11th National Convention on Statistics (NCS)
EDSA Shangri-La Hotel
October 4-5, 2010

LOCALIZING THE MEASUREMENT OF THE IMPACT OF CLIMATE CHANGE

by
Romulo A. Virola, Edward P. Lopez-Dee
Mark Rex S. Romaraog and Leo Allan C. Halcon

For additional information, please contact:

Author's name	Romulo A. Virola
Designation	Secretary General
Affiliation	National Statistical Coordination Board
Address	403 Sen. Gil Puyat Avenue, Makati City
Tel. no.	+632-8952395
E-mail	ra.virola@nscb.gov.ph
Co-author's names	Edward P. Lopez-Dee, Mark Rex S. Romaraog and Leo Allan C. Halcon
Designation	Information Technology Officer II, Statistical Coordination Officer IV and Statistical Coordination Officer I
Affiliation	National Statistical Coordination Board
Address	403 Sen. Gil Puyat Avenue, Makati City
Tel. no.	+632-8965388
E-mail	epl.dee@nscb.gov.ph; mrs.romaraog@nscb.gov.ph; lac.halcon@nscb.gov.ph

LOCALIZING THE MEASUREMENT OF THE IMPACT OF CLIMATE CHANGE

by

Romulo A. Virola
Edward Eugenio P. Lopez-Dee
Mark Rex S. Romaraog, and
Leo Allan C. Halcon[1]

ABSTRACT

Ondoy and ***Pepeng***, the twin tropical storms that wrought havoc in a number of regions of the Philippines in October 2009, typhoon ***Basyang***, that caused a large tract of blackout and left a trail of wreckage in the National Capital Region in July this year, and the water crisis in Metro Manila resulting from the El Niño phenomenon brought to the fore once again the inconvenient truth about climate change.

In the global arena, preparations are underway for the conduct of the sixteenth Conference of the Parties (COP 16) to the UN Framework Convention on Climate Change to be held in Cancun, Mexico in November 2010. Unfortunately, the Bonn Climate Change talks held last June 2010, a prelude to the Cancun Summit, was perceived to be a big disappointment in its effort to pick up the pieces and pave the way for firmer action after the Copenhagen Summit produced the legally non-binding, controversial and perceived-to-be-weak Copenhagen Accord.

But many agree that the threat of climate change on people's lives has reached alarming proportions. Based on a study made by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), the country's average annual mean temperature is projected to increase by 0.9°C to 1.2°C by 2020 and by 1.7°C to 3.0°C by 2050. The PAGASA simulation study also projected a change in annual precipitation from negative 0.5 percent to 17.4 percent in 2020 and negative 2.4 percent to 16.4 percent in 2050. A rise in sea level has been experienced in many parts of the world, which will increase the risk of flooding and storm damage. In the Philippines, the National Mapping Resource Information Authority (NAMRIA) estimates that a one-meter sea level rise can translate to a land loss of 129,114 hectares.

Clearly, climate change warrants a comprehensive strategic planning on the part of international, national and local policy and decision-makers to address the vulnerability of various sectors and to come up with mitigation and adaptation strategies. Planning to be effective, however, should be based on evidence, on statistics. Unfortunately, despite global initiatives that have been started towards the measurement of the impact of climate change, there are very few available and timely official statistics at the country, not to mention at the sub national level. This is true not only in developing countries like the Philippines but even in developed countries.

Before climate change became a hot global issue, the National Statistical Coordination Board (NSCB) had actually undertaken a number of initiatives to mainstream the monitoring and measurement of climate change and its impact. Under the Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) project implemented in 1998-2001, the NSCB compiled Asset Accounts of five resources as well as the

---

[1] Secretary General, Information Technology Officer II, Statistical Coordination Officer IV, and Statistical Officer I, respectively of the National Statistical Coordination Board (NSCB) of the Philippines. The views expressed in this paper are those of the authors and do not necessarily reflects the views of the NSCB.

The authors would like to acknowledge ***Irenea B. Ubungen*** and ***Gil R. Arce***, head of the NSCB Regional Divisions I and V, respectively for providing their valuable comments and data inputs to the paper. Likewise, the authors would like to acknowledge Governor ***Joey S. Salceda*** of the province of Albay and his staff, ***Zaldy O. Santillan,*** for providing the presentation materials on Climate Change Adaptation and Mitigation in the Philippine context.

degradation/depletion accounts resulting from economic activities in five sectors. In September 2007, the NSCB created an Interagency Committee on Environment and Natural Resources Statistics (IAC-ENRS) to serve as a forum for discussion and resolution of concerns/problems and issues on the compilation of ENR statistics and environmental accounts. The NSCB has also developed a statistical framework that was originally intended to be presented during the Conference on Climate Change and Official Statistics in Oslo, Norway in April 2008. It was presented in Seoul, Korea during the Conference on Climate Change, Development and Official Statistics in the Asia-Pacific Region on 11-12 December 2008. The said framework was also presented in the Expert Group Meeting on the Framework for the Development of the Environment Statistics organized by the United Nations Statistics Division and Statistics Canada held in New York from 10 to 12 November 2009.

This paper takes off from the NSCB statistical framework and localizes it to two regions and a province of the Philippines, namely, the National Capital Region (NCR), the Ilocos Region and Albay Province. More precisely, the paper assesses the available statistics and information system dealing with climate change and its impact in the two regions, noting that they were badly hit by ***Ondoy*** and ***Pepeng*** in 2009. Moreover, it will illustrate the differential impact of climate change, if any, between an urban and a rural setting in the island of Luzon.

From the impact and vulnerability statistics, some adaptation and mitigation strategies will be discussed using the successful model developed in Albay, i.e., disaster management preparedness, environmental sustainability, etc. The last part of the paper will deal with recommendations on Integrating climate change and related matters into the official statistics in NCR, Ilocos and Albay.

KEYWORDS AND PHRASES: Climate Change, vulnerability, adaptation, mitigation, statistics, official statistics, impact of Climate change, environmental accounting, asset accounts, degradation/depletion, economic activities, statistical framework, information system, urban, rural.

I. Introduction

Global Concern on Climate Change

Climate change is now playing an important role in the development agenda and activities of countries and international agencies. Such role has been carved out from the four assessment reports of the Inter governmental Panel on Climate Change (IPCC)[*], the inter governmental scientific body established in 1988 by the World Meteorological Organization (WMO) and the Untied Nations Environment Programme (UNEP), to provide decision-makers and others interested in climate change with an objective source of information about climate change based on scientific evidence and reflects existing viewpoints within the scientific community.

