and marine resources; and (4) human health.

The vulnerability of the agriculture and food sector to climate change stems mainly from its strong dependence on water supply and predictable growing seasons. Production is greatly affected by typhoons and extreme weather events that disrupt farming activities and affect the productivity of the soil. Adaptation strategies include, among others, use of more climate-resistant crop varieties, improvement of irrigation systems and practices, technological improvement, promotion of organic agriculture, increasing farmers' awareness, and provision of support like financial assistance and post-harvest facilities.

In addition to the threat posed by the fast-growing upland population, pollution and unsustainable use of resources, climate change has brought additional pressure to the country's watersheds. The increasing heat intensity during the dry season has caused water shortage, while the increasing occurrence of heavy rainfall has caused floods and landslides that damage the watersheds and their biodiversity. The government has been undertaking continuing reforestation activities for the past two decades, along with complementing efforts in agro-forestry development, mangrove rehabilitation, and capacity-building of forest communities for watershed protection and alternative livelihoods. Infrastructure improvements have also been made to safeguard and efficiently manage water resources.

The more frequent and stronger storm surges and rising sea levels brought about by climate change have put the country's already precarious coasts into even greater danger. Coastal erosion, coastal floods, salt water intrusion, and ocean acidification threaten not only the marine and coastal resources, but also the safety and livelihood of coastal dwellers. To enable coastal communities to cope with climate change, several adaptation measures have been taken, such as the strengthening of the disaster management program, improvement of the typhoon warning system, shoreline stabilization, putting a stop to the conversion of mangroves into fishponds, upland and coastal reforestation, and programs like the Integrated Coastal Management Program and Coastal Environment Program, among others. The capacities of coastal LGUs have also been enhanced for better management and protection of coastal resources.

Extreme climate events have also created conditions for the rise of certain diseases and health emergencies that threaten human health. These include infectious diseases like dengue and malaria, non-infectious diseases like heart and respiratory problems, new diseases like AH1N1 influenza and severe acute respiratory syndrome (SARS), and even seafood poisoning. The situation has put added strain to the already challenged health sector. There are, nonetheless, adaptive measures that can and have been taken in the areas of: education and awareness; surveillance, early alert systems and disease control; and disaster preparedness and collaboration with other agencies.

Mitigation Analysis

The GHG Inventory provided data that served as the basis for projecting the emissions that will come from each subsector within the energy sector (the biggest source of emissions in the country) by the year 2020. Using the Long-Range Energy Alternatives Planning System (LEAP) analysis, it was further projected how much reduction in the emissions could be achieved if certain mitigation options were taken. For example, for the transport subsector, it was computed that up to 15.1 metric tons of GHG emissions can be mitigated through the use of biofuels, 2.5 MT can be mitigated with the use of the Bus Rapid Transit (BRT) system, and so on with the other mitigation measures.

It was noted, however, that more data will be needed to enhance the analysis and come up with more reliable projections for different mitigation options. For instance, there should be data on investment requirements and other costs, updated data on emission factors, and updated studies on potential installed capacity and actual production for each energy resource.

Policies and Measures

The Philippines has not been neglectful in putting in place the necessary policies, programs and structures to respond to the challenges of climate change. The Medium-Term Philippine Development Plan (MTPDP), which is the overall blueprint for all the government's development plans for all the sectors in the next five years, underscores the need to manage the environment effectively to address poverty. Accordingly, policies addressing climate change have been initiated, complementing international conventions that the Philippines has agreed to.

The Philippines has an Inter-Agency Committee on Climate Change (IACCC), which was created even before the Philippines participated in the UNFCCC. Composed of different agencies led by the Department of Environment and Natural Resources (DENR) and the Department of Science and Technology (DOST), the committee coordinates, develops and monitors climate change-related concerns and activities in the country. After the signing of the UNFCCC, the National Action Plan for Climate Change (NAP) was drafted. And after the Kyoto Protocol, the Philippines implemented the Clean Development Mechanism (CDM).

In 2009, the Climate Change Act was enacted and the Climate Change Commission (CCC) was created, becoming the government's lead policymaking body on climate change that ensures that climate change concerns are being mainstreamed in government agencies. More recent policy developments include the crafting of the National Framework Strategy on Climate Change (NFSCC) and the approval of a long-term plan for climate change adaptation and mitigation – the National Climate Change Action Plan 2011-2028.

In addition, there are existing policies on specific other concerns that also involve climate change response and adaptation measures, such as those on disaster risk reduction and management, agriculture and food security, renewable energy development and energy conservation measures, protection and rehabilitation of watersheds, and an integrated coastal enhancement program for monitoring and managing climate change impacts on coastal resources. In health, the Department of Health (DOH) National Framework of Action contextualizes climate change issues in the country's health system.

Transfer of Technologies

In accordance with the UNFCCC provision for the promotion, development, application, diffusion and transfer of environmentally sound technologies that help reduce greenhouse gases and mitigate the consequences of climate change, the Philippines has passed a number of laws that support these actions in the different sectors. These include: the Renewable Energy Act of 2008, the Biofuels Act of 2008, an Act Granting Incentives to Mini-hydro Electric Power Development, and several executive orders providing incentives for the development and use of climate-friendly technologies in the energy sector; and the Ecological Solid Waste Management Act of 2000 in the waste sector. The Investment Priority Plan of 2009 also provides policy and fiscal incentives for biofuel production, adoption of environment-friendly technologies, projects supporting the Clean Development Mechanism, and other technologies that reduce energy consumption and GHG emissions.

Likewise, each concerned sector implements its own climate technology programs and projects. The Department of Energy (DOE) has the Energy Resources Program, Alternative Fuels Program, and Energy Efficiency Program. The Department of Agriculture (DA) has several programs for mitigating greenhouse gas emissions, such as the National Organic Agriculture Tamang Abono Program, the Knowledge Working Towards Enhancing Agricultural Communities Program, and a number of web-based programs to spread knowledge on climate-friendly agricultural technologies.

The Philippines is also a signatory to the Manila Declaration on Green Industry, which supports the transition to resource-efficient and low-carbon industries in the ASEAN region. Through the Philippine Environment Partnership Program (PEPP), DENR helps business establishments adopt pollution prevention and clean production processes. Aside from these, these are also initiatives by the private sector to reduce the environmental impact of their industrial activities.

An assessment of the technology transfer needs for the mitigation of global warming, conducted in 2003, lists the technologies that are of high priority for development.

Despite these many policies and programs, the development and application of climate change-mitigating technologies are hampered by the lack of institutional resources, and lack of technological capacity of the agencies. There is need for more capacity building, advocacy and education, research, and financial and economic mechanisms.

Research and Systematic Observation

There are programs and structures in place for the systematic observation of climate in the Philippines. The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the country's weather bureau,

maintains a network of observation facilities and information systems throughout the country. These, however, are still lacking in many of the needed equipment for accurate weather and climate monitoring and forecasting, and for the observation of related bio-geophysical changes.

There is an ongoing research program to predict future climate scenarios and their impact on the people and ecosystems, which are taken into consideration in the formulation of development plans. Risk assessment is also conducted to gauge the vulnerability and adaptation of all of the country's provinces. Impact modeling is done to come up with realistic adaptation strategies in the different sectors. Recently, the Nationwide Operational Assessment of Hazards (NOAH) program was launched. The program undertakes research using modern technologies and recommends innovative information services for disaster prevention and mitigation.

The Philippines also participates in the global exchange of meteorological data through the World Meteorological Organization (WMO), and of tidal data through the Intergovernmental Oceanographic Commission (IOC) Global Sea Level Observing System.

The country's climate research and observation efforts can benefit from improved computerization capacity and more sophisticated equipment in order to enhance data acquisition and management. There is also a need to expand the country's tide station network, and to improve collaborative research and data sharing with other nations.

Public Awareness and Capacity Building

The Climate Change Commission oversees public awareness programs on climate change, with individual agencies, LGUs, civil society organizations, research institutions, and private establishments conducting information, education and communication (IEC) activities within their sectors. Competency development programs in concerns like vulnerability and adaptation assessment, climate proofing of development plans, development of sectoral strategies, and other concerns have also been developed for institutionalization and national rollout.

Several capacity-building initiatives have also been undertaken by the government and its development partners with assistance from international organizations.

Based on a perception survey, a communications audit, and an inventory of IEC materials and activities, gaps were identified and recommendations were made to improve and expand the public awareness and education efforts on climate change in the country.

Photo by CAD

Gaps, Needs and Constraints

A summary of all the needs, gaps and constraints that need to be addressed within each aspect of climate change management – vulnerability and adaptation assessment, mitigation, technology transfer, research and systematic observation, public awareness and capacity building – is given at the end of the report. The list provides an overall view of the challenges that the Philippines needs to take on in order to deal with the issue of climate change, and reduce the country's vulnerability to its consequences.

Chapter 1: National Circumstances

Overview

The mere location of the Philippines on the tropical rim of the Pacific Ocean and its archipelagic grouping of water-bound islands make it highly vulnerable to the atmospheric disturbances and environmental irregularities resulting from climate change. Climate change, defined as any change in the climate over a long period of time, is most commonly manifested by increasing global temperature, changes in rainfall patterns, occurrence and frequency of extreme weather events, and rise of sea levels. These changes have pervasive effects on the natural environment as well as the well-being of human communities and a nation's development.

In addition to its location and natural formation which make it highly prone to the effects of climate change, certain events and trends in the development of the Philippines – such as the high population growth rate, deforestation and overuse and abuse of natural resources, pollution and waste accumulation, and rapid urbanization and industrialization, among others – have created conditions that further aggravate the impact of climate change and increase the country's, and the people's, vulnerability.

The Philippines' ranking on vulnerability to climate change has moved up from No. 12 to No. 3, meaning we have become more vulnerable compared to other countries. Considering that climate change is intensifying not only in the Philippines but globally, then the country's increased vulnerability could only be either or both of two reasons: (1) that the national conditions that make us vulnerable have worsened; and (2) we have not taken measures to prepare and protect ourselves from the effects of climate change as adequately or as effectively as other countries have, making us more vulnerable than them.

This chapter on national circumstances presents the overall development context of the country. It provides a brief description of the Philippines' geographic setting, climate, population, government structure, economy (including energy, transport, industry, mining, tourism, agriculture and food security), the state of the environment (including watersheds, water resources, coastal and marine resources, and wastes), and human development (including education and health). Information in this section is critical to understanding the country's vulnerability to climate change and serves as the basis for addressing issues related to it.

1.1 Geographic Setting

The Philippines is one of the largest island groups in the world. It lies 966 kilometers off the southeastern coast of Asia, bounded in by the waters of the South China Sea on the west, the Pacific Ocean on the east, the Basha Channel on the north, and the Sulu and Celebes Seas on the south. Its northernmost islands are approximately 240 kilometers south of Taiwan, and the southernmost islands lie approximately 24 kilometers from the coast of Borneo.

The Philippines is an archipelago composed of 7,107 islands, with a land area of 299,764 square kilometers. Its length measures 1,850 kilometers while its breadth is about 965 kilometers. It has three major island groups: Luzon, with an area of 104,687.8 square kilometers; Visayas, 57,201.9 square kilometers; and Mindanao, 94,630.1 square kilometers. The country is divided into 17 regions, which are in turn divided into 79 provinces. There are a total of 116 cities and 1,500 municipalities within these provinces. The cities and municipalities are divided into barangays (the smallest political units each with less than 1,000 inhabitants). There are a total of 41,974 barangays in the entire country.

The topography of the bigger islands – Luzon and Mindanao, in particular – is characterized by alluvial plains, narrow valleys, rolling hills and high mountains. Most of the smaller islands, as those in the Visayas, have a mountainous interior surrounded by narrow strips of discontinuous flat lowlands on the coastal rims. The shorelines of both large and small islands are irregular.

The Philippines' fertile land accounts for its rich biodiversity; for example, it has more than 900 species of orchids representing 100 genera. The country's fauna includes some highly endangered species, like the Philippine eagle, the tarsier, and the mouse deer.

Metro Manila, the country's premier metropolis comprising 16 cities (including the capital, Manila) and one municipality, is strategically located in the middle of Luzon. It is bounded by Manila Bay on the west and Laguna de Bay on the southeast. The Pasig River, a major waterway, runs through the metropolis. The 626 sq km metropolis sits in the middle of a floodplain that is one of the biggest in the country. Metro Manila has a population of 11.55 million.

1.2 Climate

The Philippines generally has high temperatures due to its tropical maritime setting and the warm air currents flowing over its land masses. The mean annual temperature is 27.1°C. The hottest months are April and May, and the coolest months are December, January and February. The seasonal temperature variation is about 3°C on the average. The lowest temperature of 6.3°C was observed on January 18, 1961 in Baguio City, which has an elevation of 1,483 meters. The highest temperature was recorded at 42.2°C in Tuguegarao, Cagayan Valley on April 22, 1912 and on May 11, 1969.

Rainfall distribution in the country varies geographically with topography and distance to seas. During the months of June to September, heavy rainfall is concentrated in the western sections of the country (Figure 1.1) because the southwest monsoon is prevalent during this season. From October to March, on the other hand, heavy rainfall is concentrated in the eastern coastal portions of the country due to the prevalence of the northeast monsoon air mass. In addition to these monsoon-induced rains, there are also cold fronts that occur at certain times of the year. Rainfall during the months of April, May and October is largely controlled by scattered local convection. The mean annual rainfall of the Philippines ranges from 959 to 4,464.9 millimeters.

The single element that defines the climate of the Philippines is rainfall. Using this as basis, the climate of the

Figure 1.1. Seasonal rainfall distribution in the Philippines

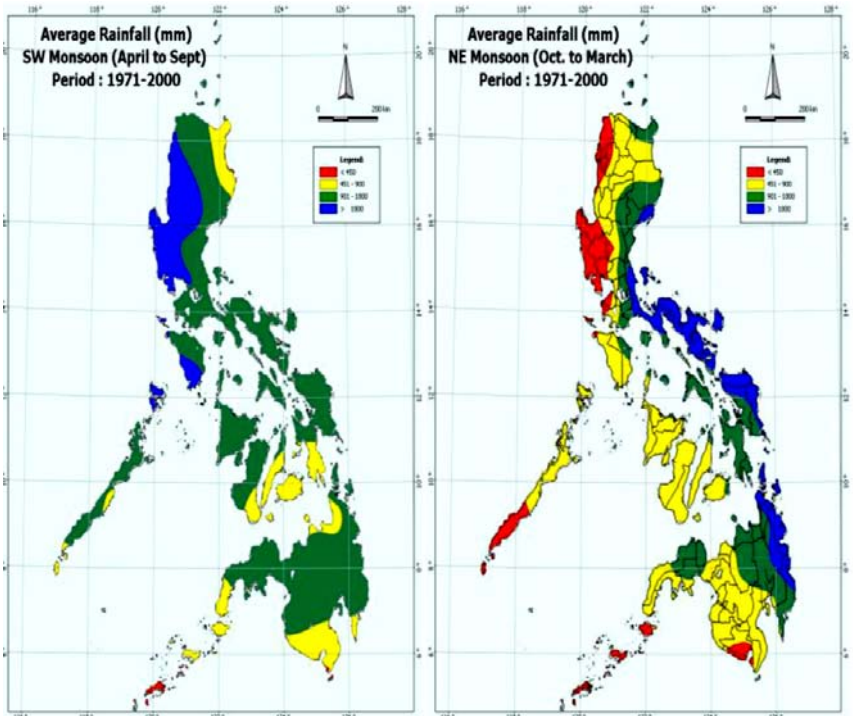
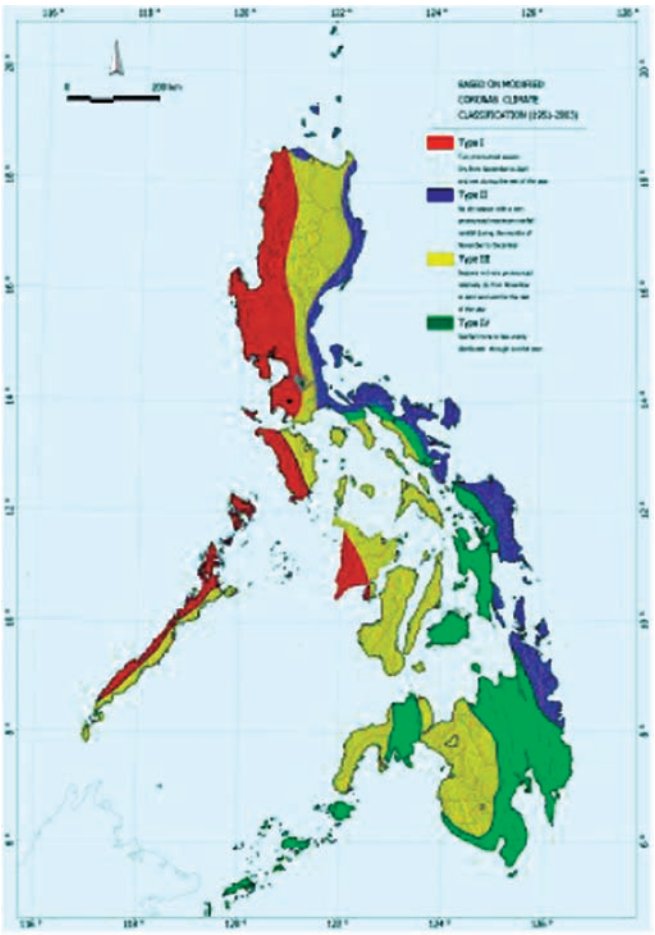


Figure 1.2. Climate map of the Philippines (PAGASA, Climate Change in the Philippines, 2011)



country can be divided into two major seasons: (1) the rainy season from June to November; and (2) the dry season from December to May. The dry season may be subdivided further into: (a) the cool dry season from December to February; and (b) the hot dry season from March to May. Based on the distribution of rainfall, four climate types are recognized, which are described in Figure 1.2.

The Philippines is situated in a region where more tropical cyclones occur than anywhere else in the world. About 19 to 20 tropical cyclones, on the average, enter the Philippine area of responsibility (PAR) annually, with about 7 to 9 making landfall. The period from May to December is considered the tropical cyclone season, with the peak tropical cyclone activity occurring from July to September at an average of 3 or more occurrences.

Tropical cyclones are usually responsible for the maximum values of rainfall and strongest winds observed in many parts of the country. Typhoon extremes are those typhoons with maximum winds of 150 kph or more. The five-year running average shows more tropical cyclones of typhoon intensity during El Niño events. These are the typhoons responsible for the most destructive weather-related losses in the Philippines.

In recent years, these typical weather patterns have altered noticeably, as climate change became more evident in the country. Climate change has been identified as a major reason for the sharp increase in the

Photo by CAD

Table 1.1. 20 most disastrous cyclones in terms of damages (in billion pesos) from 1970-2011

NO.	PHILIPPINE NAME	INTERNATIONAL NAME	PERIOD	DAMAGES (billion pesos)	REMARKS
1	Pepeng	Parma	Sep 30 – Oct 10, 2009	27.296	Crossed Northern Luzon
2	Pedring	Nesat	Sep 24-28, 2011	15.552	Crossed Northern Luzon
3	Frank	Fengshen	June 18-23, 2008	13.500	Crossed Visayas, Southern and Central Luzon
4	Juan	Meg	Oct 16-21 2010	11.500	Crossed Southern Luzon
5	Ondoy	Ketsana	Sep 24 – 27, 2009	10.952	Crossed Central Luzon
6	Ruping	Mike	Nov 10-14, 1990	10.846	Crossed Central Visayas
7	Rosing	Angela	Oct 30 – Nov 4 1995	10.799	Crossed Southern Luzon
8	Kadiang	Flo	Sep 30 – Oct 7, 1993	8.752	Crossed Central and Northern Luzon
9	Loleng	Babs	Oct. 15-24, 1998	6.787	Crossed Bicol and Central Luzon
10	Milenyo	Xangsane	Sep 25 – 29, 2006	6.606	Crossed Southern Luzon
11	Unsang	Mike	Nov 28 – Dec 03, 1988	5.636	Crossed Northern and Central Luzon
12	Reming	Durian	Nov 28 – Dec 03, 2006	5.448	Crossed Southern Luzon
13	Iliang	Zeb	Oct 10 – 26, 1998	5.375	Crossed Northern Luzon
14	Cosme	Halong	May 14 – 20, 2008	4.700	Crossed Northern Luzon
15	Caloy	Changchu	May 09 – 15, 2006	4.320	Crossed Northern Visayas and Southern Luzon Area
16	Reming	Zangsane	Oct 25-31, 2000	3.944	Crossed Southern Luzon
17	Nitang	Ike	Aug 31 – 04 Sep 1984	3.913	Crossed Surigao and Central Visayas
18	Gading	Vicki	Sep 17 – 31, 1998	3.794	Crossed Northern Luzon
19	Trining	Ruth	Oct 28 – 31, 1991	3.719	Crossed Northern Luzon
20	Feria	Utor	Jul 02 – 05, 2001	3.486	Crossed Extreme Northern Luzon

Source: PAGASA

amount and intensity of rainfall throughout the country. Warming has been experienced in the past years, but now there appears to be greater intensity in the northern and southern regions.

Of the 20 most disastrous cyclones in terms of damages that the Philippines had from 1970-2011, 18 occurred in the last two decades (1990-2011), as seen in Table 1.1. In 2011 alone, the top 10 destructive tropical cyclones caused PhP26.5 billion worth of damage to property (Table 1.2). The trend clearly shows an increasing occurrence of extremely damaging cyclones in recent years. Their combined cost of damages reached PhP38 billion (Climate Change in the Philippines, 2011).

In August 2012, a southwest monsoon that flooded Metro Manila and other parts of Luzon surpassed the rainfall dumped by Ondoy. The accumulated rainfall during the 22-hour downpour reached 472 mm. Although the volume of the accumulated rainfall from the southwest monsoon was higher, Ondoy's rainfall was more intense in that much of the rain came within a shorter time frame. Of the 455 mm rainfall released by Ondoy over the 24-hour period, 341 mm fell in just 6 hours.

Table 1.2. Philippines top 10 destructive tropical cyclones in 2011

DATE	DESTRUCTIVE TROPICAL CYCLONES	AFFECTED AREAS	CASUALTIES	AFFECTED		EVACUATED		TOTALLY DAMAGED HOUSES	DAMAGES TO PROPERTIES
		REGIONS	DEAD	FAM	PERS	FAM	PERS		
December 15-18	TS Sendong (Sitrep 23 a/o 30 Dec 2011)	VI,VII, IX, X, XI, CARAGA, & ARMM	1,257	113,651	721,844	97,019	525,945	13,337	1,382,008,527.00
September 24 - 28	Typhoon Pedring	I, II, III, IV-A, IV-B, V, VI, CAR & NCR	85	667,602	3,105,355	97,797	387,641	7,491	15,552,586,957.49
July 25 - 28	TS Juaning	III, IV-A, IV-B, V, VI, VII,VIII & NCR	77	255,129	1,285,906	123,394	614,688	11,196	4,441,798,208.89
August 21 - 29	Typhoon Mina	I, II, V, VI, CAR, NCR	36	97,006	411,468	3,869	17,691	159	2,089,349,409.79
May 6-11	TS Bebeng	III, IV-A, IV-B, NCR, V, VII and VIII	35	83,632	431,837	8,354	42,855	64	2,253,233,275.00
September 29 - October 02	Typhoon Quiel	I, II, III & CAR	17	323,303	1,489,535	24,565	106,764	5,553	115,075,527.81
June 21 - 25	TS Falcon	I, II, III, NCR	12	389,348	1,792,376	4,958	24,243	165	646,851,793.75
October 10 - 14	TS Ramon	IV-B, VI, VII, VIII, X, XII & CARAGA	10	17,971	88,506	1,385	6,837	29	-
July 28 - August 5	TS Kabayan	I, III, IV-A, VI & NCR	8	23,238	93,888	742	3,402	11	2,500,000.00
May 20 - 28	Typhoon Chedeng	NCR, II, V, IX, X, XII & ARMM	4	91,767	446,907	49,454	226,166	83	18,933,499.00
	Grand Total	14 regions	1,541	2,062,647	9,867,622	411,537	1,956,232	38,088	26,502,337,198.73

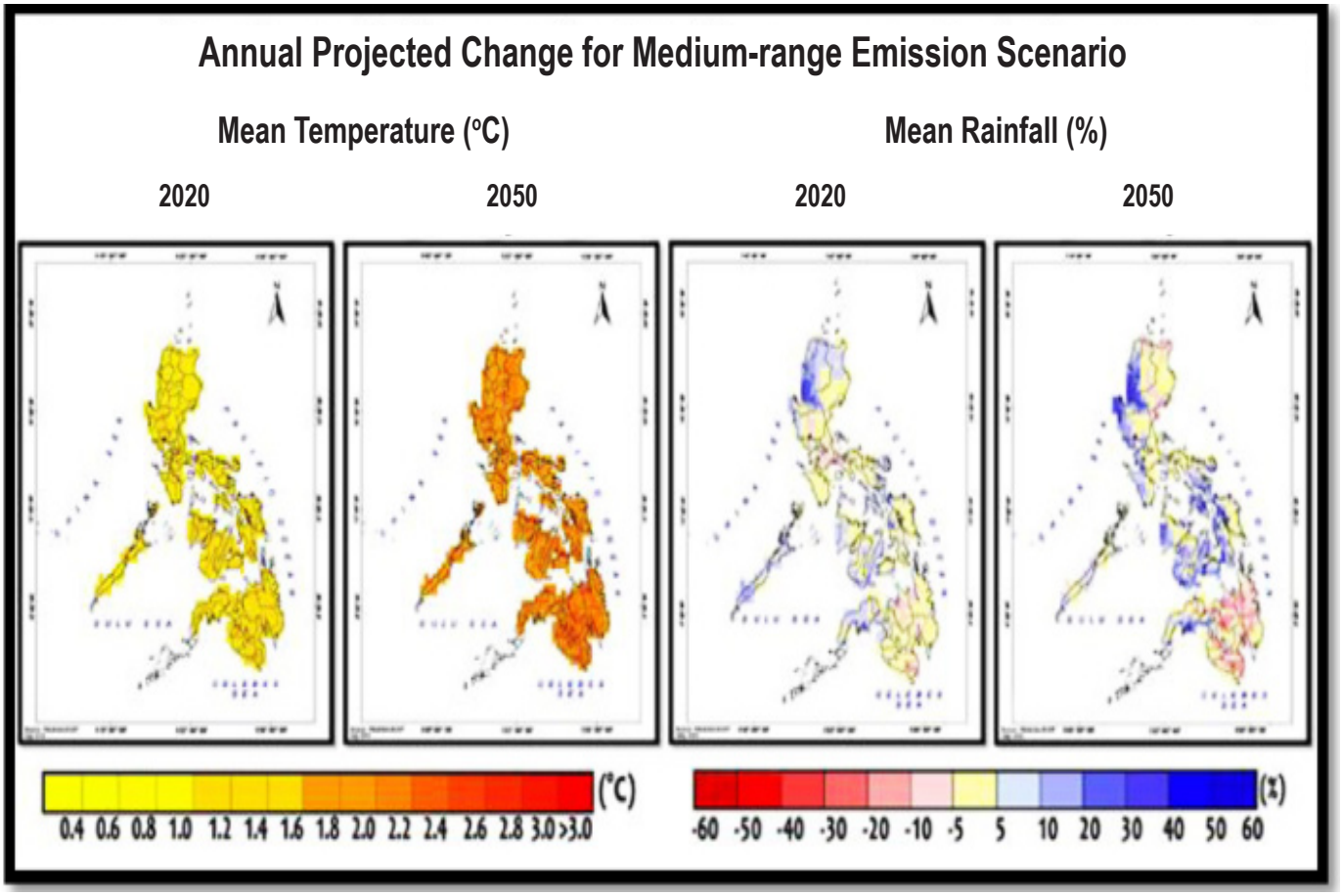
Source: NDRRMC

Within the period September to October 2009, two unusual tropical cyclones visited the Philippines, one after the other. Tropical cyclone Ondoy (international name "Ketsana") poured 455 mm of rain within 24 hours on September 26, 2009. This 24-hour downpour is already equal to the average rainfall for the whole month of September during the period 1971-2000. Less than a week later, with the entire nation still shaken by the devastation wrought by Ondoy, came Pepeng (international name "Parma"), which left a trail of destruction in Northern Luzon for almost two weeks. The two tropical cyclones left almost a thousand deaths and 84 missing.

1.3 Climate Change Scenarios

Changes in temperature and precipitation over the Philippines have been simulated based on a regional climate model developed by the Hadley center. The model, known as Providing Regional Climates for Impacts Studies (PRECIS) Regional Climate Modeling System, projected changes of surface air temperature and precipitation for two time-slices. Temperature and rainfall changes were obtained by comparing future simulations with the simulation for the 20th century (1971 to 2000).

Figure 1.3. Annual projected change under A1B (Medium-Range Emission Scenario)



1.3.1 Projected Change in Annual Mean Temperature and Precipitation

The model results indicated that significant warming will occur in the Philippines in the middle of the 21st century, with the largest warming occurring in June, July and August (JJA) and March, April and May (MAM) over Mindanao. Under the A1B emission scenario of greenhouse gases, the country-averaged annual mean temperature is projected to increase by 0.9°C to 1.1°C by 2020 and 1.8°C to 2.2°C by 2050. Generally higher temperatures are simulated in all provinces of the country by 2050. The rate of temperature increase by 2050 is generally double the rate of increase simulated for 2020. (Figure 1.3)

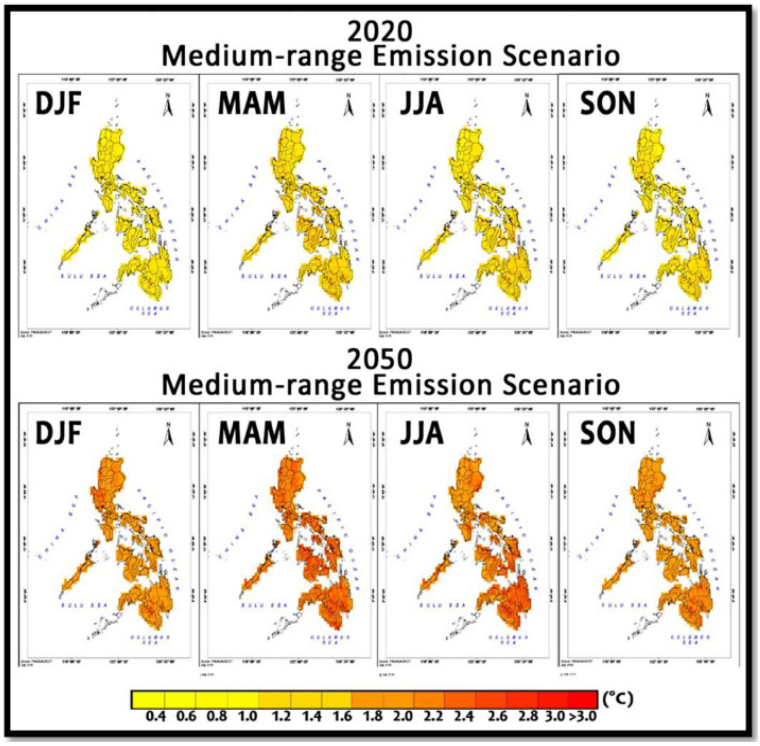
Likewise, the model projected a change in annual precipitation from -7.5% to 23% in 2020 and -9.5% to 27.8% in 2050. Increases in rainfall are particularly evident in most areas of Luzon and Visayas, while Mindanao is projected to undergo a drying trend. There are large seasonal differences in the amount of rainfall in all the seasons. The model indicated that anthropogenic climate change will probably lead to a much stronger and more active southwest monsoon in Luzon and Visayas as manifested in the projected significant increases in seasonal rainfall in JJA.

