IN THE EYE OF THE PERFECT STORM: WHAT THE PHILIPPINES SHOULD DO ABOUT CLIMATE CHANGE

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I. INTRODUCTION

The perfect storm is the convergence of two or more events with exceptional, powerful results. The recent popular use of the term was inspired by a meteorologist's description of how the combination of three smaller storms turned out to be the "perfect situation" to unexpectedly produce an unimaginably calamitous event. Now, the motion picture based on this event shares its title as an oft-used modern idiom applied not just to the weather but to education, health, sports, or even food prices.

Climate change represents the most serious, most pervasive environmental threat the world faces. The "perfect storm" is the result of the convergence of humanity's improvident past, its difficult present, and the uncertain future. The issues are not merely scientific; climate change spans political, social, and economic dimensions, crosses national boundaries, and promises to impact future generations in a crisis of global proportions.

The consensus in the scientific community solidly points to evidence that the earth is indeed warming up, and such warming is attributed to the dramatic rise in human-induced greenhouse gas emissions since the mid 20th-century. Overwhelming scientific evidence paints an unmistakable picture. Climate change is real, it is caused to a large extent by human activities, and its impacts will be serious and highly damaging. The Intergovernmental Panel on Climate Change (IPCC), the international body tasked with studying the greenhouse effect, concluded that the warming has become "evident from observations of increases in global average air and ocean temperatures, widespread

melting of snow and ice, and rising global average sea level." The IPCC declared that the "warming of the earth's climate system is unequivocal" (IPCC AR4, 2007).

The Philippines incessantly confronts the predicament of being prone to both natural and man-made disasters. Climate change intensifies the convergence of these different storms. Given that a majority of our people is mired in poverty, with livelihoods highly dependent on fragile natural resources, and living in settlements extremely vulnerable to climatic events, the Philippines finds itself in the eye of the perfect storm.

Beyond Science and Technology

Climate change is inexorably linked to economic activities crucial to most modern societies – energy production and consumption, transportation, agriculture and forestry, real estate, marine resource utilization, industry and manufacturing, insurance, and so on. As such, it cannot be separated from the fundamental concerns of human society: national economic planning, public administration, and the quality of life for individuals, families, and communities.

Ultimately, the issue of climate change goes beyond science and technology and is about ethics. It poses a question to all of us about what kind of world we want to live in. All technological choices represent a hierarchy of values. These values manifest themselves in systems of inclusion and exclusion. Each society's survival ultimately rests on the dominant culture's capacity to wrestle with development options – and to affirm or reject them. It should also be noted that the persons most affected by climate change are not the present but the future generations. Finally, the irrelevance of national boundaries in dealing with the challenges presented by climate change provides the ultimate demonstration of global interdependence. Indeed, climate change negotiations involve the very foundations of global security and the development of nations. As the General Assembly of the United Nations (U.N.) accurately asserts:

> *Climate change affects humanity as a whole and should be confronted within a global framework so as to take into account the vital interests of all mankind* (UN General Assembly, 1988).

Overview of the Paper

In the Eye of the Perfect Storm: What the Philippines Should Do About Climate Change explores the entire spectrum of climate change issues – from scientific to political dilemmas, from global to local impacts, and from international to Philippine responses.

The *Introduction* provides the context of the whole paper by describing the climate change crisis as a convergence of societal, political, and environmental factors that result in a perfect storm. It also presents the issue ultimately as an ethical one.

The Science of Climate Change: Implications for the Philippines explores the current scientific evidence of climate change and discusses the causes as well as the uncertainties behind the science.

The Impacts of Climate Change explains the impacts on a global scale, on the Asian region, and on the Philippines, with emphasis on the vulnerability of people to climate and weather-related risks.

The Philippines and the Global Response to Climate Change presents the history of the global community's response to combating climate change, with a thorough description of the international climate treaties and the road from Rio de Janeiro to Kyoto, and from Bali to Copenhagen. This chapter also outlines the country's efforts in addressing climate change.

Policy and Implementation Options for the Philippines discusses what the nation can do in terms of mitigation and adaptation strategies to deal with the consequences of climate change. It highlights the solutions that do exist, but points to the urgent need for an integrated Adaptation-Mitigation framework that will ensure the effectiveness of these solutions especially for the Philippines. In order to successfully respond to the enormous challenge, it is imperative, not only for the industrialized countries but also for the Philippines, to adopt robust and effective policies that will result in both mitigation and adaptation schemes to address climate change.

II. THE SCIENCE OF CLIMATE CHANGE: IMPLICATIONS FOR THE PHILIPPINES

The Physical Basis of Climate Change

The idea that climate could change as a result of global warming can be traced as far back as over 200 years ago. The first scientist to formally propose that gases in the atmosphere could absorb some of the heat radiation constantly emitted by the earth's surface was Jean-Baptiste Joseph Fourier (1768-1830). Fourier theorized that the earth is kept warm by this process, in the same way that the glass of a greenhouse keeps the interior warm on a cold day. He called it "*l'effet de verre*" (the glass effect). Hence, the term "greenhouse effect" came about.

In terms of regulating the surface temperature of the Earth, the greenhouse effect is a benign mechanism. Greenhouse gases (GHGs), despite their important climate regulation function similar to that of a thermostat, are in trace amounts in the atmosphere compared to other gases such as oxygen and nitrogen (Villarin, 2001). These gases retain some of the outgoing infrared radiation in the atmosphere that would otherwise escape to space. The outgoing infrared is what critically regulates the temperature levels that make biological life possible.

Today, scientists know that human activity is adding more of these greenhouse gases to the atmosphere, disrupting the natural dynamics of the climate system by increasing global average temperatures.

The Enhanced Greenhouse Effect

GHGs have been present in trace quantities in the atmosphere for the longest time in earth's history. They enter the atmosphere both through natural processes and as a result of human activities. Water vapor, because of its abundance, is the most significant natural greenhouse gas. Carbon dioxide (CO_2), the second most important, has been emitted by volcanoes throughout history, and cycles into and out of the atmosphere through a number of naturally-occurring pathways. In fact, without this gas, the temperature of the earth's surface would be about 33ºC lower than it is today – insufficient to support life. Today, CO_2 is added to the atmosphere in large quantities as a result of human activities. Hence, it is essential to distinguish between the natural greenhouse effect and the human-made or anthropogenic greenhouse effect (Villarin, 2001).

While natural GHGs keep the earth warm enough to be hospitable, increasing their concentrations through human activity contributes to raising the global-average annual-mean surface air temperature. Strictly speaking, this is an **enhanced greenhouse**

effect (see Fig. 1) – above the level due to natural GHG concentrations. Hence, "climate change" has been defined as a:

> *"... change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."* (UNFCCC, 1992)

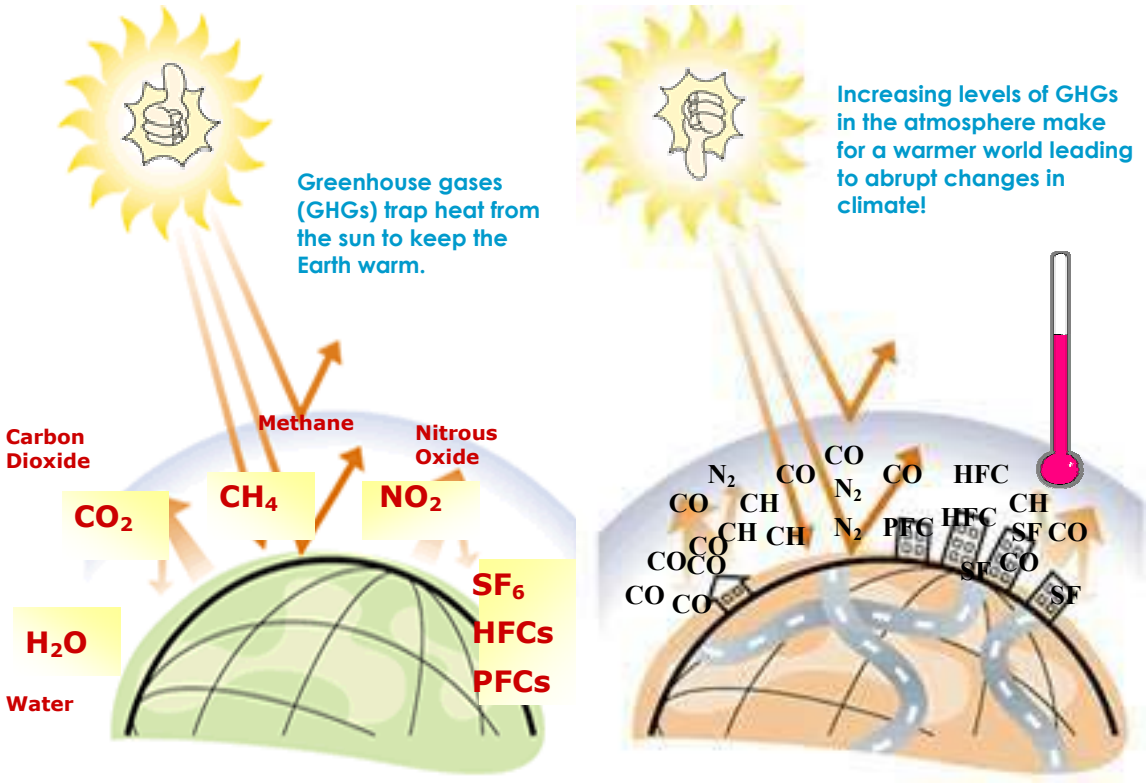

Figure 1. The Natural and Enhanced Greenhouse Effect.

Natural Versus Anthropogenic Change

The climate has been changing throughout the course of the planet's evolution. Global temperatures have undergone natural shifts throughout the course of human history. However, scientists have asserted that the rapid changes, specifically the increase in global temperatures in the past few decades, cannot be attributed to natural climate variability alone.

The balance of the climate system is influenced by changes in the atmospheric concentrations of GHGs and aerosols, by variations in solar radiation and by land surface properties. Such changes are referred to in terms of radiative forcing, or the change in balance between radiation entering and escaping the atmosphere, which relates to comparisons of how human and natural factors contribute to the warming or cooling of

the world's climate (IPCC AR4, 2007). The latest scientific reports reflect more accurate estimates of radiative forcing as they take into account new observations and modeling of GHGs, solar activity, and land surface properties.

The IPCC (see Box 1) has declared that the "warming of the climate system is **unequivocal**, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level" (IPCC AR4, 2007). Furthermore, the IPCC affirms that:

> *"Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)."*

In the language of the IPCC, the term "*very likely"* represents a likelihood of 90 to 99 % and "*likely"* refers to 66 to 90% probability. Plainly, overwhelming scientific evidence has established that indeed, the earth is warming, and confirmed the profound influence of humans on the climate system and vice versa.

Box 1. The Intergovernmental Panel on Climate Change (IPCC).

The IPCC was established in 1988 to provide decision-makers and others interested parties with an objective source of information about climate change. The IPCC does not conduct any research nor does it monitor climate-related data or parameters. Its role is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical, and socio-economic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts, and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy, although they need to deal objectively with policy-relevant scientific, technical, and socio economic factors. They should adhere to high scientific and technical standards, and aim to reflect a range of views, expertise, and wide geographical coverage.

The IPCC is a scientific intergovernmental body set up by the ***World Meteorological Organization*** (WMO) and the ***United Nations Environment Programme*** (UNEP). Its members are:

- The Governments: The IPCC is open to all member countries of WMO and UNEP. Governments participate in plenary sessions of the IPCC where key decisions about the IPCC work programme are made and reports are accepted, adopted, and approved. They also participate in the review of IPCC Reports.
- The Scientists: Hundreds of scientists all over the world participate in the work of the IPCC as authors, contributors, and reviewers.
- The People: As a United Nations body, the IPCC work promotes United Nations human development goals.

IPCC reports reflect existing viewpoints within the scientific community. The comprehensiveness of the scientific content is achieved through contributions from experts in all regions of the world and all relevant disciplines, including appropriately documented industry literature and traditional practices, and a two-stage review process by experts and governments.

Because of its intergovernmental nature, the IPCC is able to provide scientific, technical, and socio-economic information in a policy-relevant but policy-neutral way to decision makers. When governments accept the IPCC reports and approve their Summary for Policymakers, they acknowledge the legitimacy of their scientific content.

The IPCC provides its reports at regular intervals and they immediately become standard works of reference, widely used by policymakers, experts, and students. The findings of the ***IPCC First Assessment Report of 1990*** (AR1) played a decisive role leading to the creation of the ***United Nations Framework Convention on Climate Change*** (UNFCCC), which was opened for signature during the ***Rio de Janeiro Summit*** in 1992. The UNFCCC entered into force in 1994 and provides the overall policy framework for addressing climate change. The ***IPCC Second Assessment Report*** of 1995 (AR2) provided key input for the negotiations of the ***Kyoto Protocol*** in 1997. The ***Third Assessment Report of 2001*** (AR3) as well as Special and Methodology Reports provided further information relevant for the development of the UNFCCC and the Kyoto Protocol. The IPCC continues to be a major source of information for negotiations under the UNFCCC. IPCC already released its ***Fourth Assessment Report*** (AR4) in 2007.

Philippine experts who are part of the panel include Dr. Rex Victor O. Cruz (Forest and Watershed Management), Dr. Rodel Lasco (Agroforestry), Dr. Rosa T. Perez (Meteorology), Dr. Juan M. Pulhin (Social Forestry), and Fr. Jose Ramon T. Villarin, Ph.D., SJ (Atmospheric Physics). *(Source: http://www.ipcc.ch/about/index.htm)*

Rising Temperatures

Over the past 100 years, the average annual surface temperature on the planet has increased by 0.56 to 0.92°C. Global temperatures are now about 0.74ºC warmer than they were a century ago (IPCC AR4, 2007). Since 1850, when thermometer records of global surface temperatures became available, eleven of the twelve warmest years occurred between 1995 and 2006. With the 1990s as the hottest decade on record, 1998 tops the chart as the hottest year ever (see Fig. 2). Scientists point to an acceleration of the earth's warming trend and a continuing increase in the decades ahead. Experts are alarmed about the much faster warming that may reach 2.5-5.5ºC late in the 21st century.

In its 2001 report, the IPCC concluded that if business and industry continue operating as usual, global temperatures would increase by 0.3ºC per decade – greater than that seen over the past 10,000 years. In 2001, the IPCC further concluded that under such a scenario, the global average temperature relative to 1990 is projected to increase by about 2ºC (between 1.4ºC and 5.8ºC) by 2100. Even if GHG concentrations are stabilized today, the heat that has already accumulated in the atmosphere and in the oceans will cause significant warming, with as much as 0.1ºC per decade.

The unprecedented warming caused by the enhanced greenhouse effect is not just a matter of altered temperatures. It is causing dangerous changes in climate globally.

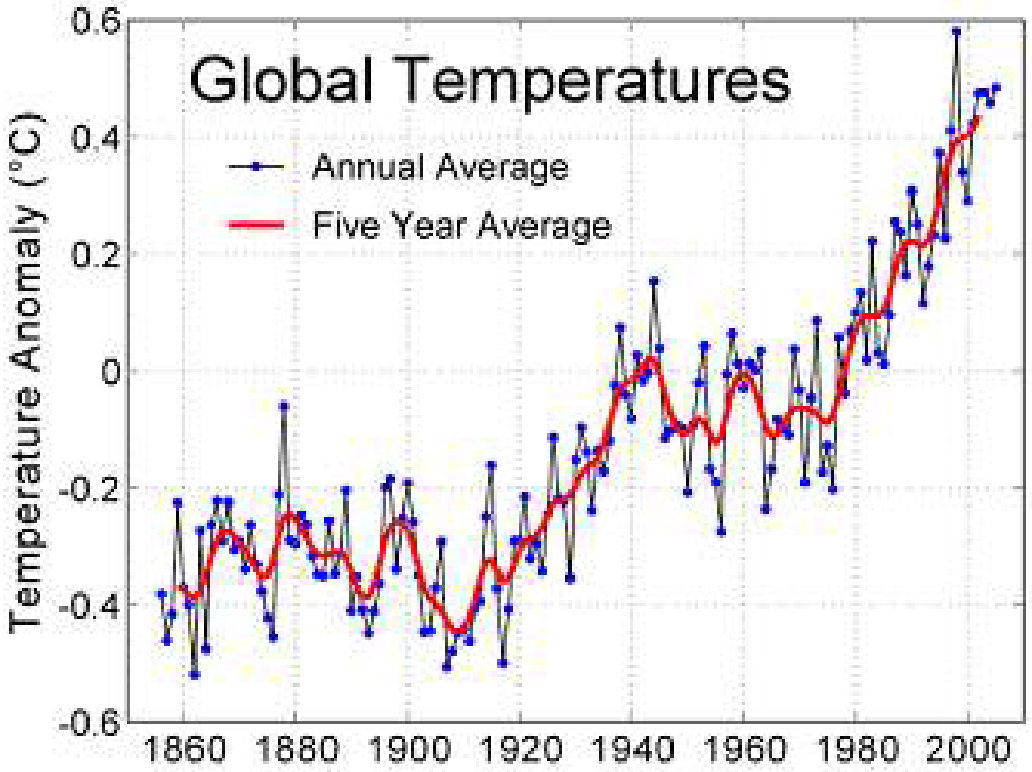

Figure 2. Global Average Temperature from 1860 to 2000. *(Source: Climatic Research Unit of the University of East Anglia)*

Causes of Climate Change

Most economic activities, in varying degrees, contribute to climate change with energy consumption (the use of fossil fuels), land use change, and forestry activities probably being the largest contributors. Historically, the biggest contributors to climate change are the industrialized countries of the North, with the United States as the biggest emitter. However, developing countries will also have to exert efforts to limit their GHG emissions over the long term (Baumert and Kete, 2001). CO_2 remains the most important anthropogenic GHG. Global GHG emissions due to human activities have grown since pre-industrial times. Annual CO_2 emissions increased by about 80% between 1970 and 2004 (IPCC AR4, 2007).

The sources of global GHG emissions can be traced to the activities of various sectors. Agriculture, for instance, adds to the concentrations of *nitrous oxides* (N_2O) and CH_4 in the atmosphere via fertilization and farm cultivation practices. The forest sector is also critical since deforestation allows the release of carbon stored in trees as CO_2 (a major GHG) to the air. Even municipal and industrial wastes contribute to GHG emissions by way of CH_4 release due to the decomposition of wastes. The situation is aggravated by rampant improper waste management practices. Most importantly, the dependence on fossil fuels by most countries intensifies the release of CO_2 in the atmosphere because of the combustion of fossil fuels for energy and transport. In

addition, manufactured industrial gases such as *perfluorocarbons* (PFCs), *hydrofluorocarbons* (HFCs), and *sulphur dioxides* (SO_2) contribute to increasing GHG concentrations (Villarin, 2001).

According to the IPCC, *"global atmospheric concentrations of CO_2, CH_4, and N_2O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years."* (IPCC AR4, 2007).

Figure 3 shows the atmospheric concentrations of CO_2, CH_4, and N_2O over the last 10,000 years and since 1750 (insets). The graphs show measurements from ice cores (indicated by the symbols with different colors for different studies) and atmospheric measurements (indicated by the red lines). The corresponding radiative forcings are shown on the right hand axes (IPCC AR4, 2007).

A large quantity of CO_2 has been released through human activities since the industrial revolution. Cast against a 650,000 year backdrop, the CO_2 levels of up to 385 parts per million (ppm) in the atmosphere today are higher than they have ever been. Based on projected scenarios, the threshold to avert a runaway greenhouse effect is 450 ppm. Beyond this, the warming cannot be contained below 2ºC and the consequences will be serious (IPCC AR4, 2007).