Climate change was further accentuated with the conduct of the Copenhagen Climate Change Conference (COP15) or the Copenhagen Summit in 2009. Although the Summit failed to produce a binding instrument that should have followed through the Kyoto Protocol on emission cuts, it made sure that climate change became central to the political thinking of every country on the planet. The most concrete part of the Copenhagen Accord

[*] Although the IPCC had been by beset by some issues, e,g., the disappearance of the glaciers in the Himalayas by 2035 and the "climategate" scandal, the Panel's assessment reports are still considered as authoritative reports when it comes to climate change. The IPCC was also awarded the Nobel Prize in 2007.

is an agreement that richer countries should raise funds to help poorer nations adapt to climate impacts and "green" their economies (see [8]).

The IPCC's Fourth Assessment Report (AR4) concluded among others the following observed changes in earth's climate (see [15]):

> *Warming of the climate system, which is attributed to the observed increase in anthropogenic greenhouse gas (GHG) concentrations, 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.*
>
> *Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.*

The AR4 reported that the global surface temperature registered an increase of 0.74 degree Celsius (1906 to 2005, a hundred year linear trend). Scientific studies show that human health, ecological systems, and socio-economic sectors (e.g. hydrology and water resources, food and fiber production, coastal systems, human settlements) all of which are vital to sustainable development, are sensitive to changes in climate - including both the magnitude and rate of climate changes - as well as to changes in climate variability.

The AR4 also projected a warming of about 0.2° C per decade for the next two decades. Even if the concentrations of all GHGs and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1° C per decade would be expected. Extreme events, e.g., hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and heavier precipitation. Moreover, Global mean sea level is projected to rise by 0.19 – 0.59 meters between 1990 and 2100, due primarily to thermal expansion and loss of mass from glaciers and ice caps.

Recent researches however, reported that: satellite measurements show sea level is rising at 3.4 millimeters per year since these records began in 1993. This is 80 percent faster than the best estimate of the Third Assessment Report (TAR) for the same time period; by 2100, global sea-level is likely to rise at least twice as much as projected by Working Group 1 of the IPCC AR4; for unmitigated emissions it may well exceed 1 meter. The upper limit has been estimated as approximately 2 meters sea level rise by 2100 (see [2]); and, El Niño Southern Oscillation (ENSO) already switches on and off regularly. Climate change models suggest ENSO will enter a near-permanent switch-on with a possible time frame of 100 years and temperature increase of 3°centigrade - 6°centigrade.

The consequences of climate change will become disproportionately more damaging with increased warming and will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs, which will increase over time as global temperatures increase (see [15]). Anthropogenic warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change.

Moreover, AR4 explicitly stated that the poorest developing countries will be hit earliest and hardest by climate change, even though they have contributed little to causing the problem. Their low incomes make it difficult to finance adaptation. The international community has an obligation to support them in adapting to climate change. Without such support there is a serious risk that development in these countries will be undermined.

Climate Change and the Philippines

The Philippines is considered as one of the climate hotspot largely due to its geographical features, low level of economic development and exposure exacerbated by poor access to resources. (see [16]). The Philippines suffered immensely from natural disasters, as it was struck by two major disasters in 2009: tropical Storm Ondoy (Ketsana) which affected 4.9 million victims including 501 deaths, and typhoon Pepeng (Parma) which hit 4.5 million victims including 539 deaths. The number of deaths due to these natural disasters put the Philippines with the third largest disaster mortality for 2009 (see [32]).

The Philippines being a climate hotspot was further illustrated by the Untied Nations 2009 Global Assessment Report on Disaster Risk Reduction rating the Philippines as number three (3) on its list of top ten countries on the Mortality Risk Index for tropical cyclones and number ten on its top ten countries on the Mortality Risk Index for landslides (see [28]).

The sector most affected by climate change, so far, is agriculture and food security. The sharpest fall in agricultural productions was experienced during strong El Niño events and after the occurrence of severe tropical cyclones. These are clearly illustrated by the recorded decline of 3.5 percent and 6.4 percent in the gross value added in agriculture (NSCB, annual GDP estimates) during the El Niño years of 1982-83 and 1997-98, respectively. Likewise, the rains brought by Ondoy and Pepeng nailed the growth of agriculture and fishery sector to zero in 2009.

On health, the Department of Health (DoH) records showed that the number of cases for dengue fever was significantly high during the 1997- 98 El Niño with 44.5 thousand cases. That number has been surpassed by the current year (January to mid of August) number of 54,659 cases with at least 429 deaths (see [22]).

The country should expect more of these effects because based on a study made by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), the country's average annual mean temperature is projected to increase by 0.9°C to 1.2°C by 2020 and by 1.7°C to 3.0°C by 2050 relative to the baseline period of 1970 – 2000 figures. The PAGASA simulation study also projected a change in annual precipitation from negative 0.5 percent to 17.4 percent in 2020 and negative 2.4 percent to 16.4 percent in 2050. A rise in sea level has been experienced in many parts of the world, which will increase the risk of flooding and storm damage. In the Philippines, the National Mapping Resource Information Authority (NAMRIA) estimates that a one-meter sea level rise can translate to a land loss of 129,114 hectares.

Clearly, the alarming threat of the adverse effects of climate change warrants a comprehensive strategic planning on the part of international, national and local policy and decision-makers to address the vulnerability of various sectors and to come up with mitigation and adaptation strategies. Planning to be effective, however, should be based on evidence, on statistics. Unfortunately, despite global initiatives that have been started towards the measurement of the impact of climate change, there are very few available and timely official statistics in the country, specially at the sub national level. This is true not only in developing countries like the Philippines but even in developed countries.

Before climate change became a hot global issue, the National Statistical Coordination Board (NSCB) had actually undertaken a number of initiatives to mainstream the monitoring and measurement of climate change and its impact. Under the Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) project implemented in 1998-2001, the NSCB compiled Asset Accounts of five resources as well as the degradation/depletion accounts resulting from economic activities in five sectors. The

PEENRA project was also piloted in the Cordillera Administrative Region and the Province of Palawan.

In September 2007, the NSCB created an Interagency Committee on Environment and Natural Resources Statistics (IAC-ENRS) to serve as a forum for discussion and resolution of concerns/problems and issues on the compilation of ENR statistics and environmental accounts. The NSCB has also developed a statistical framework originally intended to be presented during the Conference on Climate Change and Official Statistics in Oslo, Norway in April 2008 (see Annex 1). It was presented in Seoul, Korea during the Conference on Climate Change, Development and Official Statistics in the Asia-Pacific Region on 11-12 December 2008. The said framework was also presented in the Expert Group Meeting on the Framework for the Development of Environment Statistics organized by the United Nations Statistics Division and Statistics Canada held in New York from 10 to 12 November 2009.

The draft framework has been presented to some local fora, e.g., DENR National Statistical Assessment workshop, and comments are being solicited to enhance its deficiencies particularly in the adaptation and mitigation categories for its improvement.