1.3.2 Projected Change in Seasonal Mean Temperature and Rainfall

The key findings of the model showed that seasonal mean temperature under the A1B scenario are projected to rise by about 0.8°C to 1.3°C for 2020 and 1.5°C to 2.6°C by 2050. Again, generally higher temperatures are simulated in all the provinces in 2050. And, as with the annual mean temperature, the rate of seasonal mean temperature increase in 2050 is double the rate of increase simulated for 2020. (Figure 1.4)

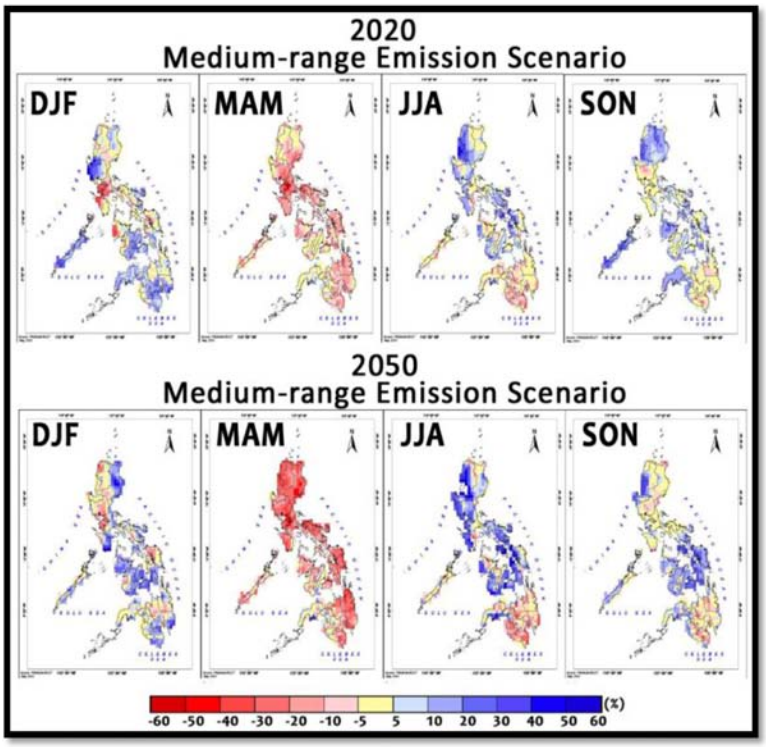
Projected changes in the Philippine rainfall regime under the A1B emission scenario indicate the largest seasonal variation (-39.8% to 72.5%) during the seasons of JJA and MAM. It is expected that the drier season of March-April-May will become even drier, while the wetter seasons of June-July-August and September-October-November will become even wetter, with increases in rainfall becoming greater with time in 2050 (2036-2065). The model showed that during this period, precipitation increases in JJA will become even greater,

Figure 1.4. Projected change in seasonal temperature in 2020 and 2050



	Medium-Range Emission Scenario	
	2020	2050
Dec-Jan-Feb (DJF)	0.8 to 1.0	1.6 to 2.2
Mar-Apr-May (MAM)	0.9 to 1.3	2.0 to 2.5
Jun-Jul-Aug (JJA)	0.8 to 1.3	1.6 to 2.6
Sep-Oct-Nov (SON)	0.8 to 1.1	1.5 to 2.2

Figure 1.5. Projected change in seasonal rainfall in 2020 and 2050 under the A1B scenario



	Medium-Range Emission Scenario	
	2020	2050
Dec-Jan-Feb (DJF)	-0.4 to 54.3%	-0.1 to-25.1%
Mar-Apr-May (MAM)	-0.2 to -33.3%	-1.4 to -39.8%
Jun-Jul-Aug (JJA)	-0.4 to 43.1%	-0.7 to 72.5%
Sep-Oct-Nov (SON)	-0.4 to 30.0%	-0.5 to 39.0%

while rainfall in MAM will become less and less. More rainfall is seen for JJA in 2050 with a projected increase of -5.5% to 72.5% in most parts of Luzon and Visayas. The model indicated that climate change will probably lead to an active southwest monsoon in Luzon and Visayas, as evident in the projected future increases in rainfall both in 2020 and 2050. A downward trend is more likely in Mindanao where a reduction in seasonal rainfall is expected in MAM, JJA and SON in 2020. (Figure 1.5)

1.4 Population

Based on the 2010 Census, the National Statistics Office (NSO) placed the Philippine population at 92,337,852 people inhabiting around 1,000 of the archipelago's 7,107 islands. The average annual rate of increase was 1.90%. Table 1.3 shows the country's population size and growth rate over the eight censuses conducted by NSO since 1970.

Table 1.3. Population in the Philippines (census years)

Year	Population	Average Annual Rate of Increase (%)
1970	36,684,486	3.08
1975	43,070,660	2.78
1980	48,098,460	2.71
1990	60,703,206	2.35
1995	68,616,536	2.32
2000	76,504,077	2.36
2007	88,574,614	2,04
2010	92,337,852	1.90

Although population growth has slowed down since 1970, the growth rate is still high enough to cause substantial additions to the population every year. The Philippine population is expected to double in just a little over 30 years, based on the population census of May 2000. Rapid population growth has important implications on the demand for and management of natural resources, quality of air, land, water and the environment in general, the adequacy of services and infrastructure, and the overall quality of people's lives. It also weighs upon the capacity of government to cope with natural calamities and disasters. All of these impact upon the country's vulnerability to climate change.

Migration is another dimension of population that can affect people's ability to adapt or their being prone to the consequences of climate change. Of the country's total population in 2005, 62.7% lived in urban areas. The urban annual growth rate was 3.45%, much higher than the annual population growth rate of 2.28% for that year. Since 1995, increasing numbers of people have been migrating to the urban areas. Urban growth rates peaked in the late 1980s to the early 1990s. From 2000 onwards, the population growth rate in the rural areas has become negative. .

Metro Manila is the 17th most populous urban agglomeration in the world. As of the 2010 Census, it had 11.85 million inhabitants, which accounts for 12.83% of the total population of the Philippines.

The exponential growth of the country's population, as well as the increasing migration to high-risk and flood- and earthquake-prone urban areas, both contribute to the vulnerability of the country to climate change.

1.5 Government Structure

The Philippines is a democratic republic with a presidential system of government. The powers of the government are equally divided among three sovereign but interdependent branches, namely, the executive, legislature and judiciary. This system ensures check and balance while adhering to the doctrine of separation of powers.

The Philippine president heads the executive branch and is elected by a direct vote of the people for a one-time six-year term. The president controls all executive departments, bureaus and offices, and ensures that laws are faithfully executed. The Philippine Constitution grants the president to appoint the Cabinet members.

The executive branch of government currently consists of 19 executive departments. These departments are: Agrarian Reform, Agriculture, Budget and Management, Education, Finance, Energy, Environment and Natural Resources, Foreign Affairs, Health, Interior and Local Government, Justice, Labor and Employment, National Defense, Public Works and Highways, Science and Technology, Social Welfare and Development, Tourism, Trade and Industry, and Transportation and Communication. These national government agencies comprise the largest part of the country's bureaucracy and are headed by Cabinet secretaries nominated by the president and presented to the Commission on Appointments, a body of Congress which approves or rejects the nominations.

There are also administrative positions that are not necessarily secretaries of executive departments but who are Cabinet secretary level in rank. These include, among others: the vice president, executive secretary, and heads of various agencies such as the Climate Change Commission (CCC).

The legislative branch consists of the Upper House or the Senate, and the Lower House or the House of Representatives. The Upper House is composed of 24 nationally elected senators with a six-year term of

office. The Lower House is composed of more than 200 locally elected district representatives and party list representatives each with a term of three years. The party list representatives constitute 20% of the total membership of the Lower House. The legislature makes, amends and repeals laws governing the government, the citizens, and the country in general.

The judicial power is lodged in the Supreme Court and lower tribunals established by law. Among these are the Court of Appeals and the *Sandiganbayan*, a court for criminal and civil cases involving graft and corruption and other offenses of public officials and employees. The scope of power of the Supreme Court includes adjudication, judicial review, and other incidental powers.

At the local level, the territorial and political subdivisions of the Philippines are provinces, cities, municipalities, *barangays*, special metropolitan subdivisions, and autonomous regions. In a move towards decentralization, the Congress enacted the Local Government Code in 1991. This code enabled local government units (LGUs) to enjoy local autonomy and to exercise certain basic powers that are decentralized and devolved by the national government. The president of the Philippines exercises general supervision over LGUs.

In October 2012, the Moro Islamic Liberation Front (MILF) and the Philippine government signed a framework agreement on establishing a new autonomous Muslim area in Mindanao called the Bangsamoro. The agreement officially ended more than 40 years of tension between the Muslims and the government. Under this agreement, the Bangsamoro is not seen as a local government but as a special category of a political system.

1.6 Economy

There are three main industry sectors in the Philippines that contribute to the country's economic growth, namely: (1) agriculture, hunting, forestry and fishing; (b) industry; and (c) services. From 1990 to 2010, the service sector contributed an annual average of 52% of the total gross domestic product (GDP) (at current prices) while the industry sector and the agriculture, hunting, forestry and fishing sector contributed 34% and 14%, respectively . (NSCB)

The Philippines has been receiving several upgrades from credit rating agencies. As of 2012, Standard and Poor's and Fitch Ratings both gave the Philippines a credit rating of BB+ while Moody's Investor upgraded the country's rating to Ba1. All of these ratings are one notch below investment grade. A number of sound fundamentals have been key drivers for a very positive economic outlook, such as strong domestic spending from public and private sectors, fast economic growth, expanding service sector, lower inflation, exchange rate appreciation, and increase in foreign exchange reserves, as well as lower outstanding government debt percentage of GDP.

The Philippines posted a 6.4% GDP growth in the first quarter of 2012, one of the fastest in the region, second only to China with 8.1%. For the second quarter of 2012, the Philippines recorded a 5.9% GDP growth, still one of the better-performing economies in the region, just lagging behind China with 7% and Indonesia with 6.4%.

The Philippine peso is also appreciating and has broken the 41-peso mark, stronger than the 42-45 peso exchange rate assumed by the Bangko Sentral ng Pilipinas (BSP) for 2012. The gross international reserves of the

Philippines has surpassed the $77-78 billion forecast by posting a record high of $81.9 billion in the first nine months. The government debt has fallen to 50.9% of GDP compared to 74.4% of GDP in 2004. The Philippine stock market has also reflected this strong economic outlook. In 2012 it experienced several record-breaking points that the Philippine Stock Exchange index could reach as high as 6,000 points in 2013.

Despite the country's positive economic performance, the Philippines is still highly vulnerable to natural hazards such as those related to climate and weather – a vulnerability that arises not only from the impact of the altered climate patterns per se, but also from the people's lack of protection and inability to cope and manage their surroundings, because of poverty, lack of the knowledge and the means, and a degraded and precarious environment that could turn what would have been just a minor hazard into a major disaster.

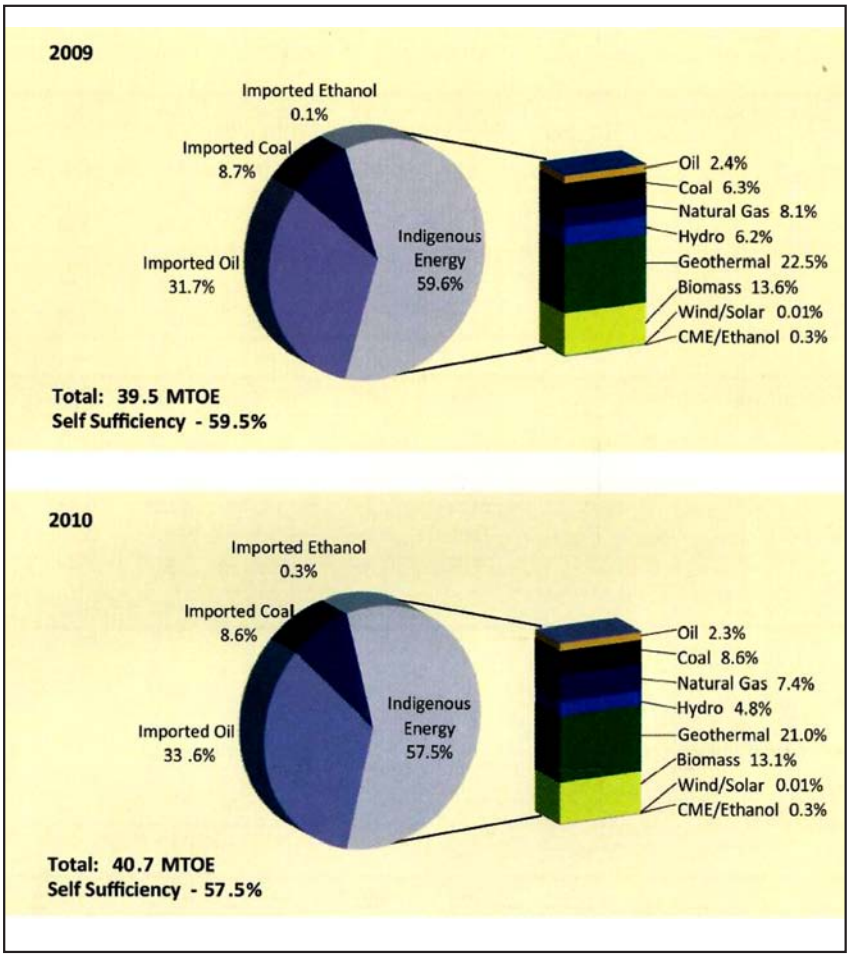
The fact that many Filipino families live and make their living along coastal areas and depend highly on the natural resources from the sea, the land, and the forests for their livelihood and survival makes the Philippines doubly susceptible to the harsh impacts of climate change.

The World Bank and the National Disaster Coordinating Council (NDCC) recorded that over the past 36 years, disasters in the Philippines have cost an average of PhP15 billion a year. Typhoons alone cost the country an average of 5% of the GDP. For 2011, typhoons caused a total of PhP26.50 billion estimated damages in the country. (NDRRMC)

1.6.1 Energy

Total energy use increased proportionally with the country's population growth rate. Increased energy use, in turn, is associated with higher levels of greenhouse gases (GHG), which cause global warming that causes climate change.

Figure 1.6. Indigenous energy production in the Philippines in 2009 and 2010.



Source: Department of Energy website: http://www.doe.gov.ph/policy-planning/key-energy-statistics-2010/1154-energy-mix; http://www.doe.gov.ph/policy-planning/key-energy-statistics-2010/1220-indigenous-energy-resource-development

In 2010, the amount of energy consumed per person remained constant at 0.49 tons of oil equivalent (TOE). Oil per capita, however, went up by 3.7% equivalent to 1.19 barrels/person (BBL/person), reflecting an increase in oil consumption per person. On the other hand, the intensified campaign for and implementation of electrification programs pushed electricity per capita to 0.72 MWh/person in 2010, after remaining at 0.67 MWh/person for the past three years.

All sectors registered higher energy consumption in 2010, led by the commercial sector, where energy use grew fastest by 10.4%, from 2.4 million tons of oil equivalent (MTOE) in 2009 to 2.7 MTOE in 2010. Industry followed closely with a 10.1% hike in energy consumption, from 5.8 MTOE in 2009 to 6.4 MTOE in 2010.

The country's total primary energy supply (TPES) in 2010 was 40.7 MTOE. Oil is the Philippines' main energy source, which accounts for 35.9% of the primary energy supply mix, followed by geothermal energy with 21.0% and coal with 17.3%. The country had an energy self-sufficiency of 57.5% in 2010. Total indigenous energy production slightly went down by 0.3%, from 23.5 MTOE in 2009 to 23.4 MTOE in

2010. This is due to lower production of local resources such as crude oil, natural gas, geothermal, hydro, biomass and biofuels. Energy production from geothermal and biomass declined by 3.8% and 0.7%, respectively, compared to their 2009 levels. Similarly, in 2010, natural gas production from the Malampaya well decreased by 5.8%. However, production of local coal and solar power increased by 41.9% and 0.2%, respectively.

The breakdown of indigenous energy and the decrease in energy production from 2009 to 2010 are shown in Figure 1.6.

Photo by CAD

Total domestic oil production in 2010 was at .92 MTOE, a slight decrease by 4.2% from .96 MTOE due to the scheduled production shutdown for a few months of the Galoc field and due to the failure of the Tindalo Extended Well Test to produce oil at economic rates.

Domestic natural gas production has reached 3 MTOE. Most of the natural gas is being sourced at Malampaya with an estimated daily production capacity of 10.48 kTOE. Coal, on the other hand, accounts for 15% of the total indigenous production, which reached 3.5 MTOE in 2010.

In the interest of achieving self-sufficiency, the Philippines is also shifting towards the development and use of renewable energy sources. The Philippines is the second largest producer of geothermal energy next to the US. In 2010, this subsector was able to produce 8.5 MTOE.

The country's hydropower resource has contributed 8.3% of the total indigenous energy supply in 2010. However, this is 20.3% less than its production in 2009 due to severe El Nino, which greatly reduced water levels in the country, especially in Mindanao where hydropower is more dominant. Based on the 2010 Energy Statistics of the Department of Energy (DOE), the drought caused prolonged power outages and disruptions in the region due to a significant decline in the dependable capacities of the Agus (663.6 MW) and Pulangi (225.8 MW) plants from 889.4 MW to a minimum daily dependable capacity of 122 MW for Agus and 22 MW for Pulangi. This means a 75.4% reduction in dependable capacity for both power plants.

Biomass is also seen as a major contributor to the indigenous energy supply mix, where fuel wood accounted for 58% of the total biomass supply. Bagasse accounted for 870.4 kTOE in 2010 while charcoal supply reached 711.8 kTOE. Other biomasses, such as municipal waste, agriwaste and animal waste, reached a total of 664.6 kTOE as an aggregate, accounting for 12.4% of the total biomass supply in 2010.

Wind energy production contributed only 0.01% of the total indigenous energy. As of 2010, the 33-MW Bangui Bay Wind Power Project in Ilocos Norte is the only wind power farm that is connected to the national electricity grid. This is also one of the 58 registered Clean Development Mechanism (CDM) projects by the Philippines and is one of four projects that were issued Certificates of Emissions Reduction (CERs).

1.6.2 Transport

Transport remains as the biggest energy-consuming sector with a 36.8% share of the total final energy demand. A growing national population necessarily leads to greater use of transportation. In the urban areas particularly, where people migrate to and population is therefore densest, roads are full of transport activity, and traffic is congested. Increased transport activity results in increased overall greenhouse gas emissions.

In 2006, 5.33 million vehicles were registered. This is 5.3% higher than the previous year's 5.06 million. Of this number, 1.55 million or 29.1% of registrations came from the National Capital Region (NCR). Based

Photo by CAD

on the motorization growth rate of 6% and projected population increases, GHG emissions from road transport, estimated at 24 $MtCO_2e$, will likely increase to 37 and 87 $MtCO_2e$ in 2030.

The Philippines subscribes to the low-carbon path framework in the transport sector. In order to decongest Metro Manila streets and improve air quality from decreasing fuel use, the government launched the Strong Republic Transit System which entails the construction of seven links to integrate the existing Light Rail Transit (LRT) and Metro Rail Transit (MRT) lines. It also promotes the use of compressed natural gas (CNG) and liquefied petroleum gas (LPG) to decrease carbon emissions in the atmosphere.

In 2011, the national strategy for environmentally sustainable transport (EST) was formulated, with the Department of Transportation and Communication (DOTC) and Department of Environment and Natural Resources (DENR), United Nations Centre for Regional Development (UNCDR), Clean Air Initiative Asia (CAI-Asia), University of the Philippines National Center for Transportation Studies (UP-NCTS), and other supporting agencies such as the Institute for Global Environmental Strategies (IGES), Asian Development Bank (ADB), World Health Organization (WHO), Swedish International Development Cooperation Agency (SIDA), Japan International Cooperation Agency (JICA), and the Ministry of Japan spearheading this endeavor. The overall goal is to develop and mainstream EST strategies that are sensitive to future development scenarios. These strategies may include the following:

- Reduction of the annual growth rate of energy consumption and associated GHG and air pollutant emissions from the transport sector, especially in urban areas of the country.
- Enhancement of sustainable mobility through the development of a viable market for EST goods and services. This involves, among others, the promotion of transportation systems of low carbon intensity and shifting towards the use of more sustainable transport modes.

(Final Report on the Formulation of a National EST Strategy for the Philippines: 2011)

1.6.3 Industry

For the national statistical accounts, the industry sector is divided into three major groups: (1) agriculture, hunting, forestry and fishing; (2) industry; and (3) services. These major industry groups are further divided into subsectors as outlined below.

- Agriculture, hunting, forestry and fishing
  - Agriculture industry
    - Agriculture
    - Forestry
  - Fishing
- Industry
  - Mining and quarrying
  - Manufacturing
  - Construction
  - Electricity, gas and water supply
- Services
  - Transportation, storage and communication
  - Trade and repair of motor vehicles; motorcycles, personal and household goods
  - Financial intermediation
  - Real estate, renting and business activity
  - Public administration and defense; compulsory social security
  - Other services

1.6.3.1 Agriculture and Food Security

Agriculture is a major contributor to the Philippine economy. In 2008, agriculture, along with fisheries, constituted 15% of the country's gross domestic product valued at 1.1 trillion at current prices (NSO, 2008). In 2009, 34% of the total employed labor force came from agriculture (NSO).

However, the heavy reliance on agriculture of a large percentage of the country's population for their source of livelihood, plus their dependence on existing natural resources for their needs (such as firewood and housing material), make this sector even more gravely affected by the impact of climate change. The vagaries of climate change increase the vulnerability of the entire population, but particularly those whose primary occupation is agriculture and fishing.

Based on the figures posted by the National Statistical Coordination Board (NSCB), for the first quarter of 2012, the agriculture sector slowed down as production of major crops such as palay and sugarcane declined. Palay declined by 1.1% compared to a 15.6% growth recorded the previous year. And this can be attributed to the floods that severely affected some palay farms in Davao, and to some changes in harvest schedules in Western Visayas and Cagayan Valley, which also affected the production output for the first quarter period. From a 26.6% production growth in sugarcane in 2011, production declined in the first quarter of 2012 due to frequent rains which affected crop yield in the provinces of Bukidnon, Davao del Sur, and Lanao del Sur. Crop shifting from sugarcane to palay in Tarlac and from sugarcane to oil palm in Mindanao also contributed to the decline.

Addressing climate change is indeed one of the most pressing tasks facing the agriculture and fisheries sector and its stakeholders.

Generally, threats to food security, livelihood of the rural sector, human communities' welfare, and sustainability of the country's development path are central to formulating a program and an extension program for climate change. Addressing the impacts of climate change requires a two-pronged approach which, on one side, studies its impact on the ability of the natural resource system to support human communities, both rural and urban, and on the other side, identifies the appropriate climate change adaptation technologies and pilot-tests them in different geographical areas in the country. In this respect, the Research Development and Extension (RDE) program of the Department of Agriculture-Bureau of Agricultural Research (DA-BAR) examines the different adaptation strategies by the agriculture sector to cope with different climate change stresses. (DA-BAR Research Development and Extension Agenda and Program for Agriculture and Fisheries, 2011.)

1.6.3.2 Industry and Mining

Among the industry subsectors, electricity, gas and water supply posted the highest growth of 8% based on constant 2000 prices, followed by manufacturing with 5.7%, and construction with 3.6%.

Mining and quarrying, on the other hand, declined by 11% compared to a 32.2% growth in 2011 due to the poor performance of gold, crude, natural gas, chromium, and other non-metallics. Other metals posted positive growth for the sector, such as nickel mining which grew by 82.8%, stone quarrying and sand pits by 5.6%, copper mining by 4.1%, and other metallic mining by 58.1%.

In 2004, the Supreme Court upheld the provision of the Philippine General Mining Act of 1995 to allow foreign-owned firms to explore and process minerals in the country. This attracted new investors and resulted in investment expansions. It also renewed interest in the mining sector at a time when world prices of metals were high, and boosted the production of gold, copper, chromium, nickel, and other metallic minerals due to intensified demand. In 2012, President Aquino signed Executive Order no. 79 to institutionalize and implement reforms in the mining sector. Prior to the EO, areas banned from mining were limited to protected areas. With the EO, 78 more mine-free areas were identified to include:

- Tourism development areas identified by the National Tourism Development Plan
- Prime agricultural lands such as plantations and other properties devoted to valuable crops
- Fisheries development zones and marine sanctuaries as declared by the agriculture secretary
- Island ecosystems to be determined by DENR through mapping technology

1.6.4 Tourism

While international tourism showed a downward trend in terms of tourist arrivals and contribution to the global economy, Philippine tourism remained stable. In 2007, tourist arrivals breached the three million mark, having reached 3.09 million visitors, which generated a foreign exchange receipt of US$4.885 billion. In 2008, this grew by 1.53% to 3.14 million visitors.

Still, the Philippine tourism industry pales in comparison with its ASEAN neighbors. Malaysia had 17 million visitors in 2007; and Thailand and Singapore had 14 million visitors each. Vietnam is slowly overtaking the Philippines. Nonetheless, tourism makes a significant contribution to the country by providing employment, both direct and indirect, to 4 million people. It also provides livelihood opportunities to farmers, fishermen, factory workers, and other suppliers of food, goods, equipment and services.

In 2012, the Department of Tourism (DOT) came up with the campaign "It's More Fun in the Philippines". Given the limited resources of the department to embark on a full-scale marketing campaign, it encouraged the citizens to come up with creative ways to promote the slogan as well. From January to September 2012, tourist arrivals went up by 9.08%, attracting 3,149,985 tourists compared to 2,887,715 the previous year.

Since the Philippines is an archipelago, a lot of its tourist destinations are in coastal and marine areas. In 2010, there were already reports of coral bleaching in some dive sites, such as Nasugbu and Anilao. Around 95% of the corals in the Philippines suffered bleaching during the 2009-2010 El Nino, surpassing the 1998 event. Rising temperatures of the oceans have also affected blue whale shark sightings in Donsol. In a study conducted by Herman Cesar in 2000 on the tourism impacts of coral bleaching at the El Nido Resort, annual losses to the local economy were estimated to be roughly $1.5M a year.

1.6.5 Services

The services sector has been spearheading economic expansion, growing at an average of 7.1% in 2004-2006 and 8.1% in 2007. This sector was the only production sector that was within, if not exceeding, targets for 2004-2007. As the global crisis unfolded, growth registered at 4.8% in the first three quarters of 2008. Strong consumer demand supported by record levels of remittances from overseas Filipinos and a liberalized environment in transport, communication, and retail trade spurred growth in the sector. The information technology (IT)-related businesses, such as business process outsourcing (BPOs) and call centers, and the robust growth of cellular phone services in the country benefited from the government's liberalization efforts to expand broadband services, promote the development of e-commerce and e-business, and improve transparency and speed up the delivery of frontline government services through IT.

The services sector served as the main driver of GDP. The fastest growing sectors for the first quarter of 2012 came from the following:

- Other Services: 10.5%
- Transport, Storage and Communication: 9%
- Trade: 8.9%
- Financial Intermediation: 8.8%
- Real Estate, Renting and Business Activity: 7.9% (including BPOs)
- Public Administration and Defense: 1.5%

1.6.6 Water Resources, Forestry and Biodiversity

The Philippines is one of the 17 mega diverse countries in the world, with more than 65% of the described spe-

cies in the country found nowhere else. There are more new species described every year in the Philippines than in any other country. This is partly because forests comprise 24.27% or 7.2 million hectares of the total land area. Yet the country is highly regarded as one of the critical hotspots with more than 800 of its plant and animal species threatened with extinction.

The decline of forest cover in the country from almost 27.5 million hectares in the late 1500s to 21 million hectares in the early 1900s to only 7.2 million hectares today can be attributed to the combined effects of logging, inadequate forest protection, incoherent policies, expansion of upland agriculture, fires, pests and diseases, and unplanned land conversion. Many of these causes of forest cover decline are associated with or exacerbated by population growth, pervasive poverty, rapid urbanization and industrialization, and excessive utilization of natural resources.

The contribution of the forestry sector to GNP has been minimal over the last two decades. At the same time, forest degradation has resulted in the deterioration of its key services and functions, particularly in biodiversity conservation, soil and water conservation, climate regulation, supply of raw materials for wood, food, and other products, and economic and socio-cultural development. The impairment of these forestry functions, in turn, could ultimately slow down the development process.

Forests play an important role in the reduction of greenhouse gas emissions and are therefore critical in climate change mitigation efforts. They also help prevent or lessen the magnitude of some eventualities resulting from climate change, like drought, desertification and water shortage. And by providing shelter and nurturance to wildlife, they help prevent the disruption of ecological balance, another consequence of climate change.

The total number of watershed forest reserves in the Philippines was recorded at 135 as of 2011, with a total area of 1.56 million hectares, or 5% of the country's total land area (http://www.forestry.denr.gov.ph/2011PFS.pdf). Watersheds remain to be the principal sources of water for domestic, agricultural, industrial and commercial uses in the country. Around 975 million cubic meters (mcm) of water are estimated to be available daily to meet the demands from various sectors. However, due to uneven distribution of rainfall and differences in climatic patterns, some regions in the country do not get as much water as other regions, and thus have an inadequate supply.

Per capita water availability per year in the Philippines is only 1,907 cubic meters – the second lowest among the Southeast Asian countries. This is much lower than Asian and world averages. If the present pattern and rate of consumption do not change and no increase in the present supply of available water takes place, it is projected that some areas of the country will soon be experiencing water scarcity.

1.6.7 Coastal and Marine Resources

The Philippines' diverse coastal zone consists of a variety of tropical ecosystems, including sandy beaches, rocky headlands, sand dunes, coral reefs, mangroves, sea-grass beds, wetlands, estuaries, and lagoons. The various ecosystems are interconnected, making it virtually impossible to alter one feature of the coastal zone without affecting another, either directly or indirectly.

Figures from the National Economic and Development Authority (NEDA) show that the country's fishing grounds in inland bodies of water (including lakes, ponds, reservoirs, swamps, irrigation canals, and mangrove estuaries) have an estimated aggregate area of 842,247 hectares. Its marine resources cover an estimated area of 220 million hectares, including the Exclusive Economic Zone (EEZ). Its coastal zone covers about 11,000 sq. km. of land and 267,000 sq. km. of water.

The Philippine coral reef area, the second largest in Southeast Asia, is estimated at 26,000 sq. km. and holds 2,177 species of fish. Much of these are found in habitats that are most proximate to the dwelling sites of the poor.

Currently, in the Philippines, fisheries account for about 4% of GNP. In 2007, the fisheries production of PhP180.5 billion showed a remarkable 10% increase from the previous year's production of PhP163.4 billion. The municipal fisheries subsector contributed the highest value of about PhP64.21 billion. Total fish caught by marine fishermen was valued at PhP58.42 billion while inland fisheries production was valued at PhP5.79 billion. The aquaculture subsector contributed PhP61.60 billion or 34.10% while the commercial subsector contributed PhP54.74 billion or 30.3% to the total fishery output.

The tremendous growth in aquaculture, however, needs to be viewed also from the point of view of sustainability, that is, if the growth does not amount to overfishing, which jeopardizes not only the supply of fish in the future, but also the ability of the fish to reproduce succeeding generations for the preservation of the species.

With over 80% of original tropical forests and mangroves in the Philippines having been cleared, the outflow of sediments into the reefs has been increasing. Mangroves continue to be cut and the areas converted into fish ponds, causing a lot of nutrients and sediments to be washed out into the reefs. Domestic and industrial wastes are also rarely treated in the Philippines; often, they are simply discharged directly into the sea.

1.7 Wastes

Solid waste generation in Metro Manila is estimated at 5,345 tons per day. Waste collected in Metro Manila is only about 65-75% of total wastes generated and the recycling level is estimated to be about 13%. The 25-35% uncollected wastes are thrown anywhere, mostly in esteros or estuaries and creeks. These threaten the health of the population and contribute considerably to flooding.

With industrialization came an increased use of chemicals, resulting in greater production and release of chemical wastes, such as ammonia and chlorine. At present, only about 45% of all industries using chemicals like cyanide, mercury, asbestos and ODS have been registered. For polychlorinated biphenyls or PCBs (e.g., coolant or oil for transformer), only 25% have been inventoried. The unregistered industries do not go through government inspection and may not be complying with the regulations set regarding industrial wastes.

Photo by CAD

Based on a study by JICA (2001), around 700 industrial establishments in the Philippines generate about 273,000 tons of hazardous wastes per annum. An ADB study on hospital wastes reported that about 30,000 tons of hospital wastes are generated per annum.

At present, there is no integrated treatment facility for hazardous wastes in the country, although there are about 95 small to medium-scale facilities that treat hazardous wastes. It is estimated that there are approximately 50,000 tons of hazardous wastes stored on-site or off-site due to lack of proper treatment and landfill facilities. Other hazardous wastes are exported to other countries for recovery, disposal and treatment. However, this entails additional costs to industries that affect their international competitiveness. Consequently, only a few industries do this.

Improperly disposed wastes not only pose hazards to the health and safety of humans in their immediate vicinity. They also pollute the soil, water and air, creating threats to the bigger human population as well as to plant and animal life. Air pollution, in particular with carbon dioxide (CO_2) from intensified human and industrial activities, is a contributory factor to climate change. In addition, a degraded and polluted environment can aggravate the impact of climate change, as what happened during the catastrophic floods that hit the country in recent years – the unusual amount of rainfall may have been due to climate change, but it was the wastes clogging the sewers and waterways that trapped the water, resulting in floods that caused immense damage and loss of lives.

1.8 Human Health

The Filipino's average life expectancy at birth rose from 61.6 years in 1980 to 64.6 years in 1990. It increased further to 69 years in 2000 and was projected to reach 70.5 years in 2005. This means a higher proportion of older persons in the general population is expected in the future. With this trend comes the increase in the occurrence of degenerative diseases and disabilities associated with an aging population.

From 1995 to 2000 the 10 leading causes of morbidity were communicable diseases, which include diarrhea, bronchitis, pneumonia, influenza, tuberculosis, malaria, chickenpox and measles. Leading non-communicable causes of morbidity are hypertension and diseases of the heart.

The same maladies continued to be the leading causes of morbidity until 2006. Acute lower respiratory tract infection and pneumonia combined, with a rate of 770.62 cases per 100,000 population, remained on top of the list as the cause of morbidity. Other leading causes of morbidity and their corresponding rates were acute watery diarrhea (657.98), bronchitis (619.72), influenza (390.79), and hypertension (469.64). Diseases of the heart (44.25), malaria (25.62), and dengue fever (17.67) were also counted as among the top causes of morbidity in 2006.

The mortality rate in the Philippines has been going down from 1950 to the present. A sharp decline of the crude death rate (CDR) was noted from the 11.2 deaths per 1,000 population in 1950 to 7.3 per 1,000 population in 1959. From the 1960s until 2000, a slow but steady decline in the CDR was noted, from 7.8 per 1,000 population in 1960 to 4.8 per 1,000 population in 2000.