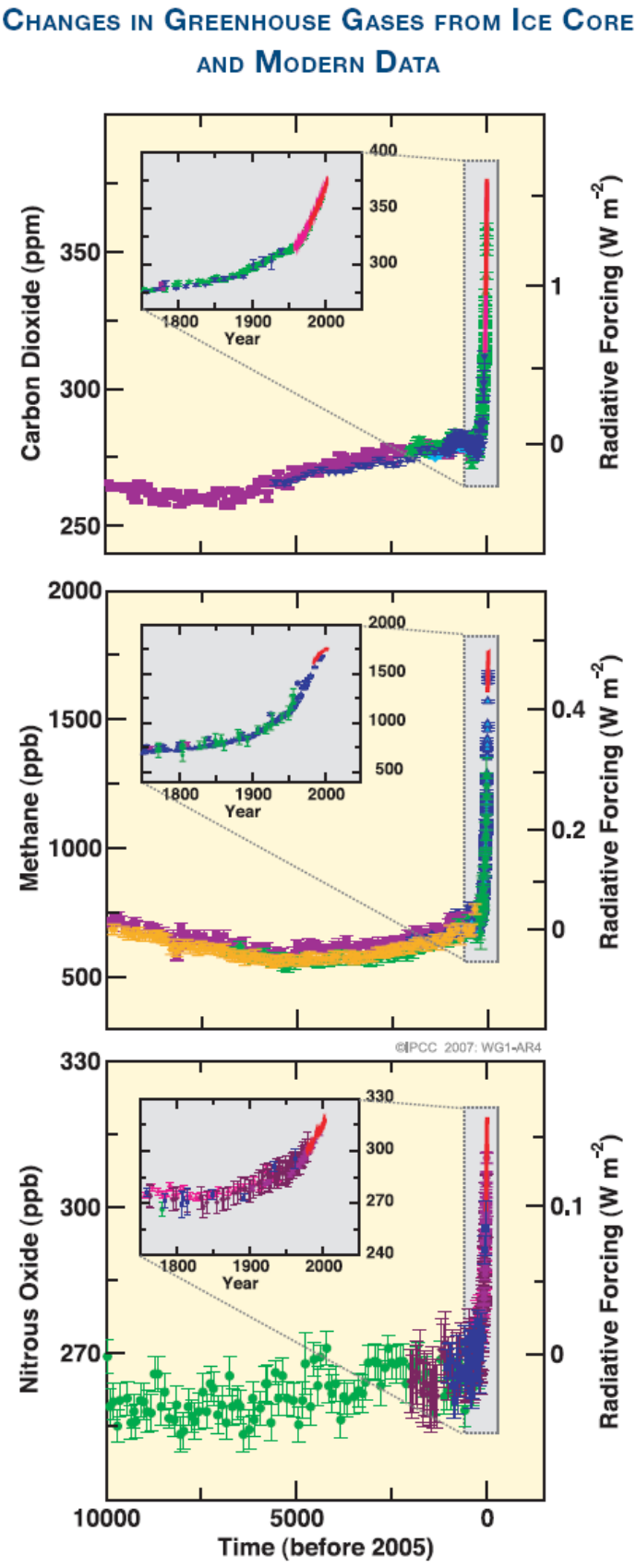

Figure 3. Atmospheric concentrations of GHGs in the last 10,000 years.
(Source: IPCC AR4, 2007)

Implications for the Philippines

The findings of the global scientific community establishing evidence of the link between climate change and human activities will have serious implications for the planet, and in particular, for developing countries such as the Philippines. Some of the global impacts of climate change may not apply to particular countries. In the Philippines, for example, the occurrence of deadly heat waves and melting glaciers are unlikely to happen since the country is situated in the tropics.

Climate change will influence Philippine weather in terms of changes in temperature, rainfall, and tropical cyclone activity. This, in turn, will cause impacts in various sectors including agriculture, forestry, and water resources.

How about the uncertainties?

Uncertainties are intrinsic to science. Scientific knowledge is "probabilistic rather than absolute and provisional rather than final; it can never be devoid of uncertainty or the possibility of inaccuracy or incompleteness." (Silbergeld, 1991).

Uncertainties continue to persist in the science of climate change, principally in terms of how data are analyzed and how climate models function. Some of the ambiguities are still associated with the extent of the influence of human activity on global warming.

It has taken quite a while before a large segment of the scientific community was convinced that the earth's climate is indeed changing and that temperatures are truly rising. In 2007, the IPCC pointed out that, "As climate science and the Earth's climate have continued to evolve over recent decades, increasing evidence of anthropogenic influences on climate change has been found". The Panel made even more definitive statements about climate change:

- *Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.*

- *There is now higher confidence in projected patterns of warming and other regional-scale features including changes in wind patterns, precipitation, and some aspects of extremes and sea ice.*

- *Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized* (IPCC AR4, 2007).

Uncertainties continue to revolve around the impacts of climate change. In particular, it is not yet clear how climate change impacts will be distributed globally and regionally. However, it is important to recognize and evaluate these uncertainties, to communicate them carefully, and to make expert judgments.

III. THE IMPACTS OF CLIMATE CHANGE

Global Impacts

Climate change is an ecological peril unlike any the international community has faced. While many human activities have had a negative impact on natural resources and ecological systems, the resulting damage has usually been local or regional in scope and reversible. Changes in the atmosphere are global and - for all practical purposes - "irreversible."

For example, climate change will aggravate the problems already being faced by communities threatened with desertification, particularly in the semi-arid zones of Africa. Those living in coastal and low-lying areas are also especially vulnerable because of sea level rise. An expected surge in extreme weather events (i.e., typhoons, floods, and drought) will translate to more catastrophic and damaging natural resource disasters. Together with the anticipated increases in global mean temperatures, these disasters are expected to result in public health outbreaks like malaria, dengue, and other vector-borne diseases.

The worst case scenario of future global warming is an environmental catastrophe called the "runaway" greenhouse effect, a phenomenon that is postulated to have happened in Venus wherein GHG levels accelerated rapidly due to positive feedback mechanisms. At present, a significant amount of the earth's GHGs are stored in large natural reservoirs (e.g. ocean and land) still isolated from the atmosphere. In a warming world, these natural storage areas may be stimulated to release even more GHGs into the atmosphere than are directly produced by human activities. Such an enhanced irreversible greenhouse effect will be globally catastrophic.

Today, most of the changes we observe are flickering episodes of climate change. These may appear to be slow and moderate for now, but it is possible that rising GHG levels in a business-as-usual scenario for this century may irreversibly accelerate the pace of change beyond reversibility.

As the Earth heats up, there will be global climatic effects and warming impacts. A warmer earth surface may result in stronger forcing of atmospheric circulation and a faster water cycle. More and heavier rainfall events are also anticipated. More intense large scale weather patterns are projected resulting in more pronounced periods of heavy precipitation and drought as well as more intense storms. There is also an expected decrease in snowfall and more precipitation falling as rain. There will be fewer run-offs in late summer and fall.

The rise in temperature of a few degrees Celsius by the middle of this century is projected to cause thermal expansion of seawater. As recent evidence shows, there will be melting of Arctic and Antarctic polar ice, and the retreat of glacial masses from

Alaska, to Peru, from the European Alps to the Himalayas. In fact, even if emissions are stabilized, there is already a sea level rise "commitment" due to response lags in the climate system, analogous to the human body's delayed response to a weight reduction intervention. Due to the melting of ice sheets and glaciers, sea-level rise is likely to happen, resulting in flooding, enhanced storm surges, and altered ocean circulation. According to the IPCC AR4, the global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 mm per year. The same report expressed high confidence that the rate of observed sea level rise increased from the 19th to the 20th century. The total 20th-century rise is estimated to be 0.17 m (IPCC AR4, 2007).

The impact of accelerated sea level rise is enormous given the fact that approximately 30% percent of the world's population resides in coastal, low-lying areas. The low-lying, small, coastal island states will obviously face a greater threat. Studies for the Maldives and for the Pacific island states including Tuvalu, Kiribati, Tokelau, and the Marshall Islands have confirmed that small, low-lying island states and large populations living in low-lying coastal areas mainly in the poor nations of the world will be increasingly vulnerable, particularly if adaptive measures are inadequate, to the combined forces of sea level rise, storm surges, and coastal flooding. Sea-level rise would cause extensive damage to the land and infrastructure of these nations and seriously threaten the very survival of some island states.

In certain areas, there is greater likelihood of milder winters and hotter summers, precipitation in the form of rain rather than snow, increase in drought stress, and less rain during summer (IPCC AR4, 2007). In terms of impacts in the water supply, peak flows are projected to come in early while low flows are expected during summer. These may also result in hydro-fish conflicts. The growing seasons for crops and other vegetation will be altered, such that there will be longer growing seasons but less soil moisture and shifts in growing zones. Land fires are expected to be wilder, bigger, and more intense. Poor air quality will be aggravated, with the expectation of an increase in heat waves, pollutants from coal-fired power plants, automotive emissions, and particulates from wild land fires. There will also be declines in fish catch due to migration timing impacts, higher summer water temperature, algal blooms, and other ocean conditions. Wetlands, in general, will also suffer since these ecosystems may either be flooded out or relocated. Biodiversity will also decrease due to the inability of native species to adjust to habitat changes, allowing invasive species to proliferate resulting in changes in the composition of the ecosystem. Pest infestations will most likely occur because if winters are getting warmer, there will be fewer pest die offs. Also, a warmer environment extends the reproduction period of organisms, thereby increasing the population of "explosive" native species (IPCC AR4, 2007).

Impacts on Asia

Based on IPCC's Fourth Assessment Report (AR4), new evidence shows that climate change has started to affect many sectors in Asia. The future changes will likely affect agriculture, thereby increasing the risk of hunger and water resource scarcity with enhanced climate variability and more rapid melting of glaciers. The marine and coastal ecosystems in Asia are likely to be affected by sea-level rise and temperature increases. Forest expansion and migration are also projected, and these exacerbate threats to biodiversity resulting from land use/cover change and population pressure in most of Asia. Future warming will adversely affect human health in Asia. Multiple stresses in Asia will be compounded further due to climate change. An enhanced hydrological cycle and an increase in area-averaged annual mean rainfall over Asia is projected. The increase in annual and winter mean precipitation would be highest in boreal Asia; as a consequence, the annual runoff of major Siberian Rivers would increase significantly. A decrease in rainfall during summer is likely over the central parts of arid and semi-arid Asia, leading to expansion of deserts and periodic severe water stress conditions. Increased rainfall intensity, particularly during the summer monsoon, could also increase flood prone areas in temperate and tropical Asia (IPCC AR4, 2007).

A study in Southeast Asia and South Pacific was conducted to detect significant changes in regional temperature and rainfall trends (Manton et. al, 2001). The analysis included a 38-year period (1961 to 1998) dataset of daily temperature and rainfall. Manton, et. al, looked at temperature and rainfall measurements for extreme events, not mean values, and tested outlier values if they were significantly different, thus, indicating climate change.

The results showed significant increases in the annual number of hot days and warm nights, with significant decreases in the annual number of cool days and cold nights. In terms of rainfall patterns, the number of rain days (with at least 2 mm of rain) has decreased significantly throughout Southeast Asia and the western and central South Pacific, but increased in the north of French Polynesia, Fiji, and at some stations in Australia. However, the proportion of annual rainfall from extreme events has increased in most stations. This indicates lesser rainfall events but having greater amounts of downpour. These changes will definitely affect countries such as the Philippines, where temperature and rainfall patterns are important variables for economic activities that include agriculture.

Impacts on the Philippines

In the IPCC AR4, there is no specific mention of how the Philippines will be impacted by climate change. In fact, the country is mentioned only once in the text. Local studies are needed to further understand climate variability and climate change impacts in the country.

The Department of Environment and Natural Resources (DENR) commissioned a study executed by the Manila Observatory to establish data on the impacts of climate change on the country and identify appropriate courses of action to address the adverse effects. The main findings, summarized below, indicate a changing environment that requires adaptive measures.

Sea Level Rise

One of the most discernible effects of global climate change on the Philippines will be the accelerated rise in sea level. As the oceans expand due to warming, and as mountain glaciers and polar ice melt and drain into the oceans, some islands and many coastal areas are in danger of being inundated with the rising waters. Sea-level rise due to thermal expansion is a threat to this country, given its archipelagic nature and long stretches of coastline. Rising sea levels may contaminate groundwater sources and expose communities to harsh storm surges.

The UK Climate Research Unit analysis of records in Manila and Legaspi provide evidence that the upswing started in the 1970s. Studies on sea-level rise (SLR) in the Philippines showed slight increases in values (Yanagi and Akaki, 1994). However, the data was limited to five tidal stations located in Manila Bay, Legazpi, Cebu, Jolo, and Davao.

In urban centers, the impacts of sea level rise are compounded by ground subsidence sue to over-extraction of ground-water for domestic and industrial use (Rodolfo and Siringan, 2006). The projected impacts of 1 m SLR in selected areas of Luzon (Cavite, Metro Manila, and Bulacan) show vast areas being inundated, thereby affecting coastal settlements and livelihood (Perez et al. 1999). Another study led by PAGASA estimates that a 1-meter rise by 2025 will flood over 5,000 hectares and displace more than 2 million people around Manila Bay.

Sea-level rise will increase the risk of flooding and storm damage. Water logging after heavy rains may also affect infrastructure. It will also enhance the danger of ground liquefaction brought about by earthquakes and will influence shifts in tidal action in rivers and bays (Perez, 2001 in Villarin, 2001). The following are the other potential impacts of accelerated sea-level rise:

- Increased frequency and intensity of storms and storm surges, causing backflows in rivers and bays;
- Salt-water intrusion into surface and ground water, affecting the amount and quality of water supply;
- Mangroves and other habitats of benthic organisms will be greatly affected by the changes in salinity; and
- High precipitation would increase run-off, move fresh water seaward, and result in low dissolved oxygen availability. The pattern of fish reproduction would be affected. Livelihood based on subsistence fishing would be put to risk. Low-pressure systems could pump nutrient-rich waters from outer to middle shelves, and affect spot fish yields.

Trends in Surface Temperatures

The pattern of surface temperatures in the Philippines parallels the global trend over the last half-century. The length of the cold dry season has been decreasing, while that of the warm wet season has been increasing. A regional study conducted in 2001 by Manton, et. al. highlights an observed increase in regional land and sea surface temperatures in Asia and Australia over the last 40 years. The prognosis is that there will be more hot days and warm nights with fewer cold days and nights in the coming years (Manila Observatory, 2007).

Tropical Cyclones

Due to the shifts in the climate patterns, there are projections for fewer typhoons in January to March while frequency will increase in July to November. Typhoons will affect Visayas and Mindanao mainly in December when sea-surface temperatures (SSTs) remain warm enough. In theory, warmer SSTs mean more frequent and stronger storms. At present, there are no clear trends as to how global warming will change the vertical wind structure (or wind shear) which, with the distribution of moisture, influences typhoon development (Manila Observatory, 2007).

Geographical Trends in Tropical Cyclones

The number of tropical cyclones is observed to be increasing in the Western Pacific. In the Philippines, the rise in typhoon crossings is most pronounced over the Visayas area (Manila Observatory, 2007). It is reasonable to assume that this recent trend will continue throughout the present century.

Stronger Typhoons?

There is very little research on the changing intensity or strength of typhoons in the Philippines. While a notable number of super typhoons have been recorded of late, a pattern of increasing typhoon intensity is not yet discernible. What is certain is that the direct and indirect risk from typhoons, i.e., the probability and magnitude of damage and harm due to typhoon disasters, has risen over the years. With more people living along the coasts, river banks, and landslide-prone areas, exposure to typhoon hazards is increasing. Thus, whether or not typhoon intensity increases, the number of persons at risk from such hazards continues to increase (Manila Observatory, 2007).

Changes in Mean Annual Rainfall over the Philippines

Predicting the many possible changes in rainfall over the country in the coming years is hampered by the dearth in research and technical capability. While the global prognosis is a greater amount of rainfall over this region of subtropical Asia, the geographical patterns of rainfall especially within the Philippines will be difficult to ascertain and predict. Current local research has focused on detecting trends in the changes of rainfall in the historical record, with a view to using these diagnostic trends as a basis (however imperfect) to extrapolate into the near future. While the Manton study indicates a subtle historical decrease in mean annual rainfall over the country, it, likewise, notes the marked shift in its distribution. Rainfall patterns of the past 50 years show increasing rainfall over the northeastern areas, while rainfall has been decreasing over the south-central areas of Mindanao. One significant study, for example, has shown that rainfall distribution in the island of Mindanao has important geographic differences (Villarin and Avila, 2006). This situation may or may not continue within this century but it is reasonable to assume that the pattern will not reverse itself suddenly in the coming decades.

Downstream Effects of a Changing Climate: Making a Bad Situation Worse

Various sectors in the Philippines will be affected by the changes in climate. In agriculture, the country is expected to experience dry days that are drier and wet days that are wetter, which may result in poorer crop production, storage, and distribution since changes in the timing and volume of rain are critical. In addition, a CO_2 rise favors crops, but weeds are more likely to proliferate simultaneously, thereby necessitating the development of new crop varieties or herbicides. Forest areas will also be affected. Moist forests will shrink and turn to dry forests (Lasco et. al, 2007). Biodiversity loss will be aggravated since global warming will raise the risk of floods, worsening degradation and species loss. Marine resources will be affected as well, since warmer waters induce coral bleaching which eventually leads to declining fish populations (Manila Observatory, 2007).

Roughly 20% of total power supply in the Philippines comes from hydro-electric sources. Changes in the patterns, volume and geographic distribution of rainfall threaten to increase and perpetuate intensified reliance on imported coal and oil. As discussed earlier, rainfall is increasing in rainfall over the Visayas and decreasing in Luzon and Mindanao. This trend points to implications on the hydropower generation of the country, since the country's major dams are located in Luzon and Mindanao.

There are also health implications due to a warmer wetter environment. Prolonged periods of high temperature and water impounding due to sudden heavy downpours serve as ideal breeding conditions for disease vectors such as *Aedes* and *Anopheles* mosquito for dengue fever and malaria.

Severe flooding on the extreme can totally re-write the contours of the land. Water shortages due to drought, salt-water intrusion, or floods will influence decision-making on investments in engineering and infrastructure. Political conflicts and civil unrest may intensify due to the impact of food and water constraints on areas already experiencing socio-economic pressures due to a historical clash of cultures.

Lastly, climate-related disasters, coupled with geo-physical hazard-related disasters (such as landslides or rain-induced lahar flows), increase the risk to vulnerable populations. Thus, more displacement will result in the necessary relocation of communities and rehabilitation of the affected areas (Manila Observatory, 2007).

The Economics of Climate Change in the Philippines

While the threat of climate change is long term (a 50-100 year horizon), the expected impacts on ecosystems, livelihoods, human health, and food security are enormous. Costing the impacts of climate change is a challenge because of all the uncertainties (both scientific and economic) and vast distributional issues of the actual extent of these impacts. Ironically, while the biggest contributors to global warming with the largest GHG emissions are the industrialized countries, the greatest impacts of climate change will be first felt by the poorest countries of the world. Profound economic repercussions will be accompanied by social displacement in these countries where the burden will fall disproportionately on local and impoverished communities that depend greatly on climate conditions and natural resources for their daily survival and sustenance. They also do not have enough resources to adapt to the changes global warming will bring (IPCC AR4, 2007).

Studies on the actual costs of climate change adaptation and mitigation are often difficult to determine. Several economic approaches have been suggested on how to effectively cost these impacts. Although studies vary in presenting the costs of adaptation and mitigation, there is a broad consensus on implementing adaptation and mitigation activities because the cost of preventive action is relatively cheaper in the long run (Reay, 2002; Stern, 2006; IPCC AR4, 2007). These issues require urgent attention

given that the Philippines is one of the world's most disaster-prone areas because of its geographical location (see Table 1).

Table 1. Top 10 Most Affected Countries in terms of Economic and Human Impacts for 2006.

In absolute amounts (US$ million)		As percentage of previous-year GDP		No. of people affected (in millions)		No. affected in % of the country population	
China	13,551	Guyana	21.50%	China	88.74	Malawi	40.1%
United States	5,031	Viet Nam	2.07%	**Philippines**	**8.61**	Burundi	28.7%
India	3,390	Indonesia	1.18%	India	7.38	Niger	21.8%
Indonesia	3,314	**Philippines**	**1.01%**	Malawi	5.16	Djibouti	18.9%
Japan	2,533	Tajikistan	0.94%	Kenya	4.28	Kenya	12.5%
Australia	1,282	Lithuania	0.91%	Indonesia	3.95	**Philippines**	**10.4%**
Russia	1,187	China	0.69%	Viet Nam	3.35	Mali	7.6%
Viet Nam	1,099	Ecuador	0.46%	Thailand	3.26	Afghanistan	7.5%
Philippines	**988**	India	0.42%	Niger	3.05	Mozambique	7.2%
Spain	659	Bolivia	0.36%	Ethiopia	3.03	China	6.9%

(Source: CRED Crunch, March 2007)

The capacity of the Philippines to cope with these natural disasters is constrained by our socio-economic structure and our development priorities and strategies. The National Statistical Coordination Board (NSCB) 2006 Philippine Statistical Yearbook cites that 27 out of 100 families are poor, given the annual per capita poverty threshold for the Philippines at Php15, 057 or $342 (exchange rate of $1 = Php 44). This translates to over 4.7 million poor families. The 2006 poverty statistics also shows that 33 out of 100 Filipinos are poor. This would mean that 27.6 million Filipinos live below the poverty line. It is also estimated that thirty five percent of the national population earn less than US$2.00 a day.

The country's gross domestic product is estimated at 6.6 trillion pesos in 2007 at current price. Table 2 shows that agriculture makes up 14 of the total GDP for 2007. Palay and corn continue to be the main drivers for agriculture. Sensitivity of crops to climatic changes and natural disasters such as drought spells and severe flooding can have considerable impacts on the agriculture sector and its contribution to the country's GDP.