Objectives of the Paper

This paper takes off from the draft NSCB statistical framework and localizes it to two regions and a province of the Philippines, namely, the National Capital Region (NCR), the Ilocos Region and Albay Province. Due to the voluminous need in satisfying the framework, limitations of data available and time constraint, the operationalization of the framework however, will be limited to the information category of climate change particularly on the extreme events, the impact to food security, and human health of the extreme weather events. Section two will assess the coordination mechanisms, the available statistics and the existing information system dealing with climate change and its impact in the three areas. The third part will focus on the projected climate changes and socio economic impact of the changes to the three localities. It will also discus the state of the environment of the areas.

The fourth section of the paper will focus on some adaptation and mitigation strategies using the successful model developed in Albay, i.e., disaster management preparedness, environmental sustainability, etc. The last part of the paper will deal with recommendations on integrating climate change statistics and related matters into the Philippine Statistical System, in general, and the LGUs of NCR, Ilocos and Albay, in particular.

II. The State of Social, Economic and Environment Statistics of Ilocos Region, Albay/Bicol Region and NCR

A. Organizational structure and existing coordination mechanisms in the Subnational Statistical System that would be useful in the generation of official statistics for measuring the impact of climate change

The Philippine Statistical System is a government wide system of providing statistical information and services to the public. It is a decentralized structure comprised of the major statistical agencies and other units in the government, both national and local, engaged in the production of statistics at all administrative levels, the personnel therein, and the national statistical program. Specifically, the organizations comprising the system include a policy-making and coordinating body – the National Statistical Coordination Board (NSCB); a single general purpose statistical agency - the National Statistics Office (NSO); a statistical

research and training center – the Statistical Research and Training Center (SRTC); and units of government engaged in statistical activities either as their primary function or as part of their administrative or regulatory functions.

As the highest policy-making and coordinating body on statistical matters, the NSCB formulates policies, delineates responsibilities, sets priorities and standards on statistics and administers the one-stop statistical information center. The major goal of the NSCB is to promote the independence, objectivity, integrity, relevance and responsiveness of the PSS. At the helm of the NSCB is the NSCB Executive Board, which is composed of the undersecretaries of the different departments and heads of major statistical agencies and chaired by the Secretary of Socio-Economic Planning.

The primary functions of the NSCB are replicated at the sub-national level through the NSCB Regional Divisions which perform the mandate of coordination using mechanisms similar to those available at the national level, as well as provide technical assistance to the data producers and users in the regions.

The birth of regional statistical coordination mechanisms came about with the project, Regional Statistical System Development Project (RSSDP), funded by the United Nations Development Program (UNDP) in 1988. Ilocos Region (Region 1) was one of the pilot regions of the said project.

Regional Statistical Coordination and Development Committees (RSCDC) were created and served as the highest policy-making and coordinating body on statistical matters in the regions. The RSCDC was later disbanded with the creation of the Regional Statistical Coordination Committee (RSCC) in 1992 through NSCB Resolution No. 1, series of 1992. *Creating the Regional Statistical Coordination Committees* (see NSCB website, resolution page). The resolution also paved way for the formal creation of the RSCC in Bicol Region (Region 5). Due to resource constraints, a RSCC was not created for the NCR making the central office of NSCB as the default coordinator.

RSCCs are chaired by the NEDA Regional Directors and co-chaired by the National Statistics Office Regional Directors. Its members are the heads of the following regional government offices: Department of Budget and Management (DBM), Bureau of Agricultural Statistics (BAS), Department of the Interior and Local Government (DILG), Department of Labor and Employment (DOLE), Commission on Population (POPCOM), all the Provincial and City/Municipal Planning and Development Coordinators (PPDOs/CPDOs) of the local government units in the regional centers, and representatives from the private sector.

The functions of the RSCCs are: a) Oversee the implementation in the regions of policy decisions made by the NSCB and the adoption of prescribed statistical standard methodologies and classification systems; b) Institute measures to strengthen the statistical capability in the regions by resolving problems and issues peculiar to the area within the context of national statistical policies and setting priority on the statistical activities thereby ensuring the timely production of useful and reliable data for regional/local development planning and decision-making; c) Elevate statistical matters not specific to the region and its provinces to the NSCB Executive Board through the Regional Development Council (RDC; and, d) Create inter-agency statistical task forces that could attend to technical issues and problems and to supervise the activities of these task forces. To facilitate a well-oiled coordinative mechanism, regional NSCB offices formulate guidelines on statistical coordination at the subnational level and appraise the RSCC and the RDC regarding these.

The NSCB coordinates the process of data generation and dissemination in the PSS through a number of mechanisms aimed at promoting a more efficient statistical system and ensuring, reliable, relevant and accessible information. These mechanisms can serve as

important tools to advocate for the measurement of the impacts of climate change by the PSS at the national and subnational levels.

a. **The Philippine Statistical Development Program (PSDP)**

The PSDP, which is prepared every six years and updated annually, is the blueprint of the integrated vision and priority programs and projects to be undertaken in the PSS for the medium term in order to meet current and emerging needs of the national and local planners, policy-makers and data producers. It is designed to provide vital information support to the Medium-Term Philippine Development Program (MTPDP).

The PSDP is backed up by the agency's statistical calendars which contain information on the statistical activities of the agency, such as the outputs to be generated, expected date and mode of release, and contact person. The PSDP has chapters on sectors that are most likely affected by climate change such as Environment and Natural Resources (ENR), Agriculture and Agrarian Reform, Poverty, Population and Housing, and Health and Nutrition.

At the local level, the PSDP has the following thrust and strategies that are most likely linked with statistics on climate change and its impact that include among others: Local/Small Area Poverty Statistics/Poverty Mapping, Local Governance Statistics, Local Health Statistics; Development and Localization of relevant frameworks and indicator system such as the national/regional/provincial product accounts and indicator systems including the Millennium Development Goals to asses local socio-economic development; strengthening the LGU based administrative based reporting systems to fill in the information gap and complement the regional coverage of national surveys; and generation of local statistics on emerging concerns.

b. **Statistical Survey Review and Clearance System**

The Statistical Survey Review and Clearance System (SSRCS) is a mechanism institutionalized by the NSCB which involves the process of evaluating the design and instruments of statistical surveys or censuses sponsored and/or to be conducted by government agencies including government corporations at the national and/or subnational level. The SSRCS aims to maintain and ensure adoption of statistical standards, classification systems to enhance the reliability and comparability of statistics as well as to minimize duplication of statistical activities.