Unlike the 10 leading causes of morbidity, the leading causes of death are mainly the non-communicable diseases. Diseases of the heart and the vascular system are the two most common causes of death. These accounted for 29.7% of the deaths. Deaths due to communicable diseases, on the other hand, have lessened from 645 deaths per 100,000 population in 1950 to 217.9 per 100,000 in 1980 to 102.6 per 100,000 in 2000. Deaths due to accidents and injuries increased from 6.4 per 100,000 population in 1990 to 42.4 per 100,000 in 2000. In the past decade, diabetes mellitus has emerged as one of the leading causes of death. Deaths due to diarrhea, septicemia, measles, avitaminosis and other nutritional disorders are no longer in the top ten leading causes of deaths although these are still of serious concern.

Current scientific evidence indicates that climate change will contribute to the global burden of disease. While the four climate parameters of temperature, humidity, precipitation and wind affect climate change impacts on health, it seems that temperature and rainfall may be the predominant factors that mediate the incidence of diseases more than the other parameters.

Malaria is one of the diseases the incidence of which may be sensitive to the frequency and amount of rainfall due to the breeding of malaria-carrying mosquitoes. Malaria continues to be endemic in over 57 provinces in the country, affecting the poorer communities in far-flung barangays. Over 46,000 confirmed cases were recorded in 2005, with over 140 deaths. Over 23 million people in 39 provinces are also living in filariasis-endemic areas.

Dengue, another disease transmitted by mosquitoes, continued to emerge as major outbreaks erupted in

Photo by CAD

several cities of Luzon in 2006. Metro Manila and the Cordillera Autonomous Region (CAR) recorded a 30% increase in cases, although mortality was reduced to 0.75%. Records of dengue cases from the Department of Health (DOH) showed that the trend for the number of dengue cases in Manila linearly increased with time. From 2001-2008, there were 57,118 cases reported in Metro Manila. Dengue is now spreading to semi-urban pockets of Mindanao.

Leptospirosis continues to be constantly reported, the highest incidence being in agricultural areas of the country and in areas of Metro Manila where flooding is frequent and garbage disposal is a problem. After the massive flood brought by typhoons Ondoy and Pepeng in September and October 2010, respectively, cumulative leptospirosis admission in 15 hospitals in Metro Manila between October 1 and November 3, 2009 climbed to 2,272, with 174 deaths. This is five times the incidence in all of 2008, and according to DOH, is among the highest in the world.

1.9 Science and Education

The universalization of early childhood education and standardization of preschool and day care centers yielded significant results for 2004-2007. As of April 2008, the coverage of early childhood education (ECE) reached 80 (99%) provinces and 32 (24%) cities. A total of 56,000 day care children had benefited under the Expanded Preschool Education Program as of 2006. In 2008, simple literacy was very high – 96.1% for the female population and 95.1% for the male population.

In school year 2009-2010, 13.9 million students were enrolled in elementary – 12.7 million in public schools and 1.1 million in private schools. But for the secondary level, total enrollment was only 6.8 million – 5.4 million in public schools and 1.3 million in private schools. Although the enrolment rate has improved, there is still a huge gap between student performance and targets. Low student performance may be due to the high cost of schooling-related expenditures and more students seeking employment to augment family income.

Providing critical education inputs like classrooms, teachers, desks and textbooks, and improving the learning environment remain major challenges to the Philippine educational system. From 2004 to 2007, a total of 51,999 new classrooms were constructed, exceeding the yearly minimum target of 6,000. The adoption of double-shift classes at a 1:50 classroom-pupil ratio also helped address classroom shortages in 2006. However, classroom shortages (vis-à-vis the ideal 1:45 classroom: pupil/student ratio) still persist in many schools in several areas due to the continually increasing enrolment, poor targeting of resources, classroom damages due to calamities, and disparity in resources/funding among schools in different areas.

Enrolment in technical vocational education and training (TVET) under the current Job-Skill Matching Program (JSMP) increased from 2004 to 2007 and exceeded the target of one million students annually. However, from the total enrollees of 4.6 million, only about 71.0% (3.3 million) graduated.

Table 1.4. Higher education enrollment by sector, institutional type, and academic year					
Institutional Type	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**
Philippines	**2,604,449**	**2,654,294**	**2,625,385**	**2,770,965**	**2,937,847**
Public	**881,656**	**915,191**	**982,701**	**1,083,194**	**1,193,851**
SUCs	772,079	792,143	853,280	942,077	1,040,859
LUCs	103,812	117,504	123,379	134,871	145,698
CSIs	2,132	2,132	2,132	2,132	2,132
OGS*	3,633	3,412	3,910	4,114	5,162
Private	**1,722,793**	**1,739,103**	**1,642,684**	**1,687,771**	**1,743,996**
Sectarian	401,614	389,415	443,002	462,267	466,977
Nonsectarian	1,321,179	1,347,569	1,199,682	1,225,504	1,277,019
Not specified		2,119			

** OGS enrollment includes special schools.*

- Includes enrollment from pre-baccalaureate up to doctoral courses

- Based on the submission of Higher Education Institutions as of May 29, 2012

Source: Commission on Higher Education

Of the enrollees in higher education for school year (SY) 2009-2010,26% are in the business administration and related courses, 15.89% are taking medical and related courses, and 12.6% are in the education and teacher training disciplines. In courses relevant to understanding the impacts of climate change and how to address them, following are the enrolment percentages:

- Agricultural, forestry, fisheries, and veterinary medicine: 2.15%
- Architectural and town planning: 0.74%
- Engineering and technology: 12.44%
- Information technology-related: 12.58%
- Law and jurisprudence: 0.73%
- Medical and allied fields: 15.89%
- Natural science: 0.87%
- Social and behavioral sciences: 1.31%

Table 1.5. Higher education enrolment by discipline group			
Discipline Group	SY 2007-2008	SY 2008-2009	SY 2009-2010
TOTAL	**2,654,294**	**2,625,385**	**2,770,965**
Agriculture, Forestry, Fisheries, and Veterinary Medicine	58,168	63,315	59,692
Architectural and Town Planning	19,288	18,004	20,441
Business Administration and Related Courses	612,481	649,641	727,018
Education and Teacher Training	370,441	325,186	349,634
Engineering and Technology	311,437	319,775	344,662
Fine and Applied Arts	12,931	13,732	16,682
General	35,257	13,750	14,198
Home Economics	4,952	4,847	5,149
Humanities	29,241	28,287	28,089
Information Technology-Related Disciplines	280,596	300,882	348,462
Law and Jurisprudence	18,159	19,293	20,144
Maritime Education	69,033	65,443	88,450
Mass Communication and Documentation	28,385	29,132	30,994
Mathematics and Computer Science	12,688	14,636	12,145
Medical and Allied Courses	547,595	517,250	440,226
Natural Science	25,044	22,641	24,127
Religion and Theology	107,452	108,519	117,299
Service Trades	7,884	7,804	6,943
Social and Behavioral Sciences	23,951	26,722	36,355
Trade, Craft and Industrial Courses	73,512	72,196	76,382
Other Disciplines	5,799	4,330	3,833

Source: Commission on Higher Education and National Statistical Coordination Board

The Commission on Higher Education has come up with a list of centers of excellence (COEs) and centers of development (CODs). Table 1.6 below outlines the list of COEs and CODs per discipline. Some of these, such as the COEs and CODs for agriculture, forestry and fisheries, may be tapped to undertake studies to understand local climate impacts.

Table 1.6. List of centers of excellence and centers of development by discipline

Program	COD		COD Total	COE		COE Total	Grand Total
	Public	Private		Public	Private		
Accountancy Education	-	4	4	-	-	-	4
Agricultural Engineering	2	-	2	2	-	2	4
Agriculture	8	1	9	4	-	4	13
Biology	4	3	7	3	2	5	12
Business Administration Education	-	8	8	-	1	1	9
Ceramic Engineering	1	-	1	-	-	-	1
Chemical Engineering	-	7	7	-	-	-	7
Chemistry	1	-	1	3	4	7	8
Civil Engineering	1	10	11	-	-	-	11
Computer Engineering	-	10	10	-	-	-	10
Criminology	-	4	4	-	3	3	7
Electrical Engineering	1	8	9	-	-	-	9
Electronics & Communication Eng'g	-	6	6	-	-	-	6
Entrepreneurship Education	-	2	2	-	1	1	3
Environmental Science	1	1	2	-	-	-	2
Fisheries	1	-	1	1	-	1	2
Forestry	-	-	-	3	-	3	3
Geology	-	-	-	1	-	1	1
Hotel & Restaurant Management	-	1	1	-	-	-	1
Industrial Engineering	-	6	6	-	-	-	6
Information Technology	3	28	31	3	6	9	40
Marine Science	2	-	2	1	-	1	3
Mathematics	4	-	4	3	2	5	9
Mechanical Engineering	-	6	6	-	-	-	6
Medicine	-	-	-	1	1	2	2
Molecular Biology	-	-	-	1	-	1	1
Nursing	-	3	3	2	4	6	9
Optometry	-	1	1	-	-	-	1
Pharmacy Education	-	1	1	-	-	-	1
Physical Therapy	-	1	1	-	-	-	1
Physics	1	1	2	1	2	3	5
Sanitary Engineering	-	1	1	-	-	-	1
Statistics	1	-	1	1	-	1	2
Teacher Education	5	7	12	10	21	31	43
Veterinary Medicine	1	-	1	4	-	4	5
TOTAL	37	120	157	44	47	91	248

Source: Commission on Higher Education

The Department of Education (DepEd) and Commission on Higher Education (CHED) are currently working on integrating climate change into the school curriculum. This is one of the activities outlined under the National Climate Change Action Plan for 2011-2028.

Through the Department of Science and Technology (DOST), the government adopted a seven-point agenda for science and technology (S&T) development in 2006. The agenda covers: (a) five priority research and development (R&D) areas; (b) technology transfer; (c) high-impact programs in the regions; (d) development of S&T human resources; (e) boosting innovation capacity; (f) upgrading of S&T facilities; and (g) policy development and advocacy.

Research and development and technology transfer activities focus on five areas identified to have the highest potential impact on poverty alleviation and the attainment of the Millennium Development Goals (MDGs). These are biotechnology, information and communication technology (ICT), environment, alternative energy, and health/medicinal products. In 2007, the DOST allocated PhP590.4M to R&D projects covering these areas.

Summary

Studies of recent historical records show that signals of a changing climate are already evident in the Philippines.

- The annual average mean temperature has risen by 0.62°C during the last 56 years.
- From 1960 to 2003, significant increases in the number of hot days and warm nights in many areas of the country have been noted while the number of cool days and cold nights has been generally decreasing.
- The amount and intensity of rainfall were observed to have increased in some parts of the country.
- The trend in the five-year running average of tropical cyclones that are greater than 150 kph is on the rise and found to be more during El Nino events.

The agriculture sector, coastal resources, water and health sectors have current issues and concerns that may be aggravated by climate change. All these issues contribute to the inherent vulnerabilities of the population, especially the poor, reducing their capacities to cope and adapt. The performance of the agriculture sector in terms of production has been hampered considerably by the unusual weather conditions and climate-related phenomena. This has affected the country's GDP negatively, but the bigger impact is on the lives of the farmer communities whose livelihood and sometimes even survival depend largely on the produce of the land.

The same is true with coastal communities not only whose livelihood is threatened but also their home and property. These communities are most vulnerable to the havoc inflicted by the large amounts of rainfall, strong winds and typhoons, unpredictable wind patterns, and rising sea levels that are the most characteristic of climate change.

It is also important to look at the implications to the energy sector, particularly the unbridled use of greenhouse gas-emitting fossil fuels, which has risen tremendously with the rapid urbanization of the country in recent years. The energy sector also has its vulnerabilities to climate impacts, particularly as the Philippines has been using renewable energy sources such as hydropower.

Photo by CAD

Chapter 2: Greenhouse Gas Inventory

Overview

A national inventory of greenhouse gas (GHG) emissions is a key component of the country's National Communication to the United Nations Framework Convention on Climate Change (UNFCCC). The GHG inventory presents the contributions of five key sectors to the greenhouse gases generated by the country. These key sectors are: (1) energy; (2) industry; (3) agriculture; (4) land use change and forestry (LUCF); and (5) waste. This inventory also serves as a guide to lawmakers in crafting appropriate adaptation, mitigation, and communication policies and strategies to reduce greenhouse gas emissions and address climate change.

This chapter provides a comprehensive account of the Philippines' GHG emissions for the year 2000. These consist of several gases that are the byproducts of human and industrial activities. Of these, carbon dioxide is the most predominant, accounting for the bulk of GHG emissions in the country.

The 2000 emission values are also compared with the 1994 values reported in the Initial National Communication (INC). And finally, based on the previous experiences of the different sectors in measuring GHG emissions, a proposal is presented for the institutionalization of a national GHG inventory.

2.1 Greenhouse Gas Inventory in 2000

The Philippines used the 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines in conducting the inventory of its GHG emissions, and the 2006 specific guidelines for the waste sector and solid waste subsector. The baseline for the SNC was the year 2000.

The data needed for the inventory are the activity data and the emission factors. Activity data are derived from the weight of any human activity that leads to the emission or removal of GHGs during a specified period. The specialized data sources include national statistics, government agencies, and also the private sector. Most of the emission factors for this inventory were IPCC default values while some are already country-specific, which came from various sources.

In the process of compiling the 2000 GHG inventory, the method used was documented and written in manual form, to serve as a step-by-step guide for each sector. Instructions on how to use the IPCC inventory software were provided and the types of data to enter in the appropriate sections were explained.

The recipe manual per sector, accompanied by a reference manual, is appended to the GHG inventory report. This was used in the training workshops for government agencies and other relevant stakeholders that were conducted per sector. This is an important step in providing greater transparency in the compilation of the national GHG inventory, as well as an effective strategy to broaden expertise in this area in the Philippines.

2.2 Summary of GHG Emissions in 2000

Based on the inventory conducted for the different sectors, the Philippines emitted a total of 21,767 Gg of CO_2e of GHGs in the year 2000, net of sequestered carbon by LUCF (Figure 2.1).

Figure 2.1. The Philippine forests are a significant carbon sink

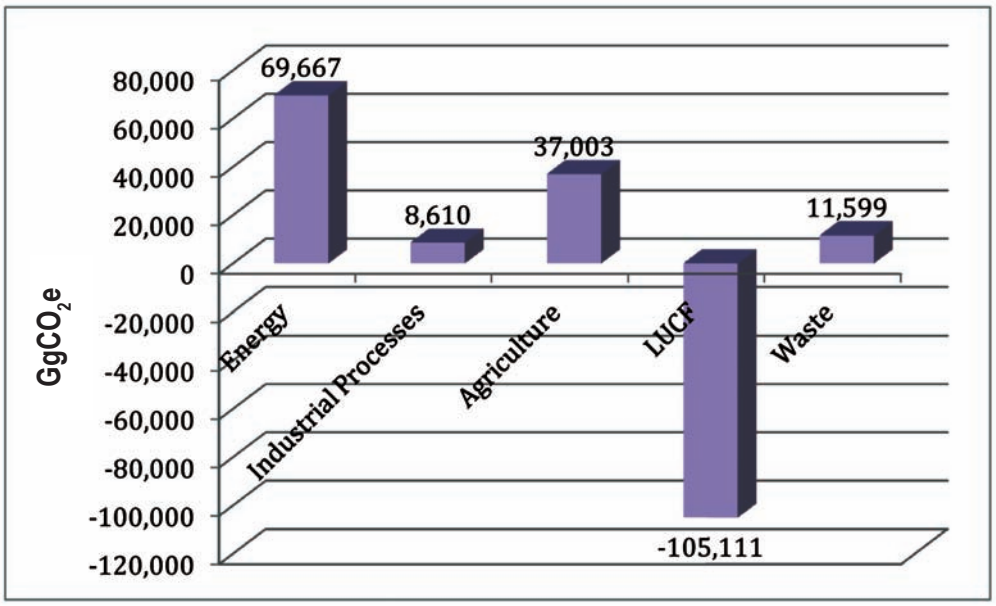
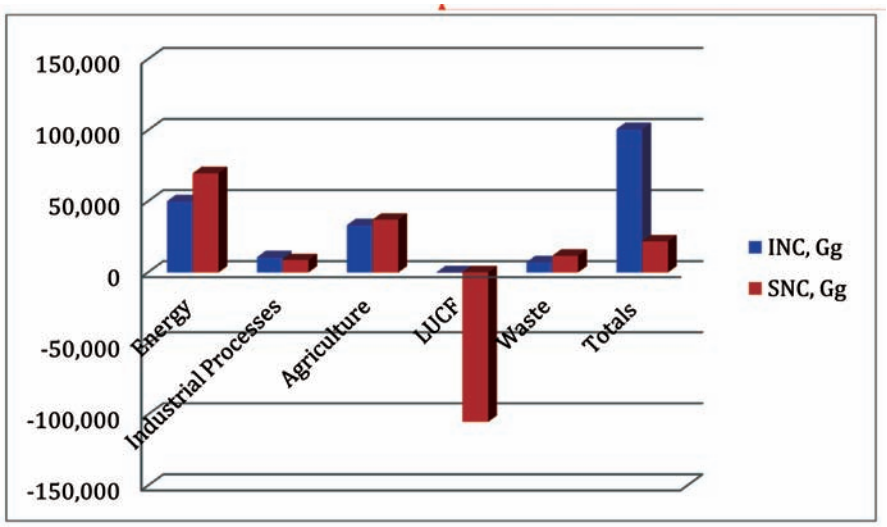


Table 2.1. Overall 2000 GHG emission per sector (in Gg CO_2 e)

Sector	CO_2, Gg	CH_4, Gg	N_2O, Gg	*CO_2e 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
Totals	**(32, 936.45)**	**1, 968.56**	**43.11**	**21, 767.41**

CH_4 GW Potential = 21; N_2O GW Potential = 310; * = CO_2+(CH_4*21)+(N_2O*310)

Figure 2.2. INC vs SNC emissions (in Gg CO_2e)

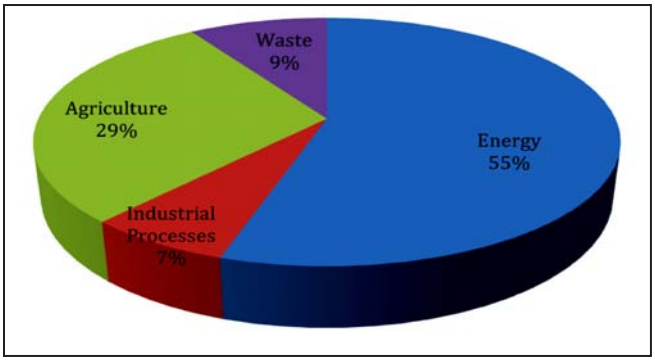


The GHG emissions for the year 2000 would appear to have decreased by 78% from the 1994 inventory. However, this is mainly due to the adjustment in the amount of emissions sequestered by the LUCF sector.[1] [2]Figure 2.2 and Table 2.2 show the comparison between the INC (1994) and SNC (2000) GHG emissions.

Table 2.2. INC vs SNC Emissions (in Gg CO_2e)

Sectors	INC, Gg	SNC, Gg	Change, Gg
Energy	50,038	69,667	19,629
Industrial Processes	10,603	8,610	(1,993)
Agriculture	33,130	37,003	3,873
LUCF	(126)	(105,111)	
Waste	7,094	11,599	4,505
Totals	**100,739**	**21,767**	**(78, 972)**

Figure 2.3. Overall contribution to 2000 GHG emissions by non-LUCF sectors



Non-LUCF sectors emitted 126,879 Gg CO_2e. Figure 2.3 shows the percentage contribution of each sector.

Table 2.3. Overall contribution to 2000 GHG emissions by non-LUCF sectors

	a	b	c	d	e	f	g
Sector	**CO_2 (in Gg)**	**CH_4 (in Gg)**	**CH_4 GW Potential**	**N_2O (in Gg)**	**N_2O GW Potential**	**CO_2-eq Emission (in Gg) a+(b*c)+(d*c)**	**Percent Share (in %)**
Energy	62,499.10	304.14	21	2.52	310	69,667.24	55
Industrial Processes	8,604.74	0.24	21	-	-	8,609.78	7
Agriculture	-	1,209.79	21	37.41	310	37,002.69	29
Waste	-	500.67	21	3.50	310	11,599.07	9
Totals	**71,103.84**	**2,014.84**		**43.43**		**126,878.78**	**100**

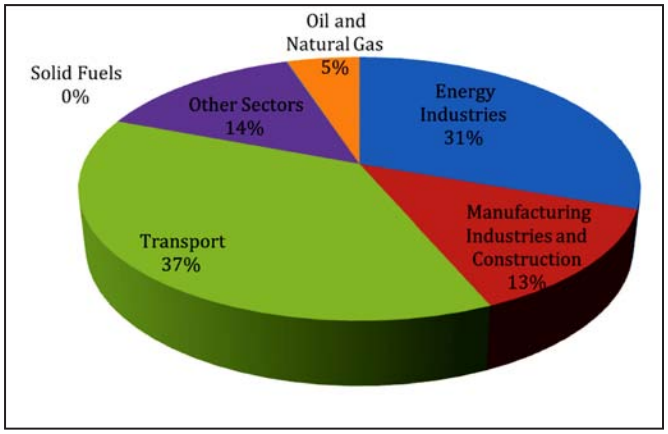
[1]To a large extent, this is due to the change in definition of forests, and availability of data. This would require a recomputation of the GHG for the INC to meaningfully compare the INC with the SNC.

2.3 GHG Emissions in 2000 by Sector

2.3.1 Energy Sector

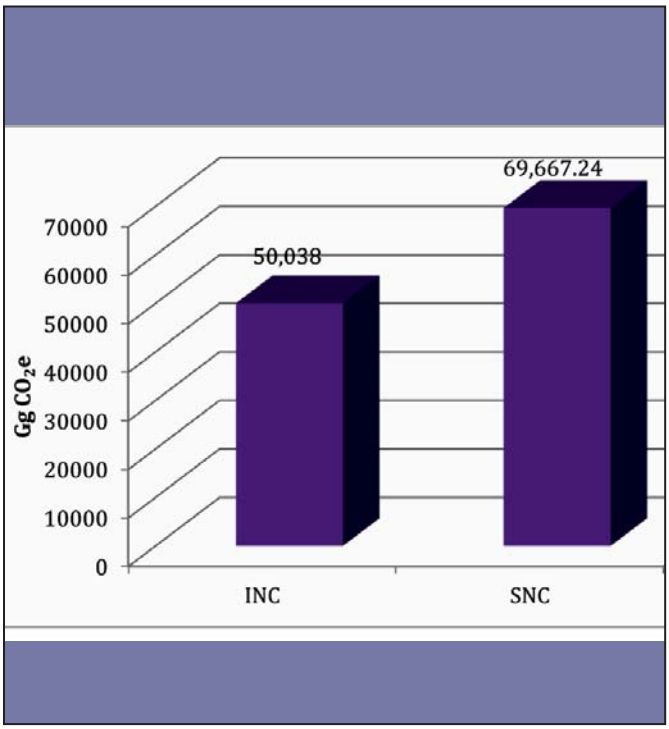
In 2000, the energy sector released 69,667 Gg CO_2e. As illustrated in Figure 2.4, the transport subsector contributed 25,936 Gg CO_2e (37%), followed by the energy industries with 21,220 Gg CO_2e (31%). The rest of the subsectors combined contributed 22,512 Gg CO_2e (32%).

Figure 2.4. Percent contribution of each energy subsector to 2000 GHG emissions



Since different energy subsector categories were used in the INC and SNC, it is not possible to do a comparative analysis based on subsectors. However, a 39% increase was observed in the total emissions, from 50,038 Gg CO_2e in 1994 to 69,667 Gg of CO_2e emissions in 2000, as shown in Figure 2.5.

Figure 2.5. INC vs. SNC comparison of GHG emissions from energy sector



2.3.2 Industry Sector

The industry sector emitted 8,609.78 Gg of CO_2e in 2000. Emissions from imported halocarbons, estimated at 560 Gg CO_2e, were excluded. Figure 2.6 and Table 2.5 show that 92% or 7,911.74 Gg came from total mineral production and use, with cement and lime production as the largest contributor. Emissions from metal production and the chemical industry accounted for 7% and 1%, respectively.

Table 2.4. Year 2000 emissions from the energy sector

	a	b	c	d	e	f	g
Sector	**CO_2 (in Gg)**	**CH_4 (in Gg)**	**CH_4 GW Potential**	**N_2O (in Gg)**	**N_2O GW Potential**	**CO_2-eq Emission (in Gg) a+(b*c)+(d*c)**	**Percent Share (in %)**
Energy Industries	21,127.35	0.40	21	0.27	310	21,219.45	30
Manufacturing Industries & Construction	9,015.30	1.91	21	0.28	310	9,142.21	13
Transport	25,792.03	3.45	21	0.23	310	25,935.78	37
Other Sectors	6,564.42	130.29	21	1.74	310	9,839.91	14
Solid Fuels		1.60	21			33.60	0
Oil & Natural Gas		166.49	21			3,496.29	5
Totals	**62,499.10**	**304.14**		**2.52**		**69,667.24**	**100**

Figure 2.6. Percent contribution to 2000 GHG emissions of industrial processes (excluding halocarbons)

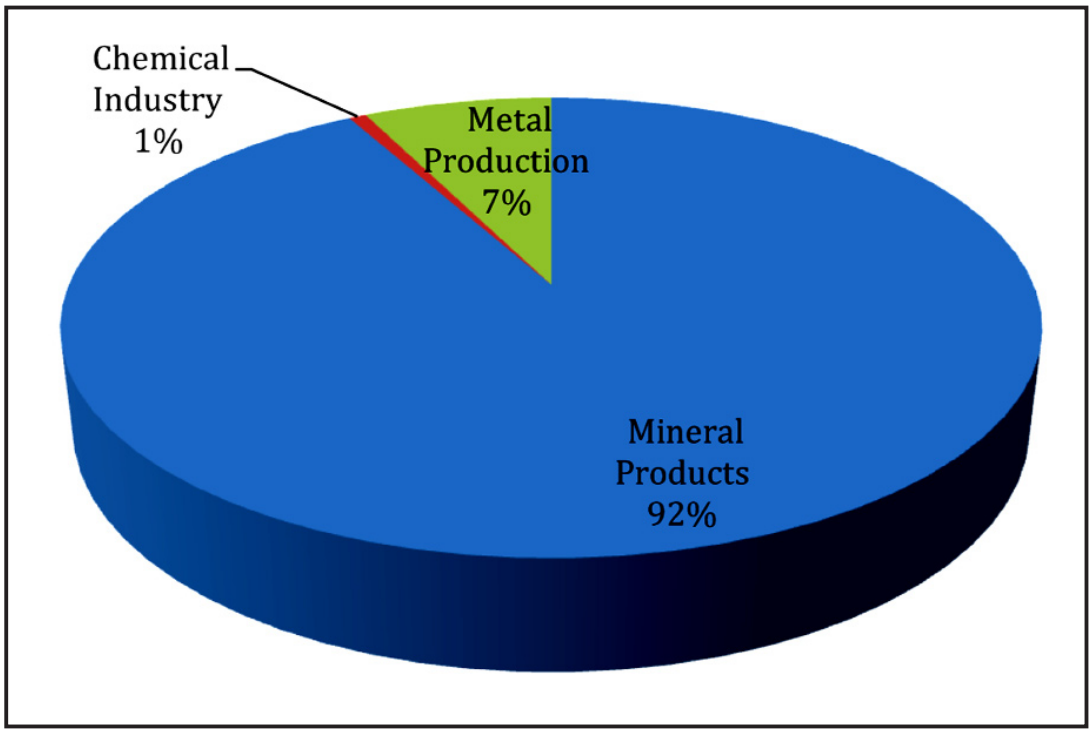
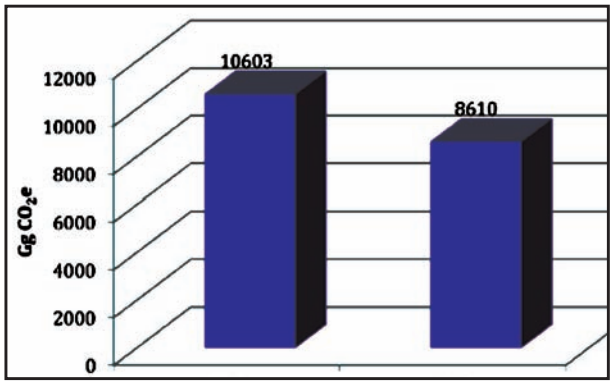


Table 2.5. Year 2000 emissions from industrial processes sector

Subsector	a	b	c	d	e	f	g
	CO_2 (in Gg)	CH_4 (in Gg)	CH_4 GW Potential	N_2O (in Gg)	N_2O GW Potential	CO_2-eq Emission (in Gg)	Percent Share (in %)
						a+(b*c)+(d*e)	
Mineral Products	7,911.74					7,911.74	92
Chemical Industry	54.00	0.24	21			59.04	1
Metal Production	639.00					639.00	7
Total	**8,604.74**	**0.24**				**8,609.78**	**100**

Overall, the total CO_2 emissions in 2000 were reduced by 19% compared to 1994, from 10,603 Gg to 8,610 Gg, as shown in Figure 2.7. The decrease is mainly due to the decrease in CO_2 emissions from metal production.

Figure 2.7. INC vs SNC GHG emissions from industry sector



2.3.3 Agriculture Sector

The agriculture sector emitted 37,003 Gg CO_2e. As illustrated in Figure 2.8 and Table 2.6, the significant sources of the emissions are rice cultivation with 16,437 Gg CO_2e (44%) and agricultural soils with 8,931 Gg CO_2e (24%). Enteric fermentation accounted for 6,604 Gg CO_2e (18%), while manure management and field burning of agricultural residues contributed 4,313 Gg CO_2e (12%) and 699 Gg CO_2e (2%), respectively, to the sector.

The total emissions in 2000 were 12% higher than the emissions in 1994. The estimates rose from of 33,130 Gg CO_2e to 37,003 Gg CO_2e, as seen in Figure 2.9 and Table 2.6.

Figure 2.8. Percent contribution to 2000 GHG emissions per agriculture subsector

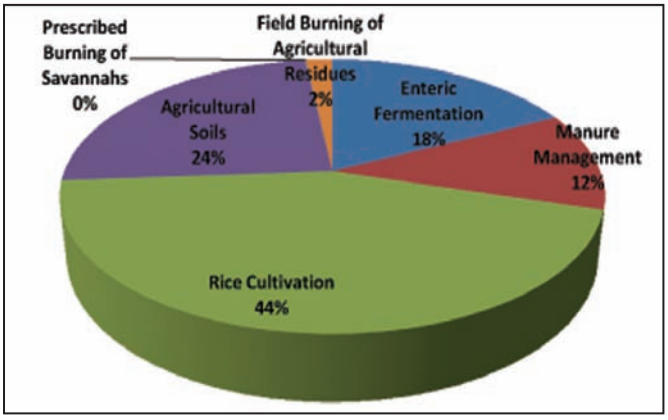
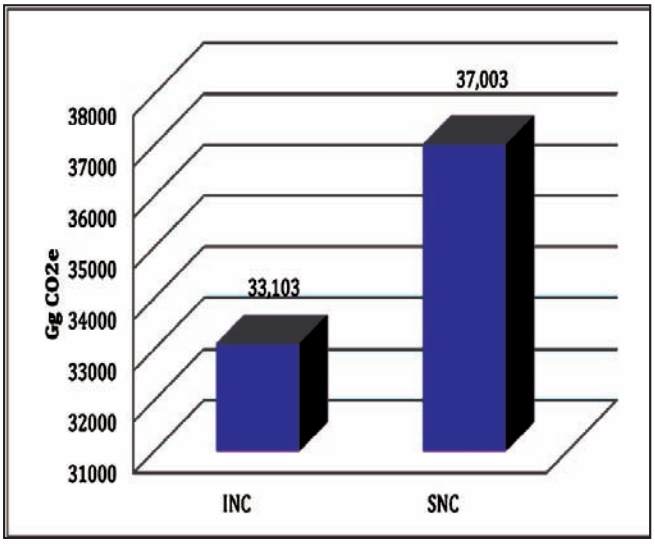


Table 2.6. Year 2000 emissions from the agriculture sector

	a	b	c	d	e	f	g
Subsector	**CO_2 (in Gg)**	**CH_4 (in Gg)**	**CH_4 GW Potential**	**N_2O (in Gg)**	**N_2O GW Potential**	**CO_2-eq Emission (in Gg) a+(b*c)+(d*e)**	**Percent Share (in %)**
Enteric Fermentation		314.50	21			6,604.50	18
Manure Management		87.43	21	7.99	310	4,312.93	12
Rice Cultivation		782.71	21			16,436.91	44
Agricultural Soils				28.81	310	8,931.10	24
Prescribed Burning of Savannahs		0.73	21	0.01	310	18.43	0
Field Burning of Agricultural Residues		24.42	21	0.60	310	698.82	2
Total		**1,209.79**		**37.41**		**37,002.69**	**100**

Figure 2.9. INC vs SNC GHG emissions of the agriculture sector



2.3.4 Land Use Change and Forestry Sector

The 2000 GHG inventory showed that the LUCF sector is a significant carbon sink, removing some 105,111 Gg CO_2e from the atmosphere, as illustrated in Figure 2.10 and Table 2.7.