The industry sector accounted for 31% of the country's GDP for 2007. Despite a mere 5% contribution to the industry sector, mining and quarrying posted the biggest growth in the industry sector with 43.2% from the previous year contributing to around 108 million pesos at current prices. The manufacturing sector still contributes to around 70% to the industry sector. This is followed by the construction sector contributing 14%. Electricity, water and Gas contributed 11%. The industry sector is largely dependent on fossil fuels to drive their economic activities. On the mitigation side, investments in the standardizing approaches to measuring and curbing emissions will drive carbon disclosure as a prerequisite of corporate governance. The industry sector is also vulnerable to natural disasters particularly floods and earthquakes. The supply of energy and raw materials, as well as, the integrity of support infrastructure and logistics will impact the cost of production at various stages of the value cycle and compel adaptation.

At 54%, the service sector continued to contribute significantly to GDP in 2007. The trade sub-sectors such as wholesale and retail trades contributed 27%. This is closely followed by the Private Services sector with 26% contribution. Within the Private Services sector, the Business Process Outsourcing (BPO) sub-sector is the highest contributor. Transport, Communication and Storage contributed 13.3% while Government Services is at 13.1%. Ownership of Dwellings and Real Estate sector contributed 10.4% while Finance sector contributed 10% with the strong performances of banks. Of the Service Sector, Agriculture-related services stand to be most impacted by climate change. Natural disasters have a considerable impact not only in the business activities of this sector but would also affect the productivity of its backbone: its human resource. Disasters impact business continuity and may pose potential health and safety issues at the work place.

Table 2. 2007 Philippine GDP (in million pesos).

Industry	2007 (at current prices)	% of GDP	2007 (at constant prices)	% of GDP
Agriculture, Fishery and Forestry	936,415	14%	251,272	18%
Industry Sector	2,107,287	31%	445,486	33%
Service Sector	3,604,542	54%	671,883	49%
GDP	**6,648,245**		**1,368,641**	

(Source: National Statistical Coordination Board (NSCB) as of May 2008)

Current Philippine Economic Studies on Climate Change

More work still needs to be done to identify the economic impacts of climate change in the Philippines. The National Statistical Coordination Board (NSCB) produced a technical paper analyzing the importance of mainstreaming climate change and its related statistics with the official statistics of the Philippines. The paper also discussed the different issues and concerns related to the generation of statistics of Philippine climate change impacts, particularly in the social sector.

The Philippines is participating in an ongoing project on a Regional Review of the Economic Cost of Climate Change in Southeast Asia (RRECCS) involving several countries such as Indonesia, Vietnam, Thailand, Malaysia and Singapore. This project is implemented by the Asian Development Bank (ADB) and is funded by the British Government. The objectives of the project are to:

- Contribute to the regional debate on the economic costs and benefits of unilateral and regional actions on mitigation and adaptation;
- Raise awareness about the urgency of climate change challenges and their potential socio-economic impact on the participating countries, while informing other stakeholders of the same; and
- Indirectly support government and private sector actions in the region to mitigate and adapt to climate change.

The Economics of Disasters

According to Charlotte Benson, "The degree of severity and nature of impact of a disaster depend on a range of factors. These include the type of hazard, the size of the economy and its economic structure, and the sectors affected by the disaster." Benson has categorized the economic costs of disasters into three types:

- Direct costs which includes the capital cost of assets
- Indirect costs which refer to the damage to the flow of goods and services brought about by disasters
- Secondary effects which concerns the short and long term impacts of a disaster to the overall economic performance

Given the nature of disasters that hit the Philippines and its attendant socio-economic consequences, coming up with strategies to effectively adapt to climate change impacts requires a framework on disaster risk preparedness and effective information awareness.

Understanding Vulnerability to Climate Change Impacts on the Philippines

Climate change causes shifts in social and economic trend. The stark reality is that the poor are the most vulnerable and will bear the brunt of climate change impacts. Changes in economic systems will affect them, making access to resources more difficult and further complicating the daily struggle for survival. The relationship of poverty to natural disasters is both cyclical and cumulative. Thirty-four percent of all income is agriculture-related. Agriculture accounts for close to fourteen per cent of GDP. The science needed to address food security should drive risk management strategies. It should be clear that our capacity to adapt and mitigate lies in understanding the nature, scale and structure of vulnerability in the country, especially of this segment of our society, and in mustering the political will to confront its complexity.

For the Philippines, one of the more crucial challenges is how to better understand climate change impacts in all sectors. For this archipelagic tropical country, climate change impacts may differ when compared to other countries. Understanding the impacts will require inter-relating physical science with socio-economic information. A space-based platform of tools is highly recommended for this essential two-fold strategy in order to formulate a concrete plan of action to address the problem. Knowing the geography of vulnerability helps in building resilience and addressing cyclic and cumulative poverty. A framework where infrastructure contributes to development, such as one that will sustain livelihoods, would decisively alleviate poverty and reverse the poverty cycle in both space and time.

The Manila Observatory's Multi-scale and Multi-temporal Poverty Mapping indicates high poverty incidence by province and municipality in the country, with the number of provinces where poverty increased the same as the number where it decreased. This seems to indicate that the poor move. The *Urban Poverty Morphology Project: RS-*

GIS Applications for Metro-Manila, Philippines is aimed at finding ways to better integrate poor communities and informal livelihood into the urban-rural ecosystem. The findings confirm that informal settlements around Metro-Manila are clustered primarily near socio-economic attractors, within available vacant spaces, including easements along waterways and sidewalks. Most informal settlements are located in areas along public transportation routes and near utilities. The results of another project on evaluating a resettlement site in Montalban shows that many resettlement areas are not suitable sites for slum relocation because of their high risk to natural hazards, the absence of potential livelihood sources, and the lack of affordable and reliable public transport. Informal settlements in Metro-Manila were found to be expanding and increasing in density. These findings reiterate the value of proper planning through the application of *Remote Sensing* (RS) and *Geographic Information System* (GIS) in order for in-fill social housing and resettlement options to work (http://www.observatory.ph/programs/ged/projects/upm/index.html).

For pre-disaster science, studies dealing with local current and projected climate trends and impacts are the basis for knowing the different degrees of vulnerability of communities in the country. Downscaling and localizing global climate models feed into risk frameworks and vulnerability assessment tools for the use of these communities. These are applicable to both slow-onset and rapid-onset impacts of increasing climate variability.

An example of a risk framework is the UNDP formula where Risk (R) is an approximation of the compounding effect of Hazard (H), Exposure (E), and Vulnerability (V). Capacity (C) as a denominator of this formula may be explored, according to the World Bank. This risk framework is especially valuable as a decision support system. It may be used to visualize an integration of spatial and temporal factors affecting sustainable development. The framework is also multi-scale. Thus, it is responsive to the decision-making needs at both the macro- and meso-scales. The *Manila Observatory* (MO), with funding assistance from the *Department of Environment and Natural Resources* (DENR), generated a preliminary series of risk maps and ranking to streamline the identification of climate and geophysical hotspots in the country. Figure 4 shows a sample map of the risks to climate disasters per province while Box 2 further explains the project.

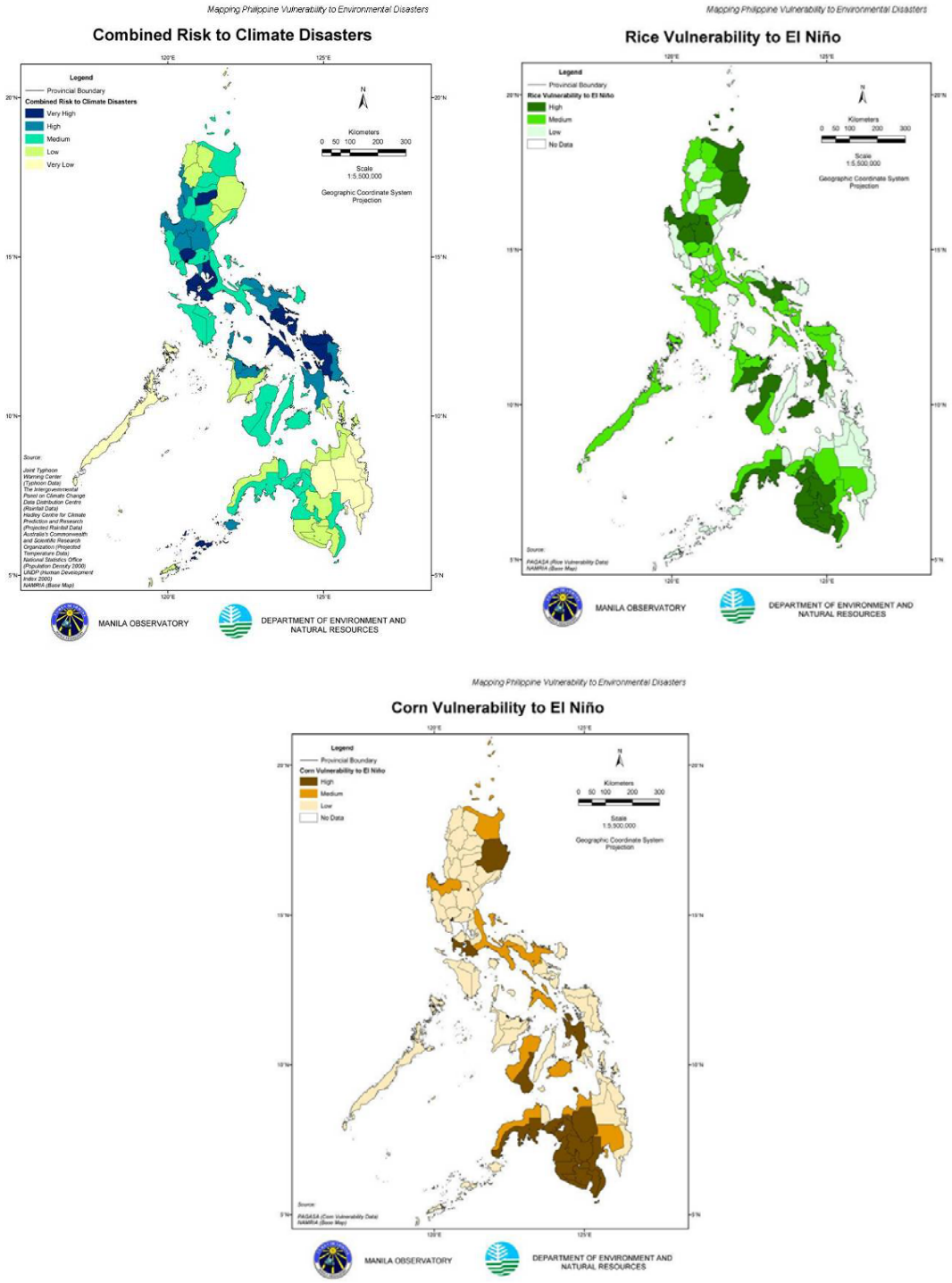

Figure 4. (A) Combined Risk for Climate-related Disasters, (B) Rice Vulnerability to El Niño, and (C) Corn Vulnerability to El Niño. *(Source: Manila Observatory)*

Box 2. Mapping Philippine Vulnerability to Environmental Disasters.

By its location in the tropics, the Philippines is found to be naturally vulnerable to environmental disasters. This situation plus other human and developmental factors compound the communities' lack of capacity to cope with such disasters.

The vulnerability of communities to hazards refers to their susceptibility to and capacity to cope with environmental stresses. Recent and major events as well as their cumulative impacts highlight the importance of identifying the vulnerability levels of certain areas and segments of the Philippine population to collective hazards that form disasters.

There are complex factors at play which are climate and weather-related, geo-physical, ecological, and anthropogenic. Identifying vulnerability and risk according to the above categories will assist in completing scenarios, whether historical and/or projected, and will enable communities to cope with and adapt to environmental disasters.

The aim of this project, **Mapping Philippine Vulnerability to Environmental Disasters**, is to identify areas in the country that are at high vulnerability and risk to environmental disasters. Hazards and disasters are mapped and analyzed via Geographic Information Systems (GIS), environmental modeling tools, and the resulting spatial databases.

The Atlas or collection of associated maps produced with these tools will be used to inform and develop policy recommendations. These maps and analytical results are for dissemination to the public and concerned agencies which are responsible for disaster management and environmental stewardship in the country.

The maps, when properly disseminated and utilized, are effective decision tools for better disaster management and adaptation in the country. It is recommended that composite vulnerability and risk indices using the GIS approach be further developed by and across categories of factors. This is aimed at improving national and local assessment of potential disasters. The results may then guide and strengthen capacity building in disaster preparedness and management. *(Source: http://www.observatory.ph /programs/ged/projects/vm/)*

IV. GLOBAL RESPONSE TO CLIMATE CHANGE AND THE ROLE OF THE PHILIPPINES

The Global Response to Climate Change

Climate change, as a global problem, presents a challenge that is characterized by the irrelevance of national boundaries both in terms of its causes and the required solutions. It requires the definitive manifestation of the interdependence of nations and the adoption of a global framework.

The global community started to recognize the importance of climate change as a concern when the WMO organized the World Climate Conference, the first ever international meeting that tackled the issue, on February 12-23, 1979 in Geneva. The conference was largely a scientific meeting attended by scientists from a broad range of disciplines. Studies presented in the conference identified human activities as the leading cause of increased concentrations of CO_2 in the atmosphere that resulted in global warming. The conclusion of the conference is summarized in the Declaration of the World Climate Conference, which highlighted the urgent need to use existing knowledge of climate and mainstreaming it in the planning process for social and economic development. The declaration also urged governments to identify and prevent human induced changes in the climate. The Conference led to the creation of the World Climate Programme (WCP). It was also pivotal in the establishment of the United Nations Intergovernmental Panel on Climate Change (IPCC) in 1988.

In 1988, the Toronto Conference on the Changing Atmosphere further advanced the debate on climate change and recommended the need for states to come up with a comprehensive global framework to address climate change. The United Nations General Assembly addressed the issue of climate change for the very first time by adopting Resolution 43/53 which recognized climate change as a common concern for mankind. It was also in 1988 when the Inter-governmental Panel on Climate Change (IPCC) was established by the WMO and UNEP (see Box 1).

The Second Climate Conference was held on 29 October to 7 November 1990, again in Geneva. It was an important step towards a global climate treaty and somewhat more political than the first conference. The main task of the conference was to review the WCP set up by the first conference. The IPCC's First Assessment Report had been completed in time for this conference. The scientists and technology experts at the Conference issued a strong statement highlighting the risk of climate change. The Conference issued a Ministerial Declaration only after hard bargaining over a number of difficult issues; the declaration disappointed many of the participating scientists as well as other observers because it did not offer a high level of commitment.

The United Nations Framework Convention on Climate Change

When the IPCC issued their First Assessment Report (AR1) in 1990, they concluded that the world is becoming warmer. They called for strong policy action and economically sound steps that the world should undertake at once to reduce future warming. This report influenced the United Nations to call for an international agreement to curb global warming.

Negotiations and lengthy discussions led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC) as one of the results of the first Earth Summit[1] in 1992. The UNFCCC's main objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to insure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."

The Convention is a voluntary, non-binding agreement among parties to reduce greenhouse gas concentrations. A principle of "common but differentiated responsibilities" is introduced as a response to the question of equity among states in terms of having responsibilities of curbing emissions. This principle means that there are responsibilities that are common to all Parties and there are responsibilities that only certain parties must do. Thus a division of parties was introduced where Annex I parties are the developed countries, most Organization for Economic Co-operation and Development (OECD) countries and economies in transition of the former Soviet Union and Eastern Europe, and Non-Annex I Parties are the developing countries. Within the Annex I Parties there are 24 Parties referred to as Annex II Parties who are the more developed countries, Annex 2 Parties have a particular obligation to provide "new and additional financial resources" to developing countries as assistance in dealing with climate change under Article 4.3 of the UNFCCC, and to "promote, facilitate and finance, as appropriate, the transfer of, or access to" climate-friendly technologies.

In relation to these "common but differentiated responsibilities," the parties agreed that:

(1) the largest share of historical and current global emissions of greenhouse gases has originated in developed countries (see Fig. 5);

(2) per capita emissions in developing countries are still relatively low (see Fig. 6), and

(3) the share of global emissions originating in developing countries will grow to meet their social and development needs (UNFCCC, 1992).

[1] The First Earth Summit is also known as the United Nations Conference on Environment and Development, which was held in Rio de Janeiro. Other results of the Earth Summit are the Agenda 21 and the Convention on Biodiversity and Desertification.

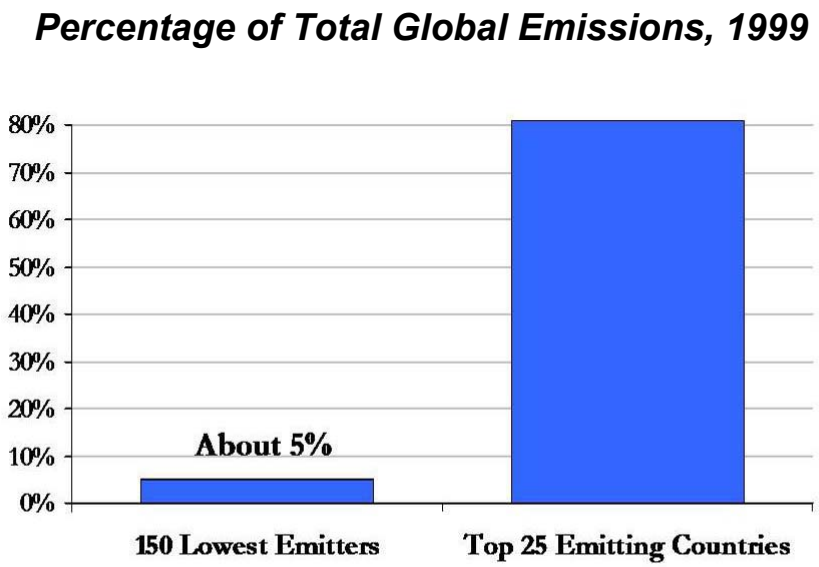

Figure 5. Percentage of Total Global Emissions, 1999. *(Source: World Resources Institute EarthTrends database. Underlying data source: U.S. DOE, Energy Information Administration, International Energy Annual 2001)*

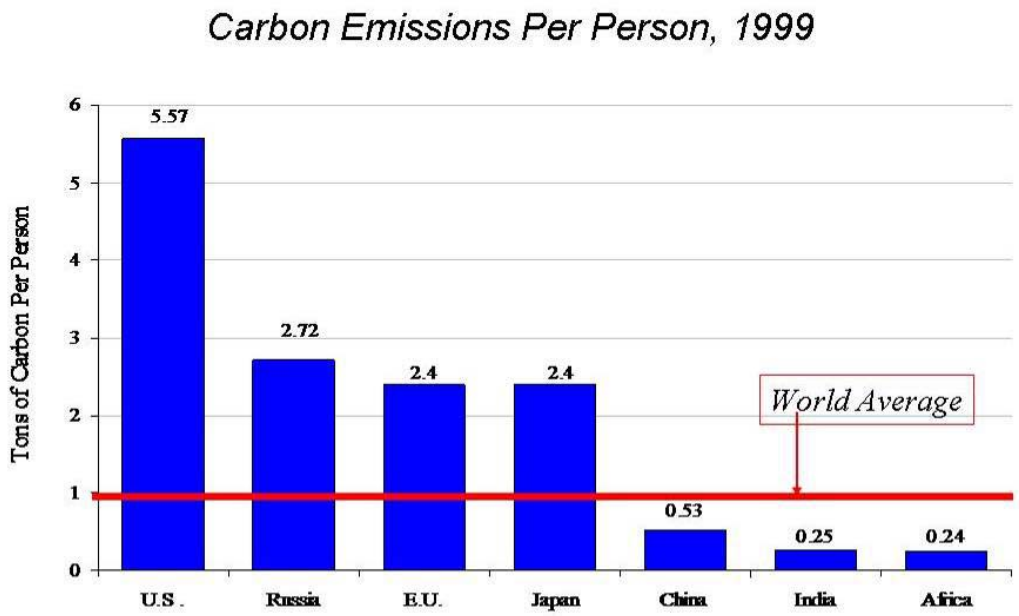

Figure 6. Comparison of per capita emissions between industrialized countries and developing countries. *(Sources: World Resources Institute EarthTrends database. Underlying data source: U.S. DOE, Energy Information Administration, International Energy Annual 1999). Notes: Shows carbon emissions associated with fossil fuel combustion.*

Box 3. Basic Premises of the UNFCCC.

- The recognition that "the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low, and that the share of global emissions originating in developing countries will grow to meet their social and development needs.".
- The acknowledgment "that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions.".
- The recognition of "the need for developed countries to take immediate action in a flexible manner on the basis of clear priorities, as a first step towards comprehensive response strategies at the global, national and, where agreed, regional levels that take into account all greenhouse gases, with due consideration of their relative contributions to the enhancement of the greenhouse effect."
- Its concern that "low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change."
- Its noting of “the special difficulties of those countries, especially developing countries, whose economies are particularly dependent on fossil fuel production, use and exportation, as a consequence of action taken on limiting greenhouse gas emissions."
- The recognition "that all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that, in order for developing countries to progress towards that goal, their energy consumption will need to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general, including through the application of new technologies on terms which make such an application economically and socially beneficial." (UNFCCC, 1992).