In the Ilocos and Bicol regions, a Technical Subcommittee on Survey Design, a team composed of experts in the field of statistical survey design and analysis, was created to undertake the review and clearance functions.

c. **Technical Assistance to Government Agencies and Local Government Units**

Technical assistance covers a wide range of services from advice on data collection techniques, data management, analysis and interpretation to review and sampling design, project proposals and socio-economic profiles. Thru this service, users will learn how to use available data and how to use them correctly.

d. **Technical and Inter Agency Committees on Statistics (TCs/IACs) and Task Forces**

The TCs/IACs/TFs are created a) to assess and evaluate the quality, usefulness and timeliness of sectoral data and determine areas of duplication, discrepancies and gaps; b) to

review the concepts, techniques and methodologies used in the collection, processing and reporting of data; and, c) to recommend efficient and workable scheme for the allocation of agency responsibilities in the production of statistics. The IACs/TFs are composed of both data producers and user from government, the private sector and the academic and research communities while TC's are composed of members who have expertise in the particular field or subject matter.

At the national level, the inter-agency committee on Environment and Natural Resources Statistic (IAC-ENRS) was created on 5 September 2007 thru NSCB Memorandum Order No. 4, Series of 2007 in recognition of the fact that the generation of accurate and reliable ENR statistics and indicators can be best achieved thru the collaborative efforts of concerned agencies. The IAC-ENRS was created primarily to serve as a forum for the discussion and resolution of concerns/problems and issues in the compilation of ENR statistics and environmental accounts. The IAC is chaired by the Undersecretary for Policy, Plans and Programs of the Department of Environment and Natural Resources (DENR) and jointly co-chaired by the Director of the Policy and Planning Services of the DENR and the Director of the Economic Statistics Office (ESO) of the NSCB. The members comprise producers and users of environment statistics from government agencies as well as other stakeholders from the academe, non-government organizations and the private sector.

Region 5 has created the Task Forces on Health, Environment and Social Services Statistics (TF HESSS) with the aim of identifying data generation systems affected by the devolution of the functions of the health, environment and social services sectors and recommend appropriate measures that would ensure the continuous generation of statistical series available prior to the implementation of the Local Government Code. Among the members of the said TF are the City Planning and Development Office of Legazpi City and the Provincial Planning and Development Office of Albay province. Region 5 has also created a Technical Subcommittee on Survey Design.

e. **Agency Release Calendar**

This mechanism aims to inform in advance the dates of release of statistics the agency produces. It also includes metadata such as reference period, level of dissagregation, method of data dissemination and agency contact person.

B. Development and Maintenance of Statistical Frameworks and Multi-Sectoral Indicator Systems

The NSCB develops and maintains statistical frameworks and indicator systems that involve various sectors and agencies. These indicator systems are used as frameworks for coordination. An example is the Philippine System of National Accounts (PSNA) that produces estimates of the Gross National Product (GNP)/Gross Domestic Product (GDP), Gross Regional Domestic Product (GRDP) and Gross Regional Domestic Expenditure (GRDE). The PSNA is maintained by the NSCB with data inputs coming from various agencies including private institutions. Other indicator systems that are maintained by the NSCB include the Poverty Statistics, System of Leading Economic Indicators, Gender and Development Indicators, Philippine National Health Accounts, Food Balance Sheet, Quarterly Economic Indices and the STATDEV, which is a tool for monitoring the targets under the Medium-Term Philippine Development Plan and the Millennium Development Goals (MDG). The NSCB also serves as the repository of the MDG database for the Philippines.

The most relevant framework and indicator systems that would be useful for assessing the impact of climate change are the Philippine Framework for the Development of Environment Statistics (PFDES) and the Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) system.

a. PFDES

The Philippine Framework for the Development of Environment Statistics (PFDES), which was based on the UNFDES, is a systematic organization of environment statistics and focuses on the identification, description and presentation of data variables which are useful for tracing and verifying interrelationships among human activities and natural events. The PFDES was undertaken to help address the weaknesses in the collection and compilation of environment statistics.

The PFDES relates each component of the environment (Flora, Fauna, Atmosphere, Water, Land and Soil, Mineral and Energy Resources, Flora and Human Settlements) to four information categories, namely: (1) Social and economic activities and natural events; (2) Environmental impacts of activities and events; (3) Responses to environmental impacts; and (4) Stocks and inventories.

Compilation of environment statistics based on the PFDES was institutionalized at the NSCB starting 2000 through the biennial release of the Compendium of Environment Statistics (CPES). Statistics gathered from the PFDES which have regional dissagregation would be a rich data source for assessing the socio-economic and environmental impacts of climate change, specifically the component on Environmental Impacts of Activities and Events.

b. PEENRA System

The PEENRA system is a satellite account of the Philippine System of National Accounts (PSNA) which is being compiled by the NSCB. The PEENRA covers both the physical and monetary estimates for the use of the resources (depletion) as well as the environmental impact of the selected economic activities (degradation). Environmental accounts covering five resources and fourteen economic activities have so far been released.

Although the PEENRA accounts are aggregated at the national level, some accounts e.g., water and land/soil resources, are regionally dissagregated and these may be useful in assessing the environmental impact of climate change.

C. Other Subnational Statistics/Indicator Systems useful in the measurement of the potential socio-economic and environmental impacts of climate change in Ilocos, Albay province/Bicol and NCR.

On Potential Socio-economic impacts of Climate Change

As mentioned in the earlier sections of the paper, climate change threatens the basic elements of life for people all over the world - water, food, health, and use of land and the environment. The following subnational indicator systems compiled by the regions may be useful in the monitoring and measurement of climate change impact:

a. Regional Social and Economic Trends (RSET)

The RSET contains a compilation of available government statistics in time series. The data included in the RSET cover various sectors, e.g. environment and natural resources, population and housing, agriculture, health and nutrition, social services etc., and these are disaggregated by province/city. The RSET is a useful reference material in the conduct of studies on patterns and trends of socioeconomic indicators at the regional and local level. It is updated/published annually. Both NSCB regional offices 1 and 5 publish RSET annually.

b. Countryside in Figures (CIF)

The CIF is a showcase of social, economic and governance indicators on provinces, cities and municipalities. Cities/municipalities are ranked from highest to lowest to determine the cities/municipalities with the best and worst conditions. The ranks of the province nationwide/region wide are also included for selected indicators. Each chapter contains a brief sectoral highlight. It is updated/published annually.

Ilocos region compiles CiF for its four provinces while Bicol region compiles CiF for all but one of the provinces.

c. Poverty Mapping

Poverty mapping is an activity of the NSCB in support of the government's poverty alleviation program. Poverty maps are produced through the integration of data from various sources and from different disciplines such as social, economic and environment data. The maps serve as useful tools to local government units and other concerned entities in identifying priority areas that should benefit from anti-poverty programs and interventions.

NSCB RD1 prepares poverty maps for its four provinces. Likewise, NSCB RD5 has compiled poverty maps for all its six provinces with Sorsogon having institutionalized poverty mapping through its PPDO.

d. Millennium Development Goal (MDG)

To monitor the attainment of the MDGs, the Ilocos and Bicol Regions compile MDG indicators at the regional, provincial, city and municipal levels. Likewise, both regions maintain a MDG Dev Info database which contains regional, provincial and city level MDG indicators and municipal level.