Figure 2.10. 2000 emissions from the LUCF sector

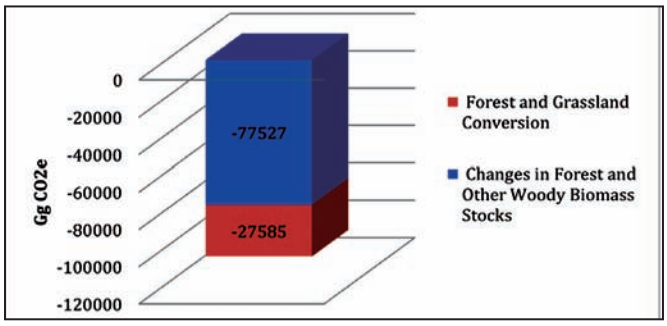


Table 2.7. Year 2000 emissions and sinks from the land use change and forestry sector

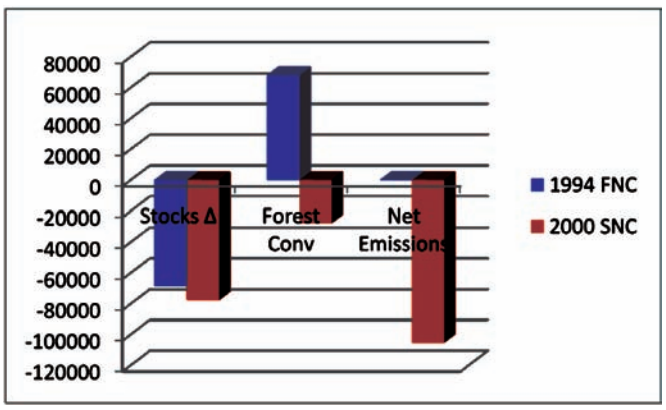
	a	b	c	d	e	f
Subsector	**CO_2 (in Gg)**	**CH_4 (in Gg)**	**CH_4 GW Potential**	**N_2O (in Gg)**	**N_2O GW Potential**	**CO_2-eq Emission (in Gg) a+(b*c)+(d*e)**
Changes in Forest and Other Woody Biomass Stocks	(77,526.65)					(77,526.65)
Forest and Grassland Conversion	(26,513.64)	(46.28)	21	(0.32)	310	(27,584.72)
Total	**(104,040.29)**	**(46.28)**		**(0.32)**		**(105,111.37)**

From an insignificant sink of carbon in 1994, the LUCF sector became a huge sink of carbon in 2000 (Figure 2.11). Based on the 1994 and 2000 inventories, the LUCF sector sequestered 126 Gg of CO_2 and 105,111 Gg of CO_2, respectively.

The big difference in the performance of the LUCF sector as a carbon sink between 1994 and 2000 is mainly due to the shift in the definition of forests used in the computations. There were a number of errors in the 1994 GHG inventory that necessitated the change, including: (1) inability to account for millions of hectares of upland farms, tree plantations and grasslands, mainly due to lack of data at that time; (2) different assumption used in calculating forest and grassland conversion; and (3) very low biomass density for grassland. In order to get a more analytical comparison between the 1994 and 2000 emissions, it is recommended that the INC figures be recalculated using the assumptions used in SNC.

Nonetheless, part of the difference could be due to an actual improvement, considering that a total log ban policy was issued by the DENR in the 1990s and reforestation efforts were undertaken to put a halt to the massive loss of forests in the country.

Figure 2.11. Comparison between 1994 and 2000 GHG emissions in the LUCF sector



2.3.5 Waste Sector

Solid wastes, industrial and domestic wastewater, and human sewage are the sources of greenhouse gas emissions for the waste sector. For the year 2000, the waste sector released 11,599 Gg of CO_2e to the atmosphere. Approximately 47% of the total emissions came from solid waste which generated 5,447 Gg CO_2e. As in the Initial National Communication, this amount only accounted for the wastes that were brought to the solid waste disposal sites. Municipal and industrial wastewater and human sewage were considered to be under the sector of wastewater handling, which collectively accounted for 6,152 Gg CO_2e or 53% of the emissions.

Figure 2.12. 2000 emissions from the waste sector

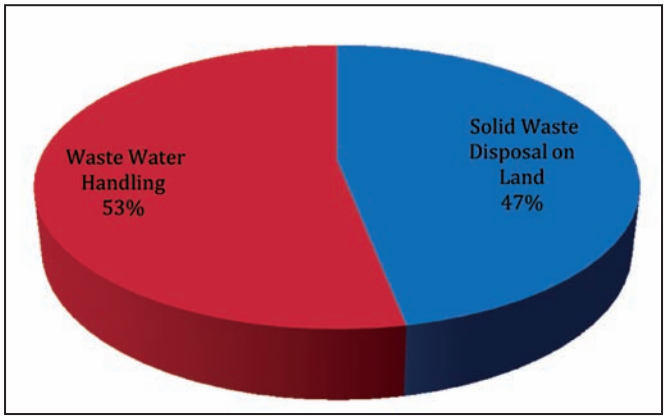
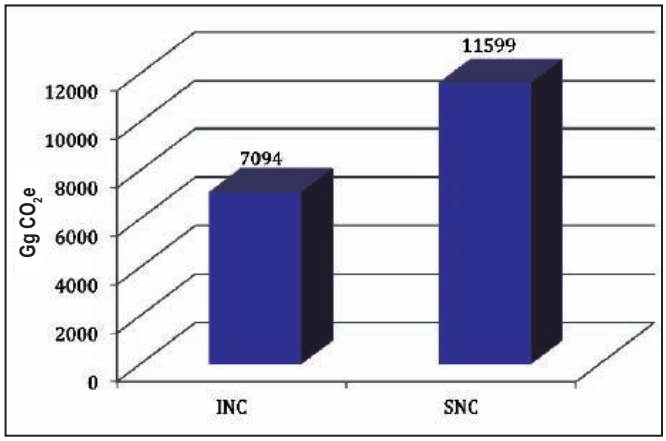


Figure 2.13. INC vs SNC GHG emissions from waste sector

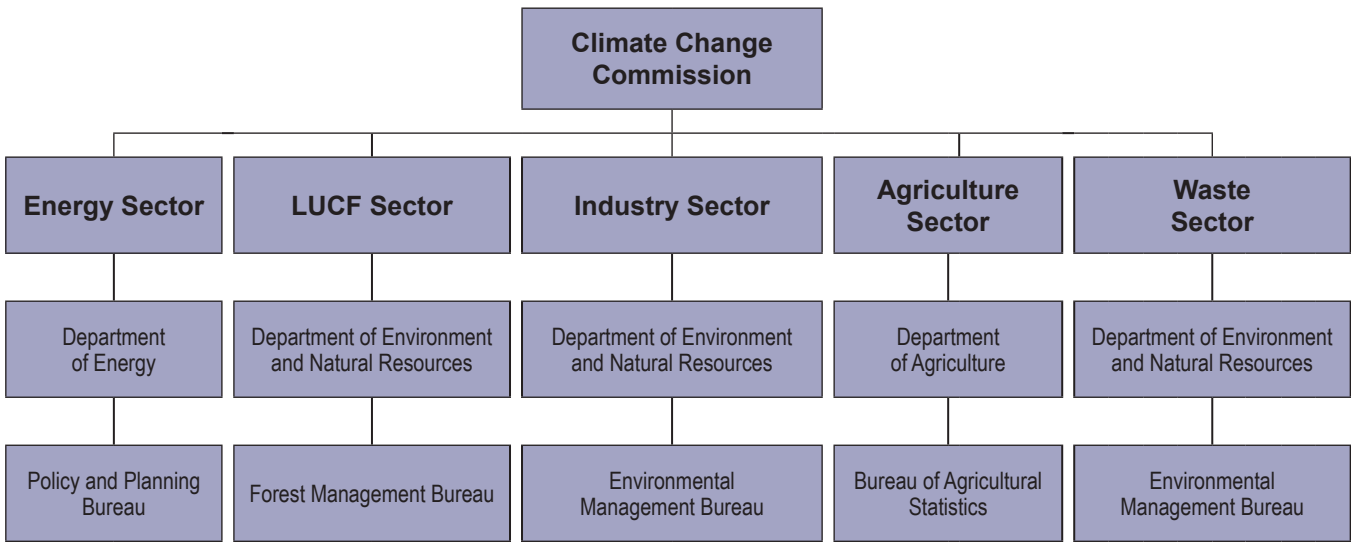


Year 2000 emissions from the waste sector represented a 64% increase compared to the 1994 emissions, as shown in Figure 2.13. The estimates increased from 7,094 Gg to 11,599 Gg of CO_2e. It should be noted that the emissions from solid waste were computed differently in the INC and SNC. In the INC, the mass balance approach was used, which assumes that GHG is released at the same time that the waste is deposited and that they are emitted at a constant rate. In the SNC, the first order decay method was used, which assumes that the rate of decomposition and emission of GHG is proportional to the amount of waste in the landfill. Thus, it is necessary to do a recomputation of the INC using the SNC methodology.

Many of the sector agencies and offices concerned with climate change in the Philippines already have individuals equipped with the skills to perform a GHG inventory, as well as the needed tools and techniques to calculate GHG emissions. However, to carry out a regular, sustainable and wide-scale GHG inventory process, individual agency capacities need to be mobilized and systematized for a consolidated national output. The regular compilation of the national GHG inventory requires coordinated action, appropriate standardized tools and techniques, and the support of all institutions concerned.

Based on the individual sectors' experiences with the process of gathering and compiling GHG data, the following structure for the institutionalization of the national GHG inventory has been proposed. The Climate Change Commission will be the main compiler of the inventory. It will coordinate and guide the GHG data gathering activities of the different sectors, provide capacity building where needed, prescribe the instruments and technologies to use, and finally, perform data assessment and overall compilation of the inventory. The lead agencies, specifically the assigned bureau in the department, will oversee the conduct of the GHG inventory process within their respective sectors.

The following flowchart presents the proposed institutional structure for the national GHG inventory.



Chapter 3: Vulnerability and Adaptation Assessment

Overview

The Vulnerability and Adaptation (V&A) Assessment part of the Second National Communication provides valuable information for mainstreaming climate change adaptation into national policy and planning. Important economic sectors included in the assessment are: (1) agriculture and food; (2) watersheds covering forestry, biodiversity, and water resources; (3) coastal and marine resources; and (4) human health. The methods and tools developed for the V&A assessment were used in three pilot provincial sites: Albay, Bohol and Surigao del Norte.

Climate change is both an environmental problem and a developmental issue. The changes in the regional climate have affected not only the biophysical systems but also the social and economic systems. Sea level rise and increased weather variability could increase water stress, alter the growing seasons, flood crop fields and settlements, and increase the occurrence of waterborne diseases such as dengue and leptospirosis. Given the lack of resources and inadequate access to technology and finances, the Philippines has a limited capacity to develop and adopt strategies that reduce the country's vulnerability to the changes in climate.

3.1 Vulnerabilities

As mentioned earlier in this report, the Philippines' vulnerability ranking has moved up from Number 12 to Number 3, indicating greater exposure of Filipino communities and the country's resources, both natural and manmade, to the risks created by climate change.

3.1.1 Agriculture and Food

The agriculture sector in the Philippines is highly dependent on a constant water supply and predictable growing seasons. Climate-related changes, such as increased tropical cyclone activity and associated storm surges, intense rain events, prolonged droughts, and resulting physical factors, such as nutrient-poor soils, disrupt farming activities and hamper agricultural production. Moreover, pest infestations, which tend to increase with weather variability, damage crops, especially in areas with little or no technology available.

3.1.2 Watersheds: Forestry, Biodiversity, and Water Resources

Major river basins in the Philippines are considered the lifeblood of the Philippine economy. However, because of pollution, unsustainable resource use, and the additional pressure brought on by climate change, these areas have become less viable as waterways and less resource-rich to contribute significantly to the vibrancy of development activities.

The rapidly growing upland population, which depends highly on the natural resource base for their survival and livelihood, puts additional pressure on watershed areas. About 75 million tons of soil in watershed areas are lost annually to erosion, affecting about 70% of the country's total area, especially surface water resources. Groundwater resources are diminishing, causing a 20-30% water reduction in irrigated areas and streams. Land productivity and the condition of microclimate habitats have also been rapidly deteriorating.

Water shortages are also intensifying during the dry season and are expected to increase in the future.[2] On the other hand, watershed disasters such as landslides and floods are rapidly increasing because of the increasing occurrence of heavy rainfall.[3] These events could potentially affect the biodiversity and overall productivity of watersheds.

3.1.3 Coastal and Marine Resources

Even without climate change, many parts of the Philippine coasts were already getting damaged and deteriorating due to natural causes or human-induced activities (Figure 3.1). Some examples are coastal erosion, bleaching of coral reefs, loss of sea grass and destruction of mangrove areas. These have downstream effects in terms of the coastal communities' livelihood, thus lowering also their adaptive capacity.

With the more frequent and stronger storm surges created by climate change, the coastal areas are in an even greater threat. Coastal erosion potential is enhanced, and communities will be affected by coastal floods. With sea level rise, there will be more salt water intrusion, affecting the groundwater sources of communities near the coast. Ocean acidification also occurs as a result of CO_2 sequestration.

[2]The island of Mindanao, for example, is expected to be generally drier, according to the country's climate scenarios for 2020 and 2050.

[3]Flooding and rain-induced landslides (RILs) have been occurring with alarming regularity – the Quezon tragedy of 2004, the Leyte RILs of 2005, and lately, the Metro Manila flashfloods of 2009, and the devastating floods and landslides in Cagayan de Oro and Iligan City in 2011.

Figure 3.1. Sea level rise, increase in carbon dioxide and climate impacts on coastal and marine environment

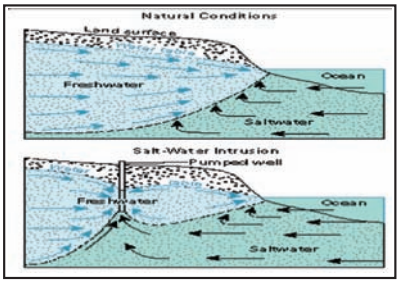
Coastal erosion

Coral bleaching

Destruction of mangroves

Storm surges/coastal floods

Ocean acidification due to increased CO_2



Salt water intrusion

3.1.4 Human Health

In the Philippines, the health sector's coping capacity has been largely dependent on the LGUs' ability to mobilize resources. The devolution of health services to LGUs has been in effect for more than a decade now but health responses vary widely depending on the level of commitment and political will of local chief executives and health managers.

Many local health systems have been coping in their own way oblivious to or unaware of climate change impacts. Provincial health offices have implemented some adaptive mechanisms to health problems during disasters or emergency situations, such as dengue fast lanes in hospitals, social health insurance funds, and house-to-house recording and case finding for malaria and TB, among others. Adaptive capacities are hard to establish but needs are reflected in such instruments as the DOH support for the Provincial Investments for Public Health (PIPH).

Infectious diseases that are climate-sensitive become vulnerabilities of a population that is threatened by the increasing frequency of extreme climate events. Non-communicable diseases can also affect vulnerability since they lower the resistance of the body to respond to the stresses brought about by changes in climate. An ADB study on the characteristics of notifiable diseases (e.g., malaria, dengue, diarrhea, cholera, etc.) showed a 10-58% association between health and climate variables. The study also revealed that non-infectious diseases, like cardiovascular and respiratory problems, are also affected by climate changes, variability and extremes. Climate change may also have something to do with the increased incidence of shellfish poisoning and other health emergencies caused by unhealthy environments.[4]

New diseases have surfaced in the country over the past decade. Notable among these are the AH1N1 Influenza strain (swine flu), which has become a pandemic, and severe acute respiratory syndrome (SARS). Other diseases have reemerged or have become harder to treat. For example, treatment protocols for malaria and tuberculosis now require multiple drugs. This has posed vulnerabilities in terms of the possibility of drug reactions and added strain on the budget.

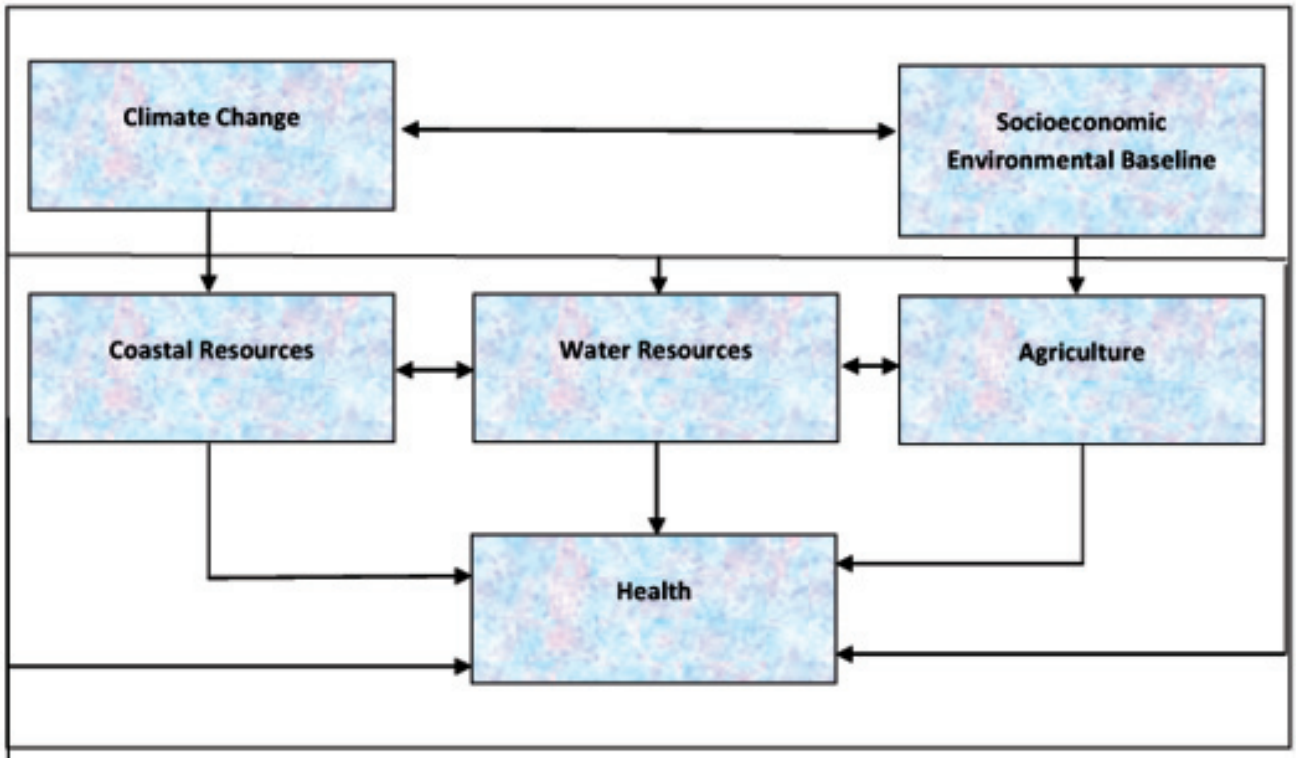
The health infrastructure in the Philippines is also challenged. Physical infrastructure were built without provisions for climate-proofing or adapting to extreme climate events. While the Health Emergency Management Services (HEMS), a DOH bureau, has provided for health disaster response mechanisms in communities and major health facilities, responses specific to the impact of climate change have not been instituted. As noted earlier, climate has both direct and indirect impact on health, particularly on the infectious disease pathway.

[4]Perez, Rosa. ADB Climate Change Assessment, 2008.

3.1.5 Cross-Sector Vulnerabilities

Cross-sector integration links two or more related sectors, models relationships, and aids in the understanding of the cross-sectoral implications of climate change. Figure 3.2 provides a schematic overview of the cross-sectoral relationships among sectors that are being assessed.

Figure 3.2. Simple schematic diagram of qualitative cross-sectoral relationships



3.2 Adaptation

3.2.1 Agriculture and Food Security Sector

Listed below are adaptation strategies that are currently being implemented to reduce the vulnerability of rice production to extreme climate events:

- Utilization of aerobic rice varieties that are resistant to drought and submergence, and saline-tolerant.
- Improvement of irrigation through: rehabilitation, restoration and repair of existing irrigation systems; improved water management using controlled irrigation technology; alternate wetting and drying (AWD); planting of trees in priority critical watersheds of existing irrigation systems/ facilities; construction of adequate drainage systems in irrigated areas; provision of shallow-tube wells; construction of reuse facilities in irrigated areas; and intensification of establishments and rainwater-harvesting structures.
- Enhancement of the technological improvement and support services.
- Fertilization strategy that promotes organic agriculture while reducing the use of inorganic fertilizer (Balanced Fertilization Technology).
- Improvement and provision of seeds.
- Initiatives that increase awareness on and promote advocacy for climate change adaptation.
- Loans and credit that will ensure crop insurance and minimize risks and losses in crop production.
- Use of dryers and other post-harvest facilities that will minimize losses and handle production surplus.

A number of other initiatives have been taken by government and the private sector to address the impacts of climate change, both in the medium term and long term. (Tables 3.1 and 3.2)

Table 3.1. Government-initiated programs and projects to address the impacts of climate change
Adaptation options
Review of programs currently being implemented vis-à-vis climate change risks (medium term only)
Mainstreaming climate change in plans/programs
Review of subsidies such as fertilizers, seeds, etc.
Modifying subsidies, if necessary, and support services to influence farm level practices
Establishment/support of risk-transfer mechanisms (weather-based insurance)
Fund research and development of technologies
Establishment/enhancement of post-harvest facilities
Enhancement of the implementation of the agrarian reform program for marginalized farmers
Technologies
Development of crop varieties that increase tolerance and suitability
GIS-based mapping of climate, soil and water resources for crop/variety matching
Water management innovations, including efficient and effective irrigation technologies
Decision support tools such as weather/climate forecast/information
Farmers' field schools/demonstration farms
Farm production/management practices
Crop diversification (vertical/horizontal)
Adoption of organic farming
Community-based seed production
Sustainable rice intensification
Rainwater collection for irrigation
Change in timing/calendar of farming activities to fit observed changes (growing seasons/local climates)
Implementation of selective irrigation practices
Alternative practices found to be unsustainable

Table 3.2. Private-led interventions to address the impacts of climate change
Adaptation options
Behavioral changes
Change in consumption patterns
Farm financial management
Diversification of livelihoods to augment family income
Establishment of cooperatives to lower costs of production inputs and develop marketing strategies
Empowerment of women in farm management

Following are some of the technologies that have been introduced and adopted to help farmers cope with the conditions brought about by climate change.

communities' capacity to adapt to climate change will also be enhanced through the creation of favorable financing mechanisms. In addition, the employment of

Table 3.3. Technologies that have been adopted to cope with the impact of climate change

Technology	Description
Palay Check	Integrated rice crop management system which helps farmers to manage rice crops according to targets (right timing, synchronous planting, etc.) to avoid overlapping of insects and disease
Leaf Color Chart (LCC)	A tool to help farmers manage nitrogen fertilizer input
Palayamanan	A system which allows farmers to venture into vegetables, fish and livestock production to complement income from rice
Alternate Wetting and Drying (AWD)	Controlled irrigation depending on the water needs of the crop during its different stages
Site-Specific Nutrient Management (SSNM)	Management tool that allows farmer to "feed" rice with nutrients as and when needed
Farmers' Field School (FFS)	An extension service to provide farmers information/advice on the various technologies and how to use climate forecasts in farm management
Aerobic Rice	Technology which: uses inbred and early maturing rice line, direct or furrow-seeded on unflooded field; requires less labor, less water and less farm inputs (less production costs); is more tolerant to weeds and pests; and allows for two rice crops per year with as much as 7t/ha yield
GIS Mapping Technology	A tool to identify drought-prone areas for determining crops that can be planted in these areas to optimize land use
Low-Intensity Farm Mechanization	Use of a drum seeder (low seeding rate) using only 51 kgs of seeds to plant a hectare
Nutrient Farming Approach	An integrated farming system that allows for no chemical fertilizers and pesticides with two cropping seasons for upland rice with 3.25 t/ha yield
Controlled Irrigation Technology	Technology which gives a 16-35% reduction in water use without reducing yields

3.2.2 Watersheds: Forestry, Biodiversity and Water Resources

A current project of national importance, which rehabilitates degraded areas within watersheds through the planting of trees, includes strategic environmental assessment, climate change implications, associated adaptation measures, and other aspects relating to an enabling policy and institutional environment.

The preliminary accomplishments of the project include: reforestation, application of assisted natural regeneration, agro-forestry farms, bamboo planting, rattan enrichment, mangrove rehabilitation, and seedling production. All these accomplishments will, in the long run, contribute to lessening the vulnerability of the watersheds to climate change. Through this project, the the community members will help them cope with the adverse effects of climate change.

Figure 3.3 shows the general trend in forest devolution in the Philippines. A historical review of the Community-Based Forestry Management (CBFM) program reveals that its evolution is shaped by the different policies and practices of key players. The figure shows that the government has vigorously pursued the involvement of the local communities and allocation of suitable portions of forestlands for local control by the communities. This move is supported by the various policies and operational guidelines that have been issued by the DENR. Still, after more than 35 years, the journey to meaningful involvement in forestry development of the millions of forest-dependent communities is still a work in progress.

Figure 3.3. General trend in forest devolution in the Philippines

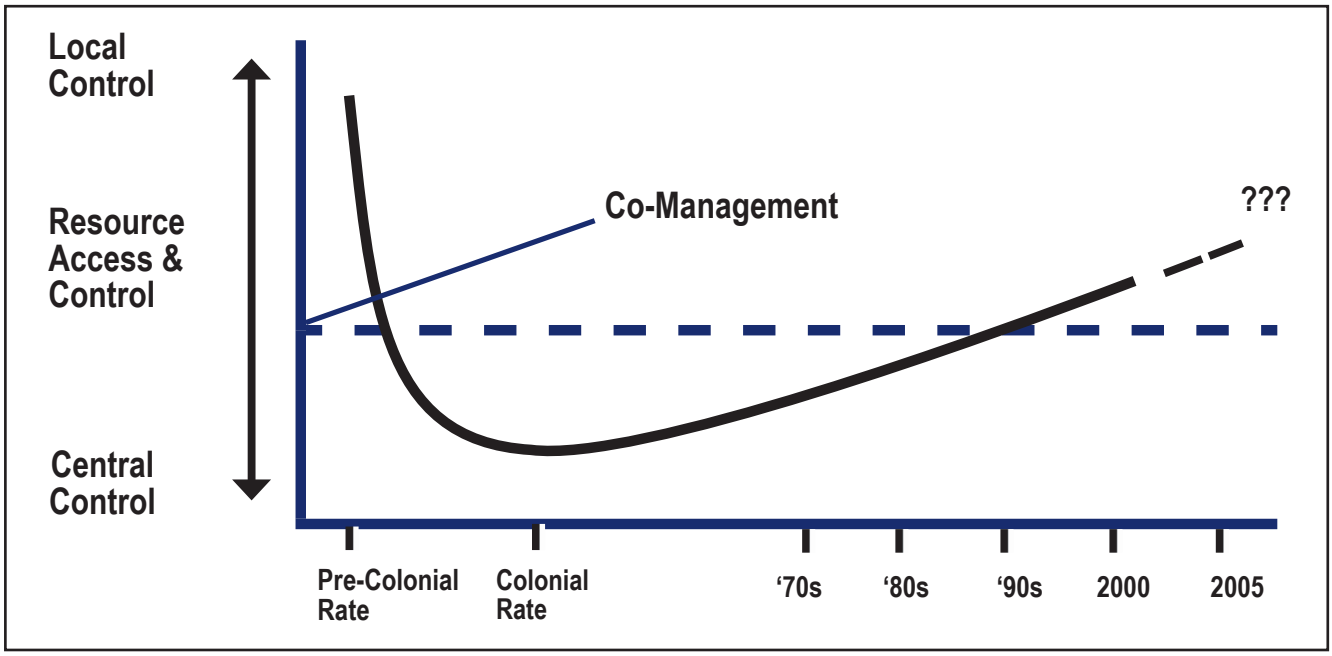
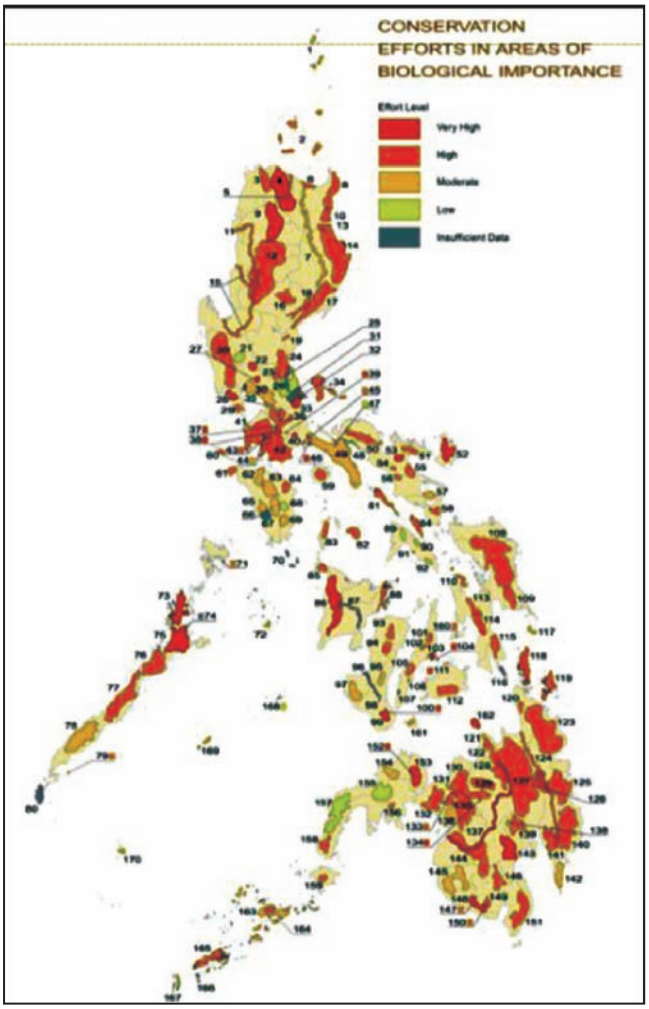


Figure 3.4. Conservation efforts in areas of biological importance in the Philippines



Aside from the regular DENR reforestation projects, there are also other government agencies involved in reforestation activities. These include the National Irrigation Administration (NIA), National Power Corporation (NPC), and the Philippine National Oil Company (PNOC), among others. These agencies, by virtue of legal arrangement with government, undertake or oversee reforestation activities in watersheds under their jurisdiction. The Department of Finance (DOF) also undertakes some reforestation activities in partnership with LGUs through its Community-Based Natural Resources Management Project supported by the World Bank.

Through the Local Government Code, the LGUs are mandated to implement reforestation and related forestry projects in partnership with the DENR and local communities. Among the most successful LGU reforestation initiatives are those conducted by the provinces of Nueva Vizcaya, Bukidnon and Bohol.

The Philippines, because of its rich forest resources and diverse flora and fauna, has been categorized by Conservation International (CI) as one of the world's megadiverse countries. Around 203 protected areas have been established in different parts of the country since 1920. The establishment of protected areas continues at present as more and more areas are prioritized for biodiversity conservation. In areas where the conservation activities of the LGUs and other sectors are still low, efforts are expected to double in the next few years (Figure 3.4).

One of the major impacts of climate change is the change in the temporal and spatial distribution of precipitation and temperature. The resulting runoff or hydrological resource may be shifted in time and space. This means that extremely high or low temperatures or heavy rains or drought may be experienced in places and at times of the year where and when they were not normally experienced before. A change in the distribution with respect to time and space of runoff could greatly affect the effectiveness of existing systems. Adaptation measures in the water resources sector, in this context, could be divided into two major classes (Table 3.4).

Institutional efforts in order to adapt to climate-related impacts in both agriculture and water requirements of the sectors include: (1) Establishment of small impounding systems such as small water impounding project (SWIP) diversion dams, shallow tube well small farm (BSWM, 2000); (2) promotion of soil and water conservation (BSWM, 2000); and (3) inclusion in the Philippine Medium-Term Philippine Development Plan of a directional plan to guide all levels of governance in the implementation of integrated water resource management (IWRM) at all levels of the government (NWRB, 2008).

Table 3.4. Two major classes of adaptation measures in the water resources sector

Supply Adaptation	Demand Adaptation
Construction of new infrastructure	Conservation and improved efficiency
Modification of existing physical infrastructure	Technological change
Alternative management of the existing water supply systems	

Source: Philippines' Initial National Communication, 1999

Table 3.5. Measures to enhance the capacity of the coastal sector to adapt to climate change, variability and extremes

Adaptation Measures	Capacity-Enhancing Measures
• Modification of setback policies to address climate change/sea level rise • Conduct of research studies on salt water intrusion, fisheries and aquaculture • Strengthening of the Disaster Management Program • Improved typhoon warning system • Flood prevention/protection • Shoreline stabilization/ preparation of hazard and vulnerability maps to floods and to probable sea level rise • Stopping further conversion of mangroves into fishponds • Putting in place the Integrated Coastal Management (ICM) Program and expanding the Coastal Environment Program (CEP) • Massive upland and coastal reforestation, including the expansion of community-based mangrove reforestation program • Information, education and communication (IEC) and awareness-raising program • Monitoring sea level rise and climatological data: Tidal gauge stations (costly) vs. indigenous methods (staff gauges) • Installation of the Geographical Information System (GIS)	• People empowerment in the management of coastal resources • Inventory and survey of coastal resources • Provincial environment and natural resource accounting • Requiring industries to install desalination facilities for sea water, instead of groundwater withdrawal • Regulation of installation of water pumping systems • Expansion of artificial reefs, marine sanctuaries, and marine reserves • Strengthening of coordination between DENR and LGUs • Appropriate land use and zoning • Strict monitoring and enforcement of mining laws (sand and corals) and other coastal management policies, laws and regulations • Formulation of a comprehensive coastal development plan • Development/improvement of watershed management, including identification and development of potable water sources • Reactivation/reorientation of Environment and Natural Resources Committees (ENRCs) in the coastal municipalities • Implementation of a poverty alleviation program • Strengthening/enhancement of the integrated waste management program, including adoption of coastal cleanup movements • Provision of alternative livelihood and resettlement program

Source: Perez, 2002

3.2.3 Coastal and Marine Resources

A local adaptation planning exercise conducted in eight provinces in 1999 produced a list of adaptation measures and adaptive capacity-enhancing actions that are being used or contemplated for use by the local populations in the study sites at that time (Perez, 2002). These adaptation measures and capacity-enhancing actions, as highlighted in Table 3.5, enable the users to respond to climate change, variability and extremes in the coastal sector.