The Framework Convention disappointed many environmentalists and states because it did not provide mandatory reductions for greenhouse gas emissions. However, viewed from the perspective of an ongoing process, the convention was an important first step in formulating an international response to the greenhouse gas challenge. It has been described as a "process treaty" and an essential step in implementing a common global strategy for addressing climate change, as well as creating a solid and comprehensive foundation for further national measures and policies. It was designed to attract the widest possible participation of industrialized and developing states while taking into account their respective responsibilities and capabilities.

The Kyoto Protocol

A key achievement of the UNFCCC process was the adoption of the Kyoto Protocol on Climate Change in Kyoto, Japan on 10 December 1997. Upon concluding in its first meeting in 1995 at Berlin, Germany that the obligations of developed countries were inadequate in responding to climate change, the UNFCCC Conference of the Parties

(COP) initiated the negotiating process which culminated with this Protocol. The Protocol imposes quantified emission limitation and reduction targets within specified commitment periods on Annex I Parties. It contains provisions intended to advance the implementation of UNFCCC obligations shared by all Parties, including commitments by developing countries.

The Kyoto Protocol's main feature is that it sets binding targets for 37 industrialized countries and the European Union (http://unfccc.int) for reducing GHG emissions by an average of 5% against 1990 levels which these countries should achieve within the commitment period of 2008-2012. It established individual legally binding targets for Annex I parties to reduce their greenhouse gas emissions.

Under the treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers countries an additional means of meeting their targets by way of three market-based flexibility mechanisms. Agreeing on the rules of the Kyoto Protocol mechanisms has been one of the most difficult issues in the negotiations. These mechanisms – the Clean Development Mechanism (CDM), Joint Implementation, and Emissions Trading – are all intended to provide flexibility for developed countries in their efforts to reach their Kyoto emission limitation or reduction targets. CDM is the mechanism through which developing countries, can participate more actively in the mitigation of climate change in a manner consistent with sustainable development.

Since its adoption in 1997, governments negotiated the details of the Kyoto Protocol to enable its ratification by key players. The negotiations were protracted and complicated by complex technical and political issues. In early 2001, the Bush Administration decided to abandon the negotiating process supposedly because it was too costly for the US economy and unfair for excluding developing countries. Nevertheless, the negotiations continued and were completed that same year in Morocco with the adoption of the Marrakech Accords.

While Parties awaited the entry into force of the Kyoto Protocol, the adoption of the Marrakech Accords shifted the focus of the negotiations to the implementation of the decisions contained in the Accords and to other Convention issues. During COP 8, Parties agreed to the Delhi Declaration on Climate Change and Sustainable Development (decision 1/CP.8), highlighting the importance of adaptation which is "of high priority for all countries." Adapting to climate change continued to be a principal issue during negotiations, resulting to the Buenos Aires Programme of Work on Adaptation and Response Measures (decision 1/CP.10) at COP 10 in 2004.

The requisite for the Protocol's entry into force is that at least 55 countries representing at least 55% of the global GHG emissions ratify it. According to Article 25 of the Protocol, it enters into force "on the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted in total for at least 55% of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance,

approval or accession." (Kyoto Protocol, 1997). Of the two conditions, the "55 parties" clause was fulfilled on May 23, 2002 when the government of Iceland ratified. Following ratification by Russia on November 18, 2004, satisfying the 55% clause, the Kyoto Protocol entered into force on February 16, 2005. As of April 2008, a total of 178 countries have ratified the agreement, representing over 61.6% of emissions from Annex I countries.

The Bali Agreement: The Roadmap to 2009

2007 was a year full of important events for climate change, and the series of developments provided a fitting backdrop to the climactic Bali Conference in December. The Fourth Assessment Report of the IPCC, released in September, presented the latest and most authoritative scientific position ever on the reality of climate change and the obvious influence of human activities on the global climate system. The circumstances surrounding the Bali meeting were made more compelling politically with the awarding of the Nobel Peace Prize in Oslo jointly to former U.S. Vice-President Al Gore and the IPCC. The Bali Conference also marked the first climate conference where global public awareness on climate change was at its highest, owing to the incredible success of Gore's film *An Inconvenient Truth*. Australia's spirited declaration of its ratification of the Kyoto Protocol likewise provided a context within which expectations for success were intensely heightened.

Despite the near breakdown of the Bali conference, as the U.S. dropped its last-minute demands and agreed with the new deal after a torrent of outrage and disappointment from other delegations, and after much pleading from U.N. Secretary General Ban Ki-Moon, the Bali Action Plan was forged. The Bali agreement launched a two-year negotiating process, popularized as the "Bali Roadmap," which aims to secure a new climate treaty by 2009. Thus, the Bali Roadmap will involve substantive negotiations in 2008 to produce an international binding agreement on exactly how countries will meet their "common but differentiated responsibilities" in fighting climate change. The Ad Hoc Working Group on Long-term Cooperative Action, tasked with implementing the Bali Roadmap, has begun work with four major meetings in 2008, with the first held in Bangkok last April, the second in June, a third one in either August or September, followed by a major meeting in Poznan, Poland in December 2008 in conjunction with COP-14. The negotiation process is scheduled to conclude in 2009 at a major summit in Copenhagen, Denmark. The target is for the new deal to be ratified by all countries by 2012, when the first phase of the Kyoto Protocol expires.

The negotiations will be anchored on four main pillars. Mitigation will be at the center of the deal as the first pillar. Industrialized countries, which are historically responsible for the vast majority of GHG emissions, are expected to cut their emissions by as much as 40% by 2020, while developing countries are expected to pursue more climate-friendly development strategies. Adaptation, the second pillar, has finally been focused on after decades of being disregarded in the negotiations. The third pillar of the roadmap is financing. A key feature of the Bali deal is the commitment from the

developed countries to operationalize financing for adaptation so as to be accessible to developing countries and to help them adapt to the threats of rising sea levels, more frequent extreme weather events, declining crop yields, and increased migration. It also lays down the case for appropriate mitigation actions by developing countries, subject to technology transfer and financing. The fourth pillar is aimed at helping poorer nations cut their emissions through the transfer of technology.

Bali also marked the agreement on the mechanism for governing and administering the Adaptation Fund, which was set up under the Kyoto Protocol to help poor countries cope with climate change. The Fund will be taken from a levy of two percent on CDM projects. Another important decision in Bali was to include the new regime on emissions from deforestation and land degradation, which account for 20% of global emissions; these were excluded from existing mechanisms.

The Role of the Philippines

The Philippines has been very active in terms of climate change policy. Even before the UNFCCC was signed in 1992, the Philippines established the Inter-Agency Committee on Climate Change (IACCC) in 1991 through Administrative Order (AO) 220 and has outlined the following tasks:

- Coordinate, develop, and monitor implementation of various climate change related activities;
- Coordinate representation(s) and formulate the Philippine position(s) in international negotiations, conferences, and meetings on climate change;
- Formulate and recommend climate change related policies and actions; and
- Serve as technical committee for the review and evaluation of project proposals for Global Environment Facility (GEF) funding.

Through the IACCC, the National Action Plan on Climate Change was formulated in 1997. The Plan aims to integrate climate change concerns in the development plans of government agencies (Capili, 2006). Because climate change is an environmental issue that needs scientific and technical understanding, the IACCC is chaired by the Department of Environment and Natural Resources (DENR) and is co-chaired by the Department of Science and Technology (DOST). It is made up of 13 government agencies and 1 NGO network, the Philippine Network on Climate Change (PNCC) (See Fig. 7).

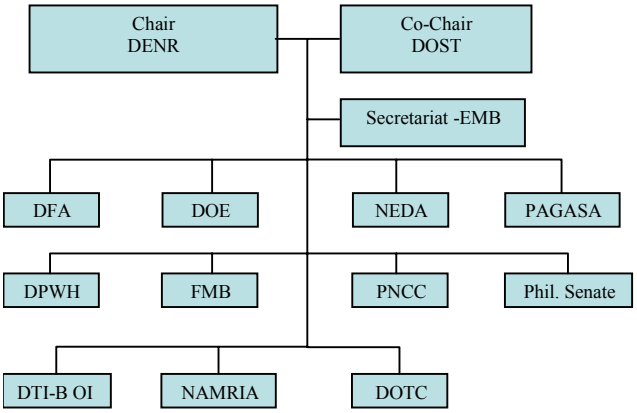

Figure 7. Structure of the IACCC. *(Source: Philippines' Initial National Communications, 1999)*

The Philippines ratified both the Convention and the Protocol in 1994 and 2003 respectively. As a party to the Convention, the Philippines completed its Initial National Communication (INC) in 1999 and submitted it to the UNFCCC Secretariat in 2000. The INC included an inventory of the country's national GHG emissions with 1994 as its base year (See Box 4).

Box 4. The Philippine GHG Inventory.

In 1994, the Department of Environment and Natural Resources (DENR) commissioned the Manila Observatory (MO) to conduct a GHG Inventory for the Philippines in preparation for its Initial National Communication. The ***National Communication*** is a mandatory requirement to be submitted by the different country signatories to the UNFCCC. Besides from the inventory, the document contains local initiatives on climate change, key stakeholders, mitigation and adaptation options, and other relevant information.

In the Philippines, the Energy Sector contributes almost 50% to the country's CO_2 emissions, followed by the Agriculture, Industry, and Waste sectors (see Fig. 8). The country has relied mostly on fossil fuels as its power source for over three decades now.

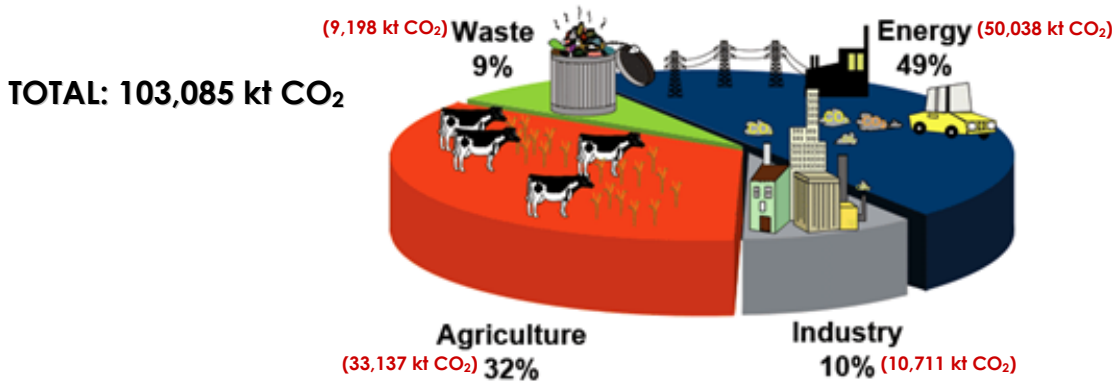

Figure 8. Summary of the 1994 emissions for the Philippines. *(Source: Manila Observatory, Underlying data source: Initial National Communication on Climate Change, 1999)*

As a Party to the Kyoto Protocol, and in order to participate in CDM, the Philippines designated the DENR as the National Authority for CDM through Executive Order No. 320 in 2004. The Executive Order outlines the powers and functions of the DENR as the Philippine Designated National Authority (DNA). These are as follows:

- *Formulate and develop a national CDM policy;*
- *Develop the criteria, indicators, standards, systems and procedures, and evaluation tools for the review of CDM projects;*
- *Undertake the assessment and approval of CDM projects that will be submitted to the UNFCCC and Kyoto Protocol;*
- *Monitor the implementation of CDM projects; and*
- *Perform other functions that are related to and are in pursuance of the development of CDM*

In September 2005, the Implementing Rules and Regulations (IRR) of E.O. 320 were promulgated and named as Department Administrative Order (DAO) No. 2005-17. It provided details on the powers of the DNA, the roles and functions of its support mechanisms, the criteria for assessing Philippine CDM projects as well as the institutional structure of the DNA (See Fig. 9).

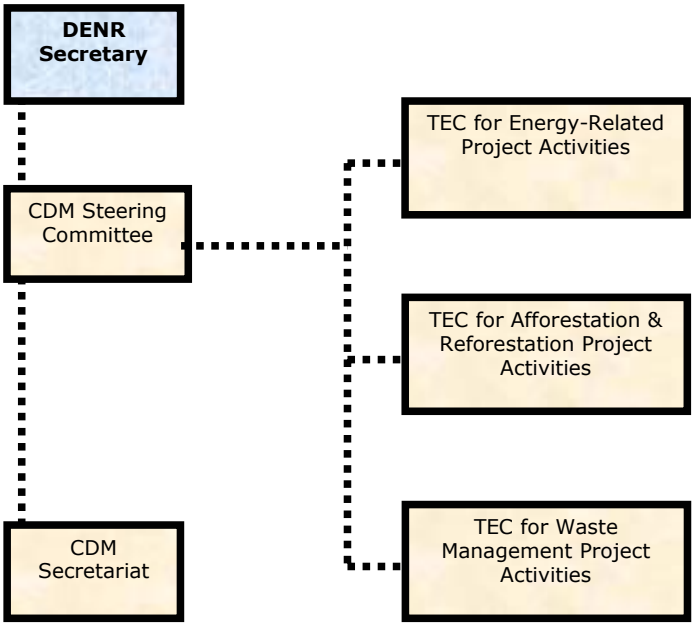

Figure 9. Institutional Structure of the Philippine DNA. *(Source: DAO 2005-17)*

On February 20, 2007, President Gloria Macapagal–Arroyo signed Presidential Administrative Order No. 171 creating the Presidential Task Force on Climate Change (PTFCC). The PTFCC is headed by the DENR Secretary, with the heads of different agencies such as the Departments of Energy (DOE), Science and Technology (DOST), Agriculture (DA), and the Interior and Local Government (DILG). Two representatives from the private sector and the civil society serve as members (see Fig. 10).

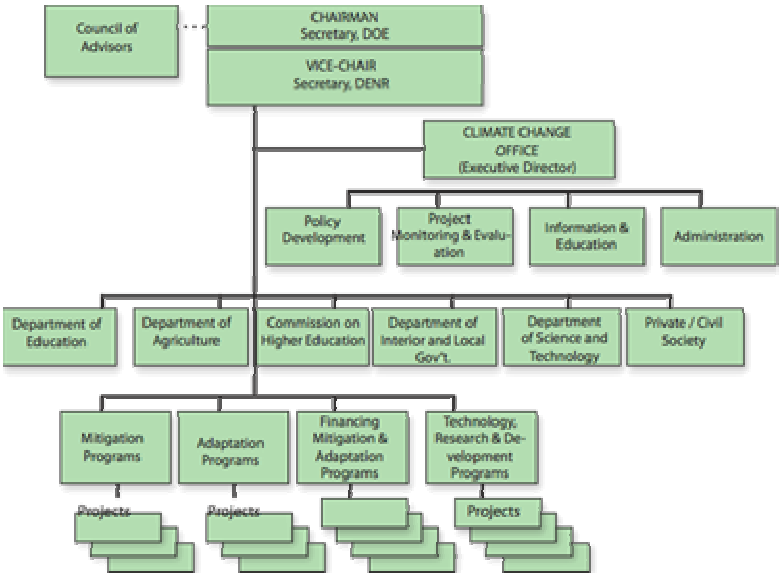

Figure 10. Organizational Structure of the PTFCC. *(Source: David, 2008)*

The main task of the PTFCC is to conduct a rapid assessment of the impact of climate change to vulnerable sectors such as water, agriculture, coastal areas, and marine ecosystems. The PTFCC's functions also include undertaking strategic approaches and measures to prevent or reduce GHG emissions in the country; conducting a comprehensive nation-wide public information and awareness campaign on climate change; designing concrete risk reduction and mitigation measures and adaptation responses; and spearheading the integration and mainstreaming of climate risk management with development policies, plans, and programs of governments.

On August 15, 2007, Administrative Order No. 171-A was issued by Malacañang transferring the chairmanship of the PTFCC from the DENR to the DOE and increasing the membership of the Task Force to include the Secretary of Education and the Chairman of the Commission on Higher Education. In the meantime, an Advisory Council on Climate Change Mitigation, Adaptation, and Communication was created through DENR Special Order No. 2007-453 in September 25, 2007. One of the roles of the Advisory Council is to recommend mitigation, adaptation, and education policies to the DENR and IACCC.

With the increasing interest in climate change, proposed legislation has been filed in the 14th Congress. Senate Bill 1890 filed by Sen. Loren Legarda outlines a national framework program on climate change. The bill seeks to establish a Climate Change Commission in charge of formulating policies related to climate change and spreading public awareness on the impacts of climate change on the country. In order to encourage and promote investments in climate mitigation and adaptation projects, provisions for incentives are included in the said bill along with a Climate Adaptation Fund for providing financial assistance for priority adaptation projects identified by the Commission. In the House of Representatives, House Bill No. 400 authored by Hon. Roilo Golez seeks to create a Global Warming Commission as an attached agency to the DENR. Among the primary functions of the Commission are: regulating and supervising the dissemination of information on global warming, climate change, GHGs and their effect; recommending rules and regulations for global warming impact assessments and providing technical assistance for their implementation and monitoring; and advising the President on the economic and legal aspects of global warming and climate change.

Aside from government initiatives on climate change, many of the programs implemented in the Philippines were facilitated by international as well as local NGOs. The PNCC, an alliance of non-governmental organizations involved in the advocacy of climate change and sustainable development issues, is at the forefront of articulating the civil society position on climate change both in international negotiations as well as in local planning and deliberations (see Box 5). Various programs implemented by international NGOs, including Greenpeace, World Wide Fund for Nature, Christian Aid, Oxfam, and Friends of the Earth, have been instrumental in highlighting climate change issues in the country.

Box 5. Citizen Action on Climate Change: – The Role of Civil Society on Climate Change and The Philippine Network on Climate Change (PNCC).

Established in 1992, the Philippine Network on Climate Change works to enhance the capacity of civil society organizations and local communities, particularly the marginalized sectors, by mainstreaming and integrating climate change into the development process geared towards alleviating poverty, the fulfillment of climate justice, and attaining sustainable development.

PNCC envisions a society that fosters social equity and a climate-friendly, sustainable economy characterized by simple lifestyles and consumption patterns for the benefit of both present and future generations.

In general, PNCC aims to build the awareness and capacity of civil society organizations and local communities to effectively engage key stakeholders- i.e., the government, the corporate sector, the academe and other community service organizations (CSOs) in developing and implementing climate change-sensitive development policies and plans supportive of poverty reduction and sustainable development.

Currently, the members of the network include the following progressive organizations that have strong grassroots presence:

- Haribon Foundation
- Legal Rights & Natural Resources Center Kasama sa Kalikasan (LRC-KSK)
- Lingkod Tao Kalikasan (LTK)
- Miriam Public Education & Awareness Campaign for the Environment (PEACE)
- Mother Earth Foundation, (MEF) Inc.
- Philippine Rural Reconstruction Movement (PRRM)
- SOLJUSPAX/SOL JUSTITIAE ET PAX
- Tanggol Kalikasan
- Upholding Life and Nature (ULAN)
- YAMOG Renewable Energy Development Center, Inc.

(Source: PNCC, 2008)

The Climate Change Information Center, now known as klima Climate Change Center, was established in 1999 under the Climate Studies Division of the Manila Observatory at the Ateneo de Manila University as a joint venture of the Inter-Agency Committee on Climate Change (IACCC), the Department of Environment and Natural Resources (DENR), and the Department of Energy (DOE) under the Philippine Climate Change Mitigation Program (PCCMP) with funding assistance from the United States Agency for International Development (USAID). In 2006, the World Resources Institute and the World Business Council, together with local partners, launched the Philippine Greenhouse Gas Accounting and Reporting Program (see Box 6).

Box 6. The Philippine Greenhouse Gas Accounting and Reporting Program (PhilGARP).

The Philippine Greenhouse Gas Accounting and Reporting Program (PhilGARP) is a voluntary GHG accounting program for Philippine businesses. This is a project of the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) with their local partners which include the Department of Environment and Natural Resources, the Department of Energy, the Philippine Business for Environment (PBE), and the Manila Observatory (klima Climate Change Center of the Manila Observatory serves as the Secretariat). It aims to assist these businesses in preparing their GHG inventories enabling them to identify GHG reduction opportunities. The program was launched in 2006 with the training of a business pilot group that would serve as trainers to assist other companies in doing their GHG inventories. A total of 25 companies have signified their intention to participate in the program. An Inventory Management Plan template was specifically devised for the companies to help them in completing their GHG inventories.