D. Issues in the generation of data/indicators in measuring Climate change impact in Ilocos Region, Albay/Bicol Region and NCR

A daunting task awaits the statistical and non-statistical agencies of Region 1, Albay Province/Region 5 and more strikingly the National Capital Region in measuring climate change impact. Based on the current coordination mechanisms of the regions and the available statistics at hand, a number of issues and challenges can be enumerated:

Institutional

- Lack of awareness and appreciation of the significance of statistics in all levels of the region which is more evident at the provincial/city and municipal levels.

- Need for a statistical coordination structure particularly at the Provincial/City/Municipal levels.

Technical

- Since climate change and its impact is a relatively new field for statistical agencies and other data producers, there is a need to equip them with the necessary training on climate change impact analysis.

Resource Constraints

- Lack of manpower, technology, and infrastructure to conduct coordination and statistical activities.
- Lack of investment on statistics by the national government and the local government units.

III. Impacts and Vulnerability of Ilocos Region, Albay Province/Bicol Region and National Capital Region to Climate Change

As AR4 concluded, warming of the climate system is unequivocal and this is evident in changes in the global average air/ocean temperatures resulting to extreme weather events.

A. Extreme Weather Events

1. The El Niño/La Niña-Southern Oscillation (ENSO)

ENSO is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean on average every five years, but over a period which varies from three to seven years. It is characterised by variations in the temperature of the surface of the tropical eastern Pacific Ocean - warming or cooling known as *El Niño* and *La Niña* respectively - and air surface pressure in the tropical western Pacific - the *Southern Oscillation*. The two variations are coupled: the warm oceanic phase, El Niño, accompanies high air surface pressure in the west Pacific, while the cold phase, La Niña, accompanies low air surface pressure in the west Pacific (see [20]).

To identify El Niño and La Niña events in the tropical Pacific, particularly for the Niño 3.4 region where the Philippines is categorized, the National Oceanic and Atmospheric Administration (one of the sources of data of PAGASA) used the Oceanic Niño Index (ONI). ONI is the running 3-month mean of the sea surface temperature (SST) anomaly for the Niño 3.4 region (i.e., 5ºN – 5ºS, 120º – 170º W). Events are defined as 5 consecutive months at or above the +0.5º anomaly for warm (El Niño) events and at or below the –0.5º anomaly for cold (La Niña) events. The threshold is further broken down into weak, moderate and strong and must be with the threshold for at least three months. Figure 1 illustrates the different ENSO threshold.

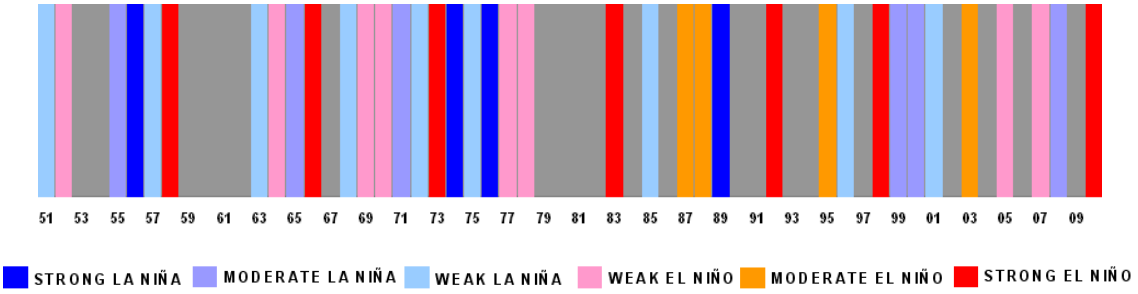
Figure 1. ENSO Thresholds

Color Code							
Classification	Strong La Niña	Moderate La Niña	Weak La Niña	Normal	Weak El Niño	Moderate El Niño	Strong El Niño
SST Anomaly	<= -1.5	-1.4 to -1.0	-0.9 to -0.5	-0.4 to 0.4	0.5 to 0.9	1.0 to 1.4	>= 1.5

1.1. El Niño Events in the Philippines

Based on these thresholds, the Philippines experienced a total of 19 El Niño events, 7 of which are considered as strong, 4 moderate and 8 weak from 1950 to 2010. According to PAGASA, some of the El Niño years that hit the Philippines were: 1965 - 66, 1968 - 69, 1972 - 73, 1976 - 77, 1982 - 83, 1990 - 94, 1997 - 98, 2002 – 2003, and, 2009 – 2010 (see [21]) (see Figure 2 and Table 1).

Figure 2. ENSO Events in the Philippines, 1950 to 2010



Source: NOAA

According to PAGASA, the primary impact of El Niño in the Philippines is drought. The second and third order impacts of El Niño related drought include:

- Environmental - soil degradation which could lead to desert-like conditions if the drought is persistent, salt water intrusion in water reservoirs, high forest/grass/bus fire risk, domestic water supply shortages, etc.;
- Social - disruption of normal human activities, migration to urban communities, human and health problems, etc.; and,
- Economic - unemployment, food shortages, significant reduction in the productivity and subsequent revenue of various industries, hydro-electric power generation, etc.

1.2. La Niña Events in the Philippines

On the other hand, the Philippines experienced a total of 19 La Niña years events, 4 which are considered as strong, 6 moderate and 9 weak during the same period. Some of the La Niña events on record are 1955-56, 1964-65, 1970-71, 1973-74, 1975-76, 1988-1989 and 1995-1996 (see [21]). (see Figure 2 and Table 1)

During La Niña conditions, major parts of the country experience near normal to above normal rainfall conditions particularly over the eastern sections of the country. La Niña conditions also favor tropical cyclone formation over the western Pacific which tend to increase the number of tropical cyclones (see [21]).

2. Tropical cyclones and rainfall

Tropical cyclones are classified into tropical depression (TD) with maximum winds from 40 to 63 kilometers per hour (kph) near the center, tropical storm (TS), maximum winds from 64 to 117 kph near the center, and typhoons (TY) with maximum winds of 118 kph or more near the center.

Historical records of PAGASA (see [21]) from 1948 to 2009 show that tropical cyclones entered the Philippine Area of Responsibility (PAR) most frequently in July (55 TD, 53 TS, and 96 TY), August (45 TD, 60 TS, 88 TY), September (35 TD, 55 TS, 95 TY) and October (24 TD, 37 TS, 96 TY). The highest number of tropical cyclones to enter the PAR occurred in 1993 while the lowest occurred in 1998 (see Table 2).