3.2.4 Human Health

As reported by the DOH (2008), climate change adaptation practices have been recommended for application in the health sector. These adaptive strategies may be divided into the following categories: (1) education and awareness; (2) surveillance, early alert systems and disease control; and (3) disaster preparedness and collaborative efforts with other agencies and health services groups. Details are given in Table 3.6.

Table 3.6. Climate change and health: Main types of adaptation strategies

Category	Specific Strategy
Education and awareness	Public information drive Conduct and coordination of capacity-building activities, such as training workshops and orientation seminars
Early alert systems	Heat waves Impending weather/climate extremes Infectious disease outbreaks
Indirect cause: Climate-sensitive infectious diseases (vector, waterborne)	NEC-consolidated database for epidemic-prone diseases National disease-specific program response, e.g., dengue, malaria, cholera National health advisory and alerts
Direct cause: Floods, storm surge	DOH Health Emergency Management Service Local: HEMS provincial counterparts
Disaster preparedness	Climate-proofed housing design Health system surge capacity Community-based neighborhood support
Enhanced infectious disease control programs	Vaccines, vector control, case detection and treatment
Improved surveillance	Risk indicators, e.g., mosquito numbers, aeroallergen concentration Health outcomes, e.g., infectious disease outbreaks, seasonal asthma peaks
Coordination with other groups	Coordination of efforts on the implementation of commitments and obligations to the UNFCCC Coordination with relevant organizations

Source: Department of Health

Some of the possible adaptation mechanisms are:

- Increasing herd immunity for climate-sensitive diseases (e.g., flu vaccine, measles)
- Improvement of rapid diagnostic tests for climate-sensitive diseases (e.g., malaria, dengue)
- Focused integrated health messages (associated socioeconomic and physical links, intervention)
- Integrated early warning systems – community-based response systems (development of maps, identification of hotspots)
- Integrated planning, inclusion of health (considering climate-sensitive disease affectation and disaster response) and governance – integrated policies
- Land use planning for health infrastructure, referral systems and emergency response
- Surveillance and capacity building of service providers
- Increased private-public response mechanisms (funding and activities) for awareness and action
- Integrated (horizontal multidisciplinary) evidence-based studies

In recent meetings with DOH, the following were recommended as adaptation strategy clusters:

- Climate Change and Health Development
- Policy and Systems Development
- Program/Systems Integration
- Financing Climate Change
- Partnership Building

Chapter 4: Mitigation Analysis

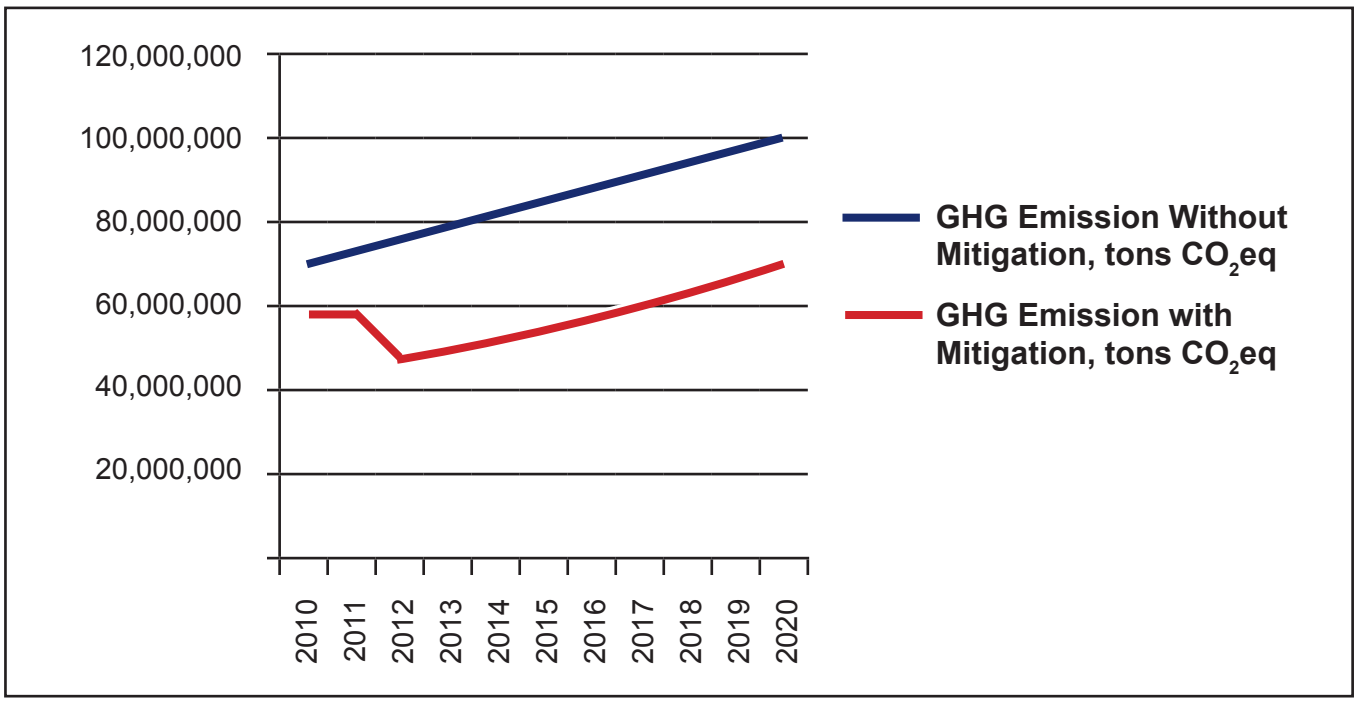
Overview

The energy sector is still the biggest source of GHG emissions for the Philippines in the year 2000, as it was in 1994, when the first national GHG inventory was undertaken as part of the First National Communication to the UNFCCC. The 2000 GHG inventory shows that the energy sector contributed 55% of the total non-LUCF GHG emissions. This amounted to 69,667 Gg CO_2eq of the total 126,878.78 Gg CO_2eq emitted that year.

Using the Long-Range Energy Alternatives Planning System (LEAP) analysis, it is estimated that by 2020, emissions from the energy sector will increase to 100,402 Gg CO_2eq under a business as usual scenario with an annual growth rate of 3%.[5] Still using the LEAP analysis, if certain mitigation options are implemented, it is estimated that there will be a 30% emission reduction (around 29,986 Gg CO_2eq), which would lower emissions to 70,416 Gg CO_2eq by 2020. (Figure 4.1)

[5]The 3% growth rate was taken from the Philippine Department of Energy's "Philippine Energy Plan 2007-2014" (PEP 2007-2014)

Figure 4.1. Comparison of baseline scenario (GHG emissions without mitigation) and mitigation scenario (GHG emissions with mitigation)



4.1 Transport

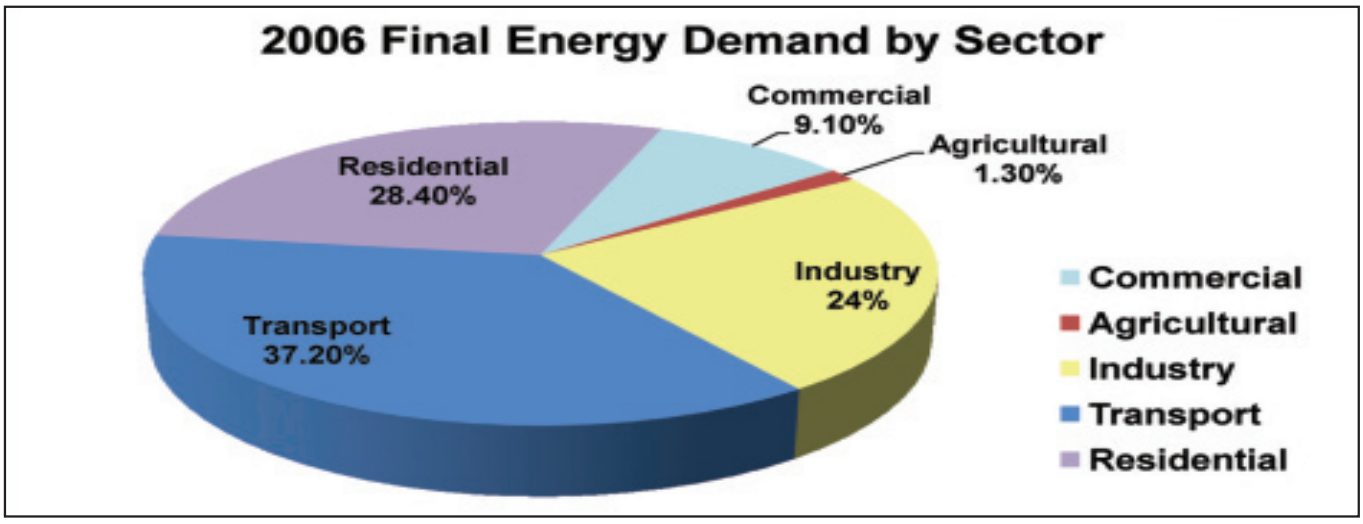
Within the energy sector, the transport subsector releases the highest amount of GHG emissions. Based on the 2000 GHG inventory of the energy sector, 37% of emissions from the energy sector or 25,935.78 Gg CO_2eq came from transport. The overall energy consumption for 2006 was 22.5 MTOE. Of this total, the transport sector contributed around 8.37 MTOE or 37.2% of the energy demand (Figure 4.2).

Road transport accounted for almost 80% of the energy demand of the transport sector (PEP 2007-2014), representing the sector's highest demand contribution and source of emissions. In 2008 alone, a total of 5.9 million motor vehicles were registered at the Philippines' Land Transportation Office (LTO).

4.1.1 The Mass Rail Transit System

To lessen congestion in Metro Manila and improve air quality, the Philippines developed its own mass rail transit system. At present, there are three lines operating. (Table 4.1)

Figure 4.2. 2006 final energy demand by sector



Source: DOE PEP 2007-2014

Table 4.1. Light rail systems in the Philippines			
Light Rail System	**Start of Operation**	**Length**	**Passengers (in millions as of 2011)**
Light Rail Transit 1 (LRT 1)	1984	15km	156.93
Light Rail Transit 2 (LRT 2)	2003	13.8 km	63.83
Metro Rail Transit (MRT)	1999	24 km	158.81

Table 4.2 1990 GHG emissions from mobile combustion (Gg)								
	CO_2	CH_4	N_2H	NOx	CO	NMVOC	CO_2 Equivalent	Percent of Total CO_2 Equivalent
Road	9,272	1.46	0.38	62.09	493.2	93.06	9,440	87.4
Marine	895	0.08	0.02	21.25	2.1	0.61	924	8.3
Aviation	453	0.02	0.02	1.81	4.8	0.20	461	4.3
Total	**10,640**	**1.56**	**0.42**	**85.15**	**500.1**	**93.87**	**10,804**	**100**

Source: ALGAS Philippines, 1998, p.33

Among urban commuters, the light rail system is the third most preferred mode of transportation, next to private cars and taxis, in going around the metropolis (Fillone, et al., 2007), suggesting efficiency of travel as an important choice criteria.

4.1.2 Studies on the Estimation of Greenhouse Gas Emissions in the Transport Sector

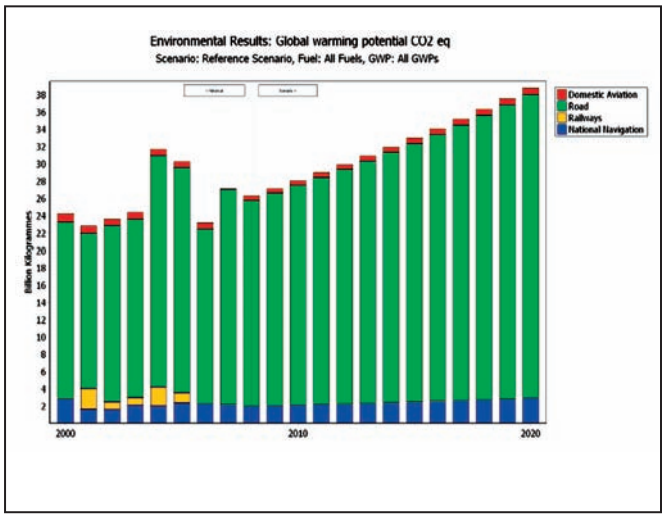
To provide a basis for policy decisions, a number of studies were undertaken, one of which was the ALGAS Philippine Study. The study, which was conducted in 1998, found the total emission from the transport sector – including road, marine and aviation transport – to be 10,804 Gg CO_2eq. The road transport subsector accounted for the bulk of the emissions – 9,440 Gg CO_2eq or 87.4% of the transport sector emissions.

For the Second National Communication, the GHG Inventory conducted by the Philippines in 2000 provided the emission data. The inventory shows that the transport sector contributed a total of 25,935.78 Gg CO_2eq or 37% of the total emissions from the energy sector, as shown in Table 4.3.

Table 4.3. Emission of greenhouse gases by energy-using subsectors					
Subsector	**CO_2 (Gg)**	**CH_4 (Gg)**	**N_2O (Gg)**	**CO_2-eq Emission (Gg)**	**Percent Share**
Energy Industries	21,127.35	0.40	0.27	21,219.45	30
Manufacturing Industries & Construction	9,015.30	1.91	0.28	9,142.21	13
Transport	25.792.03	3.45	0.23	25,935.78	37
Other Sectors	6,654.42	130.29	1.74	9,839.91	14
Solid Fuels		1.60		33.60	0
Oil & Natural Gas		166.49		3,496.29	5
Total	**62,499.10**	**304.14**	**2.52**	**69,667.24**	**100**

The SNC further used the LEAP program to project GHG emissions from the transport sector until 2020, with 2000 as the base year. The GHG emission due to electricity consumption of the transport sector, which is already accounted for under Energy Industries, is no longer reflected here to avoid double counting. The transport sector consumes 0.13% of the electricity generated (2007 data).

Figure 4.3. LEAP projection for transport subsector



4.1.3 Estimation of Mitigation Cost in Transport

World Bank figures in 2007 placed the emission coming from the transport sector at 29.3 $MtCO_2$. Of this total, 24.5 $MtCO_2$ or more than 80% came from road transport alone. This confirms the PEP estimates on the contribution of road transportation, its total emissions, and percent share of the total. Table 4.4 shows the breakdown of emissions by type of road transportation.

Table 4.4 Breakdown of total emissions per type of road transportation

Road Transport Type	CO_2 Emissions (Mt)	Percent Share
Motorcycle/Tricycle	2.0	8
Car	4.4	18
Utility Vehicle	9.1	37
Bus	0.9	4
Truck	8.2	33
Total	**24.6**	**100**

Source: http://www.mlit.go.jp/kokusai/MEET/documents/MEETFUM/S3-Philippines.pdf

To address emissions in the transport sector, the study identified a number of mitigation options. Table 4.5 shows the options with high mitigation potential and their corresponding cost per Mt of CO_2.

In an effort to further reduce greenhouse gas emissions from the transport sector, the Philippines' Clean Technology Fund Investment Plan (CTFIP) has formulated a program called National Environmentally Sustainable Transport Strategy (NESTS) (CTFIP, November 2009). The overall goal of this program is to reduce "the annual growth rate of energy consumption and associated GHG emissions from the transport sector in the urban areas in the country and to mainstream environmentally sustainable transport which involves the promotion of low-carbon intensity transport systems". This will promote, among other things, the development of the Bus Rapid Transit (BRT) system, expansion of the existing urban rail network in Metro Manila, deployment of hybrid vehicles in the public transport, and fuel switching in public transportation.

Table 4.5. Transport options and corresponding cost

Option	Impact	Cost per Mt of CO_2 Reduction (US$/t$CO_2$)
Motor Vehicle Inspection System (MVIS) and road maintenance	Improvement in fuel economy	2.3
Optimization of public transport operation	Reduction in vehicular kilometer travel (VKT)	5.4
Bus Rapid Transportation (BRT) introduction	Reduction in VKT	8.9
Liquefied petroleum gas (LPG) conversion of cars	Improvement in fuel economy	9.7
Natural gas conversion of vehicles	Improvement in fuel economy	45.8 (preliminary estimate)

Source: http://www.mlit.go.jp/kokusai/MEET/documents/MEETFUM/S3-Philippines.pdf

The plan identified a number of mitigation options for the transport sector. These are shown in Table 4.6 along with their corresponding cost-effectiveness (USD/tCO_2eq) and potential mitigation in terms of emission reduction (annual and cumulative from 2010-2030). This would help policymakers prioritize which option to adopt based on the country's financial resources and mitigation policy.

Table 4.6. GHG abatement options and cost-effectiveness at full scale-up

Transport Sector Options	Cost-Effectiveness (US$/$tCO_2e$)	Potential Annual Mitigation (MT/year)	Potential 2010-2030 Mitigation (MT)
Traffic management	3	1.2	26
Congestion pricing	4	1.1	23
BRT system	5	2.5	53
Motor vehicle inspection	8	2.2	46
Biofuels	31	15.1	318
Light vehicle technologies	104	0.2	5
Four-stroke tricycles	154	0.2	4
Road maintenance/ improvement	172	2.2	47
TOTAL		**24.4**	**554**

Source: Clean Technology Fund Investment Plan for the Philippines, 2009

4.2 Energy Industries

Within the energy sector, the energy industries subsector is the second highest contributor of GHG emissions. Based on the 2000 GHG inventory, 30% of emissions from the energy sector or 21,219.45 Gg CO_2 came from the energy industries subsector.

In an effort to increase energy self-sufficiency, the Philippine government has identified the following strategies:

- Increase resources of indigenous fossil fuels.
- Aggressively develop renewable energy potentials from biomass, solar, wind and ocean resources.
- Increase the use of alternative fuels.
- Strengthen and enhance energy efficiency and conservation programs.

The Philippines is blessed with abundant renewable energy resources. These renewable energy resources can be harnessed to reduce the country's dependence on fossil fuels. Utilization of renewable energy resources will also mitigate GHG emissions.

4.2.1 Geothermal Energy

Geothermal energy is an energy resource that comes from heat within the earth. As the Philippines is situated within tectonic plate boundaries, it is endowed with an abundant supply of this resource. The Philippines is in fact currently the second largest producer of geothermal power in the world. The potential untapped capacity of this resource is estimated to be 2,600 MW with a maximum available potential of around 1,200 MW in proven reserve areas (http://www.doe.gov.ph). In the 2010 primary energy supply mix, geothermal energy accounted for 8.5 MTOE or 21% of the total indigenous energy. Indigenous energy accounted for 57% of the total primary energy supply mix in 2010.

4.2.2 Wind Energy

The geographic location of the Philippines makes it possible for the country to have a large potential for tapping energy resources from wind. It is estimated that the overall installed capacity potential for wind energy is around 76,600 MW (US National Renewable Energy Laboratory). Currently, the 33 MW Bangui Bay Wind Farm is the only wind power farm connected to the national power grid. Wind power contributed only 0.01% of the total indigenous energy production.

4.2.3 Hydropower

Based on the 2010 Energy Statistics, hydropower energy resources accounted for 1.9 MTOE or 8.3% of the indigenous energy sources. There is an estimated 10,500 MW potential installed capacity from hydropower resources.

4.2.4 Biomass

Biomass, another potential indigenous energy source for the Philippines, comes mainly from bagasse and rice hull. Because of its large agriculture sector, the Philippines produces large volumes of bagasse and rice

hull. These materials, which are ordinarily just discarded or burned, can now be tapped to produce energy. The UP Solar Laboratory estimates a 235 MW energy potential from bagasse alone for the country. A number of projects using bagasse are now either operational or under development. In the 2007-2014 PEP, the DOE listed several rice hull cogeneration projects for development with an estimated potential capacity of 183.9 MW.

In 2010, the bagasse supply increased to 870.4 kTOE, from 832 kTOE in 2009. Other biomass sources, such as municipal waste, agriwaste and animal waste, reached an aggregate supply level of 664.6 or 12.4% of the total biomass supply in 2010.

In 2009, contracts for the development of a total of 18.4 MW biomass capacity were awarded. Another 120.7 MW biomass capacity is expected to be contributed by the newly awarded biomass renewable energy operating contracts, based on the 2010 energy statistics.

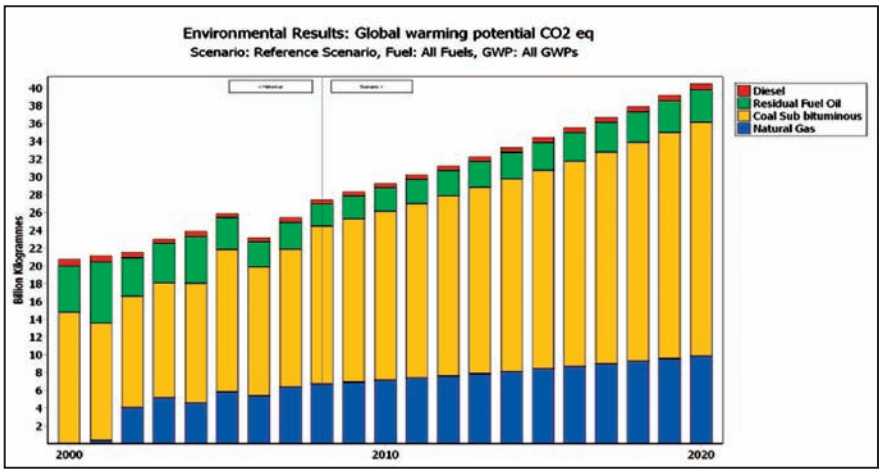
4.2.5 Projection of GHG Emissions from the Energy Industries Subsector

In the LEAP program, the GHG emissions from electricity use by each sector are subsumed and accounted for under Energy Industries. Table 4.7 shows the percentage use of electricity by each sector. It is seen that the residential sector is the highest consumer of electricity followed by the industrial and commercial sectors. Through the LEAP program, GHG emissions from the energy industries subsector were projected for 2020 from 2000.

Table 4.7 Share of electric consumption by energy industries

Energy Industry	Share of Electric Consumption (%)
Industrial	31.15
Commercial	31.13
Transport	0.13
Residential	37.58
Agriculture	0.01

Figure 4.4. GHG emissions in energy industries



4.2.6 Computing for Cost per Ton of CO_2 Mitigated per Energy Resource

This section answers the following questions:

- How much tCO_2 could be mitigated by a particular renewable energy resource?
- How much is the total annual cost for each renewable energy resource?
- How much is the cost per tCO_2 that is reduced?

1. *The following formula is used to calculate for the tCO_2 that could be mitigated by a particular renewable energy resource:*

tCO_2 mitigated = [(kW potential capacity) x (capacity factor) x (annual operation in hours) x (EF)] - PE - L

Where:

- kW potential capacity is the estimated potential installed capacity in the pipeline. The source of data is the PEP 2007-2014; unit is "kW".
- EF stands for emission factor; unit is "tCO_2/kWh".
- The source for the data on the capacity factor is the World Bank Group, Energy and Mining Sector Board, Energy Sector Management Assistance Program (ESMAP).
- Annual operation assumes operating hours as 8,760 hours/year (24 hours x 365 days in a year); the unit is "hours".
- PE stands for project emission.
- L stands for Leakage.

Table 4.8: Calculation for the potential tCO_2 mitigated for the year 2007-2014 according to energy resource

RE Resource	Economic Life	Potential Capacity (MW)	Capacity Factor	Annual Operating Hours (hours)	Emission Factor (Grid Emission Factor) (tCO_2/MWh)	Estimated Annual CO_2 Mitigated (tCO_2)	Estimated CO_2 Mitigated During Economic Life (tCO_2)
Geothermal	30	580	0.90	8,760	0.512	2,341,233	70,236,979
Hydropower	40	1,025	0.50	8,760	0.512	2,298,624	91,944,960
Biomass	20	184	0.80	8,760	0.512	660,210	13,204,193
Wind	20	556	0.30	8,760	0.512	748,118	14,962,360

Sources: The World Bank Group, Energy and Mining Sector Board, Energy Sector Management Assistance Program (ESMAP) for the economic life, kW potential capacity and capacity factor

2. *The following formula is used to calculate for the total annual cost per renewable energy resource:*

Total annual cost = annualized capital cost + annual operating and maintenance cost

Where:

- Annualized capital cost = required investment/ economic life of the project
- Annual operating and maintenance cost is assumed to be 3% of the annualized capital cost.
- EF stands for emission factor.
- It is assumed that the energy resource is operational for 8,760 hours/year.

3. *The following formula is used to calculate the cost per tCO_2 that is reduced per renewable energy resource:*

Cost/tCO_2 = total annual cost/tCO_2 mitigated annually

Table 4.9. Calculation for the total annual cost per renewable energy resource

RE Resource	Economic Life (years)	Investment Requirement (billion PhP)	Annualized Capital Cost (billion PhP)	Annual Operating and Maintenance Cost (billion PhP)	Total Annual Cost (billion PhP)
Geothermal	30	61.62	2.05	0.061	2.11
Hydropower	40	114.81	2.87	0.086	2.95
Biomass	20	19.57	0.97	0.029	1.00
Wind	20	62.33	3.11	0.093	3.20

Sources: The World Bank Group, Energy and Mining Sector Board, Energy Sector Management Assistance Program (ESMAP) for the economic life, DOE PEP (2007-2014) for the investment requirement

Table 4.10. Calculation for the cost/tCO_2 reduced per renewable energy resource				
RE Resource	Total Annual Cost (billion PhP)	Economic Life (years)	Estimated CO_2 Mitigated During Economic Life (tCO_2)	Cost/tCO_2 (billion PhP)
Geothermal	2.11	30	70,236,979	30.04
Hydropower	2.95	40	91,944,960	32.08
Biomass	1.00	20	13,204,193	75.73
Wind	3.20	20	14,962,360	213.87

4.2.7 Summary/Recommendation for Energy Industries

Based on the above information, it is recommended that priority development be focused on geothermal and hydropower technologies (see Figure 4.5 and Table 4.11). However, geothermal power resources are site-specific. Information on the sites of potential resources can be obtained from the Department of Energy.

Figure 4.5. Mitigation cost curve

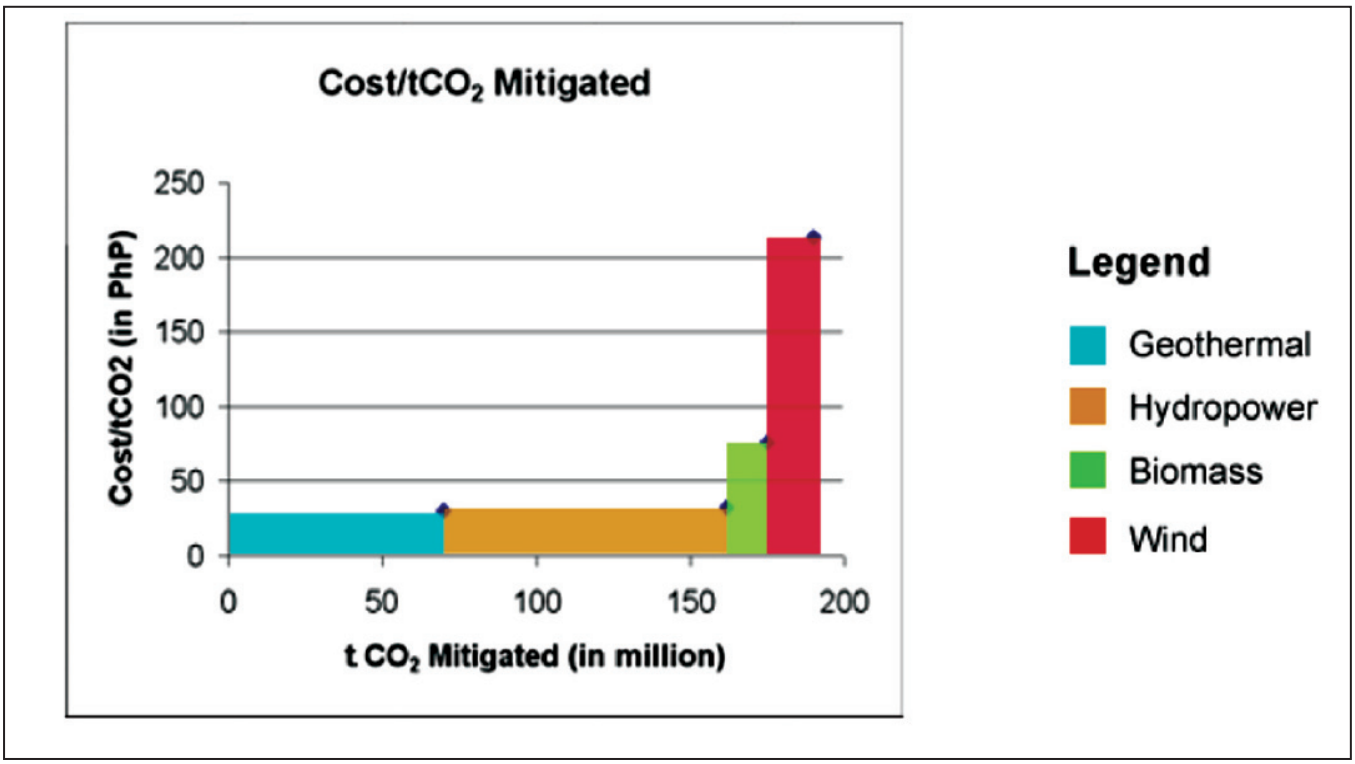


Table 4.11. Cost, tCO_2 mitigated, and economic life per renewable energy resource			
RE Resource	Cost/tCO_2 (PhP)	Total tCO_2 Mitigated Within Economic Life	Economic Life
Geothermal	30.04	70,236,979	30
Hydropower	32.08	91,944,960	40
Biomass	75.73	13,204,193	20
Wind	213.87	14,962,360	20

Geothermal technology has the highest tCO_2 mitigated (2,341,232,640) during its economic life of 30 years, at the least cost per tCO_2 (PhP 0.90/tCO_2). Hydropower is next with 2,298,624,000 at PhP 1.29/tCO_2 during its economic life of 40 years. Biomass may be considered the next option because it has the third lowest cost per tCO_2 (PhP 1.53) but has only 660,209,664 tCO_2 mitigation potential during its economic life of 20 years. Wind energy is the most expensive in terms of cost per tCO_2 mitigated (PhP4.29/tCO_2) compared to biomass but it can mitigate more (748,118,016 tCO_2) than biomass throughout its economic life of also 20 years.

Other renewable energy sources such as ocean and solar technologies were not considered in this study because investment data were not included in the DOE's PEP 2007-2014.