Business Pilot Group

Energy and Power Sector	• Bauang Private Power Corp. • First Phil. Holdings Corp. • Mirant Pagbilao (Team Philippines) • Pilipinas Shell
Manufacturing	• Ford Philippines • Holcim • Nestle Philippines • PASAR • Steel Asia • Unilever Philippines
Industry Estate/Industry Association	• Clark Development Corp. • Environmental Practitioners Association • Energy Management Association of the Philippines • Cement Manufacturers Association of the Philippines
Service Sector	• Ayala Land, Inc. • Central Luzon Doctors' Hospital • Development Bank of the Philippines • DHL Global Forwarding • Island Transvoyager, Inc. • Land Bank of the Philippines • SMART Communications Inc.
NGO/Academe	• John J. Carroll Institute of Church and Social Issues • Manila Observatory • Philippine Business for the Environment
Utilities/Service Providers	• Gulf Oil Petroleum Products • HMR Envirocycle • Manila Water Co. • Manila Electric Co.

While some progress has been made in terms of the institutional arrangements in the Philippines in tackling the challenge of climate change, the current situation requires a more proactive and comprehensive strategy that will enable the country to effectively chart a more sustainable future that takes into account significant contributions towards mitigation and ensure that the country can well adapt to the impacts of climate change. Such a mindset necessitates the establishment of a clear institutional mechanism by which the challenge of climate change can be addressed. This includes the elimination of ambiguities in the government institutions tasked to deal with climate change issues. It also underscores the imperative to establish a long-term and authoritative government institution that will be in charge of climate change.

The Philippines has played a key role in international climate negotiations, having been a major player at the very start while serving as the main spokesperson for the Group of 77 (G77) and China (the developing countries negotiating bloc), particularly on financial resources and technology transfer. The Philippines has also been instrumental in obtaining the major agreement in Kyoto where the country chaired key negotiations that included the debates on Land Use, Land Use Change, and Forestry (LULUCF). Today, the leaders of the Philippine delegation continue to play a vital role in the negotiations launched in Bali for long-term cooperation and to serve as spokespersons for G77 and China.

The challenge for the Philippines in the international negotiations is how to translate this political role into concrete benefits for the country. For that to happen, we have to be clear about what we want to do about climate change in the Philippines.

V. POLICY AND IMPLEMENTATION OPTIONS FOR THE PHILIPPINES

Mitigation Options for the Philippines

The world community's response to climate change consists of strategies that include prevention, mitigation, and adaptation. As the principal objective of the UNFCCC is to stabilize GHG concentrations in the atmosphere at levels that do not threaten to cause serious anthropogenic alterations of the global climate system, prevention and mitigation play central roles in addressing the problem, especially in the context of historical emissions of industrialized countries. Achieving this objective would involve limiting or reducing anthropogenic GHG emissions by sources and preserving or, as appropriate, enhancing sinks and reservoirs of GHGs. However, the complexity of prevention and mitigation stems from the fact that the atmosphere is part of the global commons and as such, no single country, region, or economic sector can, reverse the trend of increasing GHG emissions by itself. Although industrialized countries account for a big slice of the total global fossil fuel emissions each year and have very high per capita emissions rates and developing countries emit significantly less, the current emission growth rates of the latter are substantial. In a matter of a few decades, while industrialized nations pursue cuts in emissions, it is likely that the rapidly expanding energy use by developing countries would account for a majority of emissions.

Most developing countries have low per capita emissions. The Philippines in particular accounts for less than 1 ton of CO_2 per capita per year. Nonetheless, the emissions growth rates of developing countries, including the Philippines (see Table 3), are rising. A long term solution to climate change will rely greatly on whether emerging economies and developing countries can leapfrog into the future and avoid damaging emissions even as their economies grow. In 1994, the Philippine power sector had total emissions of 13.5 million metric tons of CO_2. By 2001, the emissions had soared to 18 million metric tons - a 36% increase in just 7 years. This illustrates how effective prevention and mitigation strategies will be greatly dependent on global cooperation and participation. Developing countries, such as the Philippines, will play a key role in ensuring that the global community will achieve the long-term objectives of mitigation.

Table 3. Historical Environmental Emissions of Power Plants in the Philippines (metric tons).

Environmental Emissions	1991	2001	% Increase
CO2	10,580,233	18,411,762	74
SO2	115,725	189,729	64
NOx	58,726	146,807	150
CO	16,124	20,796	29
CH4	587	904	54
NMVOC	975	1,075	10
N2O	415	842	103
Particulates	10,989	29,611	169

(Source: WWF, 2003)

For the Philippines, prevention and mitigation offer huge opportunities for addressing current challenges that are not necessarily limited to explicitly addressing climate change. This crisis presents an opportunity for us to prudently choose to develop in a sustainable manner, implementing strategies that take the character of "no regrets" options. For a country that is a net importer of fossil fuel, it makes great sense for the Philippines to reduce our energy dependence on other countries as well as on fossil fuel itself. Energy independence, as a goal, is a judicious target as it will have immediate tangible benefits for the economy, environment, and society.

While the diversity of geographic sources of CO_2 emissions pose a complicated challenge, so do the varied distribution among sectoral sources. Anthropogenic emissions come from coal-fired power generators, oil-powered plants, transportation, tropical deforestation, agriculture, waste disposal, and other human activities. Solutions to reducing emissions will have to be applied across a wide range of economic activities and energy uses.

In the INC submitted by the Philippines in 2000, four sectors were identified to be significant sources of GHG emissions: energy, industry, agriculture, and waste. (See Figure 8)

Energy Sector

The energy sector plays a pivotal role in development. In its INC, the Philippines reported that the energy sector emitted 50,038 ktons of CO_2 emissions in 1994, mainly from fuel combustion from power generation and the transport sector (see Table 4).

The Philippines continues to rely on imported fossil fuels such as oil, natural gas, and coal as there is not enough local supply to meet the growing demand. In 2005, the Philippines imported a total of 77,636,000 barrels of crude oil, up from 73,066,000 barrels in 2004.

For the generation of power, the Philippines still relies heavily on coal. While there has been a decreasing trend in the use of coal since 2001, overall coal was still the second largest fuel after natural gas for power generation in 2006. In fact, fossil fuels account for 64% of the 2006 Philippine Electricity Gross Generation Mix (see Table 5). The current Philippine energy mix consists of the use of oil (domestic and imported), natural gas, coal (domestic and imported), geothermal power, and other forms of renewable energy (primarily hydropower). Figure 11 shows the primary energy supply mix in 2006 for the country. Imported oil accounted for much of the energy supply in 2006, used mainly in the transport sector.

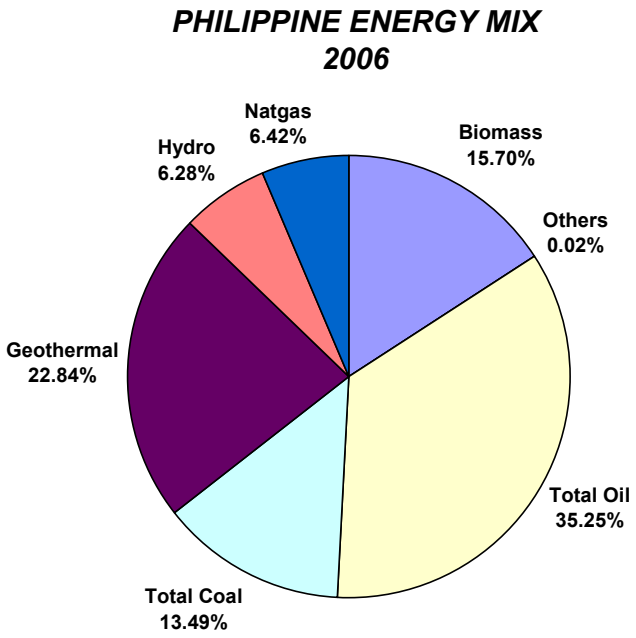

Figure 11. 2006 Philippine Energy Supply Mix. *(Source: Department of Energy)*

Table 4. GHG Emissions from the Energy Sector.

Sub Sector	CO2 Emissions (ktons)
Power Generation	15,508
Residential	4,359
Industries	9,497
Agriculture	1,189
Transport	**15,888**
Commercial	3,370
Fugitive Emissions	227
Total	**50,038**

(Source: Philippine National Communication, 1999)

Table 5. 2006 Philippine Electricity Gross Generation per Fuel Type (in MWh).

Fuel Type	Gross Generation
Coal	15,294,066
Combined Cycle	238,870
Diesel	4,152,144
Gas Turbine	193
Oil	273,593
Natural Gas	16,365,960
Geothermal	10,465,279
Hydro	9,939,413
Wind/Solar	54,612
Total Generation	**56,784,130**

*Renewable sources: geothermal, hydro, wind and solar

(Source: Department of Energy, http://www.doe.gov.ph/EP/Powerstat.htm.)

The transport sector is one of the most significant contributors to increasing GHG emissions. In the Philippines' INC, the transport sector accounted for 30% of the total emissions from the energy sector.

Potential for Reducing Emissions in the Energy Sector

Based on the Philippine Energy Plan 2005-2014, the government will pursue efficient energy utilization and clean energy technology applications. The target by 2013 is a cumulative emission avoidance level of 32,000 gigagrams of carbon dioxide (Gg CO2), alongside a goal to generate cumulative energy savings in the amount of 82.6 million barrels of fuel oil equivalent (MMBFOE) in the next coming years.[2] The strategies to achieve these goals include aggressively promoting the use of renewable energy resources, prioritization of converting old and retiring oil and coal-fired power plants to natural gas, and the stricter implementation of the Philippine Clean Air Act provisions concerning fuel quality standards. In addition, targeted emission and energy saving levels can be achieved with enhanced implementation of energy efficiency and conservation measures, including the expanded coverage of energy standards and labeling programs.

The Philippines is blessed with vast renewable sources of energy (see Fig. 15) which can be tapped in order to lessen the country's dependence on fossil fuels as well as to reduce GHG emissions. In order to double its renewable energy capacity from 30% to 60% in 2013, the Philippines is exploring its opportunities and has set the following goals: (www.doe.gov.ph)

- To be the largest geothermal energy producer in the world
- To be the leading wind energy producer in Southeast Asia
- To install 130-250 MW of biomass, solar and ocean capacity
- To be the solar manufacturing export hub in Southeast Asia

In a study called "Power Switch! *Scenarios and Strategies for Clean Power Development in the Philippines,*" conducted by the University of the Philippines Solar Laboratory for the World Wide Fund for Nature (WWF-Philippines), it was shown that clean energy from wind, small hydro, geothermal, and biomass can result in economic savings for the country, even when considering externalities such as the costs of environmental damage and savings from fossil fuel imports. Projections based on the study showed that renewable energy is the least cost option. Comparing a business as usual scenario with a moderate Power Switch scenario, the latter can generate up to $235 million in savings by between 2003 and 2012. Factors that the study accounted for include installed capacity, coal share in the energy mix, share of renewable energy sources, CO_2 emissions, investment and fuel costs, as well as abatement costs. In the business-as-usual (BAU) scenario, power rates were pegged at PhP 3.1592 per kWh while the moderate Power Switch scenario would redound to a PhP 3.1235 per kWh rate,

[2] Philippine Energy Plan 2004-2013, p. 4-5

not withstanding abatement costs to achieve zero pollution which would run up to $29.3 billion for BAU and $23.2 billion for the Power Switch scenario (WWF, 2003).

Geothermal Energy

The Philippines is the second largest producer of geothermal power in the world, second only to the United States. The country has an installed capacity of 1980 MW from geothermal energy. In 2006, geothermal energy accounted for at least 22% of the country's total power generation mix equivalent to 51% of the power generation from renewable sources (See Table 5). The total estimated untapped potential geothermal resource in the Philippines is around 2,600 MW.

The PNOC-Energy Development Corporation (PNOC-EDC) is the leading Philippine company that explores and develops indigenous clean and renewable energy sources. PNOC-EDC's facilities account for more than 60% of the country's installed geothermal capacity from its geothermal steam fields.

Aside from PNOC-EDC, the other pioneer in geothermal energy is Chevron (formerly known as Philippine Geothermal Incorporated or PGI-Unocal), a private company that pioneered exploration and development of the geothermal potentials of the country in 1971. In partnership with the Philippine government, it has been operating steam fields that provide geothermal energy to the Tiwi and Mak-Ban power plants in Albay and the Laguna-Batangas provinces. These operations provide an additional 747 MW of geothermal power that can supply 12% of the peak power demand in Luzon.

Wind Energy

The Philippines has a large potential for wind energy because of its geographic location. A USAID-funded study conducted in 1999 led by the US National Renewable Energy Laboratory (NREL), in collaboration with Preferred Energy Inc. (PEI), and the Manila Observatory (MO), resulted in the identification of potential wind sites across the country with over 10,000 sq. km (see Fig. 11). The study estimated that the overall wind energy potential installed capacity of the Philippines is around 76,600 MW. Using additional screening criteria, the Power Switch study considered sites with wind power density of at least 500 W/m^2 and whose grid connection costs would be less than 25% of the total life cycle cost of the wind power plant if installed. Based on these criteria, the study posits utility grade capacity of the Philippines at around 7,404 MW scattered over 1,000 sites (WWF, 2003).

The Philippines' first wind farm in Bangui, Ilocos Norte has paved the way for the development of wind energy resources in the country (see Box 7). State of the art space-based and ground-based tools and technology for evaluating capacity should enable us to enhance our present knowledge and are badly needed for actual implementation of the maps.

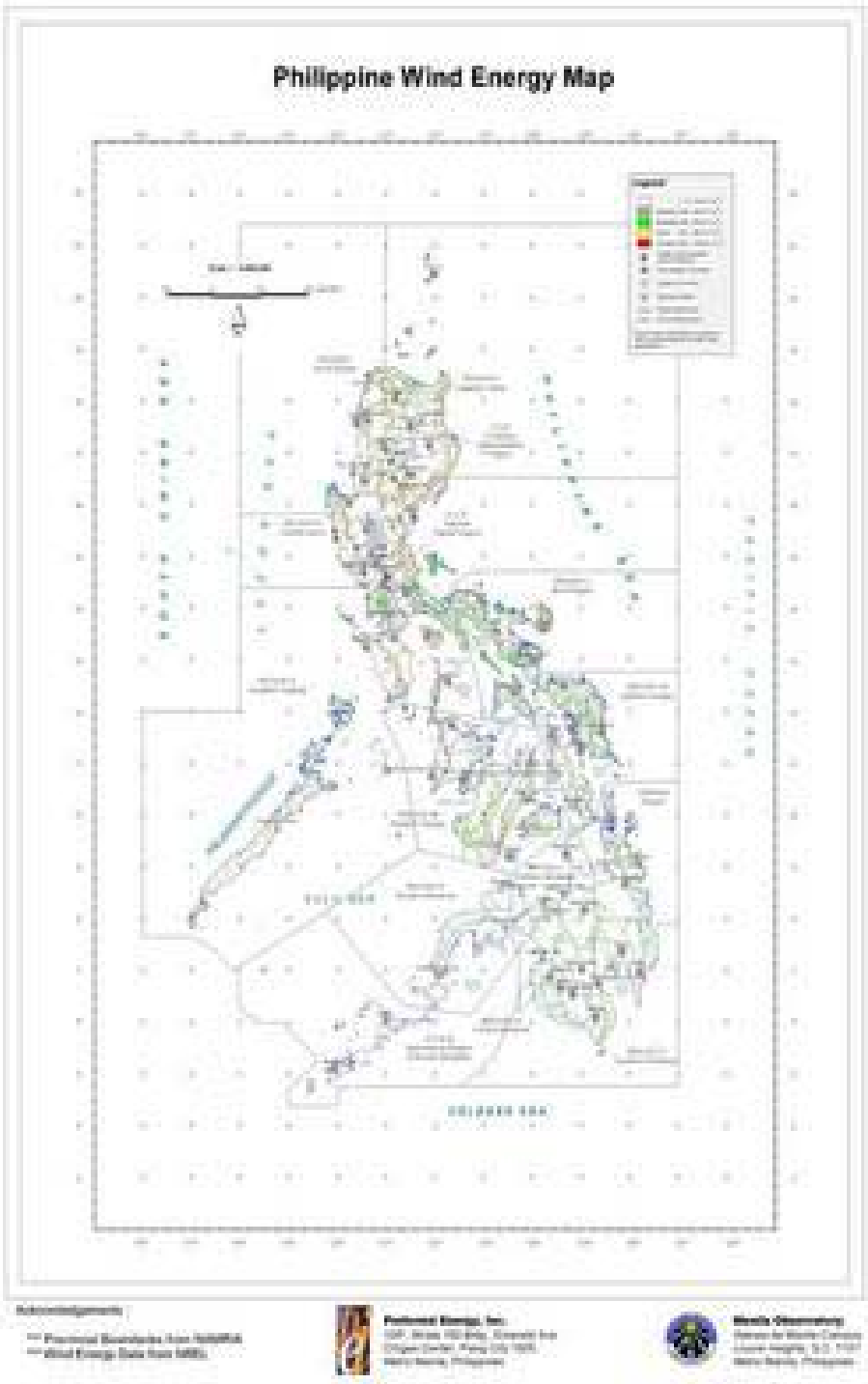

Figure 12. Potential Wind Sites in the Philippines. *(Source: Manila Observatory)*