On an annual basis during the period 2000-2007, the most number of tropical cyclones occurred in 2003 and 2004 (25 each); while the most number of typhoons occurred in 2004 (13) followed by 2006 (11) and 2007 (10). From 27 typhoons during the period 2000-2003, the number ominously increased to 39 from 2004-2007. (see [21]) Moreover, the cyclones are getting stronger and stronger especially since the late 1990's.

2.1. Tropical Cyclones/rainfall and its impact in Bicol Region

From 1947 to 2006, a total of 29 intense tropical cyclones (with highest wind speed of 120 kph to 320 kph) passed through the Bicol region, eight of which occurred during the 80's, 7 during the 70's, and 2 during the current decade. The strongest so far was typhoon Reming with a highest wind speed recorded at 320 kph. (see Table 3)

The deadliest typhoon that crossed Bicol region was Reming (Durian) 2006 causing 754 dead* (see Table 4). Its torrential rains loosened the saturated volcanic materials at Mayon Volcano's slope sending lahars to populated areas and burying villages in Sto Domingo, Legazpi City, Guinobatan, Camalig and Daraga (see [3]). The affected population/areas was 707,966 families in 3,507 barangays of 163 municipalities and 13 cities in 114 provinces of Regions IV-A, IV-B and V.

In 2006, November was the rainiest month pouring 689.6 mm of rain, the time when Reming hit the Bicol region.

2.2. Tropical Cyclones/rainfall and its Impact in NCR

Of the 10 most destructive tropical cyclones that hit NCR from 1947 to 2009, three occurred during the last 4 years (see [4]). (see Table 5) The costliest cyclone that hit NCR was ONDOY (Ketsana) 2009, with an estimated cost of damage of 11.121 billion pesos*; next is Frank (Fengshen) 2008, with estimated cost of damage of 13.321 billion pesos*; and, Milenyo (Xangsane) 2006, with estimated cost of 6.610 billion pesos.*(see Table 6) Incidentally, Ondoy recorded the highest number of death caused by tropical cyclones that hit NCR. (see Table 4)

Tropical storm Ondoy poured 455 millimeters of rain for 24 hours straight last September 26, 2009. The downpour is almost one and a half times the historical average for 1993 to 2008 for the entire month of September (364 mm). In fact the rainfall exceeded all the monthly averages except for July (459 mm).

2.4. Tropical Cyclones/rainfall in Ilocos Region

The most prominent and destructive tropical cyclones that hit Ilocos region were: Typhoon Kadiang (Flo) in 1993 with wind speed of 130 kph, an estimated cost of damage of P 8.752 B, and 576 deaths; Super Typhoon Loleng (Babs) in 1998 with a wind speed of 250

* Includes other regions

* Includes other regions (no breakdown)

kph, an estimated P 6.787 B cost of damages and 303 death; and Pepeng (Parma) in 2009 with a wind speed of 120 kph, estimated cost of damage P 27.195 and 492 death.[*]*

For the past 9 years, rains have been falling heavily in Laoag. Records from the Laoag Station, Ilocos Norte show that only the rainfall in year 2003 did not exceed the 166.5 mm rainfall climatological normal[*]. On the monthly average rainfall, only August, September and December did not exceed the rainfall climatological normal. (see Table 7).

Looking at the Dagupan City, Pangasinan Station, August ranks first as the rainiest month followed by July, September, June, May and October. July used to be the rainiest in Pangasinan, but since 2003, there was a shift to August as the rainiest month except in 2006 (see [21]). For 2009, the rainiest month recorded by Dagupan station was in October with 807.2 mm, caused by Pepeng. During the period 2001 to 2009, the average rainfall for years 2002, 2003, 2004 and 2009 have exceeded the 199.3 mm rainfall climatological normal.

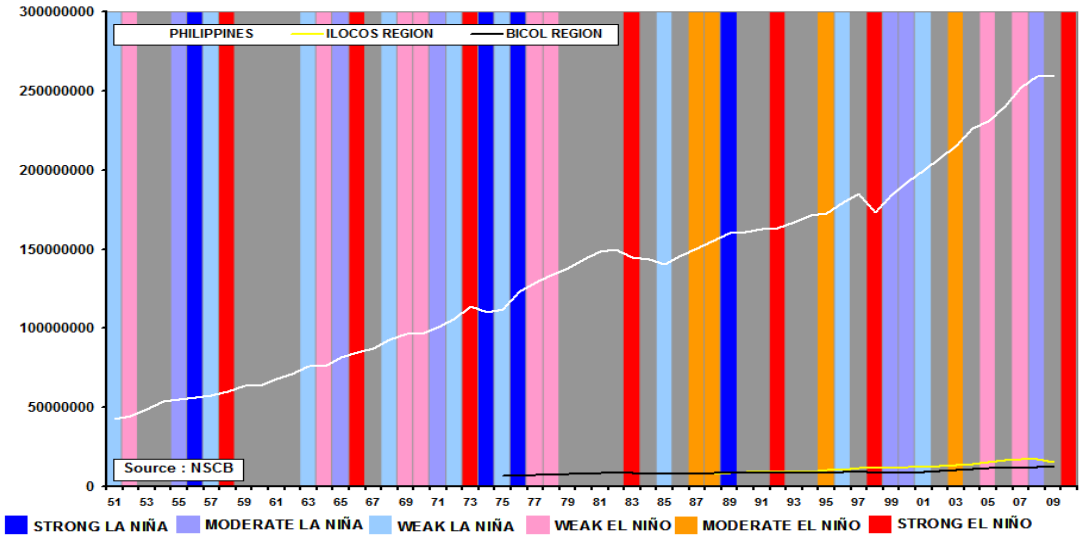
B. Economic Impact of Climate Change

The discussion on climate change impact to the economy will focus on agriculture and fishery. More particularly, it will deal on the palay and corn production in Ilocos region and Albay province/Bicol region (NCR has an insignificant palay and corn production activities) vis-à-vis strong El Niño or strong La Niña compared with non strong ENSOs (moderate ENSOs, weak ENSOs and normal). In the case of regional fish production, the focus will be on the three areas vis-à-vis moderate ENSOs due to short data span.

B.1. Agriculture/Fishery

As already cited, agriculture and fishery will suffer most from the effects of climate change particularly the extreme natural events.

Figure 3: GVA of AFF (In Million Php)



[*] includes other regions, no breakdown

[*] Climatological Normal refers to the period averages for a uniform and relative long period comprising at least 3 consecutive 10 year period (1971 to 2000).

During strong El Niño and La Niña years from 1951 to 2009, gross value added of Agriculture, Fishery and Forestry (AFF) at constant prices on the average is lower by 10.2 percent and 18.2 percent, compared with non-strong El Niño and La Niña years, respectively, at the national level (see Figure 3 and Table 8).