Further studies and additional data are needed in order to improve this mitigation analysis, such as the following:

- Studies and data on investment requirement and other costs incurred, such as operation and maintenance (O&M) expenses as well as projected revenue from sale of electricity per technology. The O&M used (3% annually of the capital cost) is just a default value.
- Updated emission factors, specifically country/local emission factors
- Updated studies of potential installed capacity and actual production per energy resource

4.3 Gaps, Needs and Constraints

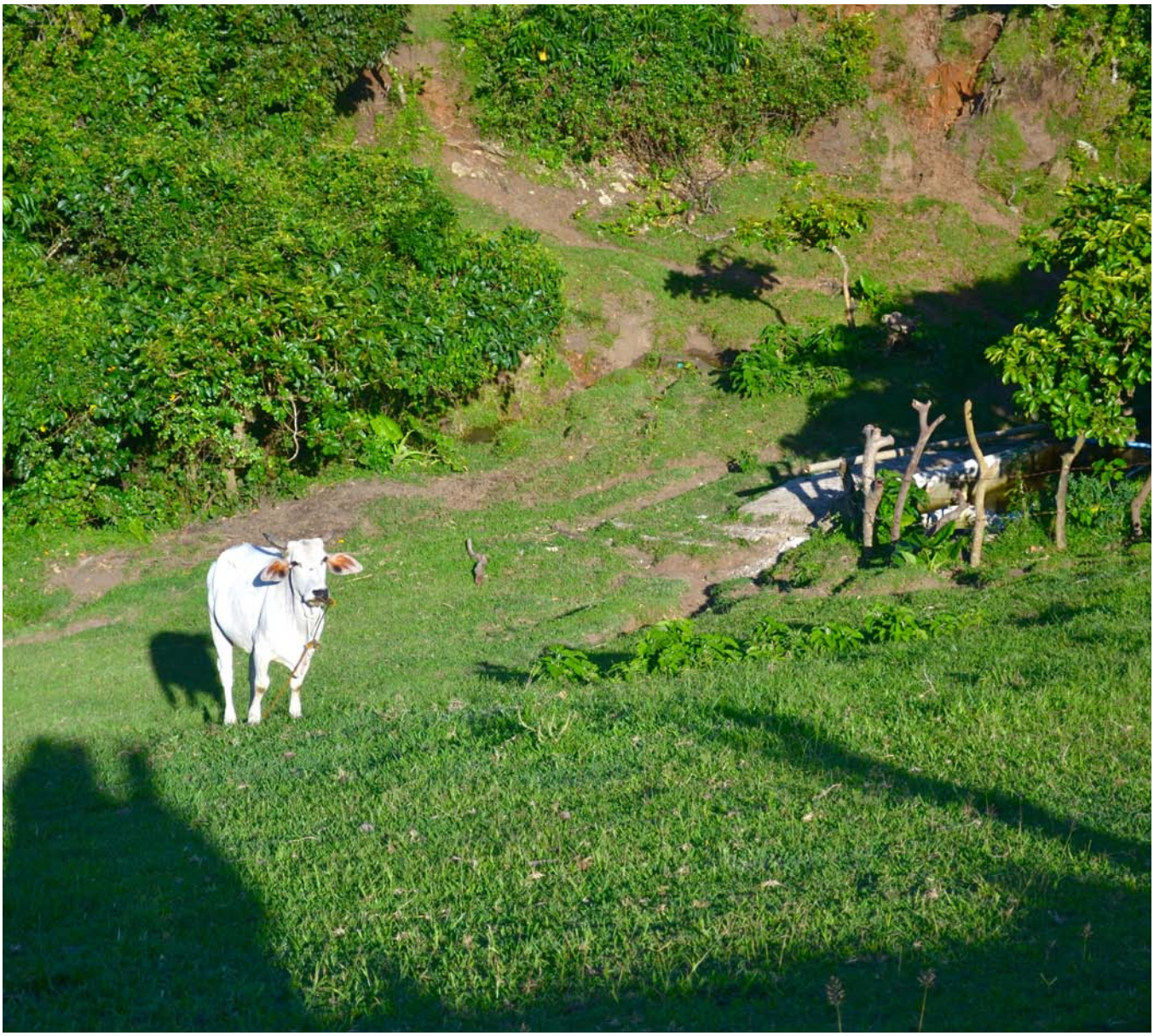
The following are the challenges that were encountered in the course of conducting this analysis:

Issues	Recommendations
The listing and prioritization of mitigation options should be a consequence of robust mitigation analyses, which require sound data.	As with the GHG inventory, continue to develop in-country capacity to conduct mitigation analysis. This includes developing the institutions tasked with database management and analysis.
Given the limited resources in a developing country such as the Philippines, mitigation potential needs to be evaluated in tandem with adaptation potential.	Develop methodologies which will enable the country to combine the carbon reduction and risk reduction potentials of climate change-related projects.
Projections of future business-as-usual and mitigation scenarios are based on LEAP and on simplified growth assumptions.	Compare these results with those of other models. Examine the energy and power projections more carefully, as well as the planned mitigation measures that have been listed.
This mitigation analysis needs to undergo QA/QC.	Develop and expand the base of inventory and mitigation experts to assure better quality analysis.

Photo by CAD

Chapter 5: Policies and Measures

Overview



In its commitment to engage in multilateral efforts to address climate change and achieve sustainable development, the Philippines has participated in discussions and negotiations leading to the ratification of international agreements on climate change adaptation and mitigation. In support of these, national policies have been directed towards supporting research and systematic observation, as well as promoting education, training, and public awareness on climate change.

Some of the most important outcomes of these negotiations include the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. At the national level, the Medium-Term Philippine Development Plan underscored the need to manage the environment more effectively in order for the country to address poverty, particularly in the rural areas.

Global and regional climate change policies have already been initiated at the national and local level. These policies cover the following sectors: disaster risk management; agriculture and food security; watersheds; coastal resources; and human health. These policies complement the requirements set forth by international conventions to which the country is a party.

5.1 Policies and Measures for Climate Change

The Philippines had recognized early on that the path towards enhancing the integrity of the country's ecological domain would involve heightened and sustained implementation of environmental laws, as well as the continued pursuit of resource conservation and environmental restoration/enhancement programs.

In 1989, the Philippines formally took on sustainable development as a guiding principle in its development efforts through the approval and adoption of the framework of the Philippine Strategy for Sustainable Development (PSSD). This framework identified 10 strategies for sustainable development, which were later elaborated into the Philippine Agenda 21 after the Rio Earth Summit in 1992.

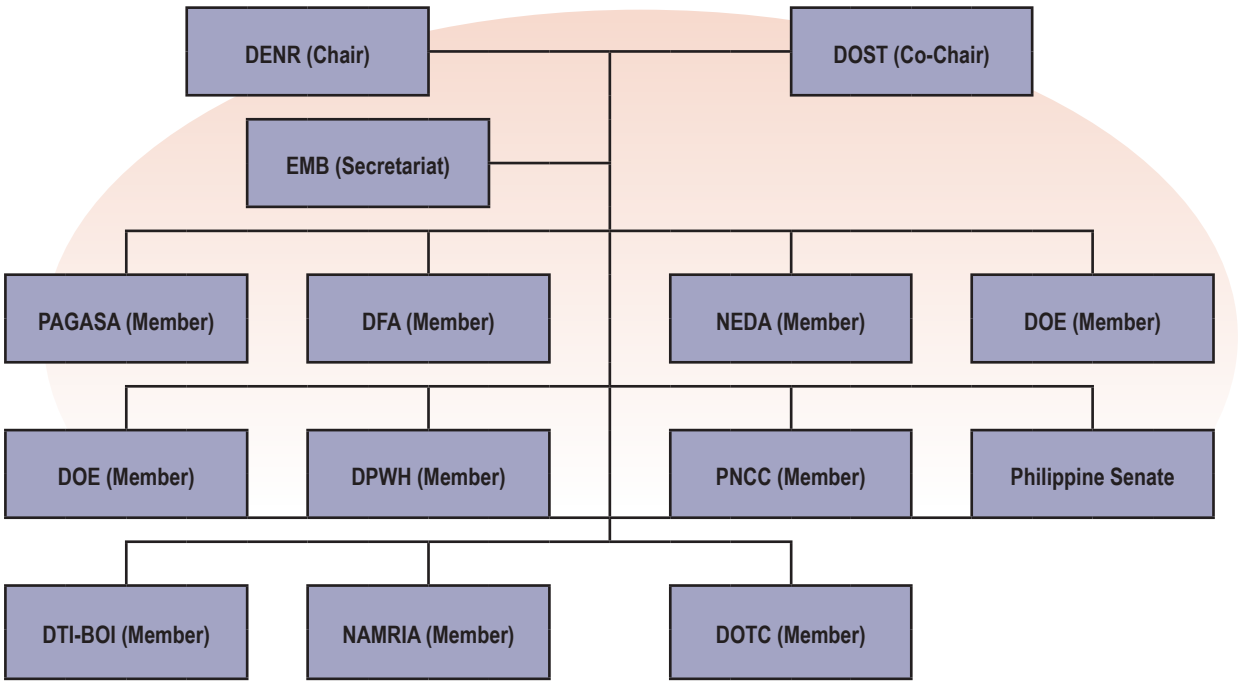
Even prior to the signing of the UNFCCC in 1992, then Philippine President Corazon Aquino created the Inter-Agency Committee on Climate Change (IACCC) in 1991 through Presidential Order No. 220. The IACCC, composed of government agencies and an umbrella non-government organization (NGO), coordinates, develops and monitors activities related to climate change in the country. It also formulates policy actions and recommendations, which shape the Philippines' positions in international negotiations on climate change.

In 1992, the Philippines signed the UNFCCC and agreed to the mandate of protecting the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. The agreement was ratified on August 2, 1994 and entered into force on October 31, 1994. Three years after, the country drafted the National Action Plan on Climate Change (NAP), a framework aimed at identifying the general thrusts of the government to address the issue of climate change. However, this framework, which was the first of its kind, was not enacted.

In 2003, the Philippines ratified, nearly five years after signing, the Kyoto Protocol, which called for agreeing parties to pass and implement national measures that advance environmental preservation through the reduction of greenhouse gas emissions in the atmosphere. Under the protocol, developing countries can reach sustainable development goals and increase investment flows through the Clean Development Mechanism (CDM).

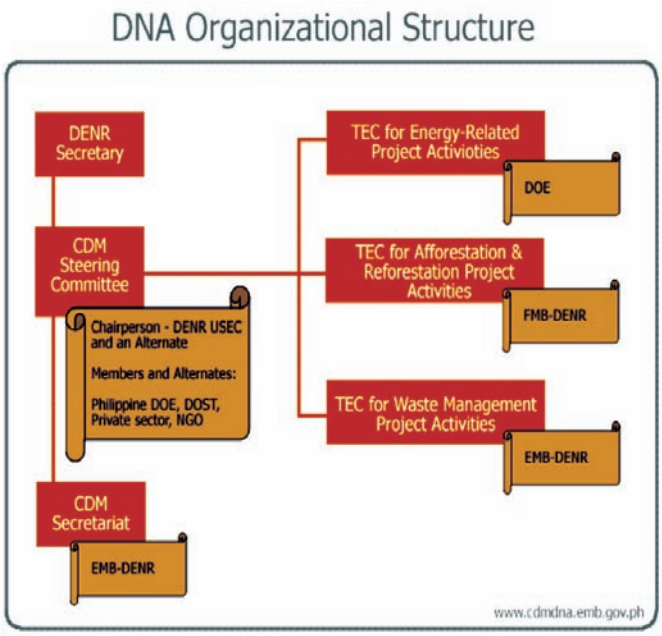
The DENR was designated as the national authority (DNA) for CDM. According to DENR's Environmental Management Bureau (EMB), which serves as the CDM secretariat, the government had received 118 CDM applications as of September 2012. Out of the 118, there were 112 projects (44 large-scale and 68 small-scale) that were given letters of approval, with an estimated

Figure 5.1. Institutional structure of the Inter-Agency Committee on Climate Change



8.6M tCO_2e. As of September 2012, the Philippines ranked 10th globally in terms of the number of registered CDM projects, which then numbered 58. Of the 58 projects, four projects were issued CERs of around 164,460.

Figure 5.2. Institutional structure for the CDM DNA



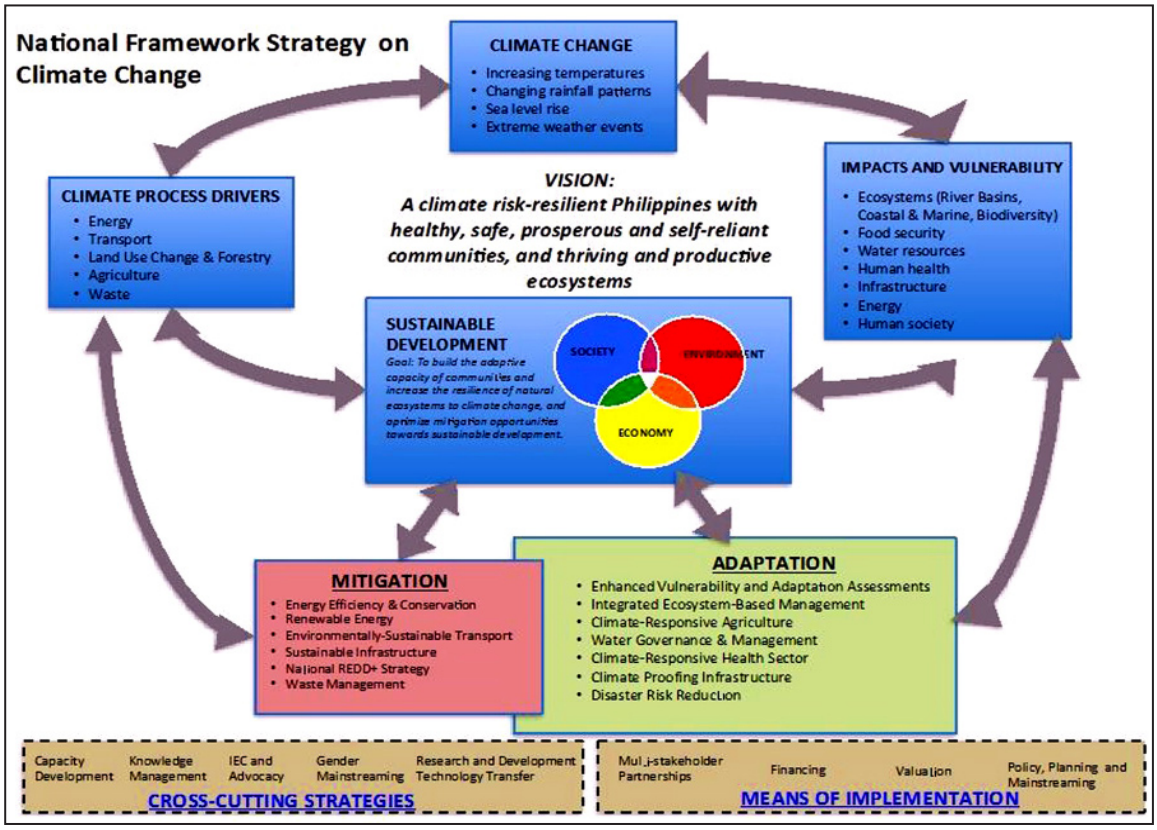
Source: EMB CDM Secretariat

In 2007, the Presidential Task Force on Climate Change (PTFCC) was created by virtue of Administrative Order (AO) No. 171, with the DENR secretary serving as chair. This was later amended through AO No. 171-A where the chairmanship was transferred to the Department of Energy.

The Climate Change Act (Republic Act 9729) was enacted in 2009, reiterating the urgency of addressing the climate problem concertedly at the local, national and global levels. This resulted in the creation of the Climate Change Commission (CCC). The CCC is housed under the Office of the Philippine President and is being chaired by the President. The CCC serves as the lead policymaking body of the government on climate change issues. One of its functions is to coordinate, monitor and evaluate the climate change programs and plans of the different government agencies and ensure that climate change is being mainstreamed.

In 2010, the National Framework Strategy on Climate Change (NFSCC) was crafted (Figure 5.3). One of its guiding principles is to look at adaptation and mitigation as pillars, with special emphasis on adaptation. Should the country pursue mitigation actions, it should be seen as a function of adaptation.

Figure 5.3. National Framework Strategy on Climate Change

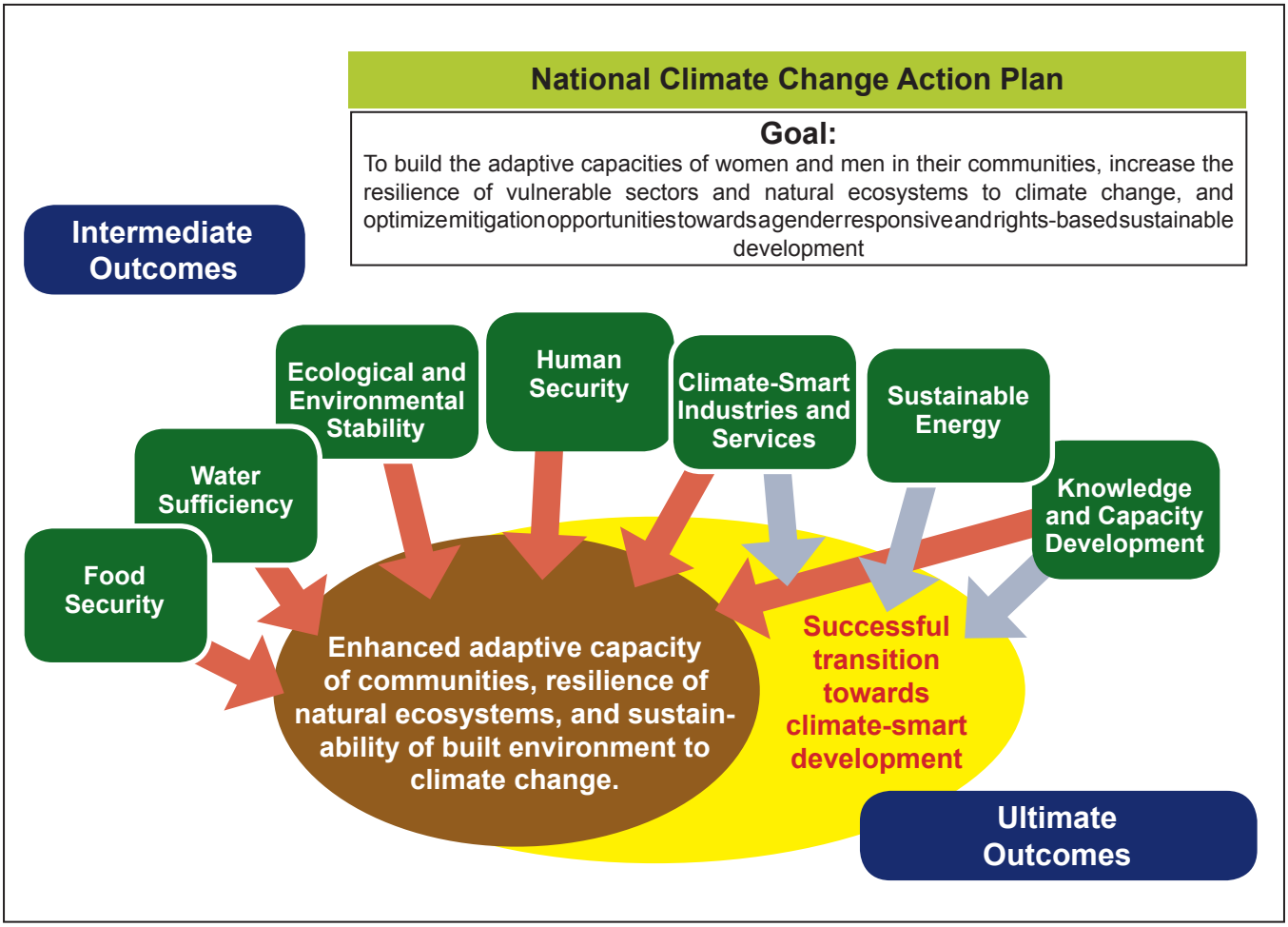


In 2011, the President approved the National Climate Change Action Plan (NCCAP). The NCCAP is a long-term plan that outlines the country's agenda for adaptation and mitigation from 2011-2028. The main goals of the NCCAP are to build the adaptive capacities of women and men in their communities, increase the resilience of vulnerable sectors and natural ecosystems to climate change, and optimize mitigation opportunities towards a gender-responsive and rights-based sustainable development. It has seven thematic areas or intermediate outcomes, which are shown in Figure 5.4.

In August 2012, Republic Act 10174 was passed which contains amendments to the Climate Change Act. The key revisions include:

- The inclusion of finance ministries, such as the Department of Finance (DOF) and the Department of Budget and Management (DBM), and the inclusion of the National Youth Commission (NYC) as part of the Advisory Board of the Climate Change Commission
- The introduction of the Peoples' Survival Fund (PSF)
    - This serves as a special fund in the National Treasury for the financing of adaptation programs and projects based on the National Strategic Framework. This shall be used to support adaptation activities of local governments and communities.
    - PhP1B is appropriated by the National Treasury as the opening balance and may be augmented by donations, endowments, grants and contributions, which shall be exempted from donor's tax.
    - The PSF board shall be lodged under the Climate Change Commission and shall be composed of the following:
        - Secretary of the Department of Finance as chair

Figure 5.4. NCCAP strategies



Source: Climate Change Commission

- Vice chairperson of the Climate Change Commission
- Secretary of the Department of Budget and Management
- Director-general of the National Economic and Development Authority
- Secretary of the Department of the Interior and Local Government (DILG)
- Chairperson of the Philippine Commission on Women
- Representative from the academe and scientific community
- Representative from the business sector
- Representative from the NGOs

*PSF board representatives from the academe, scientific community, business and NGOs are disqualified from accessing the fund during their term.

Leading the initiatives on climate change mitigation and adaptation at the local government level is the Province of Albay which convened the 2nd National Conference on Climate Change Adaptation in Legazpi City in October 2007. As an offshoot of the conference, the Albay Declaration on Climate Change Adaptation was adopted to prioritize climate change adaptation in local and national policies, to advocate for climate-proofing development, and to mainstream adaptation through local and regional partnerships. This currently serves as a model framework to mainstream climate change concerns into national and local planning, accounting and budgeting systems, and support initiatives by LGUs, civil society and private sector groups.

The Albay in Action on Climate Change (A2C2) of the Province of Albay is a pioneering local initiative on local climate change mitigation and adaptation. One of the component programs of this initiative is a 90-hectare mangrove plantation project in Manito, Albay and other land use and land use change and forestry (LULUCF) activities. The Sangguniang Panlalawigan (SP) has also passed SP Ordinance 2007-51 mandating the integration of disaster risk reduction and climate change adaptation in the review and update of its CLUP. The Albay initiative is being replicated by other LGUs throughout the country. It has demonstrated that while climate change is a global issue, local action contributes to both local and global solutions.

5.2 Policies on Disaster Risk Reduction and Management

Prior to the passage of the Disaster Risk Reduction and Management Act in 2010, there were already the National Calamity Fund (NCF) and the Local Calamity Fund (LCF) as the two major sources of funding for disaster efforts. The funds, however, operate in a reactive fashion, being mobilized only after the occurrence of a disaster, with little or no preemptive response. This was what happened when typhoon Ketsana (local name "Ondoy") hit the Philippines in September 2009 and severely damaged the capital city and its nearby regions.

This unfortunate experience expedited the passage of the Disaster Risk Reduction and Management Act (Republic Act 10121). Signed into law by the President in May 2010, it upholds the Filipinos' constitutional rights to life and property by addressing the root causes of vulnerabilities to disasters, strengthening the country's institutional capacity for disaster risk reduction and management (DRRM), and building the resilience of local communities to disasters, including climate change impacts.

Mainstreaming disaster risk reduction in the country's policies, programs, and plans is at the core of the DRRM Bill. The bill has expanded the guiding policies and objectives for disaster risk management to include the following:

- Adherence to universal norms, principles, and standards of humanitarian assistance
- Supremacy of civilian authority over the military, especially in complex emergencies and human-induced disasters
- Good governance through transparency and accountability
- Integrated, coordinated, multi-sectoral, inter-agency, and community-based approach to disaster risk reduction
- Empowerment of LGUs and civil society organizations (CSOs) as key partners in disaster risk reduction
- Including provisions on the declaration of a state of calamity, remedial measures, prohibited acts and corresponding penalties

Furthermore, the National Disaster Risk Reduction and Management Council (NDRRMC) was formed by virtue

of the act. The council was to oversee the Philippine disaster management system and be responsible for developing the National Disaster Risk Reduction and Management Framework, the set of guidelines serving as basis for formulating the National Disaster Risk Reduction Management Plan (NDRRMP).

The National Disaster Risk Reduction and Management Authority (NDRRMA), attached to the Office of the President, is the implementing arm of the NDRRMC. The NDRRMA has policymaking powers and executive functions that allow it to manage, coordinate, and synchronize programs related to DRRM.

The Philippines is committed to include the Hyogo Framework of Action (HFA) 2005-2015 in its long-term development agenda. The government's economic plan, drawn up by the NEDA, has come up with guidelines to integrate disaster risk reduction within local development planning and has launched a three-year project to assist local government units in using these guidelines.

Concurrent with this, the Housing and Land Use Regulatory Board (HLURB) is revising its guidelines for developing risk-sensitive land use plans that incorporate the use of hazard maps. Both of these initiatives, as well as the Strategic National Action Plan for Disaster Risk Reduction (SNAP), aim to reduce the risks of major damage caused by the multitude of disasters that occur in the country.

A national multi-sectoral platform for disaster risk reduction is being institutionalized to shift paradigms from disaster preparedness and response to disaster risk reduction. The private sector, civil society and academe are beginning to take part in National Disaster Coordinating Council (NDCC) activities, consultations and workshops, such as those on the following:

- Hazard mapping and assessment for community-based disaster risk management
- Instituting early warning systems for identified hazards
- Using knowledge innovation and education to build a culture of safety and resilience among Filipinos
- Social development policies to reduce the vulnerability of populations at risk, including housing and livelihood projects for informal settlers
- Health care that will reduce vulnerability of people to disasters
- Establishment of a conditional cash transfer system and other insurance schemes that will help cushion shocks experienced by poor households

5.3 Policies and Measures for Agriculture and Food Security

The Philippine Agriculture 2020 (PA 2020) envisions a holistic view of agriculture and considers three building blocks or pillars:

- Organizing and managing agriculture as a business, thus making it market-oriented and private sector-led, with the government leading in making marketing investments in the countryside attractive.
- Alleviating poverty through: asset reform which would involve transfer of property/rights to the poor, stimulation of increased investments among rights holders, acceleration of agrarian reform, and organization of beneficiaries into agrarian reform communities; change of policies regarding community-based forest management agreements; and farming of 255,000 ha of shallow coastal waters.
- Nurturing values of nature and community in people through: civil society participation in safeguarding the use of common resources; fostered stewardships in use of resources; respect for the rights of indigenous peoples and other rural communities; and their participation in the conservation of the environment.

PA 2020 will use three strategies: (1) public sector technology development; (2) promotion and investments; and (3) governance reforms. There will be 15 agro-industrial clusters that will form the major agriculture-forestry-fishery subsectional components of PA 2020.

The International Rice Research Institute (IRRI), in its strategic plan to help nations across the globe to reach the United Nations (UN) Millennium Development Goals by 2015, aims to achieve the reduction of poverty and the sustainability of the rice production environment through the use of modern technology and the latest communication tools.

5.4 Policies and Measures for Energy

In terms of policy, the Department of Energy leads the implementation of two laws that support the efforts on climate change: the Biofuels Act (2006) and the Renewable Energy Act (2008). Under Executive Order (EO) 774, DOE leads the Task Force on Renewable Energy, which is focused mainly on implementing the Renewable Energy Act. In 2007, at the height of the oil price hike of more than $100 per barrel, DOE called more aggressively for energy conservation measures, the use of alternative fuels, and the promotion of renewable. Renewable energy (RE), in particular, was promoted not only as a vital tool for attaining energy self-independence, but also for serving the climate change imperative.

Early initiatives to promote energy efficiency and conservation, such as the Power Patrol Program and Road Transport Patrol Program of the DOE, later expanded to the National Energy Efficiency and Conservation Program (NEECP). NEECP is an ongoing program of the DOE that targets different stakeholders, in particular, the transport sector, industrial and commercial sectors, and the general public, to practice energy efficiency and conservation.

Another flagship project of DOE is the Philippine Efficient Lighting Market Transformation Program (PELMATP), which is jointly implemented with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF). This five-year project aims to address the barriers to the widespread utilization of energy-efficient lighting (EEL) systems in the Philippines and the reduction of greenhouse gas emissions to the environment.

Another project supporting the cause of climate change mitigation is the Capacity Building to Remove Barriers to Renewable Energy Development in the Philippines (CBRED) Project. This project aims to reduce greenhouse gas emissions by removing market, policy, technical and financial barriers to RE development and utilization by:

- Strengthening the capacity of national agencies to enact and implement sound RE policies
- Providing information to build the RE market
- Creating a one-stop shop for the preparation and promotion of RE projects
- Increasing coordination among organizations concerned with RE
- Assisting market penetration of RE projects in remote, off-grid communities
- Improving the quality of RE technologies and systems

5.5 Policies and Measures for Watersheds (Water Resources, Forestry and Biodiversity)

With 24 million upland dwellers (Population Center, 2005) putting great pressure on the forests and watersheds, and with the challenge of encouraging farmers, individuals and communities adopt sustainable watershed management practices, a number of policy instruments/programs were launched. These include the Integrated Social Forestry Program (ISFP), Community-Based Forest Management (CBFM) Program, Ancestral Domains Program (ADP), Coastal Environment Program (CEP), Forest Land Management Program (FLMP), Community Forestry Program (CFP), and the Socialized Industrial Forest Management Program (SIFMP). Together with these programs are tenure instruments that would ensure the participants of their long-term use of the land.

CBFM was adopted as the national strategy for sustainable forest management and social justice through the issuance of EO No. 263 in 1995. CBFM as a strategy refers

Photo by CAD

to all organized efforts of the government to work with local communities in and adjacent to public forestlands. It underscores the principles of social equity, sustainability, and community participation in forest management and biodiversity conservation. Through the CBFM strategy, the government empowers local communities, allocates to them portions of the forestlands for them to develop, protect, manage and conserve, and grants them access to forest resources that they can utilize.

The objectives of the CBFM, as clearly stated in EO 263, are the following:

- Protect Filipinos' right to a healthy environment.
- Improve socioeconomic conditions of the participating communities through the promotion of social justice and equitable access to and benefits from forest resources.
- Respect the rights of indigenous peoples to their ancestral domains.

These objectives highlight the important role expected of local communities, not only in promoting forest development but also in advancing overall socioeconomic development in the Philippine uplands.

CBFM in the Philippines evolved from five major programs: ISFP, CFP, CEP, the National Forestry Program (NFP), and the recognition of Ancestral Domain Claims. The expansion of forest management coverage through these programs addressed issues like forest occupancy, deforestation, and lack of effective management of primary and secondary forest areas. The CBFM Program covers occupied, open, denuded, reforested and forested areas.

The revised Master Plan for Forest Development (MPFD) in 2003 recognized the need to strengthen existing CBFM sites, identify and implement new sites, place open access areas under formal management systems, and pursue development activities geared towards resource generation. It aimed to provide the needed support to sustain the interest among the participating members of peoples' organizations.

As of 2005, an aggregate area of 5.97 million ha involving 690,691 households had been established. Of these areas, 1.57 million ha were allocated to organized communities through the issuance of long-term CBFM agreements. The rest of the project sites are covered by land tenure instruments under the various people-oriented forestry projects that the government had implemented in the past (Bacalla, 2005).

A review and analysis of the accomplishments of CBFM on the ground revealed that current CBFM programs and projects have helped improve the forest condition in several places. However, there is a need to further investigate the protection and maintenance of the established plantation sites in view of the termination of foreign funding support. Also, the program's contribution to carbon sequestration needs further study and confirmation. Overall, considering the limited livelihood opportunities, CBFM may not have significantly reduced the current vulnerability of communities to climate-related and other socioeconomic stressors.

There are also some major policies, mostly legislative acts issued from the 1970s to the 1990s, that constrict the improvement of watersheds. While PD 705 provides for the adoption of technologies beneficial to watersheds and prohibits certain activities, this law needs to be amended or Congress should come up with a new law. In this regard, the Sustainable Forest Management Act has yet to be approved by both the House of Representatives and the Senate.

Likewise, all other policies that could contribute to greater watershed vulnerability need to be reviewed and amended. Policies that hinder the sustained participation of the local communities need to be amended as well. There is also a need to redirect new and existing policies to consider the issue of climate change. Specifically, harmonizing these policies would give clear, comprehensive and synchronized policy strategies towards sustainable forest management that would contribute to the abatement of the adverse impacts of climate change.

Policy issuances of the DENR have reinforced activities that help minimize the impacts of climate change. In general, the various issuances will help promote conservation in government reservations. An example of these is the suspension of prospecting permits for reservations. In the long run, this will reduce the adverse impacts of climate change in the watersheds.

The following activities as expressed in the different issuances will also contribute to the reduction of the watersheds' vulnerability: application of cost-effective rehabilitation methods that will result in accelerated establishment of vegetative cover; continued protection and maintenance of established plantations through continuous project funding; good management of reservations through the adoption of appropriate technology; and implementation of a sound planning and management framework and multi-sectoral management of water resources.

Reducing Emissions from Deforestation and Forest Degradation (REDD) is another mechanism to address climate change issues. It evolved as a response to a decision of the 13th Conference of Parties to the UNFCCC in Bali in December 2007. Its goal is to assess whether carefully structured payment structures and capacity support can create incentives to ensure actual, lasting, achievable, reliable and measurable emission reduction while maintaining and improving the other ecosystem services that forests provide.

Areas of potential support include the following: scoping and alliance building, monitoring and assessment, dialogues, national REDD+ strategy, support for implementing REDD measures, and others. The Philippines and other ASEAN member-countries, where about 16% of the world's total tropical forest areas are located, share a common position on REDD. Indigenous communities in the Philippines have agreed to embark actively on implementing the REDD scheme, recognizing that the forestry sector, where most indigenous peoples (IPs) belong, accounts for 17% of global greenhouse gas emissions, deforestation being the main cause of these emissions (UN REDD, 2007).

Other ongoing reforestation projects also contribute to the reduction of greenhouse gases in the atmosphere. For example, the advocacy of the Haribon Foundation for the rainforestation of 1M ha, or about 1 billion native trees, is to help restore original rainforests and contribute to carbon sequestration and climate regulation. The DENR's National Greening Program which aims to plant 1.5 billion trees covering 1.5 ha by 2016 is also a major boost to reforestation efforts.

5.6 Policies and Measures for the Coastal Sector

There are cases when the exploitation and use of the Philippines' coastal resources result in conflicts because of the overall policy formulation that defines the "rules of the game". Such conflicts usually arise user livelihood strategies and how the resource users or "players" conduct themselves to take advantage of available opportunities amidst issues and concerns, which may include their vulnerabilities to climate-related risks.