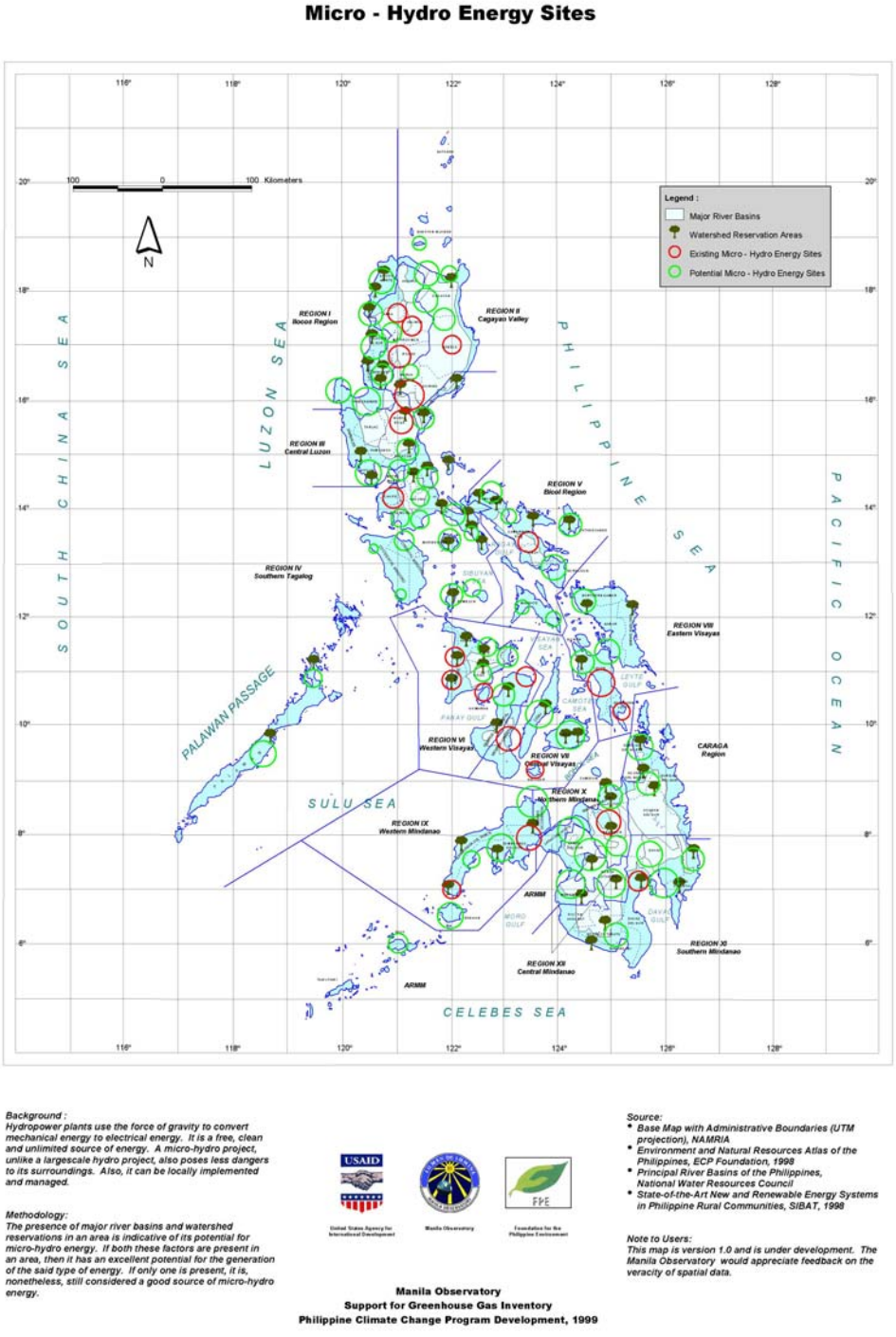

Figure 13. Micro-hydro Energy Sites. *(Source: Manila Observatory and DENR)*

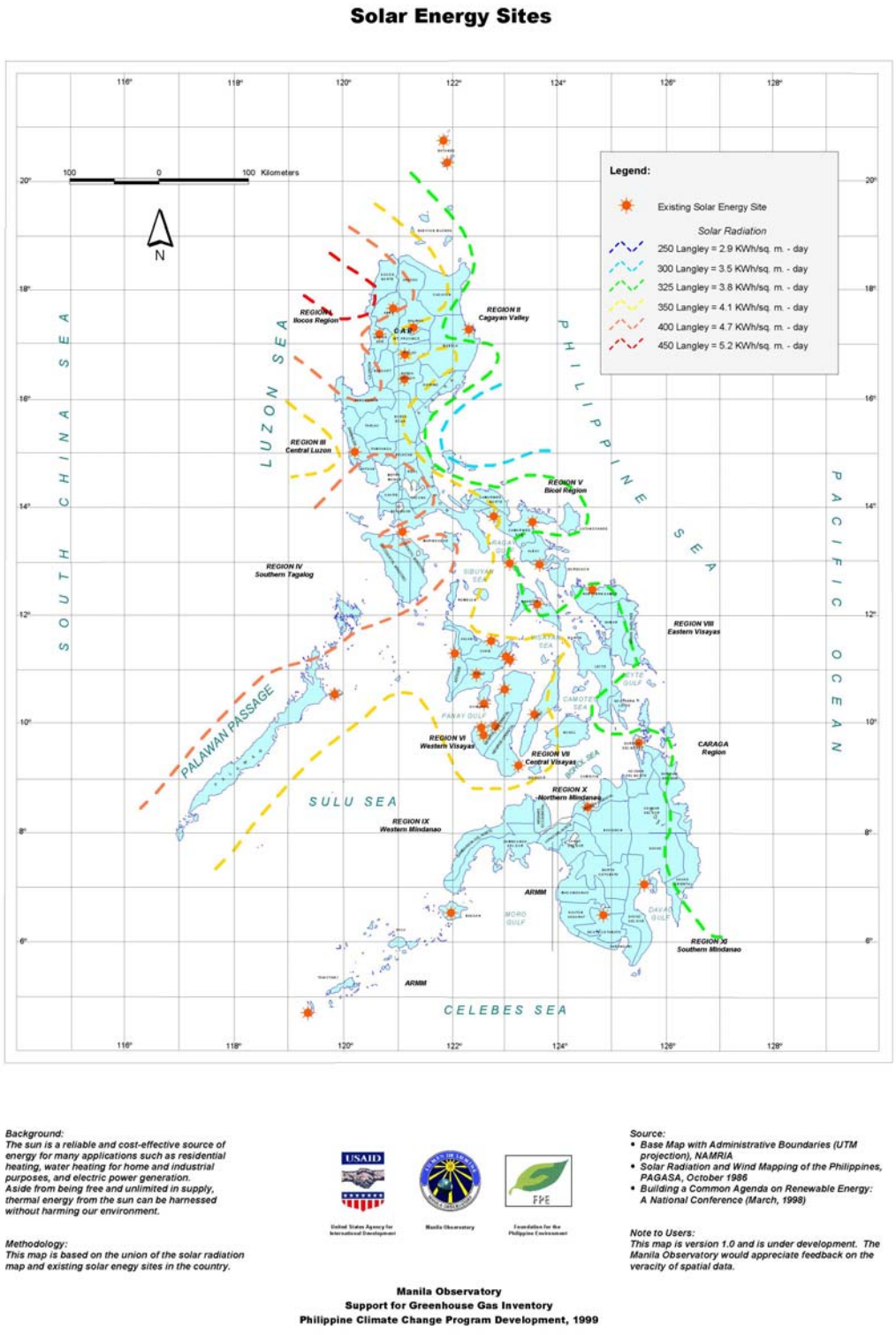

Figure 14. Solar Energy Sites. *(Source: Manila Observatory and DENR)*

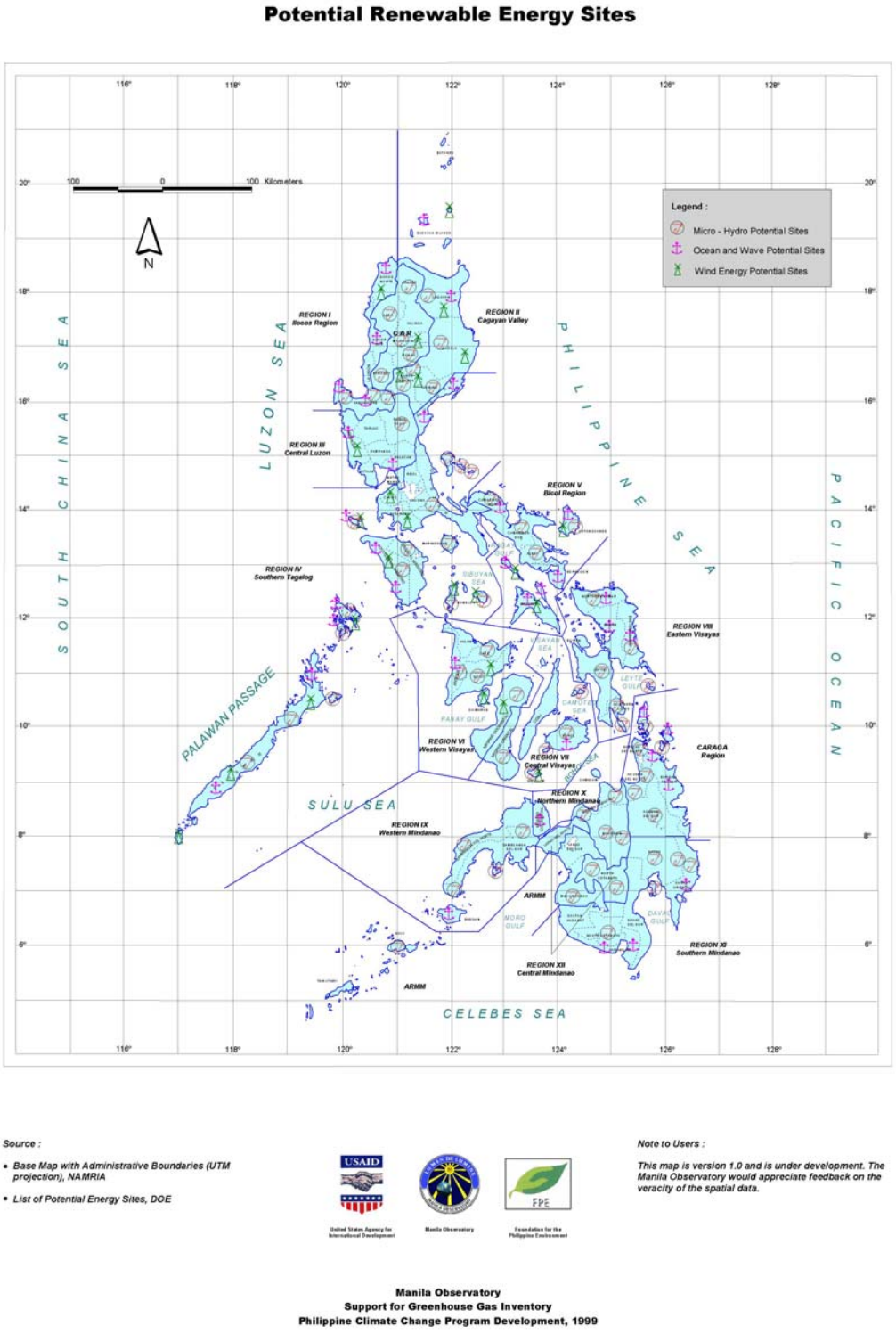

Figure 15. Potential Renewable Energy Sites. *(Source: Manila Observatory and DENR)*

Box 7. NorthWind Bangui Bay Wind Farm.

The Bangui Bay Wind Farm owned by NorthWind Power Development Corporation located in Ilocos Norte has a total installed capacity of 24.75 MW consisting of 15 units for its first phase. Energy produced by this wind farm is sold to the Ilocos Norte Electric Cooperative through a 20-year Electricity Sales Agreement. This wind farm provides several benefits to Ilocos Norte by providing clean energy accounting for 40% of its total power requirement as well as boosting the local tourism industry.

This project has many firsts. It is the first wind farm not only in the Philippines but is the first major wind farm in Southeast Asia. It is also the first and only Philippine project to be registered and certified under the Clean Development Mechanism (CDM). The CDM Executive Board has already issued it a Certified Emissions Reduction (CER) document. For May 2005-August 2006, it has reduced 27,807 tCO_2.

Phase II, which is planned to be completed by June 2008, will add 5 more wind turbines which will bring total capacity to 33MW.

Solar Energy

In the NREL Study on the Solar Energy Potential Sites of the Philippines, the country has an annual potential average of 5.1 kWh/m2/day. As in the case of all the renewable energy maps for the Philippines there is an urgent need to undertake a more in-depth study of potential solar energy sites (see Fig. 14). Solar energy is seen as a strategic source for the electrification of barangays that are far-flung and not connected to the power grid.

A number of projects using solar energy have been implemented in the Philippines. The Philippine National Oil Company (PNOC) Solar Home Systems Distribution Project, a joint cooperation between the government of the Philippines and the government of Netherlands, started in 2002 to provide electricity using solar home systems to communities. As of 2007, a total of 12,390 barangays were provided with solar-powered electricity. In the same year, the Department of Energy and the Philippine National Oil Company (PNOC) signed a Memorandum of Agreement for the electrification of 50 barangays and 100 communal facilities in Zamboanga del Sur, Sultan Kudarat, Maguindanao, and Antique. One barangay in each of the provinces of Kalinga, Negros Occidental, and Cebu will also benefit from the project.

The first grid-connected solar photovoltaic (PV) power plant was inaugurated in 2004, which is integrated into the Cagayan Electric Power and Light Company Inc. (CEPALCO) electric distribution network in the city of Cagayan de Oro. The 1 MW solar facility, although considered the largest of its kind in the developing world, supplies less than one percent of the total maximum demand of CEPALCO. It operates in conjunction with the CEPALCO's 7 MW Bubunawan run-of-the-river hydroelectric power plant, which operates as a load follower, varying part of its output inversely with the output from the PV plant. The amount of electricity produced by the PV power plant will displace about 1,500 barrels of fuel oil per year, reducing carbon dioxide emissions equivalent to about 800 tonnes per year.

Another major initiative in renewable energy is The Alliance for Mindanao Off-Grid Renewable Energy (AMORE), a seven-year project of the United States Agency for International Development (USAID) in partnership with the Government of the Republic of the Philippines, through the Department of Energy and the Autonomous Region in Muslim Mindanao (ARMM). The private sector, through Mirant Philippines, is also a partner in this project which sought to provide a sustainable approach to bring electricity to remote communities in ARMM with renewable energy[3].

Biomass

The Philippines has a wide range of biomass resources mainly from its agriculture sector. Traditionally, biomass such as bagasse, rice hulls, and coconut residues was discarded or burned in open fields. Recent projects tapped these materials as energy sources. Bagasse is used by sugar millers as boiler fuel. The U.P. Solar Laboratory estimates that the country has at least 235 MW of electric power potential from bagasse alone.

As an example of biomass potential, and in an effort to help address the problem of power shortage in the Visayas grid being felt by Negros Occidental, the province has signed a power supply agreement with First Farmers Holding Group in partnership with Ventures Factors of the Philippines. First Farmers Corp. will provide electricity from its new bagasse cogeneration power plant in Talisay City. This biomass power plant is

[3] See the website of USAID Philippines at http://philippines.usaid.gov/oee_energy_renewable_amore.php

capable of generating around 21 MW of biomass energy and is expected to begin supplying electricity by October 2008.

In 2004, the Philippine National Oil Company (PNOC) entered into a Memorandum of Agreement (MOA) with Bronzeoak Philippines, Inc. (BP), and Talisay Bioenergy, Inc. (TBI) for the joint development and operation of a 30-MW Bagasse Cogeneration Project in Negros Oriental. According to the PEP 2004-2015, six biomass projects are scheduled to open and thereby contribute a total capacity of 136 MW.

Small Hydro

Based on the UP Solar Lab's review of the small hydro resource assessment by NREL, at least 236 small hydro sites were identified with capacities of 5-10 MW and where capital costs for transmission did not exceed 25% of the total investment cost. This represents a total installed capacity potential of 2,300 MW (see Fig. 13).

Ocean Thermal Technology

The Philippines has a large potential for energy from ocean resources because of its geographic location. Its ocean resource area is around 1,000 sq. km, with an estimated potential capacity of 170,000 MW. Further research is needed to maximize the use of ocean resources for energy by examining several technological options for deploying ocean thermal energy.

Alternative Fuels

Biofuels are seen as a solution to address the rising costs of fuel importation and to hopefully attain energy independence. To this end, the Philippine government is focused on harnessing alternative fuel resources, specifically biodiesel, bioethanol, and natural gas.

A landmark bill promoting the use of biofuels, the Biofuels Act, was passed in 2006. It provides for the mandatory blending of 5% bioethanol with gasoline and the blending of 1% biodiesel with diesel, within 2 years and 3 months respectively after the law takes effect.

The relevant Energy Sector Goals under the Philippine Energy Plan 2004-2015 with Update 2006, are:

- 100% of Metro Manila buses running on compressed natural gas (CNG) by 2010
- 5% coconut methyl ester (CME) blend with diesel fuel for vehicles in 2010
- 5% ethanol blend with gasoline fuel for vehicles by 2007 to reach 10% in 2010

Energy Efficiency

Energy efficiency is another "no regrets" option for the Philippines. There are several strategies that the country can adopt to reduce energy consumption as well as help the environment in reducing emissions in the power generation, industrial (cement and semiconductor), commercial, and residential sectors. Recognizing the importance and the urgent need to reduce energy consumption and to promote energy efficiency in all sectors of economy, the government has put in place energy efficiency programs and services. This includes the National Energy Efficiency and Conservation Program. With the adoption of these energy efficiency and conservation strategies, it is projected that the country can reduce energy demand by as much as 12.7 million tons of oil equivalent (MTOE) between 2008 and 2030. This is equivalent to 16.8 GW power, representing 68.7 million metric tons of avoided CO_2 emissions with an economic equivalent of US$ 8.7 billion or PHP 384 billion (WWF, 2007).

The relevant Energy Sector Goals under the Philippine Energy Plan 2004-2015 with Update 2006, are:

- 19.8 MMBFOE (2.9 MTOE) average annual energy savings in ten years through the National Energy Efficiency and Conservation Program
- 17.7 MMBFOR (2.6 MTOE) to come from energy efficiency and conservation program
- 2.1 MMBFOE (0.3 MTOE) to come from alternative fuels for transport program

Industries

The industries are large emitters of GHGs. According to the Philippines' INC, the industry sector emitted 10,603 ktons of CO_2 in 1994. These emissions arise directly from industrial processes. Seeing the need to reduce emissions, companies started to account for their emissions and identify strategies and options for them to reduce emissions, ranging from the use of renewable energy and alternative fuels to the institution of energy-efficiency and energy conservation measures within companies. Expansion of public awareness programs for climate change and corporate social responsibility activities which undertake reforestation are additional strategies.

Note that the industrial sector in 2006 consumed slightly more power (15,888 GWh) than the residential sector (15,830 GWh) which had been consuming more power since 2002.

Transport

Understanding the link between climate change and air quality is important. Often one of the fastest growing sources of greenhouse gases is the transport sector, particularly in large urban areas where urban air quality, noise and congestion are

increasingly problematic. Common drivers such as urbanization and population growth, energy consumption and mobilization are present in climate change and urban air quality problems. Pressures and stresses on cities are created as emissions of GHGs and air pollutants increase. With increasing concentrations in the atmosphere of both GHGs and air pollutants, impacts on human health, environment, and the economy are highlighted. It is logical that the framework or approach to address these two problems would be similar or ideally integrated; hence, a co-benefits approach should be looked into.

Increasingly popular are measures involving the promotion of new and improved technologies, such as the introduction of electric or compressed natural gas vehicles, and the encouragement of early adoption of hybrid vehicles. Other strategies are the introduction of vehicle emission standards, passenger and freight vehicle efficiency standards, as well as measures focused on alternative fuels.

Box 8. The Integrated Environmental Strategies Program (IES).

The Integrated Environmental Strategies (IES) program is an example of a program using a co-benefits approach has been introduced and applied with partner local teams in developing countries such as the Philippines, China, South Korea, and India, working hand in hand with experts and tools from the United States Environmental Protection Agency (US EPA), and other organizations (e.g., the United States Agency for International Development (USAID), National Renewable Energy Laboratory). The main thrust of IES was to identify strategies that reduce GHG emissions and improve local air quality while meeting public health, environment and economic development objectives. As a result, quantitative estimates of global and local co-benefits of policies and technologies are provided to stakeholders, setting the stage for their implementation of cost-effective air quality management strategies. By transferring analytical tools and methodologies to the beneficiaries, the IES also aims to build analytical, institutional, and human capacity for multidisciplinary analysis of GHG mitigation, health, and environmental impacts of alternative strategies.

Waste

Based on the Philippines' INC, the waste sector emitted 7,094 ktons of CO_2 in 1994 (see Table 6). The sources of emissions from the waste sector are solid wastes, municipal solid wastes, industrial wastewater, and human sewage.

Table 6. 1994 Emissions from the Waste Sector.

Sub Sector	CO_2 Emissions (ktons)
Solid Wastes	4,253
Municipal Wastewater	966
Industrial Wastewater	920
Human Sewage	954
TOTAL	**7,094**

(Source: Philippine National Communications)

Waste management has been one of the challenges faced by local communities and local governments. Factors such as population growth, changing lifestyle, and improper waste disposal contributed to this growing problem. The Philippine Environment Monitor 2001 of the World Bank states that an average Filipino generates around 0.3 and 0.7 kilograms of garbage on a daily basis depending on income levels. The study also shows that Metro Manila contributes around 23% of the total waste generated by the Philippines. According to the *Garbage Book* published by ADB in 2004, Metro Manila will generate over 70 million tons of solid waste in the next 30 years.

Forestry

The forestry sector represents a special case for climate change. It is seen as both a sink and a source of GHG emissions. Trees are considered sinks because they absorb carbon dioxide from the atmosphere. Forests have the potential to mitigate climate change through forest management practices such as conservation of forests, reforestation, and agroforestry activities. However, forests can also serve as sources of emissions. When trees are burned, whatever carbon dioxide is stored will be released back to the atmosphere. In a study done by Dr. Lasco in 1998, the Philippines contributed 3.7 Gt C to the atmosphere since the 1500s, 70% of which were released in the 20^{th} century alone. Huge areas of degraded land provide great opportunities for carbon sequestration activities as potential mitigation options for climate change.

In the 2005 Philippine Forestry Statistics Yearbook, 15.039 million hectares are classified as forestland, 0.753 million hectares are classified as unclassified forestland, and 14.208 million hectares are classified as alienable and disposable lands.

Using 2001-2003 satellite images, the Forest Management Bureau (FMB) in collaboration with the National Mapping and Resource Information Authority (NAMRIA) estimated the total forest cover of the Philippines at 7.168 million hectares which is 24.27% of the country's total land area. Several forestry activities were implemented by both the public and private sectors so that in 2005, a total of 16,498 hectares of land was reforested.

Economic Options for Mitigation in the Philippines

Mitigating or reducing the amount of GHG emissions to be released in the atmosphere is seen as an important strategy to address climate change. Various approaches to consider are technology-based (developing climate-friendly technologies) or economic in nature (cap-and-trade, carbon tax, and Kyoto mechanisms).

Developing climate-friendly technologies

One strategy to curb and reduce GHG emissions is the development of climate-friendly technologies. Technological innovation however, incurs cost not making it attractive for investors to produce these climate-friendly technologies unless options are identified to lower the cost. These options include support for research and development, providing incentives for developing these technologies, existence of policies to support the development of technologies and social acceptance.

Cap-and-trade vs. Carbon tax

Discussions on which economic strategy could best reduce emissions centered on the debate between cap-and-trade vs. a carbon tax. Under the cap-and-trade system, the government usually sets an overall cap on emissions of certain industries. This allows industries within the economy to trade their emission allowances and generate credits for it. Under the carbon tax mechanism, the government imposes a tax for every unit of emissions discharged to the atmosphere. For the Philippines, these mechanisms may not be feasible at the moment unless an inventory of emissions from industries is put in place. Identifying sectors and industries that emit GHG, and quantifying their emissions is the first step towards evaluating which economic mechanism could work best for the Philippines.