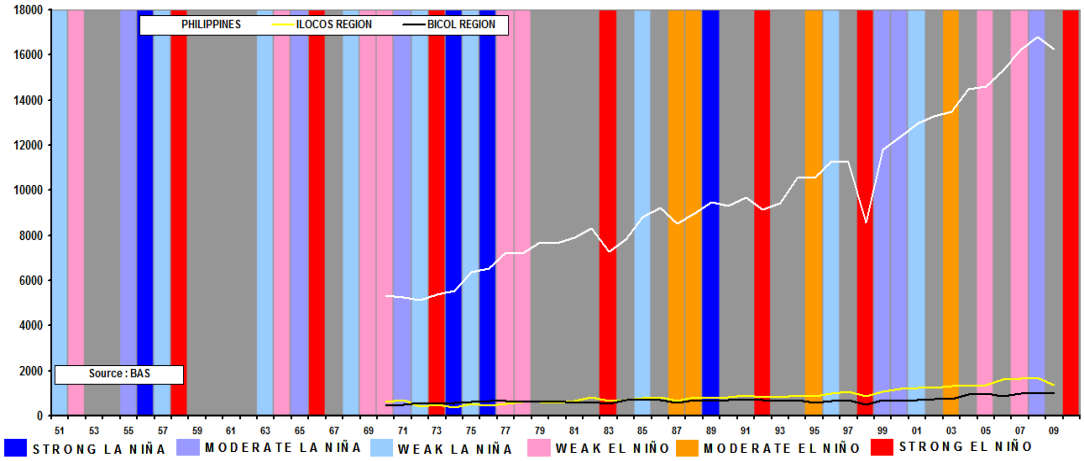
The gross value added of AFF in Ilocos region and Albay/Bicol follows the trend of the national figure.

B.1.1. Palay Production

From 1970 to 2009, Palay production during strong El Niño years is on the average lower by 26.6 percent compared to non strong El Niño years. During strong La Niña, palay production is lower by 30.5 percent as compared to non-strong La Niña years. (see Figure 4 and Table 9)

The level of palay production in Ilocos region and its provinces and Albay/Bicol region follows the trend of the national figures.

Figure 4: Palay Production (In 000 MT)

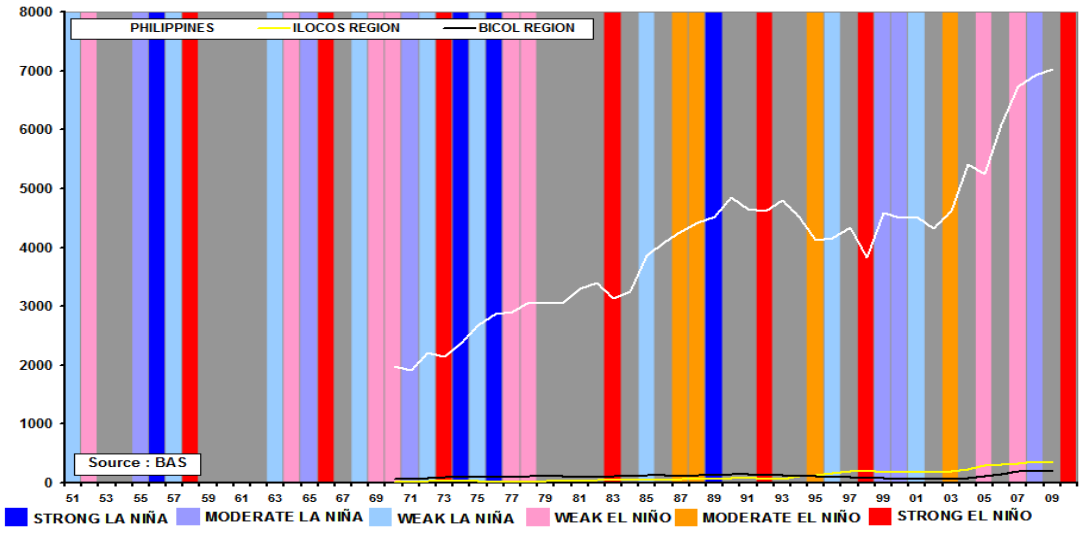


B.1.2. Corn Production

At the national level, corn production (1970 to 2009) during strong El Niño years is on the average lower by 18.5 percent compared to non-strong El Niño years. During strong La Niña, corn production is lower by 22.7 percent compared to non-strong La Niña years, (see Figure 5 and Table 9).

The corn production at the regional level follows the trend of the national figures. However, for the province of Albay, it is the reverse.

Figure 5: Corn Production (In 000 MT)

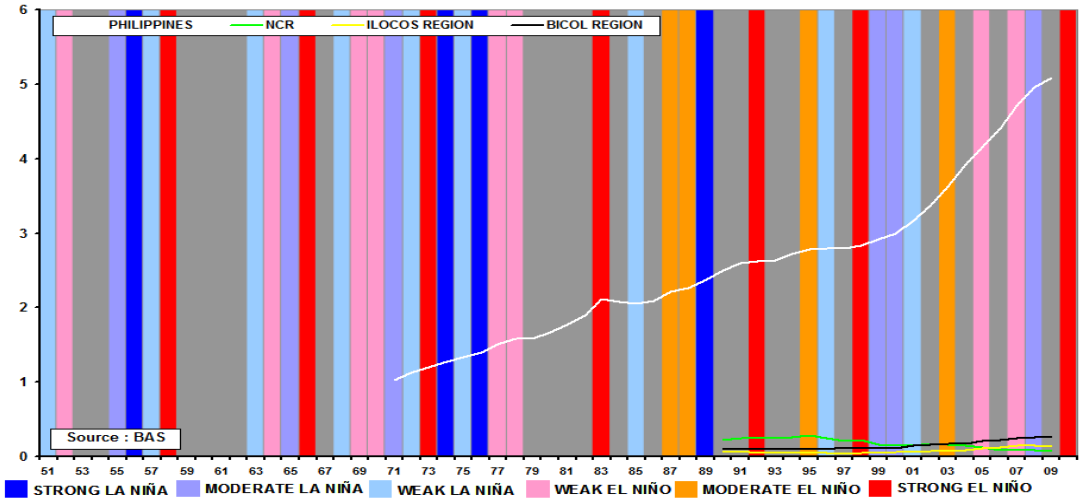


B.1.3. Fish Production

From 1971 to 2009, fish production during strong El Niño years is on the average lower by 18.8 percent compared to non-strong El Niño years. During strong La Niña, fish production is lower by 37.7 percent compared to non-strong La Niña years (see Figure 6 and Table 10).

With short data points, 1990 to 2009, discussion on regional fish production will deal only on the effect of moderate ENSO.

Figure 6: Fish Production (In 000 MT)



Fish production in Ilocos Region, during moderate El Niño years is on the average lower by 20.2 percent compared to weak El Niño/La Niña/normal years. During moderate La

Niña years, fish production is higher by 7.7 percent compared to weak El Niño/La Niña/ normal years. (see Table 10).