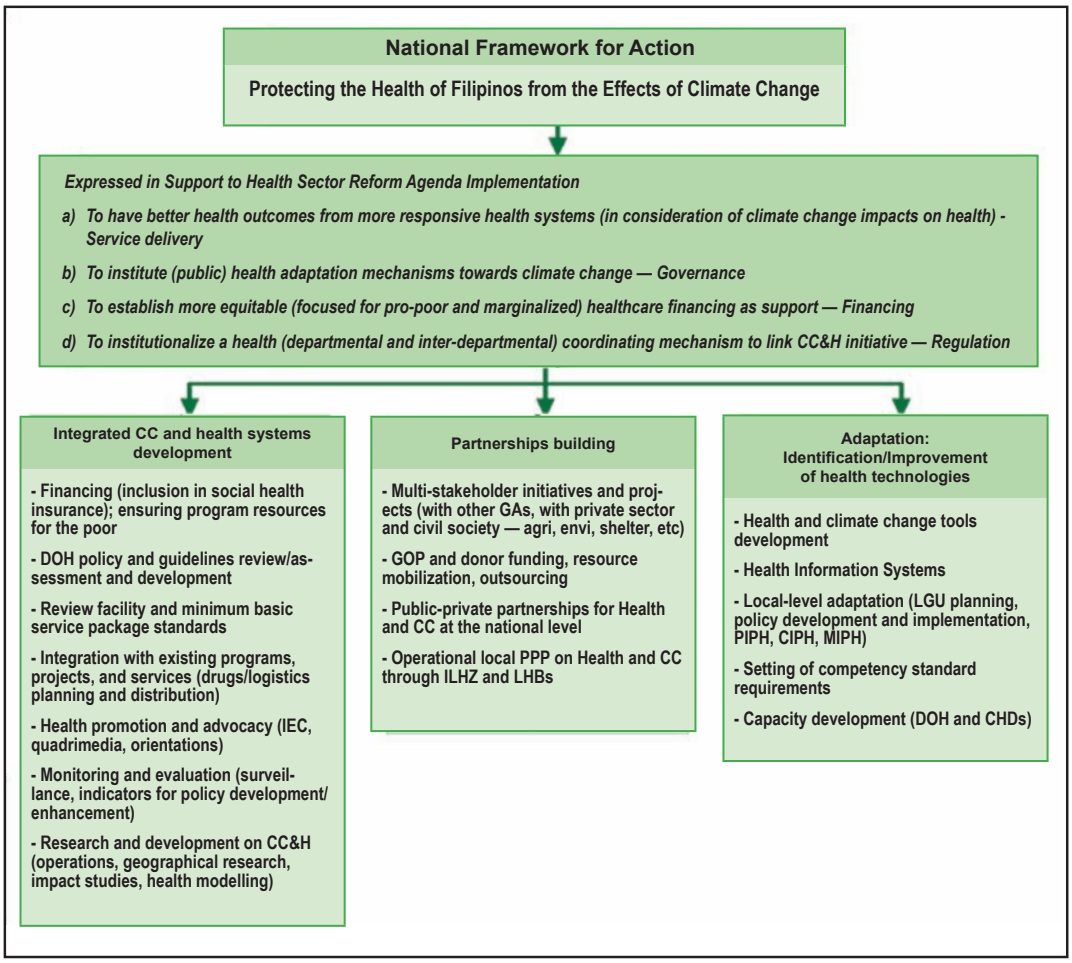
Recently, the DOST Philippine Council for Aquatic and-Marine Research and Development (PCAMRD) funded the Integrated Coastal Enhancement: Coastal Research, Evaluation and Adaptive Management (ICE CREAM) for climate change. Under this project, the World Wildlife Fund (WWF) Philippines is monitoring climate change impacts on coral reefs in protected areas such as Apo Reef.

5.7 Policies and Measures for Human Health

The National Objectives for Health (NOH) does not have climate change as a specific section in its intervention frame. However, it will be noted that most of the mechanisms for disease intervention follow an adaptation mode when climate change and health impacts are taken into account. The following short list looks at related but focused impacts on health in the different government line agencies.

5.7.1 DOH Framework of Action

Cognizant of the significance of addressing the health effects of climate change, the Department of Health, through the National Center for Disease Prevention and Control (NCDPC), developed a National Framework of



Action that would contextualize the issue of climate change in the health system, assess factors that shape program implementation, and come up with appropriate strategies that will define the overall program direction. The Framework of Action would also help DOH identify appropriate strategies that will define the overall program direction, and affirm its participation and commitment to international and national agreements on climate change.

With the overall goal of protecting the health of Filipinos from the possible effects of climate change, specific objectives were stated in support of the implementation of the Health Sector Reform Agenda (HSRA) (Figure 5.5). The framework followed the four pillars of service delivery, governance, financing and regulation to facilitate integration. Three strategy clusters were identified: integrated climate change and health systems development; partnerships building and adaptation mainstreaming; and identification and improvement of health technologies. DOH likewise came up with the corresponding institutional arrangements to help delineate interdepartmental roles and responsibilities and enhance coordination efforts.

The DOH through NCDPC has assigned the Environmental Health Unit as the focal office for climate change initiatives. Another unit, the Health Emergency Management Service, responds to the health effects of climate change during disasters. Their duties remain separate, but there are potential overlaps. Other departments respond operationally in a programmatic manner. For example, the National Epidemiology Center (NEC) and the projects that go with it may not highlight climate change as of the moment, but it points towards the direction of institutionalizing the integrated disease surveillance response system, which is in effect an adaptation response. Interdepartmental awareness and coordination on climate change and health are yet to be improved.

Subsequent projects were mainly of the awareness raising and information dissemination types, such as forums on climate change and health with the different sectors. There were parallel initiatives by other government line agencies that touched indirectly on health effects, but these may not highlight yet the linkage between health and climate change. Examples of these are projects in water and sanitation, water impounding, and solid waste management which are implemented by other agencies. Opportunities for cross-sector coordination on health and climate impacts should be encouraged to maximize efforts to address these impacts.

The DOH has participated in the MDG-F project which established a disease surveillance system for climate-related diseases for Metro Manila and other provinces. While the project is indirectly related to climate change, it monitors diseases, which may have been caused by climate change, through a comprehensive system for investigation, case management, and mitigation of communicable disease control.

Chapter 6: Transfer of Technologies

Overview

In the context of Article 4.1(c) of the UNFCCC, all parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors.

Developed country parties, as provided for in Article 4.5 of the convention, shall promote, facilitate and finance the transfer of, and access to, environmentally sound technologies and know-how to developing country parties, to enable them to implement the provisions of the convention. Article 4.7 of the convention further states that the extent to which developing country parties will effectively implement their commitments under the convention will depend on the effective implementation by developed country parties of their commitments under the convention related to financial resources and transfer of technology.

The implementation of the development and transfer of technologies is guided by Decision 4/CP.7 and its annex containing the framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the convention. The framework aims to increase and improve the transfer of and access to environmentally sound technologies (ESTs) and know-how by implementing the following key themes: technology needs and needs assessment; technology information; enabling environments; capacity building; and mechanisms for technology transfer.

A. Guidelines for preparing national communications

The guidelines for preparing second, and where appropriate, third national communications of non-Annex I parties contained in Decision 17/CP.8 encourage non-Annex I parties, in the light of their social and economic conditions, to provide information on activities relating to: the transfer of, and access to, environmentally sound technologies and know-how; the development and enhancement of endogenous capacities, technologies and know-how; and measures relating to enhancing the enabling environment for development and transfer of technologies.

This section of the Philippines' Second National Communication to the UNFCCC outlines the policies and measures relating to the development and transfer of environmentally sound climate technologies, including the identification of barriers to their implementation. It also identifies and assesses priority technology needs. Information on the development and transfer of technologies that is relevant to the achievement of the other objectives of the convention is reported under the discussion of those objectives.

B. Definition of technology transfer

The Intergovernmental Panel on Climate Change (IPCC) defined technology as "a piece of equipment, technique, practical knowledge or skills for performing a particular activity."[6] Technology, defined as such, plays a crucial role in addressing climate change. It is therefore imperative for a country to have access to environmentally sound climate technologies to implement GHG mitigation and adaptation measures.

Technology transfer as defined in the IPCC is "the broad set of processes covering the exchange of knowledge, money and goods amongst different stakeholders that lead to the spreading of technology for adapting to or mitigating climate change."[7] However, technology transfer is now universally used to mean the movement of technology from one country to another, which is also called horizontal technology transfer.[8] Therefore, cooperation among different stakeholders and parties to the convention is the key to the successful implementation of Article 4.1(c) and Article 4.5 of the convention.

[6]http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=362

[7]Source:http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=362

[8]Source:http://www.unu.edu/unupress/unupbooks/uu04te/uu04te0r.htm

6.1. The Policy Environment for Technology Transfer and Development

6.1.1 Intellectual Property Rights, Legislations and National Policies to Promote Environmentally Sound Technologies

Republic Act 8293, also known as the Intellectual Property Code of the Philippines, provides for the establishment of an Intellectual Property Office and a detailed outline of its powers and functions. It also provides for the establishment of the Documentation, Information and Technology Transfer Bureau under the Intellectual Property Office. Among the functions of this office are: to provide technical, advisory, and other services relating to the licensing and promotion of technology; carry out an efficient and effective program for technology transfer; and register technology transfer arrangements.

Republic Act 1005, or the "Act Providing the Framework and Support System for the Ownership, Management, Use and Commercialization of Intellectual Property Generated from Research and Development Funded by Government and for Other Purposes," is also known as the Philippine Technology Transfer Act of 2009. The main objective of this act is to promote and facilitate the transfer, dissemination, and effective use, management and commercialization of intellectual property, technology and knowledge resulting from research and development funded by the government for the benefit of the national economy and taxpayers (RA 10055, Sec. 3).

As technology transfer is also crucial in addressing the issue of climate change, there is a need to mainstream and institutionalize the identification of climate-friendly technologies that need to be developed and effectively transferred from mere research to commercial use.

6.1.1.1 Energy Sector

The following are the landmark legislations passed by the Philippine Congress to promote renewable energy:

- An Act Promoting the Development, Utilization and Commercialization of Renewable Energy Resources and for other Purposes (Republic Act No. 9513, otherwise known as the Renewable Energy Act of 2008)

Photo by CAD

- An Act to Direct the Use of Biofuels, Establishing for This Purpose the Biofuel Program, Appropriating Funds Therefore, and for Other Purposes (Republic Act No. 9367, otherwise known as the Biofuels Act of 2008)
- An Act Granting Incentives to Mini-Hydro-Electric Power Developers and for Other Purposes (Republic Act No. 7156)

The Renewable Energy Act created the National Renewable Energy Board (NREB), which set the minimum percentage of generation from eligible renewable energy resources and mandated the Energy Regulatory Commission (ERC), in consultation with the NREB, to formulate and promulgate a feed-in tariff system for electricity produced from wind, solar, ocean, run-of-river hydropower, and biomass. The law also mandated the Department of Energy to establish a Renewable Energy Market and Green Energy Option Program to provide options for the consumers to choose renewable energy as their sources of energy.

Several executive orders have also been issued by the president to provide further incentives in the development of renewable energy and climate-friendly technologies. One of these is Executive Order No. 462, which enables the public sector to participate in the exploration, development, utilization and commercialization of ocean, solar and wind resources for power generation and other energy uses.

For the transport sector, the government, through Executive Order 488, has introduced zero percent import duty on parts and components that will be used for the assembly and manufacture of vehicles powered by alternative fuels. Under Executive Order 449, it also reduced import duties on bioethanol products to be used in the program from 10% to 1%. And under Executive Order 396, it reduced the rates of import duty on related equipment, parts and components being used by the compressed gas motor vehicles and natural gas vehicle industry.

The passage of enabling policies and the aggressive effort of the government to promote renewable energy technologies are expected to contribute to a 100% increase in its energy contribution, from its current level of 4,449 MW to 9,147 MW by 2013. The DOE has also set a goal of increasing the renewable energy contribution to the energy mix by 10 million barrels of fuel oil equivalent (MMBFOE) in the next ten years. With this goal, the country aims to be the number one producer of geothermal energy in the world and of wind energy producer in Southeast Asia. The country also aims to double its hydropower capacity and expand the contribution of biomass, solar and ocean energy by about 131 MW.

6.1.1.2 Waste Sector

The waste sector is one of the major contributors to greenhouse gas emissions, particularly in areas with no system for managing solid waste in place. According to the World Bank's 2001 Philippine Environment Monitor, an average Filipino generates and average of 0.3 to 0.7 kilograms of waste daily, with Metro Manila contributing 23% of the country's waste generation. The National Solid Waste Management Commission (NSWMC), which is mandated to implement the Ecological Solid Waste Management Act of 2000, acknowledges the importance of addressing the problem of waste as a way to address the issue of climate change, and aims to reduce waste by 25% by 2010.

Several laws have been put in place since the 1970s relating to the development and implementation of solid waste management programs at the local level.

Republic Act 9003, otherwise known as the Ecological Solid Waste Management Act of 2000, provides for the adoption of a systematic, comprehensive and ecological solid waste management program to ensure the protection of public health and the environment. It ensures proper segregation, collection, storage, treatment and disposal of solid waste though the formulation and adoption of the best eco-waste practices.

The act also provides for the establishment of the National Solid Waste Management Commission (NSWMC) to oversee the implementation of the solid waste management plans. In response to its mandate, DENR issued a department administrative order that provides a timeframe for local government units to implement and upgrade their disposal facilities, which are mostly controlled dumpsites, to sanitary landfills within the period 2003-2009. Noncompliance to this order could warrant the filing of criminal cases against local government officials.

6.2. Incentives to Encourage Development and Transfer of Environmentally Sound Technologies

The Investment Priority Plan of 2009 provides policy and fiscal incentives to: biofuel production; renewable energy and other energy sources adopting environment-friendly technologies; power-generating plants located in missionary areas and privatized plants; modernization of iron and steel production leading to at least 5% reduction in energy usage; and projects related to the Clean Development Mechanism under the Kyoto Protocol.

To encourage the development of renewable energy projects and activities, the Renewable Energy Act provides the following fiscal incentives:

- Exemption of renewable energy developers from income taxes for seven years.
- Duty-free importation of renewable energy machinery, equipment, materials and parts for ten years.
- Special realty tax rates on equipment and machinery.
- Deduction from gross income for seven years of the net operating loss carryover (NOLCO) of the renewable energy developer during the first three years.
- Corporate tax rate – After seven years of income tax holiday, all RE developers shall pay a corporate tax of 10% on its net taxable income as defined in the National Internal Revenue Act of 1997, as amended by Republic Act No. 9337; provided that the RE developer shall pass on the savings to the end-users in the form of lower power rates.
- Zero percent value-added tax for the sale of fuel or power generated from renewable sources of energy, such as, but not limited to, biomass, solar, wind, hydropower, geothermal and ocean energy and other emerging energy sources using technologies such as fuel cells and hydrogen fuels. This is also extended to the purchases made by RE developers of local supply of goods, properties and services needed for the development, construction and installation of its plant facilities.
- Entitlement of all individuals and entities engaged in the plantation of crops and trees used as biomass resources to duty-free importation, and exemption from Value-Added Tax (VAT) on all types of agricultural inputs, equipment and machinery such as, but not limited to, fertilizer, insecticide, pesticide, tractor, trailers, trucks, farm implements and machinery, harvesters, threshers, hybrid seeds, genetic materials, sprayers, packaging machinery and materials, bulk handling facilities such as conveyors and mini-loaders, weighing

scales, harvesting equipment, and spare parts of all agricultural equipment.

- Entitlement of an RE developer to a cash generation-based incentive per kilowatt hour rate generated, equivalent to 50% of the universal charge for power needed to service missionary areas where it operates the same, to be chargeable against the universal charge for missionary electrification.
- Exemption of all proceeds from the sale of carbon emission credits from any and all taxes.

One of the major reasons preventing many LGUs from meeting the deadline set by the Ecological Solid Waste Management Law for converting their open dumpsites to sanitary landfills is the lack of funds. In February 2009, President Gloria Macapagal-Arroyo approved the revision of a cost-sharing framework between the national government and LGUs in order to help LGUs comply with the provisions of the law. Several bilateral assistance programs and projects were also provided by agencies like the United States Agency for International Development (USAID), German Organization for Technical Cooperation, and Japan International Cooperation Agency (JICA) to support national agencies and local governments in implementing the provisions of the law.

6.3 Institutional Arrangements

Various national government agencies are mobilized to implement programs and projects promoting the development and transfer of environmentally sound technologies for the mitigation of greenhouse gas emissions and adaptation to the impacts of climate change. DENR and DOE are the lead agencies at the national level that are responsible for the development of climate-related projects. Both agencies are involved in processing Clean Development Mechanism projects.

Other national agencies are also increasingly getting involved in the promotion of climate technologies.

- The Department of Trade and Industry (DTI) formulates and implements the Investment Priority Plan (IPP) that provides incentives to producers and developers of environmentally sound technologies. It is also responsible for the establishment of economic zones which attract producers of environment-friendly technologies. Efficiency in production and the use of low-carbon technologies are promoted in industries located inside the economic zones.
- The Department of Science and Technology (DOST), through its Integrated Program on Cleaner Production Technologies (IPCPT), aims to promote sustainable development and strengthen the competitiveness of Philippine industries through the adoption of cleaner production technologies. It also assists industries and other concerned sectors to reduce their pollution load, with the corresponding decrease in operating costs, and comply with environmental standards through the conduct of research and development.
- The Department of Tourism (DOT), through its Grassroots Entrepreneurship and Employment in Tourism (GREET) program, gives assistance in the form of financial aid, provision of skills and knowledge, values formation, and other entitlements to programs and projects that espouse environmental sustainability in concerned regions throughout the country. The program seeks to empower communities to be leaders in protecting ecotourism sites by building up their micro, small and medium enterprises.

The private sector plays a critical role as a government partner in the development and transfer of climate technologies, through investments in research and development and the introduction of technologies. It is represented by the Philippine Chamber of Commerce and Industry (PCCI), which recognizes the need to strike a balance between business and environment. PCCI has organized an Environment Committee to promote environmental responsibility in the Philippine business sector. One of its largest activities is the annual Excellence in Ecology and Economy (E3) Award where companies and enterprises that demonstrate innovative and outstanding environmental performance are recognized.

The Federation of Philippine Industries (FPI), under its sustainable development program, promotes the reduction of pollution through effective waste and emissions management and the efficient use of raw materials, fuels and other utilities. These objectives are also being pursued by the Pollution Control Association of the Philippines (PCAPI), which is committed to institutionalizing environmental conservation and promoting cleaner production, waste minimization, and pollution prevention among top managers, decision-makers and policymakers, workers in the industry, and the general public.

6.4. Development and Implementation of Climate Technology Programs and Projects

6.4.1 Energy Sector

The energy sector, being the largest contributor of greenhouse gas emissions in the country, has a huge potential in introducing climate-friendly technologies that mitigate emissions and at the same time bring economic benefits to the country. The programs of the national government, as implemented by the Department of Energy, include: the Energy Resources Program, Alternative Fuels Program, and Energy Efficiency Program.

The Energy Resources Program is aimed at promoting the utilization and development of the country's energy resources, including renewable and fossil fuels. The country has the potential to generate renewable energy from wind, hydro, solar, ocean and geothermal sources.

The goal of the Alternative Fuels Program is to develop indigenous and renewable energy fuels for long-term energy security. Alternative fuels are fuels which are substantially non-petroleum, and are used to provide energy to power an engine. These can include: natural gas (compressed or liquid); mixture containing more by volume of alcohol fuel such as ethanol and methanol; biodiesel (coco-biodiesel or coco-methyl ester); electricity (electric vehicle, hybrid vehicle); hydrogen; coal-derived liquid fuels; and fuels derived from biological materials.

The primary goals of the Energy Efficiency Program are to make energy efficiency and conservation a way of life, to increase awareness, and to attain 229 MMBFOE total energy savings from the implementation of energy efficiency and alternative fuels programs for the period 2005-2014. It is projected that about 50.9 million tons $C0_2$ equivalent greenhouse gas emissions will also be avoided during that period.

In 2005, the Department of Energy implemented the Philippine Efficient Lighting Market Transformation Project (PELMATP), a five-year project co-funded by the Global Environmental Facility (GEF) through the United Nations Development Programme (UNDP). PELMATP aims to address the barriers to the widespread utilization of energy-efficient lighting systems in the Philippines. It will cover energy-efficient versions of linear fluorescent lamps (standard versus the slim tubes), compact fluorescent lamps (CFLs), high-intensity discharge (HID) lamps, ballasts (low-loss electromagnetic and electronic), and luminaires. Another initiative of the government is the *Palit Ilaw* Program under the National Energy Efficiency and Conservation Program (NEECP) of DOE. The program seeks to encourage consumers to replace their incandescent bulbs with high energy-efficient compact fluorescent lamp. The program is supported by the UNDP and GEF.

6.4.2 Agriculture

The Philippines' agriculture sector, with roughly 14 million hectares of agricultural land[9] and with some 32.15 million Filipinos relying on agriculture and agriculture-related industries as their source of livelihood, produces considerable amounts of greenhouse gases. These are mostly CH_4 and N_2O. CH_4 or methane comes mainly from anaerobic decomposition of organic matter from rice paddies, enteric fermentation, and manure of farm animals like water buffaloes, cattle and swine. N_2O comes primarily from the use of synthetic fertilizers and pesticides. Addressing these concerns will drastically

[9]http://www.da.gov.ph/newindex2.php?pass=about/profile.htm

reduce this sector's contribution to the increased concentration of greenhouse gases in the atmosphere.

The Philippine government is undertaking a number of programs/projects to mitigate greenhouse gas emissions in the agriculture sector. Below are some of these programs/projects:

- The National Organic Agriculture Tamang Abono Program – Implemented by the Department of Agriculture (DA). In cooperation with the local government units, the DA will establish community-based composting facilities to produce organic fertilizers.
- Knowledge Working Towards Enhancing Agricultural Communities Program or K-Agrinet Project – A collaborative effort among the country's agencies to utilize information technology as a tool for fast-tracking the dissemination of agricultural and natural resources information and technologies to farmers, upland dwellers, and rural entrepreneurs.
- The e-Learning Program – Led by the Open Academy for Philippine Agriculture of the Department of Agriculture-Philippine Rice Research Institute (DA-PhilRice). It focuses on e-extension and distance learning for the agriculture extension workers.
- The e-Consortia – Led by DOST's Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). It intensifies technology and knowledge generation and exchange among existing partner R&D institutions through improved ICT tools and applications.
- The e-Farm – Also led by DOST-PCARRD. It promotes e-commerce by initiating e-based farm-to-market opportunities through the FITS centers and their respective farmer-scientists.
- The e-Agrikultura – Led by the Department of Agrarian Reform (DAR) and Development Academy of the Philippines (DAP). It mobilizes and generates the participation of agrarian reform communities in the program.

6.4.3 Industries

In September 2009, the ASEAN countries signed the Manila declaration on Green Industry which encourages Asian countries to set the appropriate institutional and policy framework for transition to resource-efficient and low-carbon industries. It calls for such measures as the incorporation of cleaner production policies in national development plans and the fostering of a viable business environment conducive to investments in green industries. Moreover, the declaration encourages the promotion of the increased use of renewable energy and energy-efficient processes in the industrial sector, research and development programs that will lead to green innovation, and investments and financing in low-carbon and resource-efficient manufacturing industries.

The Philippine Environment Partnership Program (PEPP) with industries aims to support industry self-regulation towards improved environmental performance. By providing a package of incentives and reward mechanisms to industries, the DENR hopes to help business establishments, particularly small and medium enterprises, to adopt pollution prevention and cleaner production processes. Regulatory privileges and assistance, such as the relaxation of report requirements, simplification of requirements for securing an Environmental Compliance Certificate (ECC), and flexible payment schemes, are also offered under the PEPP. Ten industry associations have signed up for this program.

6.4.4 Private Sector Initiatives

6.4.4.1 Cement

To reduce the environmental impact of cement manufacturing, majority of the big cement companies in the Philippines are now using new forms of selected and prequalified waste material and by-products from other industries either as alternative fuel or alternative raw material. Coprocessing of industrial and residual wastes to derive thermal energy in cement clinker production helps decrease the use of fossil fuels and reduce carbon dioxide emissions.

6.4.4.2 Cogeneration

Majority of the sugar refineries in the Philippines (particularly those in Cagayan Valley, Pampanga and Batangas) make use of "bagasse," a byproduct derived from sugarcane, as fuel. One refinery in Leyte uses this by-product as fuel for its boilers to generate steam, which is then used to drive turbines of cane milling plant equipment and turbo generators to produce electricity for the sugar processing plant. This helps lower the company's energy costs especially during the milling season. Also in Leyte, a bioethanol plant utilizes rice hull for running its boilers. With 100% rice hull fuel, fuel costs have dramatically shrunk from PhP2.8 million monthly to only PhP270,000.

A company in Cebu that manufactures electronic peripherals likewise uses co-generation. Through this technology, heat that is otherwise discarded from conventional power generation is utilized to produce thermal energy. This energy is then used to provide cooling or heating for industrial facilities, such as air conditioning and machine cooling, in selected production divisions in the plant. This practice of recycling exhaust heat resulted in energy savings of 220,896 kwh/month or PhP3.1M monthly savings for the company.

6.4.4.3 Methane Recovery

By capturing methane, environmental impacts are mitigated. A controlled disposal facility in Metro Manila and a sanitary landfill in Rizal province collect and convert methane to generate electricity. In Davao, a beer manufacturing plant recovers and utilizes methane to fire its boiler to produce steam. The brewery thus saves 180,000 liters of fuel or PhP2.7M every year and has, in addition, earned carbon credits for this practice.

6.4.4.4 Energy-Saving Programs

A semi-conductor company in the Cordillera Administrative Region has the first building in the Philippines to gain a Leadership in Energy and Environmental Design (LEED) certification. The building was designed with respect to the sun's path in order to minimize unwanted heat gain and maximize natural daylighting.

A hotel company in Metro Manila implemented sustainable energy savings programs through the use of energy-saving building management systems and the replacement of lightings and chillers, which enabled the company to save around 4,920,867 kwh of electricity or 2,952,520.20 kg equivalent reduction of carbon dioxide emission.

A brewery in Mandaue City conserves energy by reducing the use of lights and air-conditioning, replacing incandescent bulbs with energy-saving bulbs, rationalizing the operations schedule to maximize usage of utilities, and optimizing the operation of its ammonia compressors which account for 40% of the plant's energy consumption. Total energy conservation efforts led to savings of 8% for power and water alone, or over PhP18M in generated savings.

Photo by CAD

6.5 Technology Needs Assessment

In 2003, the New Energy and Industrial Technology Development Organization (NEDO) conducted a study entitled "Needs Assessment of Technology Transfer for the Mitigation of Global Warming in the Republic of the Philippines." The purpose of the study was to identify technologies that would reduce GHG emissions and were needed to be transferred to the Philippines with high priority. The prioritization of technologies was done through questionnaire surveys and needs analyses using the Analytic Hierarchy Process (AHP) and Data Envelopment Analysis (DEA). The study was carried out from November 2003 to March 2004.

Table 6.1 shows the technologies identified as high priority from the survey conducted for government respondents.

Table 6.1. Technologies identified as high priority by the Philippine government

Sector	Technology
Energy sector: Renewable energy	✓ Wind power generation ✓ Photovoltaic power generation ✓ Tidal power generation, tidal current power generation ✓ Biomass power generation (rice husk) ✓ Waste power generation
Energy sector: Coal thermal power, transmission and distribution	✓ Utilization of low-grade coal ✓ Installation of ultra super critical (USC) boiler ✓ Installation of pressurized fluidized bed combustion (PFBC) ✓ Installation of integrated gasification combined cycle (IGCC) ✓ Improvement of electric power distribution ✓ Reduction of transmission and distribution loss
Industry sector	✓ GHG reduction technologies for cement industry ✓ GHG reduction technologies for steel industry ✓ GHG reduction technologies for sugar industry
Transport sector	✓ Low-emission vehicles, clean-energy vehicles ✓ Improvement of fuel quality ✓ Improvement of fuel consumption ✓ Inspection and maintenance system ✓ Reinforcement of public transportation: railway ✓ Reinforcement of public transportation: public bus
Residential and commercial sector	✓ Highly efficient lighting (compact fluorescent lamp) ✓ Cogeneration in the commercial sector ✓ Efficient energy management and demand side management system in buildings

Source: NEDO Study on Needs Assessment, 2004

Table 6.2. Technologies identified as high priority by the private sector

Sector	Technology
Energy sector: Renewable energy	✓ Wind power generation ✓ Photovoltaic power generation ✓ Tidal power generation, tidal current power generation ✓ Fuel cell ✓ Mini and micro hydro power generation ✓ Hybrid renewables (e.g., solar and wind) ✓ Utilization of geothermal energy for non-electric purposes
Energy sector: Coal thermal power, transmission and distribution	✓ Renovation of coal thermal power plants ✓ Fuel conversion to natural gas for thermal power plants ✓ Installation of pressurized fluidized bed combustion ✓ High-voltage transmission ✓ Reduction of transmission and distribution loss
Industry sector: Cement	✓ Heat recovery for cogeneration ✓ Use of waste-derived fuels ✓ Use of waste-derived materials (eco-cement, blended cement) ✓ Technology of CO_2 capture from flue gas
Industry sector: Sugar	✓ Anaerobic treatment/biogas recovery from waste water and other organic wastes (e.g., filer cake) ✓ Commercial cogeneration (sale of power) using bagasse ✓ Highly efficient bagasse boiler ✓ Energy audit and energy management in sugar processing ✓ Automation of energy-intensive equipment/systems (boiler, heat exchange)
Industry sector: Pulp and paper	✓ Utilization of energy from paper sludge and solid waste ✓ Utilization of energy from pulp waste water (black liquor) ✓ Use of low-carbon fuel for private power generation ✓ Improvement of the efficiency of cylinder dryer ✓ Anaerobic treatment/biogas recovery from waste water and other organic wastes
Residential and commercial sector	✓ Efficient energy management and demand side management system in buildings ✓ Energy management and energy audit

Source: NEDO Study on Needs Assessment, 2004

Table 6.2, on the other hand, lists the technologies identified as high priority by respondents in the industry sector.

The study has also identified some challenges and recommendations, which are given in Table 6.3.

Table 6.3. Challenges and recommendations of the NEDO study

Key Word	Obstacles	Countermeasures Expected on Japanese Side (Opinions from the Philippine Side + Proposition by the Study Mission)
Fund mechanism	Lack of fund mechanism especially for the poor	Create a Japanese version of the Community Development Carbon Fund (CDCF*).
	Lack of information on Japanese fund mechanism	Disseminate the information on Japanese fund mechanisms to those who will benefit from the transferred technologies, and support a counterpart approach from the Philippines to Japanese companies.
Engineers	Lack of knowledge on transferred equipment and its operation and maintenance	Provide training of engineers at equipment manufacturers, hands-on training based on trouble shooting, and strengthening of the technology transfer in pilot projects.
Government policy/initiatives	Lack of tax incentives and subsidies for the introduction of environmentally friendly technologies	Provide technical assistance contributing to the introduction of tax incentives and subsidies.
	Insufficient implementation of plans in the transport sector	Provide support for establishing systems where private companies can participate in the transport sector by BOO** and BOT.***

*CDCF: Community Development Carbon Fund, which is one of the fund mechanisms for CDM projects initiated by the World Bank. It focuses on least developed countries and rural areas in countries in economic transition and developing countries.

**BOO: Build-Operate-Own. Private companies finance, build, operate and own the facilities.

***BOT: Build-Operate-Transfer. Private companies finance, build and operate the facilities for a certain period, but transfer them to the public sector.

Source: NEDO Study on Needs Assessment, 2004

6.6 Needs, Gaps and Constraints in the Development and Transfer of Technologies

The Philippines is aggressively pursuing programs to promote renewable energy and energy-efficient technologies. However, the lack of financial resources and investments, low public awareness of the benefits of these technologies, absence of commercially viable markets for renewable energy systems, and the relatively high cost of technology constrain the development and transfer of these technologies.

To address these barriers, the government is formulating programs and projects to stimulate greater private-led investments in the sector, promote renewable energy technologies as competitive energy options, and maximize the use of renewable energy potentials.

However, even at the policy level where big strides have been achieved, there is still room for improvement. For example, there is still the need to ease the restriction of foreign ownership of any geothermal venture to 40%, which is a major stumbling block to the entry of investments in geothermal resources.[10]

The energy sector may well concentrate on looking for funds to develop its renewable energy potential to drastically reduce the country's dependence on imported fossil fuels. Based on the Philippine Energy Plan 2007-2014, the country has considerable untapped renewable energy with the following investment requirements:

- Geothermal: 580MW, PhP61.63 billion
- Hydropower: 1,025.10 MW, PhP114.81 billion
- Biomass: 183.90 MW, PhP19.57 billion
- Wind: 556 MW, PhP62.33 billion

[10]Philippine Energy Plan 2007-2014

To support the development of alternative transport fuel program such as bioethanol, biodiesel and liquefied petroleum gas, PhP83.22 billion is needed.

The Energy Efficiency and Conservation Program (EECP) will require an estimated investment of PhP48.69 billion for activities like energy labeling and efficiency standards, energy management, information campaigns, energy conservation, and voluntary agreement programs.

Since developing renewable energy sources is expensive, cooperation and/or partnership with local and international funding agencies and governments are very important. One of the recent steps along this line is the partnership between the Development Bank of the Philippines (DBP) and USAID's ECO-Asia Clean Development and Climate Program (ECO-Asia) to promote clean energy investments in the country. The memorandum of understanding on the partnership was signed on October 1, 2009. [11]

The following technologies, meanwhile, are needed to reduce emissions from the waste sector:

- Technologies for wastewater treatment or sewage treatment
- Landfill technologies
- Technologies for recycling
- Waste to energy technologies
- Methane capture from disposal facilities, hog farms, etc.
- Waste heat recovery

As in the other sectors, the major barrier in the introduction of environmentally sound technologies in the waste sector is the lack of financial and technical resources. This is also the main constraint of LGUs in meeting the deadlines set by the Ecological Solid Waste Management Act to upgrade their disposal facilities. The lack of access to technologies and the lack of skilled technicians to operate the technologies also serve as barriers to implementing environmentally sound technologies in the waste sector. There is also a need to build the capacity to develop solid waste management plans and manage the disposal sites. Public-private sector partnership in developing and using new climate-friendly technologies for waste management needs to be strengthened.