Kyoto Mechanisms

A carbon market emerged when countries began realizing the importance of using a market approach to reduce the impacts of climate change with the least possible cost. The argument for the existence of the carbon market is that climate change is a global commons issue. It doesn't matter where you reduce emissions. As long as you do so, it benefits the whole planet. Given this argument, reducing emissions in a location that is cheaper became the mantra for the carbon market. In the climate regime, the Kyoto Protocol introduced three flexibility mechanisms to achieve this:

- Emissions Trading
    - This mechanism allows Annex I Parties to acquire Assigned Amount Units from other Annex I Parties that are able to more easily reduce their emissions.
- Joint Implementation
    - This mechanism allows Annex I Parties to implement projects that reduce emissions, or to increase carbon removal using sinks in other Annex I Parties.
- Clean Development Mechanism
    - This mechanism allows Annex I Parties to invest in carbon emission reduction projects in Non-Annex I Parties. This enables Annex I Parties to meet their emissions reduction commitment and at the same time help Non-Annex I Parties achieve sustainable development.

CDM in the Philippines

The Clean Development Mechanism is one of the flexibility mechanisms of the Kyoto Protocol which enables Annex I parties to meet their target emissions reduction by buying credits from emissions reduction projects in developing countries. This mechanism not only helps Annex I parties to meet their Kyoto commitments but it also helps developing countries achieve development in a sustainable manner.

In the interest of participating in the CDM process, the Philippines has conducted the necessary policy initiatives needed for the implementation of CDM. It has ratified the Kyoto Protocol in November 2003. By 2005, it designated the DENR to be the national authority for CDM. The main task of the DNA is to ensure that a project contributes and is in line with the sustainable development objectives of the host country. Because of this, the Philippines came up with sustainable development criteria in line with the Philippine Agenda 21 (Table 7).

Table 7. Sustainable Development Criteria of the Philippine DNA.

Economic	• Provides livelihood and other economic opportunities in the community • Provides proper safety nets and compensatory measures for affected stakeholders • Promotes the use of cleaner, more efficient and environment-friendly technology in the sector (e.g. renewable energy, waste management, reforestation, etc.) • Provides new financial resources
Environment	• Complies with environmental policies and standards • Improves local environmental (e.g. air, water, soil) quality • Promotes sustainable use of natural resources
Social	• Provides education and training which build the capacities of local stakeholders • Provides vulnerable groups access to local resources and services • Promotes local participation in the project

(Source: DAO 2005-17)

Project proponents who wish to submit their CDM projects for national approval are required to satisfy standards on sustainable development benefits, and ascribe to principles of transparency and participation through the conduct of consultations with stakeholders.

The Philippine DNA has also established the CDM help desk and website (http://www.cdmdna.emb.gov.ph) to provide information about CDM to the public and provide basic information about the Philippine DNA.

Capacity Building for CDM in the Philippines

Enhancing the capacities of relevant stakeholders as well as creating awareness of CDM plays a crucial role in the effective implementation of CDM projects. The Philippines was able to conduct several capacity building activities for CDM. The Manila Observatory, through its klima Climate Change Center, had several capacity building activities in collaboration with the Inter-Agency Committee on Climate Change

(IACCC) funded by several funding agencies. These capacity building activities include the following (see Table 8):

Table 8. CDM Capacity Building Projects in the Philippines.

Project	Year	Objective	Target Audience
Capacity Development for the Clean Development Mechanism (CD4CDM) *Funder: UNEP with financial support from the Government of Netherlands*	2003-2005	Aims to generate a broad understanding of the opportunities offered by the CDM and to develop the necessary institutional and human capabilities to implement CDM projects	• Project proponents • Government agencies • NGOs • Consultants
Establishment of the Clean Development Mechanism (CDM) National Authority, Operational Framework and Support Systems for the Philippines *Funder: UNDP*	2004-2005	Creating the framework for the Philippine DNA	• DENR • DOE • DOST • NGOs • Private Sector
Integrated Capacity Strengthening for the Clean Development Mechanism (ICS-CDM) *Funder: Japanese Ministry of Environment with IGES as the Implementing Agency*	2004-2008	Building the capacities of selected stakeholders on CDM	• Government agencies • Project Proponents • LGUs

The presence of policy instruments and effective capacity building helped create a pipeline of CDM projects for the Philippines. As of April 2008, the DNA has received a total of 79 requests for national approval from project proponents, 56 of which have been granted Letters of Approval by the DNA. These 56 projects amount to an estimated 2.46 million tCO_2e emissions reduction per year. Of the 56 projects, only 19 projects are registered in the CDM Executive Board. According to the Philippine DNA, 80% of the applications received by their office are for small-scale projects, mostly methane recovery and electricity generation projects. The CERs of these projects range from 241 – 79,000 per project per year. The remaining 20% are regular CDM projects with a range of 53,000 – 582,000 CERs generated by project per year (see Table 9).

Table 9. Status of CDM Projects in the Philippines as of July 2, 2008.

Status	Qty	Regular Scale Project Activities	Regular Scale: Estimated Annual CERs (tCO2-e/yr)	Small-scale Project Activities	Small-scale: Estimated Annual CERs (tCO2-e/yr)	Total Estimated Annual CERs (tCO2-e/yr)
DNA Applications Received	**79**	**15**	2,190,600	**64**	661,097	**2,851,697**
Year 2008	10	0	0	16	203,681	203,681
Year 2007	35	9	1,715,366	26	229,638	1,945,004
Year 2006	10	5	418,446	5	138,044	556,490
Year 2005	18	1	56,788	17	89,734	146,522
Total LoAs Issued	**56**	**13**	1,788,995	**43**	435,427	**2,224,422**
Year 2008	29	6	1,179,165	23	290,386	1,469,551
Year 2007	16	4	382,171	12	89,381	471,552
Year 2006	10	2	170,871	8	55,660	226,531
Year 2005	1	1	56,788	0	0	56,788
Endorsed for DNA approval						
Requesting Registration (Current)	**0**	0				
Project Activities w/ Requests for Review	0	0				
Project Activities Registered	**19**	**6**		**13**		**611,824**
Year 2008	2	1	211,513	2	34,787	246,300
Year 2007	8	1	61,702	7	63,519	125,221
Year 2006	7	3	227,659	4	12,644	240,303
						(ACTUAL)
Project Activities w/ Issued CERs	**1**	1	27,807	0		**27,807**

(Source: CDM Secretariat)

Adaptation Options for the Philippines

Climate change poses a unique set of challenges to developing countries such as the Philippines. The geography and geomorphology of archipelagic countries in the tropics present multiple constraints to opportunities for adaptation. Adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007). Within the context of development, adaptation and its sister-concept, resilience, refer to the ability to respond and adjust to actual or potential impacts of changing climate conditions in ways that moderate harm or take advantage of any positive opportunities that the climate may afford. In simple terms, adaptation is about reducing the risks posed by climate change to people's lives and livelihoods. Adaptation is regarded as having equal importance with prevention and mitigation as embodied by Article 2 of the UNFCCC which states:

> *"...such a level (of greenhouse gas concentrations) should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*

While preventive strategies essentially focus on reductions in emissions, and mitigation emphasizes solutions which lessen the effect of global warming, adaptation is geared towards approaches that states and the international community can adopt to adjust to climatic changes. The concepts of adaptation and mitigation converge in a shared understanding of social and economic vulnerability. While vulnerability speaks to various elements deemed essential to a stable, humane, and equitable co-existence, a joint framework of adaptation and mitigation addresses a range of options for positive intervention at different points of the risk cycle.

Vulnerability comprises varying natures, structures, and scales. This complexity requires that adaptation strategies, policies, and tools be dynamic and integrated, and that its methods and approaches be necessarily iterative. There is no magic bullet that will ensure the survival and the competitiveness of sectors and ultimately of societies.

There is very little integrated capacity to address vulnerability and risk to climate change in the Philippines. This is primarily caused by the lack of an institutional mechanism to link advances in the study of impacts of climate change found within the scientific research community, to mainstream policies and programs of government. Although there are recommendations for adaptation options covering agriculture, coastal resources, and water stipulated in the INC and several policies are already in place that may also address climate change impacts on the side (See Tables 10-12), climate models need to be downscaled and sectoral exposure and vulnerability factors need to be localized. Given the impact of recent disasters, certain local initiatives have emerged as discrete attempts to cope with significant loss of life and property. The provincial government of Albay cast itself in the forefront of adaptation policy work with its hosting of the First National Conference on Climate Change Adaptation (See Box 9).

Box 9. Climate Change Adaptation Initiatives in the Philippines.

Technical Assistance to Support Local Government Capacity to Manage Natural Disaster Risks in the Philippines (Phase I)

The Philippines has been identified as one of the most disaster prone countries in the world. Natural disasters, such as floods, typhoons and landslides, account for about 25% of natural disasters reported annually worldwide. Figures from the National Disaster Coordinating Council (NDCC) reveal that between 1990 and 2006, the country incurred an average annual direct damage to agriculture, infrastructure, and the private sector of around PHP19.7 billion (in real 2005 prices), which is equivalent to about 0.5% of GDP per year. Damage to agriculture alone averaged PHP12.4 billion per annum. An average of 1,009 lives is lost every year, with typhoons accounting for 74% of the fatalities, 62% of the total damages, and 70% of the agricultural damages, reflecting their high annual frequency.

In this regard, the technical assistance program aims is to contribute to strengthening the capacities of Philippine institutions at the local level to reduce vulnerabilities to the impacts of natural disasters and manage related risks. The program will focus on approximately 10 most vulnerable LGUs identified by a risk mapping exercise and consultation process with LGUs and the Government of the Philippines (GoP) to ensure that capacities and tools are made available to these LGUs to manage disaster risks. This is a

program of the World Bank Office in Manila (WBOM) and the Global Fund for Disaster Risk Reduction (GFDRR), World Bank, Washington D. C.

Mainstreaming Climate Risk Management for the Agricultural Sector in the Philippines (Hydro-Meteorological Risk Assessment and Climate Analysis)

In October 2006, the Global Environment Facility (GEF) approved phase I of the long-term Philippines' Climate Change Adaptation Program (PhilCCAP). Under GEF's Special Climate Change Fund (SCCF), the project (PhilCCAP1) would develop and demonstrate the systematic diagnosis of climate-related problems and the design of cost-effective adaptation measures, while integrating climate risk awareness and responsiveness into economic and operational planning, particularly in agriculture and natural resources management and infrastructure investments. The project aims to reduce the negative impacts of the increasing risks due to climate change on poverty alleviation and economic development, particularly in the agriculture, natural resources, and infrastructure sectors, and in part through enhanced inter-agency coordination with respect to climate change adaptation and natural hazard risk management.

In parallel to the project preparation activities by the Philippine government (GoP), a set of diagnostic and analytical activities is to be carried out to support project preparation with quantitative and rigorous risk assessments for the agricultural sector (to be coordinated by the World Bank and funded by a grant from the ProVention Consortium). The work aims to quantify and model risks arising from hydro-meteorological hazards in order to provide a scientific and numerical basis that will inform weather and climate risk management practices and policy, disaster risk reduction, and risk transfer with particular focus on the agricultural sector. It also aims to produce solid and validated climate change scenarios that will enable local stakeholders to make informed decisions on adaptive measures to climate change and integrate adaptive measures to climate change with disaster risk reduction. While the first objective is primarily focused on existing risks in agriculture and related sectors (e.g. water, natural resources), the second objective addresses how risk patterns might change with climate change in the future.

National Conference on Climate Change Adaptation

The province of Albay has been especially exposed to various climate risks such as tropical cyclones. This could worsen as a result of climate change. The coastal areas must be protected from sea level rise and storm surges. Communities living along the coastline and in the uplands must be prepared to meet these challenges to the environment, their livelihood, and their homes. Thus, there is a need to start discussion on how the Philippines can best adapt to the changing climate.

The Albay Provincial legislation unanimously proclaimed and launched the 1st and pioneering prototype for local Climate Change Adaptation, the Albay in Action on Climate Change (A2C2), and resolved that environment shall be included in the curricula of all schools, colleges, and universities in Albay in August 2007. *(Source: http://www.nccca.org.ph/)*

Table 10. Adaptation Options for the Agriculture Sector.

Economic	Technological	Institutional	Research
• Liberalization of agricultural trade barriers • Changes in existing subsidies • Extensive review/analysis of and appropriate action on economic incentives,	• Changes in agricultural management practices • Natural rainfall management including water impounding dams and evaporation • Cropping pattern adjustment according to the onset of the rainy	Institutionalizing agricultural drought management through: • Collaboration between managers of weather data, water resources, farmers, policy makers • Passage of legislative measures including	• Study, review, and improvement of existing policies associated with production, processing, storage, transport and marketing to derive optimum

subsidies, taxes, pricing, and trade barriers	season and observed frequency of tropical cyclones, including information dissemination to farmers and timely provision of farm weather services/advisories, early warning systems (PAGASA-DA) • Access to available data on soil fertility from BSWM, particularly on: ✓ Improved water management ✓ Developing heat-resistant varieties/genetic breeding ✓ Improved farm management ✓ Organic farming ✓ Diversified farming ✓ Safe and judicious use of fertilizers/chemicals ✓ Optimum/efficient use of fertilizers/chemicals ✓ Increasing effectivity/flexibility of irrigation ✓ Introduction of new least-cost technologies (such as hydroponics) ✓ Improvement of post-harvest and bulk-handling facilities (i.e. installations of grain-drying facilities in strategic areas)	those on land-use conversion • Strengthening of extension services at the local government unit level ✓ Upgrade food storage distribution system ✓ Promote and implement judicious land use planning	effectiveness from research, technological developments, and land-use practices

(Source: Philippines' Initial National Communication, 1999)

Table 11. Adaptation Options for the Coastal Resources Sector.

Coastal Resources	Adaptation to Accelerated Sea-level Rise
• Assessment of current practices on crisis management (floods, droughts, storms) • Information dissemination/education campaign on climate variability and change and its impacts for decision-makers and the public • Formulation of guidelines and legislation for the implementation of Integrated Coastal Zone Management (ICZM) for all coastal zones of the Philippines, particularly on land-use planning • Mangrove resources development should be institutionalized highlighting the massive reforestation of degraded mangrove systems through a community-based approach • Public easement and buffer strips should be treated as separate lots during land surveys, i.e. exclusion from filling or private ownership	• Selective protection after thorough cost-benefit studies • Long-term planning from the perspective of coastal zone management to include proper resources exploitation and usage • Disaster mitigation and preparedness tie-up with climate change issues • Passage and implementation of policies and regulations on habitation and construction • Inclusion of measures to address climate change in the ICZM program • Information and education campaign to include government and the general public

• LGUs should be required to reserve foreshore areas which are critical areas for recreation/tourism purposes and other public use and be excluded from disposition • Inclusion of wetlands, swamps, marshes in the NIPAS under a category of wildlife sanctuary or unique ecosystem • A multi-hazard mitigation and protection plan for natural coastal areas must be developed with priority on the maximum reduction in threat to life, structures and economic production • Formulation and strict implementation of mining laws, reforestation of denuded watersheds to reduce river/coastal erosion • Requirement of geological, hydro-meteorological and structural engineering evaluation as part of the environmental impact assessment prior to coastal development • Limitation of government subsidies or tax incentives to develop land sensitive to sea-level rise, such as barrier islands, coastal wetlands, estuarine shorelines, and critical wildlife/habitats	

(Source: Philippines' Initial National Communication, 1999)

Table 12. Adaptation Options for the Water Resources Sector.

Supply-side	Demand-side
• Comprehensive watershed management • Water allocation system and procedures	• Enhancement of irrigation efficiency • Introduction of low water use crops and efficient farming practices • Recycling (reuse) of water • Improvement of monitoring and forecasting systems for floods and droughts • Use of water pricing policies and structures • Promoting awareness of climate variability and change

(Source: Philippines' Initial National Communication, 1999)

In terms of actual implementation, engaging the local stakeholders' participation in pursuing the adaptation strategies remains a challenge. It is important to note that the weather induced disasters of the last four years have placed the Philippines among the top five most disaster prone countries in the world (CRED CRUNCH, 2008). Most notable of these are the December 2005 floods of Oriental Mindoro, the massive debris avalanche in Guinsaugon, Southern Leyte on February 17, 2006, and the great loss of life and property from the lahar and flooding caused by Typhoon Reming in Albay last November 2006. In each of these disasters, lives could have been saved by appropriate infrastructure and planning and a timely early warning. To their credit, some local government units, with the assistance of international humanitarian agencies, have taken the initiative of understanding the science, identifying the risks to their development, and drawing up local adaptation and disaster risk management plans as a counterpart to infrastructure-based mitigation by national government. In the case of the Province of Albay, various vulnerability and risk assessments are currently being conducted to provide the basis and decision-support for the local government's efforts in disaster preparedness.

The INC also provided some adaptation options for the agriculture, coastal, and water sectors (see Tables 10-12). While reviewing these, keep in mind that climate and weather related risks to Philippine development manifest in slow onset and rapid-onset disasters. Among the most notable slow onset disasters was the El Niño event of 1997-98 with an estimated loss of up to 3% of GDP.

Is Adaptation the right framework?

The major difficulties in formulating and operationalizing active adaptation strategies revolve around the knowledge gaps in the science of climate change. First, Global Climate Models (GCM) need to be downscaled in order to identify regional and global warming in specific areas that are difficult to predict accurately. Second, adaptive strategies need to address the growing issues of population and poverty. The stage, structure and size of each country's economy and their respective socio-cultural contexts all contribute to vulnerability.

As resolved in the last Conference of Parties of the UNFCCC in Bali, enhanced action on adaptation should take into consideration the following: international cooperation to support urgent implementation of adaptation actions; risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance; disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries; economic diversification to build resilience; and encouraging multilateral bodies, the public and private sectors and civil society to support adaptation in a coherent and integrated manner.

Based on the projected impacts of climate change in the Philippines, it is but appropriate to take initiatives to come up with a National Adaptation Framework for the country. As a developing country and a signatory to the UNFCCC and the Kyoto Protocol, the Philippines does not have commitments to reduce greenhouse gas emissions at present. Nevertheless, an adaptation framework is necessary before climate change related disasters occur.

Most of the natural disasters being experienced in the Philippines are climate and weather-related. It is in this context that it is so important to relate climate change with management of vulnerability. Disaster-risk reduction options can serve as adaptation options as well. Community involvement is a very effective strategy in responding to disasters. Early Warning Systems (EWS) can be developed for communities and capacity building can also be done as part of disaster preparedness. Baseline information within local communities should also be established to serve as a basis for a disaster management framework. Disaster preparedness should involve local key stakeholders. The academe's role is to provide baseline information and help capacitate local constituents to prepare in the event of disasters. The private sector can provide institutional and financial support for disaster response and management. The local government may provide policies addressing disaster risk reduction and implement

programs to support disaster response efforts. Other stakeholders (e.g. non-government organizations, civil society, etc.) can assist in information dissemination and capacity building.

The adaptation strategies that the country will have to implement at both the national and local levels should encompass preparing for disasters, planning for infrastructure, food, water, and energy security, putting safety nets into place, integrating coastal management, intensifying the conservation of biodiversity, as well as seriously considering population issues.

Box 10. Telemetric Rain Gauges (TRGs) - Basic Instrumentation for Flood and Landslide Hazard Monitoring.

Over the past 140 years, the Manila Observatory (MO) has applied science and appropriate technology to address the social and economic needs of the times. From the development of Padre Faura's aneroid barometer used to forecast inclement weather and save ships at sea, to the more sophisticated monitoring and modeling of climatic systems to assess and predict local impacts of climate change, MO carries on its tradition of applying science to appraise and forecast the wiles of nature that have severe impacts on human lives.

The Philippines is prone to many natural calamities. Recent flooding and landslides have highlighted our inadequacy to respond and provide early warning systems. At the community level, this problem may be broken down into two components: (1) the dearth of measurements and hazard monitoring instruments; and (2) the lack of community participation and hazard preparedness.

In this regard, MO, together with the American Women's Club Philippines (AWCP) and Oxfam, engaged in developing telemetric rain gauges as basic instruments for flood and landslide hazard monitoring to support the Provincial Government of Mindoro. The Observatory recognizes that local production of instruments with locally-available materials ensures suitability of the instrumentation to the Philippine (tropical) climate and sustainability of the monitoring effort. Also, MO believes in the value of having more localized and detailed mapping of multiple hazards, exposure, vulnerability, to enhance the capacity to cope and aid in hazard preparedness. Lastly, the institution realizes it can only assist in areas where government, non-government, and people's organizations are active in organizing communities in hazard preparedness.

The project aims to build a network of TRGs in high-risk areas. The network continually monitors rainfall and warns the community when accumulated rainfall has reached a critical level. Long-term monitoring of rainfall data is extremely useful not only in disaster management but also in agriculture and water resource management.

At present, 10 prototype rain gauges were constructed, tested, and deployed in various areas in the province of Mindoro (see Plate 1). A rainfall database is also being maintained. Secondary data are also gathered to avoid duplication and to maximize the deployment by locating strategic sites for rain gauge installation. Multi-sectoral local stakeholders are also consulted to determine social acceptability, maintenance schemes, rain gauge site selection, as well as development of a Community Rainfall Chart.