[11]http://www.malaya.com.ph/oct19/envi4.htm

Conclusions

The recent policies and measures set in place by the government, in partnership with stakeholders, are consistent with the framework for meaningful and effective actions in the UNFCCC, particularly on the provisions relating to enabling environments and mechanisms for technology transfer. The landmark legislations passed by Congress supplemented by the executive and administrative orders were aimed at bringing together producers and consumers of climate-friendly technologies, and encouraging them by providing them with incentives and technical support. At the same time, institutional arrangements are being strengthened at the government and private sector levels to pursue technology transfer programs.

However, policy implementation or execution is a perennial weakness in the country. This is partly due to the lack of institutional resources and capacity on the part of the agencies tasked with execution. There is also inconsistency in the enforcement of rules and regulations. Any effective transfer of technology will need to address these issues of governance and accountability.

There is also a need to continually build the capacity of concerned personnel and to put into place systems and life-cycle approaches for technologies of interest to the Philippines. All too often, cultural factors also come into play and hinder the uptake of the needed technologies. These barriers to technology transfer and diffusion must be understood and overcome through intensive advocacy and education. In addition, there is also a need to build the country's capacity for research, education and provision of sustainable technical support by the relevant institutions.

Research and development is an area that needs to be pursued in order for the country to fully tap its potential in the development and utilization of climate-friendly technologies. Also, increased support is needed for the Special Economic Zones as entry points for investments and technology transfer.

There is need to increase creative financial and economic mechanisms and instruments (at the macro and micro domestic levels) to enable technology transfer and diffusion and facilitate technology development.

The country also needs to conduct a systematic and thorough assessment of the technology needs on mitigation and adaptation. The needs assessment will be crucial in guiding the development of national strategies on climate change technology transfer, diffusion and development that are responsive to the stakeholders' and the communities' needs.

Chapter 7: Research and Systematic Observation

Overview

The Philippines has in place structures and programs for the systematic observation of its climate at the national and local levels. Different government agencies also have specific climate-related research programs, and the country has participated in global efforts in climate research and systematic observation. These programs and initiatives are discussed in this chapter.

Also discussed are the country's needs and priorities in climate research and systematic observation that might benefit from international assistance. These needs, which have to be addressed if the country is to understand its climate patterns, implement appropriate mitigation measures, and reduce vulnerability to climate change, include, among others, the following: lack of needed infrastructure and equipment; lack of trained personnel to operate and maintain climate observation systems; limited number of facilities or sites (e.g., tide stations) for data collection; and lack of funds to maintain and sustain these operations.

7.1 Status of National and/or Regional Programs for Systematic Observation

7.1.1 Atmospheric and Meteorological Observation Platforms

One of the major functions of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is to maintain a nationwide network pertaining to observation and forecasting of weather and other climatological conditions affecting national safety, welfare and economy. PAGASA, the country's weather bureau, maintains an operational network of observation and information systems consisting of:

- 79 weather stations
- 28 stream gauges
- 102 rain gauges
- 4 Dopplers (Subic, Tagaytay, Cebu and Hinatuan stations)

(Source: Project NOAH)

7.1.2 Operational Issues

PAGASA has been perennially plagued by lack of the required infrastructure to undertake appropriate weather and climate monitoring and forecasting. The recent spate of meteorological and meteorologically induced disasters has forced the government to allocate some funds in its meager national budget for the acquisition of automatic weather stations, radar surveillance, and other equipment for the proper and timely issuance of weather bulletins to the public. The government's own bureaucratic procurement system, however, has delayed the acquisition of these systems and equipment.

Multilaterals and bilaterals have provided support but cannot fully provide for the country's requirements. Other problems include finding appropriate sites for these systems and ensuring their security, considering that they usually have to be installed in remote and less populated areas where LGUs and other partners may have problems keeping them secure. There is also a lack of trained observers and operators of the systems, and inadequate budget for continued operation and maintenance. For aeronautical meteorological stations, the relocation and construction of bigger airports resulted in the dislocation of existing stations. Maintenance is particularly an issue, noting that highly sophisticated instruments and equipment (e.g., telemetry) are vulnerable to breakdowns due to high personnel turnover. When equipment breaks down, repairing and restoring it to operation usually takes time because of the unavailability of the needed spare parts locally.

7.1.3 Other Bio-geophysical Observation Platforms

The country has limited platforms for the observation of bio-geophysical changes that can be attributed to climate change. The Oceanography Division of the Coast and Geodetic Survey Department (CGSD) of the National Mapping and Resources Inventory Authority (NAMRIA) is in charge of the collection of physical oceanographic data such as tides, currents, temperature, salinity and depth.

Primary tide stations, where continuous tidal observations are conducted, are located in strategic coastal areas within the different seaports of industrial and economic convergence centers such as Manila, Cebu, Davao and Legaspi. To date, there are ten primary tide stations in the Philippines with tide house structures and tide gauge equipment. There are other types of observation platforms managed by universities but these are primarily for their own academic researches.

7.2 Information on Research Programs

The Philippines embarked on a massive research program in 2008 to determine the impact of future climate scenarios on the country's ecosystems and population. This program started with the development of the capacity of PAGASA personnel in downscaling global circulation modeling results and planning, and of other sectoral agencies in risk assessment and management.

PAGASA has produced national and provincial climate scenarios for 2020 and 2050. These are now being used as basis for the review and climate-proofing of all national, regional and local land use and development plans. A risk assessment methodology integrating disaster risk reduction and climate change adaptation has been developed and continues to be refined. This is being used in the vulnerability and adaptation assessment for all the country's 81 provinces.

Impact modeling is being employed to come up with more realistic sectoral adaptation strategies and to address the sources of disaster risk. Integrated adaptation

strategies are also being tested on a sectoral and intersectoral basis. Examples of these sectoral researches include those on: the development of agricultural systems adaptable to climate change; climate risks to and coping capacities of productive systems; analysis and quantification of risks to ecosystems; pilot-testing of innovative water management strategies; use of decision support systems for the monitoring and management of environmental hazards; development of climate diagnostics tools; development of climate-related disease surveillance systems; the use of impact quantification tools, community-based early warning systems, and other instruments.

Following President Aquino's instructions for the Philippine government warning agencies to provide a 6-hour lead time to warn vulnerable communities against impending floods, the Department of Science and Technology launched the Nationwide Operational Assessment of Hazards (NOAH). The main goal of the NOAH program is to undertake disaster science research and development through the use of modern technologies and recommend innovative information services in government's disaster prevention and mitigation efforts. The program has eight components:

- Hydromet Sensors Development
- DREAM-LIDAR 3-D Mapping Project
- Flood NET-Flood Modeling Project
- Hazards Information Media
- Enhancing Geo-hazards Mapping through LIDAR
- Doppler System Development
- Landslide Sensors Development Project
- Storm Surge Inundation Mapping Project

It is targeted that within two years, the NOAH Program will provide high resolution flood hazard maps and install 600 automated rain gauges and 400 water level measuring stations for the 18 major river basins of the Philippines.

Various government agencies, the private sector, the academe and development partners are participating in this program. Researches are thus being undertaken on several fronts: in government sectoral and research institutions, universities, extension offices, bilateral and multilaterally supported projects and programs, and LGU and civil society initiatives.

7.3 Nature and Level of Participation in Global Research and Observation Systems and Related Programs

7.3.1 Meteorological and Atmospheric Observation

Under the World Weather Watch (WWW), the national meteorological and hydrological agencies of the member countries of the World Meteorological Organization (WMO) are enjoined to exchange meteorological data through the Global Telecommunication System (GTS). The Philippines, through PAGASA, sends meteorological data from its synoptic stations every 6 hours to the WMO's Regional Specialized Meteorological Center in Tokyo, Japan and the ASEAN Specialized Meteorological Center (ASMC) in Singapore. These data are used as inputs to numerical weather prediction models, among others.

The global exchange of meteorological data is essential in weather monitoring and forecasting, seasonal climate forecasts, and climate change monitoring and prediction. Because of lack of transmitters, however, there were instances when PAGASA could not send upper air data.

Photo by CAD

7.3.2 Oceanographic Observation

There are four Philippine tide stations that are registered in the network of tide stations under the Intergovernmental Oceanographic Commission's (IOC) Global Sea Level Observing System (GLOSS) for worldwide tidal scientific studies. These are the Manila, Cebu, Legaspi and Davao tide stations. As a member of the IOC, the Philippines sends yearly tidal data to this program as part of its commitment to the oceanographic surveying activities.

7.4 Needs and Priorities for Climate Change Research and Systematic Observation, Particularly Areas of Priority that Would Benefit from International Assistance

7.4.1 Research Challenges

Like other countries, the Philippines needs detailed, high-resolution information on future climate and its impact on the country's population and ecosystems. Such information is needed by the country's scientists in disciplines requiring climate information (e.g., hydrologists), decision-makers and policymakers, and those assessing climate change impacts, adaptation and vulnerability.

However, the country faces constraints in computing capacity because of lack of models and other tools, lack of skilled manpower in the relevant institutions, and lack of finances. These inadequacies also lead to problems in acquiring actual field data critically needed in studying climate change and assessing impact and vulnerability.

7.4.2 Mode of Data Acquisition and Transfer of Information

One major challenge in acquiring field data in the Philippines is the lack of equipment and instrumentation. Tidal data, for example, are still manually obtained and it takes a while, therefore, to transmit this to the users. The geographic coverage of tidal data gathering is also extremely limited. The present number of tidal stations in the country is not sufficient to provide adequate tidal information for the entire coastline.

It is very important to expand the country's tide station network, considering the variable tidal behavior of the waters surrounding the archipelago that must be fully understood. The country lacks tidal information in many areas, both in its internal waters, which are used largely for navigation, and in the outer coastlines, which are very long and could therefore be experiencing a variety of tide patterns. The existing tide stations may not define the variety of tidal characteristics very well as they are spaced too far apart from one another.

Expanding the country's tide station network would entail the establishment of additional stations in several of the country's coastal areas, with the following as initial priorities: Eastern Mindanao, Eastern Samar, Masbate, Northeastern Luzon, Northwestern Luzon, Southwestern Negros, the Coast of Zambales, Western Palawan, and Zamboanga.

7.4.3 Data Sharing, Exchange and Collaborative Researches

Issues that constrain data sharing and exchange need to be firmly addressed, not only at the institutional level but also at a national policy level, in the interest of national and human security. Research collaborations between North-South and South-South nations will be desirable in order to take advantage of existing operational methods and tools in integrated impact, vulnerability and adaptation assessments in advanced research centers of developed countries. Also, more funds should be allocated for applied scientific researches on adaptation to climate change.

Chapter 8: Public Awareness and Capacity Building

Overview

Photo by CAD

Informing, educating and capacitating people are a basic strategy in preparing communities for and protecting them against the possible effects of climate change. This chapter reports the activities undertaken by the Philippines in terms of public awareness and capacity building on climate change through its various institutional mechanisms and programs. It also presents the main findings of a baseline perception survey conducted to determine the level of awareness and understanding of climate change among sectoral groups located in disaster-prone areas.

Recommendations are then given based on the communications audit and the results of the perception survey. Among the recommended actions and approaches is the segmentation of target audiences and the development of messages and materials that are suited to the different types of audiences and their information needs. It is also recommended that a social marketing and communication plan be developed that would raise people's awareness and change their attitudes and behaviors in favor of more effective climate change adaptation and mitigation, especially among the most vulnerable sectors.

8.1 Institutional Mechanisms and Programs

As a country party to the UNFCCC and its Kyoto Protocol, the Philippines has undertaken numerous activities over the past years to comply with its commitments under the convention, particularly on raising public awareness and developing the capacity of critical stakeholders on climate change.

Under the Amended New Delhi Work Programme on Article 6 of the Convention (Decision 9/CP.13), activities undertaken by the country for public awareness, education and training on climate change have to be reported. Since its Initial National Communication on Climate Change in 2000, where the Philippines first reported on its obligations under the convention, the country has continued to embark on different activities on public awareness that involved all branches of government, civil society organizations, research and academic institutions, the private sector, LGUs and local communities.

The mandate to oversee public awareness raising and capacity development (which is now with CCC) used to be with the IACCC, with DENR-EMB as its secretariat. Government efforts are complemented by academic-based entities like the Climate Change Information Center (CCIC), now known as Klima Climate Change Center. The CCIC went into full operation in 2000 following its creation in 1999.

In 2007, the Presidential Task Force on Climate Change (PTFCC) was created to address the urgency of climate change. It was given a specific mandate to "conduct a massive and comprehensive public information and awareness campaign nationwide to educate the public on the climate change situation and its adverse effects, and to mobilize multi-sectoral actions on climate change." The PTFCC was initially chaired by the DENR, and later by the DOE[12]. In December 2008, the Office of the President assumed chairmanship of the PTFCC. All cabinet members became members of the task force. Under the new setup, communication and education initiatives were carried out by the Task Group on Information and the Task Group on Education.

When the Climate Change Act was passed in 2009, the Climate Change Commission, which is directly under the Office of the President, assumed the mandate of overseeing public awareness programs on climate change.

Initiatives aimed at fostering public awareness and enhancing education on climate change were also undertaken by executive agencies (like DOE, DA and DOST), LGUs like the Province of Albay and the Municipality of Dumangas, the Philippine Senate, research and academic institutions, civil society organizations, financing institutions, and the business sector.

While the initial activities were focused on measures to mitigate sources of climate change, a broad range of IEC programs, materials and messages on adaptation have been developed in recent years. About half of the activities and a good majority of the materials were focused on the island of Luzon, in particular Metro Manila, and targeted the general public.

8.2. IEC Materials, Advocacy and Capacity Development Initiatives

The Philippine government and its partners have been continuously generating multimedia information materials and undertaking activities to raise public awareness and critical stakeholders' capacity on climate change. The materials include brochures, videos, promotional materials, television/radio/movie plugs, and others. The activities conducted include briefings, seminar-workshops, forums, consultations, television and radio shows, and targeted training for national government agencies, regional bodies, local government units, the academe, the private sector, and local communities. To widen the coverage of these IEC and advocacy activities, partnerships were built and various media were utilized, including innovative media like mall exhibits, multimedia contests, and local arts media, among others.

Competency development programs have also been developed, tested and now in the process of institutionalization and national rollout. These deal with specific concerns like: vulnerability and adaptation assessments; climate proofing of plans, programs and regulatory systems; development of sectoral strategies for disaster risk reduction and climate change adaptation; development and selection of mitigation strategies; development of early warning systems; and contingency planning. The competency programs are intended for the country's planners, academicians, technicians, civil society organizations, disaster managers, the media, local communities, and the youth. For the youth, curriculum and resource materials have already been developed and tested for the elementary and secondary levels.

[12] PTFCC was created in February 2007 by virtue of AO 171 with the DENR heading the task force. In August 2007, AO 171A was effected transferring the chairmanship of the PTFCC from the DENR to the DOE. The mandate of the task force remained the same.

8.3. Capacity-Building Projects by Development Partners

Development partners have been instrumental in carrying out capacity-building initiatives on climate change, as shown in Table 8.1.

- Many respondents from the tourism and household sectors correctly perceived that the causes of weather variability were related to humans.
- Only respondents from the tourism sector gave possible solutions to weather variability. Their top solutions given were tree planting/reforestation and cooperation of all humans.

Table 8.1. Capacity-building initiatives on climate change by development partners.

Project	Time Frame	Funding Source	Implementing Partner
Enhancing Capacities for Low-Emission Development Strategies (EC-LEDS)	2012-2014	US Government through USAID	CCC
Low-Emission Capacity Building Philippine Project	2012-2014	European Union (EU), Germany and Australia through UNDP	CCC
Regional Capacity Building for Sustainable National GHG Inventory Management Systems in Southeast Asia	2010-2013	US Government with technical assistance from UNFCCC and Colorado State University	EMB – 2010-2011 CCC – 2011-2013
Integrated Capacity Strengthening for CDM	2003-Present	IGES	IACCC, EMB-Climate Change Office, Klima-Climate Change Center, Ateneo School of Government
Philippine Greenhouse Gas Accounting and Reporting Program	2005-2006	World Resources Institute (WRI)	EMB, Philippine Business for the Environment (PBE), Klima-Climate Change Center
Developing Capacities for Clean Development Mechanisms	2003-2005	Netherlands Government through United Nations Environment Programme (UNEP) Riso Centre	IACCC through Klima-Climate Change Center
Developing Local, National and Regional Capacities to Sustain Climate Change Initiatives in the Philippines and East Asia	2001-2005	USAID	Manila Observatory through its Klima-Climate Change Center

8.4 Gaps and Constraints

Despite the numerous IEC undertakings, results of a recent perception survey conducted in preparation for this SNC report indicate that there is still need to refine in the content of the messages and their delivery strategies. For example, the perception survey revealed that:

- Respondents could articulate their observations on the changing environment but some do not know what caused them; hence, they were also at a loss for possible solutions.
- Fishermen's and farmers' top answers concerning the possible specific causes of weather variability were: they did not know, or the changes were natural. This points to the need for materials and delivery strategies to be customized for local level stakeholders at the community level.
- The concept of environmental action was viewed as maintaining the aesthetics of a place, as evidenced by citing cleanups and planting trees and ornamentals as activities beneficial for the environment.

8.5 Recommendations for Enhancing Education and Public Awareness Measures

Based on the communications audit and the results of the perception survey and materials/activities inventory, the following are recommended:

1. Include/articulate "belief" and "action" objectives in succeeding campaigns.
2. Use at least two methods of identifying audiences in order to increase the chances of

attaining desired outcomes. The first method is strategic market segmentation where the audience is partitioned and profiled according to geographic, psychographic and behavioral characteristics. The second method applies the "Law of the Few" (Gladwell, 2000), which differentiates audiences as one of the following: (1) innovators (those who will be the first to adopt the attitude and behavioral change); (2) early adopters (who are usually the social leaders, popular and educated); (3) early majority; (4) late majority (skeptical, traditional, lower socioeconomic status); and (5) laggards (who consider neighbors and friends as main information sources).

3. Tailor-fit primary and secondary messages to specific target audiences according to which of the following approaches would be most suitable:

    - Using the experiences of specific target audiences as a takeoff point to link climate change manifestations with the concept.
    - Exploring emotional elements in key messages that are believed to be more effective in capturing attention and persuading mass audiences.
    - Asserting that environmental degradation is man-made, and as such, can be addressed by man himself.

4. Consider tapping the innovators and early adopters in the target audiences as primary information sources (e.g., church, community leaders).

5. Use special promotional items with the support of the private sector, and tie these up with their corporate social responsibility (CSR) programs.

6. Develop printed materials more sensitive to the needs and preferences of diverse audiences other than institutions and intellectuals.

7. Use the Internet as a media platform and as a support to the other media strategies.

8. Choose specific media vehicles carefully, with full consideration of timing, campaign goals and communication objectives, desired reach and frequency, advantages and limitations of media options, sensitivity of target audiences, and budgetary constraints.

9. Consider the proposed social marketing plan that aims to teach individuals to get out of their current mindsets and behaviors and adapt to new and more desirable ones. This plan targets the surveyed sectors and prioritizes the implementation of public awareness, education, and information campaigns among these sectors, particularly the farmers and fisherfolk, given that these two sectors are the ones that are most vulnerable to the effects of climate change. The points raised from previous items have been incorporated in this plan.

10. Set up a monitoring and evaluation system to track progress on the indicators of success of future communication efforts, like level of knowledge on climate change, actual individual or group efforts to adapt to or mitigate climate change, and other indicators. It is also recommended that a bottom-up approach be considered in the development of materials for IEC on climate change.

An interagency workshop is also proposed to for national and local government agencies to discuss how to better coordinate communication efforts so that messages are unified and consistent, and to discuss and agree upon the changes in behavior and attitudes they expect to see in their target groups. The proposed social marketing and communication plans can be discussed and formulated during this workshop.

Chapter 9: Gaps, Needs and Constraints

Overview

This chapter puts together the gaps, needs and constraints identified in the previous chapters on vulnerability and adaptation assessment, mitigation, technology transfer, research and systematic observation, and public awareness and capacity building. The chapter provides an overall view of the extent of the challenges that the Philippines has to face and actions it needs to take in order to address the climate change problem, especially its impacts.

9.1 Vulnerability and Adaptation Assessment

9.1.1 Climate Scenarios

There is still a need for higher-resolution scenarios, at least up to the provincial level. The unavailability of daily projected values for impact assessments and maps for policymakers is also a constraint to the performance of more realistic vulnerability and adaptation assessments.

There is also a shortage and inaccessibility of non-climatic data (such as socioeconomic data, environment data, and other related information) from diverse sectors, which makes it difficult to make a full assessment on vulnerability to climate change and analysis of adaptation measures.

In the process of vulnerability assessment, difficulties were faced relating to data in the following areas: development of scenarios, water resources in the zone of runoff distribution, agriculture, ecosystems, population and health, and dangerous and extreme phenomena related to the climate.

Base maps (topographic, land use, resource base, etc.) are very important and need to be updated. The scale must show at least down to the municipal levels.

9.1.2 Socioeconomic Scenarios

Future scenarios are essential to carry out research on the future options for qualitative or, if possible, quantitative basis for assessing the possible consequences of climate change.

Strengthening methodological capacity in socioeconomic assessment and raising awareness/understanding of the importance of such assessments for climate change impacts are greatly needed. These are related not only to building development scenarios, but to assessing climate change impact. For example, it is important to assess damages from extreme weather and climate events in order to estimate the costs and benefits of alternative adaptation measures.

Different research and scientific institutions have taken an increased interest in the climate change and variability problem. Certain research projects are being implemented with support from international organizations. These, however, are isolated, and exchange of research findings is both limited and complicated. There is no task-oriented research program that addresses this issue.

Integrated vulnerability adaptation assessment and study alternatives with model application have not really been developed yet. Given the deficiency of domestic resources, the following are therefore necessary:

- Development of a scientific research program focused on climate change
- Establishment of research networks facilitating interdisciplinary research and information dissemination
- Improvement of coordination among the various sectors, institutions and initiatives on climate change to facilitate synergies and their integration in policy and sector-specific programs promoting adaptation

There is also a need to coordinate climate change researches associated with the needs of decision-makers in various sectors, and to inform the general populace of the future risks, potential vulnerability, and risk reduction cum adaptation measures.

9.1.3 Sectoral Issues

9.1.3.1 Agriculture and Food Security

There are numerous issues which the sector must address in order to provide conditions/environments that will enable the sector to become resilient and highly adaptive to climate change. These include, but are not limited to, the following:

- Creating an enabling environment for private investments in agriculture
- Climate-fit crop programming and climate-based cropping mix in highly vulnerable agricultural areas
- Maximization of production in climate-proofed farming areas, particularly those with moderate rainfall
- Developing policy environments for sustainable development of highland ecosystems (500-1000 meters above sea level elevation) as future expansion areas for food and nutrition security without further intrusion into or desecration of remaining forestlands, considering that the highlands have ideal soil and agro-environment support for production
- Increasing local capacity to compete with global products within local markets, including that for

Photo by CAD

bulk production and quality management of farm products

- Harmonizing food and bio-energy development and other economic uses of agricultural activities, and technological support systems for food security

9.1.3.2 Forestry, Biodiversity and Water

Among the needs for this sector are:

- Land capability evaluation tools for improved land use selection that will minimize impacts of improper land uses and minimize risks of damages and losses due to climate change and other stressors
- Participatory land use planning tools and procedures
- Comprehensive system for monitoring natural resources, watersheds and ecosystems under changing environmental conditions
- Models for assessment of watershed and ecosystem functions and services under future climate and socioeconomic scenarios
- Integrated natural resources information system technologies that enable concerned stakeholders to adopt silvicultural practices due to climate conditions such as long dry spells, increased excessive rainfall events, and frequent flooding, specifically:
  - Drought-resistant species in dry or vulnerably dry sites
  - Wind-firm species in typhoon belts
  - Water-use efficient species
  - Wind-firm species
  - Climate-adapted trees which:
    - Tolerate high C concentration
    - Have high C sequestration potential
    - Have higher yield/fast growth
    - Are drought-resistant
    - Are pest-resistant
- Measures conserving biodiversity, soil and water
  - Biodiversity corridors linking plantations to natural forests
  - Improved forest fire protection (fire susceptibility assessment tools) and control

- Mixed planting of slow-growing and fast-growing species for multi-storey plantations
- Contour planting in soil-erosion prone sites
- Shelterbelts using wind-firm species to protect plantations

- Strengthening of community-based strategies
  - Participatory land use zoning and planning that prohibits settlement in vulnerable places
  - Effective and efficient early warning system
  - Capital assets enhancement of local communities
  - Land and natural resources tenure and property rights
  - More responsive institutions sensitive to and supportive of the local needs and priorities
  - Water supply side management the aimed at maximizing the potential water resources availability through:
    - Improved watershed management
    - Building capacity to capture excess water during the wet season
    - Use of water augmentation and harvesting techniques including:
      - Rain harvesting
      - Surface runoff collection and storage
      - Stream flow diversion
      - Ponding
  - Water demand side management with the objective of maximizing the use of water and minimizing the waste of water through:
    - Soil and water conservation techniques, such as contour farming, mulching, terracing, hedgerows planting, and zero tillage
    - Regular maintenance of irrigation facilities, particularly distribution canals, to reduce water losses during transmission and distribution

9.1.3.3 Coastal and Marine Sector

The coastal and marine sector needs the following:

- Assessment of the long-term effects of external factors, including the local effects of climate change, the evolution of the intensive pressure of human use in the coastal zone, and their differences
- Access to existing and new data on land cover, topography and bathymetry to understand inundation patterns
- Training on geospatial data and inundation mapping and processes to engage stakeholders and develop strategic plans for adapting to climate change

- Tools and technical assistance to use geospatial and social science data to develop visualizations and understand risks to communities in the assessment of climate change
- Knowledge and understanding of how differential recovery in communities can be a function of differential vulnerability
- Knowledge and competency on the requirements for ecosystem services framing and quantification of benefits, including those for restoration, conservation and geo-engineering
- Knowledge and competency on how upstream water use policies impact coastal estuaries and bays
- Knowledge and understanding of how integrated management strategies can work to reduce vulnerability
- Knowledge and understanding of near-shore currents, circulation patterns, and coastal upwelling effects on natural systems and productivity
- Coupled ocean-atmosphere-watershed modeling to take into account the potential impacts of storm surge and event-related inland flooding
- Predictive capability for sea level rise
- Knowledge and understanding of land use and adaptation to climate change
- Knowledge and competency of assessment and implementation of local/regional priorities for habitat protection and restoration
- Knowledge of national coastal policies and incentives for LGUs

9.2 Mitigation

In the process of analyzing the different mitigation options and their effect on the reduction of GHG emissions, the following issues and challenges surfaced:

- There is need for sound and adequate data to be able to conduct a robust mitigation analysis that can be the basis of identifying and prioritizing the most efficient mitigation options.
- Potentials for climate adaptation should also be evaluated along with mitigation potentials.

9.3 Adaptation Technology Transfer

9.3.1 Needs

- Local area simulation tools down to barangay level (downscaling, 10km or less grid resolution)
- Development and implementation of climate warning systems
- Cooperative research and development efforts of locally adaptive technologies
- Diffusion of technologies and know-how through pilot demonstrations, training, seminars, workshops and cross-plant visits
- Assessment of capacity for system assembly, market, consumer behavior survey, and end-use impact
- Development of quantitative and qualitative performance indicators
- Early warning systems and risk reduction systems
- Climate monitoring systems and trans-boundary information dissemination systems on the occurrence and management of and preparedness for extreme events: tropical cyclones, floods, flash floods, landslides
- Disease surveillance systems, prevention and treatment

9.3.2 Barriers to implementation

The Philippines needs to push within the Convention process for the promotion of effective tools and mechanisms for technology cooperation, including the removal of barriers to promoting technology transfer. Specifically, actions need to be taken in the areas of: (1) financing; (2) intellectual property rights; (3) capacity building; (4) accelerating deployment, diffusion and transfer of technologies; and (5) encouraging cooperation on research and development.

There is a substantial financing gap for the required scaling-up technologies for both mitigation and adaptation. Private sector incentives must be reinforced. In terms of financing, substantial private sector participation in financing and investing in mitigation and adaptation technologies has to be pushed by the government. There is also need for government to: ensure protection of intellectual property rights that guarantees access to

and use of technologies by avoiding over-protectionism; ensure access to technology information, including the costs and performance/benefits of technologies; provide for international programs for joint or collaborative research, demonstration and early stage deployment of technologies; and provide guidance on national/domestic government policies in order to create greater long-term policy certainty for private financing of technologies for adaptation.

9.4 Research and Systematic Observation

9.4.1 Needs and Gaps in Climate Change Research

In climate change research, scientists like hydrologists, meteorologists, oceanographers, aerologists, and marine climatologists need accurate and precise local climate data in order to perform a good assessment of climate conditions, trends and impact. Decision-makers and policymakers, likewise, need concrete and fact-based information to be able to identify vulnerable populations and come up with appropriate adaptation measures. One of the most basic needs in the area of research, therefore, is the acquisition and installation of needed instruments, equipment and systems for gathering, storing, analyzing and sharing data.

North-South and South-South research collaborations among countries will be desirable in order to take advantage of methods and tools on integrated impact, vulnerability and adaptation assessments that have already been developed and tested in the more advanced research centers of developed countries.

Also, more funds are needed for applied scientific researches on adaptation to climate change. Internal sources for research funds are insufficient, and majority of international projects do not provide long-term support for research activities. Governments and international organizations must consider, however, that research work on climate change issues are essential for undertaking a lot of tasks, and that allocating funds for these undertakings is crucial not just for the protection of communities and the environment, but for the overall development of the country.

Among the tasks that can benefit from funding support are: analysis of social, ecological and economic consequences of climate change; risk assessment; distribution of continuously updated information on climate change issues; development and introduction of early warning systems for extreme climate events (droughts, floods, etc.); development of ecological education programs to involve people in solving problems of climate change; development of appropriate social behavior; maintaining specialized training appropriate to each level (ecological, hydro-meteorological, agro-climatic, etc.); determination of costs and benefits of potential measures; development of adaptation projects; and involvement of additional resources through international cooperation.

9.4.2 Needs and Gaps in Systematic Observation

To obtain reliable data on climate, it is necessary to have an adequate system of observation and data collection. In the Philippines, some head start has been made in the performance of its UNFCCC obligations related to systematic observation. However, efforts in the development of supplementary capacity – materials and technical support, improvement of management, in-service training of experts – are still direly lacking.

While the overall situation is generally improving insofar as climate observation is concerned, serious gaps remain in terms of observation platforms for the bio-geophysical impacts of climate change. Economic reasons, which initially caused the shrinking of the country's climate observation network, hamper as well the operation of the other networks. The hydro-meteorological network, for instance, lacks appropriate devices, gauges and equipment, and the financial, manpower and technical resources for sustainable operations and maintenance. There is an urgent need to improve the technologies for information collection and storing, saving data, establishing databases appropriate to the modern requirements, and facilitating access to information.

It is necessary to synchronize diverse international initiatives in strengthening observation networks and to develop coordination among countries in the Southeast Asian region in the context of the Regional Plan of Action on the Global Climate Observation System (GCOS). There is also a need to maintain hydro-meteorological information databases for the efficient forecasting of the runoff of major Philippine rivers, and to conduct an adequate long-term assessment of water resources considering climate change.

Establishing and maintaining observation stations and corresponding databases in coastal and marine areas are also important. It is necessary to establish provincial climatic databases, including a long-term (not less than 30 years) homogeneous series of observations of different parameters (meteorological and hydrological, upper-air and aerological, coastal and marine climatology).

The capacity-building needs for the climate observation system for the national hydromet offices, research and academic institutions, and other legally mandated offices are given below.

9.4.2.1 Meteorological and Hydrological Observations

- Improving the information interactions at the institutional level within and outside of the country (Southeast Asian Region)
- Development of plans for observation networks (procurement, replacement, maintenance and personnel)
- Improvement of networks by providing them with gauges and equipment
- Technical modernization of observation, initial data processing, and communications
- Installation of automated stations in remote areas
- Establishment of more river basin gauging stations, particularly for Visayas and Mindanao
- Improvement of operation of specialized meteorological stations (agro-meteorological, Doppler radar stations, etc.)

- Improvement of data processing, archiving and storing
- Organization of operations directed to data saving and recovery (reanalysis at the national level)
- Improvement of current databases and development of modern open-source databases

9.4.2.2 Aerological, Upper-Air and Remotely Sensed Observations

- Recovery of aerologic observations
- Funding of station networks (equipment and consumables)
- Technical modernization and provision of long-term functioning of stations
- Calibration of observations for remotely sensed data application

9.4.2.3 Tidal and Sea Observations

- Establishment of more stations (tidal gauging and buoys)
- Development plans for observation networks (procurement, replacement, maintenance and personnel)
- Database management

Additional needs involve: data generation on economic damage, and development of vulnerability indices and criteria.

9.5 Public Awareness and Capacity Building

There is still need to refine and augment the content of the information and communication messages and materials for the public, as well as capacity building programs for agency personnel. Results of a recent perception survey indicated lack of or inaccurate understanding of the following climate change-related issues, among others: causes of changes in climate and environment; how human activity and developmental processes can contribute to climate change; and what people and communities can do to help abate the adverse effects of climate change.

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