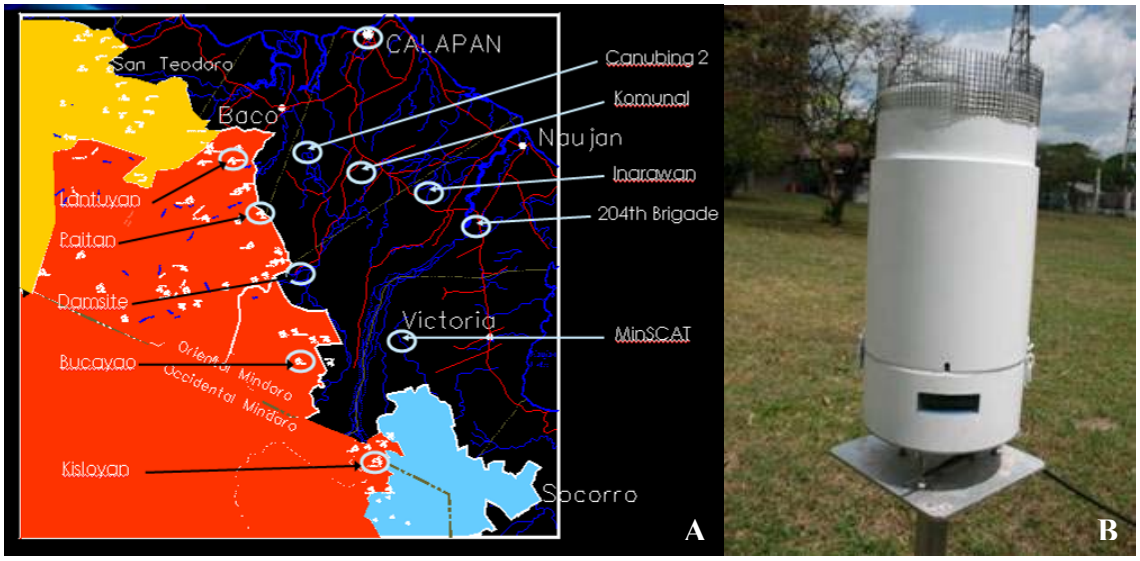

Plate 1. (A) Areas in Mindoro where the Telemetric Rain Gauges are deployed. (B) Sample Telemetric Rain Gauge.

VI. AN INTEGRATED ADAPTATION-MITIGATION APPROACH

The solutions to climate change, as embodied in the texts of the UNFCCC and as can be learned from the lobbies and aisles of the halls where the Conferences are held, is not only about mitigating the causes of climate change. A cornerstone of the Convention is its objective to help human societies adapt to climate change. At its core, adaptation requires integrated long term planning, comprehensive risk management, and good natural resources governance and management. For long term adaptation programs to work, they need to be designed to deal not only with the anticipated problems but also with those that societies and communities are presently facing. This is not difficult to do for climate change because the anticipated impacts are already being manifested, with previews of what could be the norm in terms of climate events in the future.

Box 11. Monitoring the Impacts of Disaster Risk in Albay Province: Towards Risk-Sensitive Development.

Climate change may result in more frequent and severe weather patterns in the eastern region of the Philippines. While climate change and factors related to it may remain undefined for some time, building capacity on the local level to handle impending disasters can improve a province's present ability to cope with disasters and provide urban and rural communities with greater resiliency.

The objectives of this study are to: assess major meteorological factors (e.g. typhoon, temperature increase, rainfall change, and storm surges) and geophysical factors (e.g. lahar flow, floods, and landslides) affecting the sub-watersheds around the vicinity of Mayon volcano in Albay Province; validate and analyze disaster risk (R) where the compounding effect of major meteorological and geophysical hazards as modeled via the UNDP formula R ≅ Hazard (H) x Exposure (E) x Vulnerability (V) or R = HEV are to be approximated and mapped; and recommend optional climate change adaptation and disaster risk management options.

The methods applied to the climate/weather-related and geophysical risk mapping are regional climate modeling and downscaling as well as remote sensing and geographic information systems techniques. The results indicate several areas that have high risk scores due to meteorological and geophysical factors.

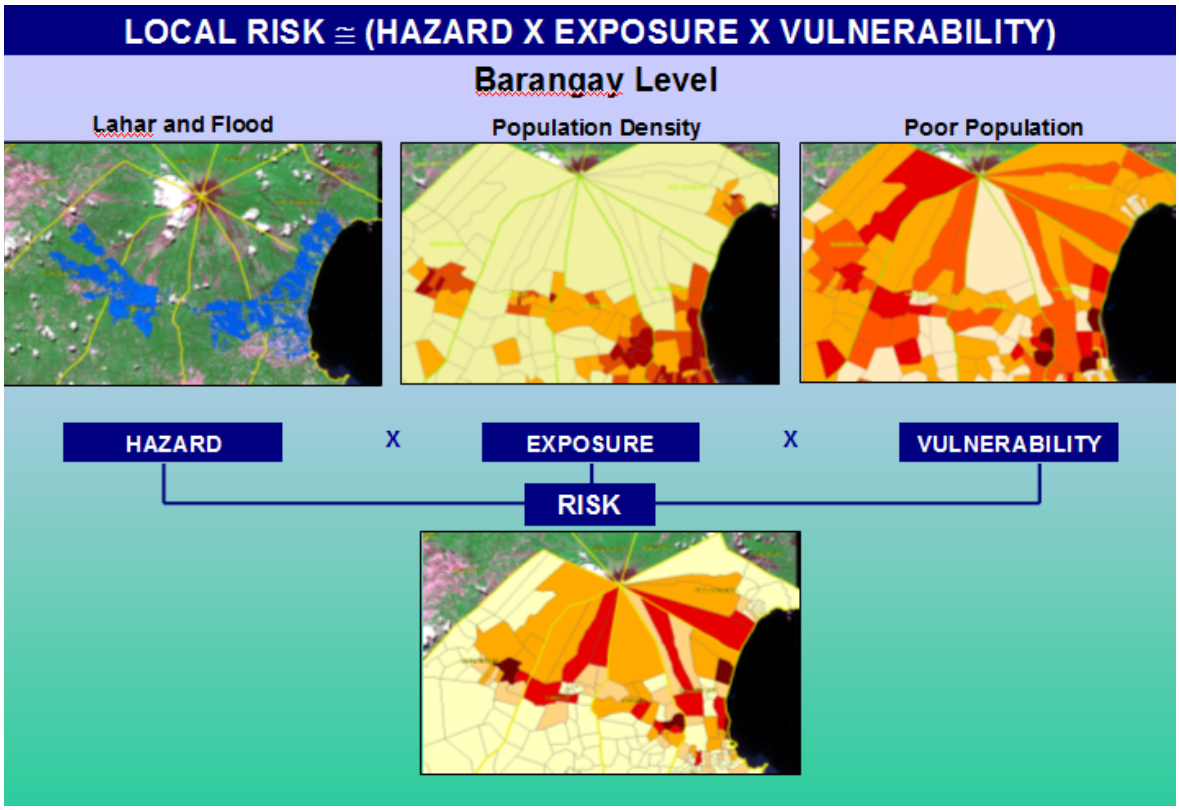

Plate 2. Method used for identifying risk areas in Albay. The hazards considered are lahar and flood, exposure is population density, and vulnerability is poverty incidence or the number of poor people. *(Source: Manila Observatory)*

To avert or to adapt? We need not choose between these two. It is rather late to avert the effects of increased GHG concentrations in the atmosphere and stop its serious consequences. Mitigation and adaptation are not mutually exclusive, so the most effective way that these strategies can be maximized in the context of Philippine development is to integrate mitigation with adaptation. A framework that builds on mitigation measures as part of adaptation, and vice-versa, will provide the necessary mechanisms by which policies, science, markets, capacity building and information are able to respond to the realities of climate change and ensure that the core objective of the UNFCCC as articulated in Article 2 are attained. This framework takes into account the existing knowledge as well as the important gaps and uncertainties.

Mitigation strategies in the Philippine context offer opportunities for enhancing development and boosting the adaptation capacity of communities. Adaptation is as much a development concern as mitigation. With the context of global-scale shifts in the climate system, development can only succeed with adaptation integrated into the process. Adaptation has long been neglected by the global community as a real solution to climate change. The development of a framework that integrates adaptation within the

development process is deemed to ensure sustainability and success (WRI, 2007). Furthermore, the IPCC AR4 states:

> *Sustainable development can reduce vulnerability to climate change, and climate change could impede nations' abilities to achieve sustainable development pathways. Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience. At present, however, few plans for promoting sustainability have explicitly included either adapting to climate change impacts, or promoting adaptive capacity. On the other hand, it is very likely that climate change can slow the pace of progress towards sustainable development, either directly through increased exposure to adverse impact or indirectly through erosion of the capacity to adapt* (IPCC AR4, 2007).

It is within this context that a framework of addressing climate change should be formulated. For instance, the pursuit of energy development should take into account the parameters of a changing climate. The Philippine policy framework should recognize the need for both mitigation and adaptation, taking action both nationally and locally. Internationally, integrated solutions are also being actively developed, and the IPCC has given increased attention to the regional aspects of climate change impacts and adaptation in its Fourth Assessment Report. The relationships between the interlinked elements of mitigation and adaptation are illustrated in Figure 16 from the IPCC 2001 Third Assessment Report.

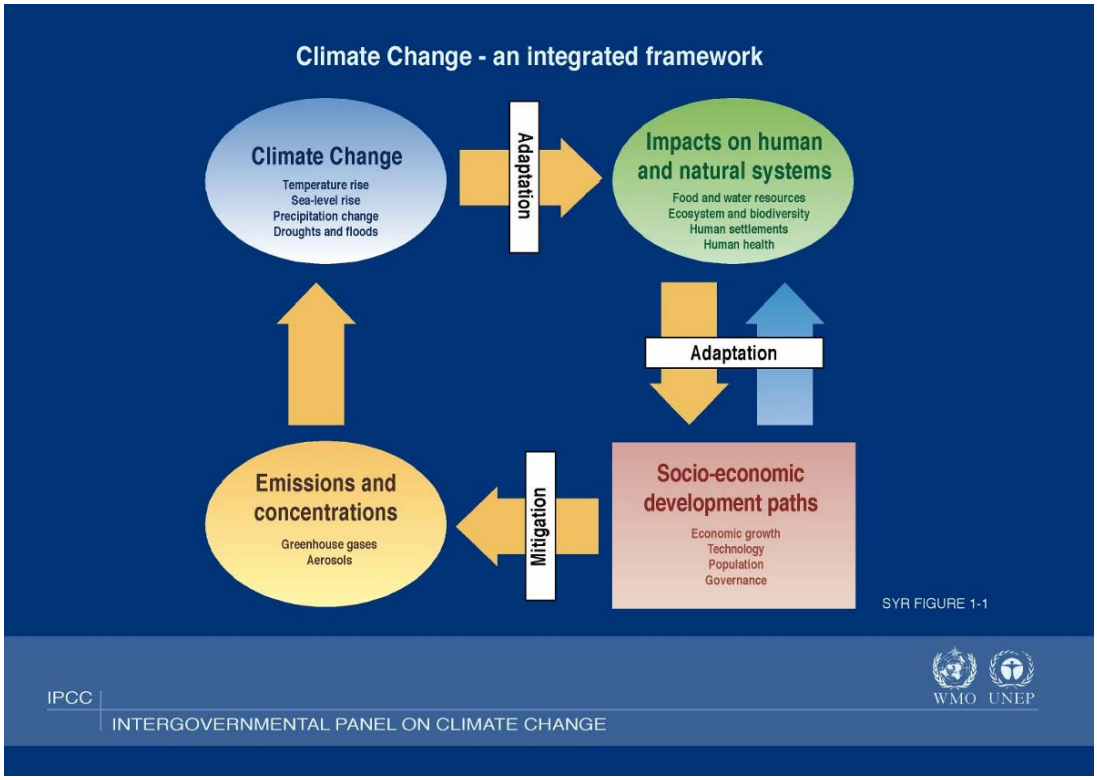

Figure 16. The IPCC Integrated Framework. *(Source: IPCC Third Assessment Report, 2001)*

Moving away from a dichotomy between adaptation and mitigation will aid in developing a more effective integrated policy approach, which in turn will be able to address realities on the ground such as the potential impacts of unmitigated climate change on the Philippines, and how much of these impacts could be reduced through adaptation. Projections of the adaptation needs under different mitigation scenarios will also be possible through this framework.

A lack of understanding of the impacts of climate change on the Philippines limits the policy analysis of these concerns. The existing understanding of the impacts is disjointed because of the sporadic nature of the research, due largely to limited resources. The existing knowledge of the impacts is rather coarse and mostly not at the scale necessary to support targeted strategies for adaptation.

Following the IPCC's integrated framework, the Philippines should adopt an integrated adaptation-mitigation framework that identifies key strategies, establishes clear responsibilities between and among sectors, and provides a clear picture of the interdependence between mitigation and adaptation efforts. We propose a framework summarized in Figure 17.

The framework identifies four main factors for the successful implementation of adaptation and mitigation strategies to address the impacts of climate change on the natural environment and the socio-economic development paths of humans. First is the development of science-based climate policies. Second is the use of market-based mechanisms to attract the use of cost-effective technologies and options to address climate change. Third is the importance of research and development in order to come up with better strategies to combat the impacts of climate change. The last factor is the importance of effective capacity development and information awareness campaigns. The authors have identified the relevant sectors needed for each of the factors.

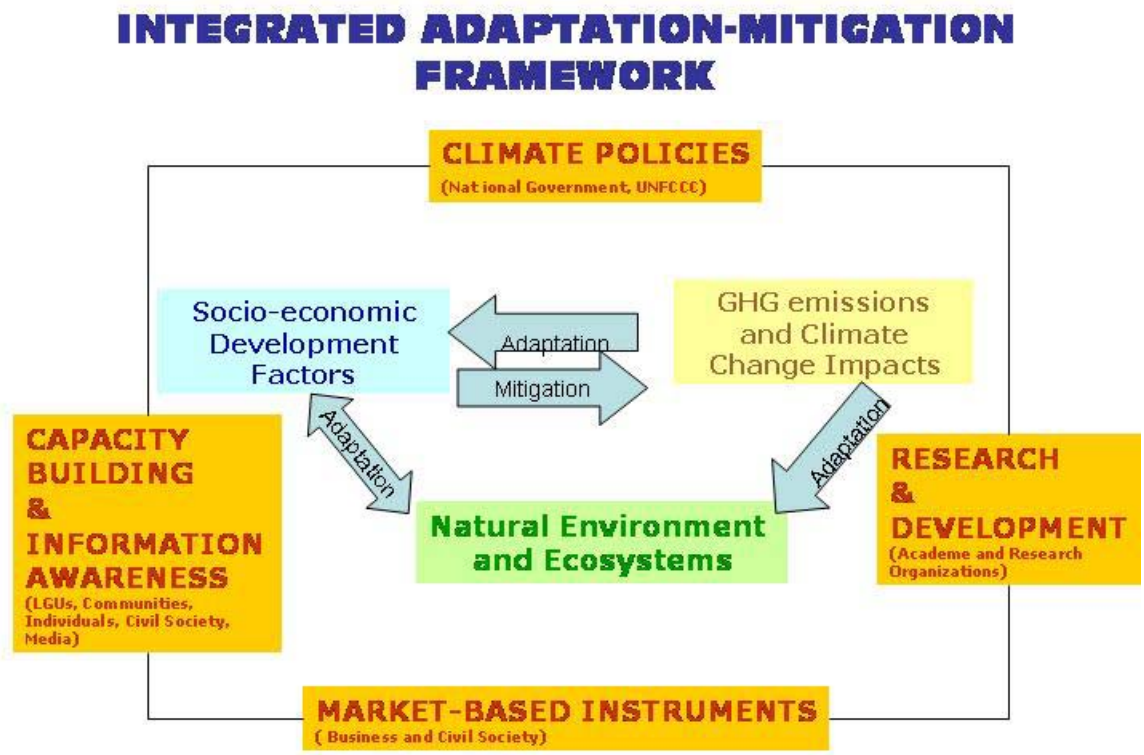

Figure 17. Proposed Integrated Adaptation-Mitigation Framework for the Philippines.

Climate Policies

Crafting climate policies is important to provide the regulatory framework that will guide the role of states and other actors in the development and implementation of effective adaptation and mitigation strategies. On the international level, the UNFCCC plays a key role in the climate regime as it provides an avenue for state parties to discuss policies and develop strategies on a multilateral level. At the national level, national governments have the responsibility to provide sound regulatory structures and policies that would attract investment in climate-friendly technologies. The national government also has the role to come up with strategies to appropriately address issues particularly involving vulnerable sectors. LGUs, on the other hand are seen as having the best role in identifying and appropriately address climate change impacts at the local level. These LGUs can adopt localized strategies which are appropriate in their area.

Market-Based Mechanisms

Economic development has often been blamed for its greed for growth without paying attention to the environment. Ironically, economic considerations are now seen as a means to attract investment in projects and technologies that provide sustainable development benefits. Economic considerations are key factors in the outcomes of

international agreements in the climate regime. The flexibility mechanisms of the Kyoto Protocol are very good examples of using market-based mechanisms to foster development cooperation in the global effort to reduce GHG emissions.

Corporations and businesses are identified as one of the main culprits for increasing GHG concentrations through their operations. These businesses are now using market-based mechanisms to address climate change. Currently, they are engaged in using the carbon market in order to identify ways to reduce emissions in their manufacturing and operation processes.

The citizen action can also play a very important role by influencing businesses and the government to come up with effective measures and appropriate policies for climate-friendly options.

Research and Development

Research and development on the issue of climate change, particularly the causes and impacts, are important to guide policy-makers in coming up with appropriate strategies to address climate change. The academe and research institutions can provide the technical and scientific researches for policymakers. Issues that will need further research from the academe and scientific institutions include the systematic observation of climate systems and their impacts particularly on the most vulnerable sectors of society. As the results of climate change impact assessments can be life altering, particularly for future generations, it is in this context that climate data must be freely shared, and a clear policy be defined for the boundaries and conditions of its use.

Capacity Building and Information Awareness

Strengthening the awareness of the public on the issue of climate change as well as building the capacities of relevant stakeholders to effectively address climate change are key strategies. LGUs, the media, civil society and even individuals play a crucial role in spreading the awareness of the impacts of climate change and how the public can take on a low-carbon lifestyle to help curb GHG emission. For this to be successful, collaboration among these sectors is needed.

VII. CONCLUSION

In this paper, we have proposed an integrated Adaptation-Mitigation framework as the basis for a Philippine response to climate change. In the final analysis, this framework is anchored on sustainable development. As defined by the Brundtland Commission in 1987 (WCED, 1997), sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Addressing climate change means pursuing such an agenda that simultaneously addresses poverty while protecting the environment.

An integrated Adaptation-Mitigation framework is consistent with this because it would allow for the identification of "no regrets" options that can serve best the long-term interests of the country. Fortunately, many response measures to climate change move towards achieving other important objectives, including infrastructure goals, disaster risk reduction and mitigation objectives, food security concerns, energy development and independence, and biodiversity conservation.

At the onset and several times in this paper, it has been emphasized that climate change is a complex problem that requires a multitude of solutions. And it has likewise been stressed that at the core of the multitude of solutions is sustainable development. As the country has made substantial progress in institutionalizing laws and policies that aim to promote sustainable development, the Philippine predicament and challenge lies chiefly in serious gaps and deficits in implementation.

Indeed, at the heart of the solutions to climate change is good governance. Good governance requires designing, adapting, and implementing a coherent approach to climate change. An integrated Adaptation-Mitigation framework is responsive to the realities of the nation, reflects the needs of its people, and empowers all sectors of society to act. This is a modest but essential step forward.

Resilience in the face of climate change and disasters should be at the heart of proper governance. Effective leadership requires a genuine understanding of the nature of our vulnerability and the complexity of its scope and structure. We should embrace the tools that science and technology provide us and use them to drive governance. Good governance demands that evidenced-based decision-making underlie the design of inter-locking adaptation and mitigation strategies.

The country is in the eye of the perfect storm. Being in the eye of the storm gives a false sense of security, for the calmness is fleeting and soon the storm's eye wall will arrive and unleash its fury once again.

Many communities in the Philippines are no strangers to the eye of the storm. Recent typhoons, such as, Reming and Milenyo in 2006 and Typhoon Frank, however, have left a trail of despair. These tempests have broken more than just homes, schools

and markets, but hearts and spirits, too, in their wake. In weathering these storms, the character of the people that endure them is critical. For the country to weather the perfect storm that is climate change, it needs to act, and the time to act is now. Only then, in the words of a great Italian poet, will we emerge from the darkness, "to see-once more--the Stars."[4]

[4] Dante, The Divine Comedy, Inferno, Canto XXXIV.

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