The trend in fish production of Bicol Region follows that of Ilocos Region. However, for NCR, fish production during moderate El Niño is on the average higher by 27.7 percent compared to weak El Niño/La Niña and normal years. During moderate La Niña, fish production is on the average lower by 24.3 percent compared to weak El Niño/La Niña and normal years (see Figure 6 and Table 10). This can be attributed to the fact that NCR is a major unloading point of fish coming from different areas. During El Niño, it is safe to travel and unload in NCR than during La Niña.

B.1.4. Summary

As shown in Figure 7, strong ENSO has negative impact in the GVA of agriculture and fishery at the national level. The trends are similar in Ilocos region and Albay/Bicol region.

Figure 7. Impact of Climate Change to the GVA of Agriculture and Fishery

Area	Impact of Strong El Niño as compared with Other	Impact of Strong La Niña as compared with Other
Philippines (1951-2009)	▼	▼
Region I (1987-2009)	▼	▼
Region V (1975-2009)	▼	▼

C. Social Impact

This part will focus on the health impact of climate change. More particularly, due to data limitation the discussion will only be for three diseases, namely: dengue, leptospirosis and salmonella borne infections vis-à-vis strong El Niño or strong La Niña compared with non strong ENSOs (moderate ENSOs, weak ENSOs and normal) at the national level. In the case of subnational analysis of the disease, it will be measured up to with moderate ENSOs only due to data limitation.

In the health sector, many of the biological organisms linked to the spread of infectious diseases are especially influenced by fluctuations in climate variables. For example, dengue fever and malaria are sensitive to such climate parameters as temperature, relative humidity and rainfall, among other factors. To illustrate, the study conducted by Tipayamongkholgul, et.al (2009) (see [33]) revealed that the strength of El Niño was consistently a predictor for the occurrence of dengue epidemics throughout time lags from 1 to 11 months in two selected regions of Thailand.

C.1. *Dengue Fever*

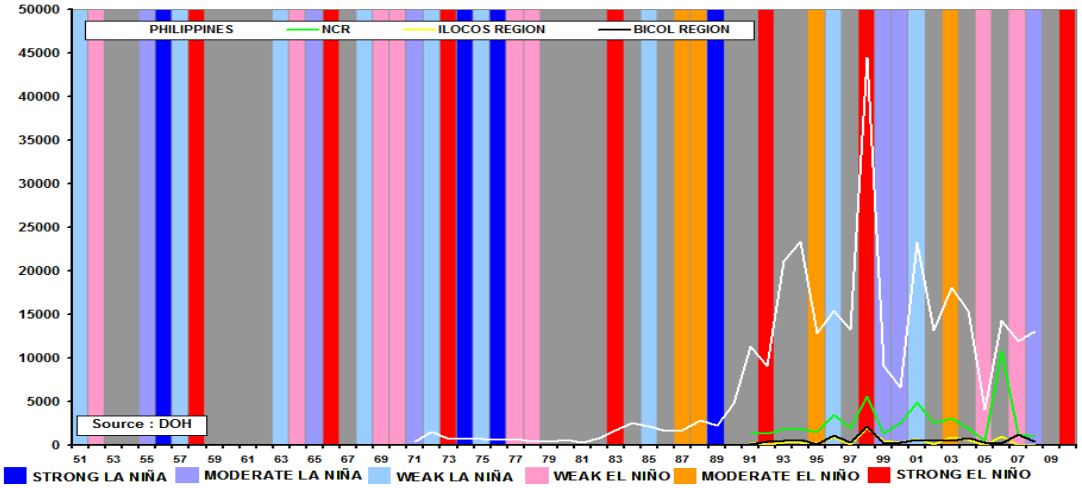
At the national level, there were on the average 14,009 dengue cases during strong El Niño compared with 1,160 cases during strong La Niña from 1971 to 2008. The incidence is 1,107.6 percent higher during strong El Niño compared with strong La Niña.

With short data points, 1991 to 2008, on incidence of Dengue fever in the regions comparison will deal only on the moderate ENSO.

As shown in Figure 8 and Table 11, during moderate El Niño years, there were 515 reported cases, on the average, of dengue in Ilocos region, 2,294 cases in NCR and 309 in Bicol. Conversely, during moderate La Niña years, there were lower occurrence of dengue in Ilocos, NCR and Bicol with 273 cases, 1,607 cases and 304 cases, respectively. The average cases during moderate El Niño is 88.4 percent, 42.7 percent and 1.4 percent higher than moderate La Niña.

The trend is in congruence with the study conducted by Tipayamongkholgul, et.al (2009) (see [33]) which revealed that the strength of El Niño was consistently a predictor for the occurrence of dengue epidemics throughout time lags from 1 to 11 months in two selected regions of Thailand.

Figure 8: Dengue Fever (No. of Reported Cases)

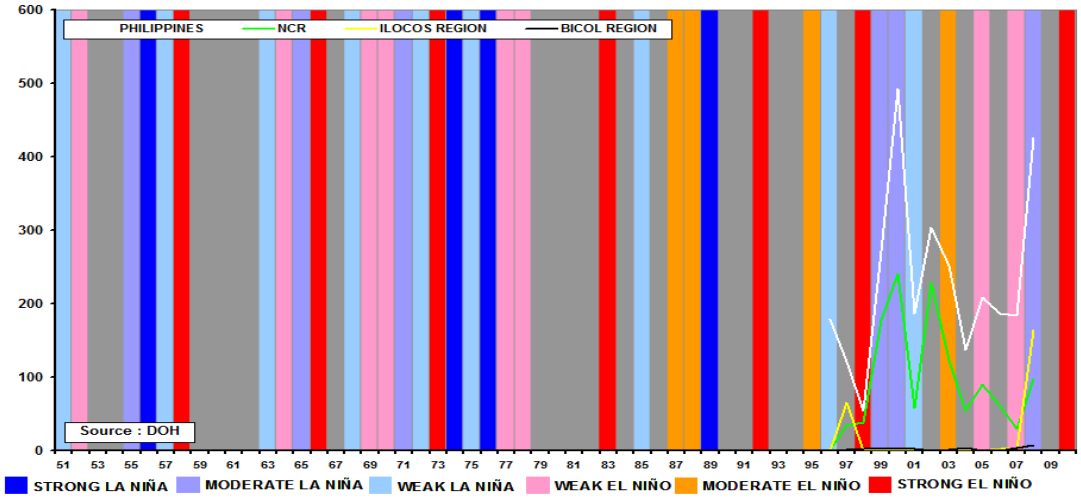


C.2. Leptospirosis

In the case of Leptospirosis, a bacterial disease transmitted by the urine of infected dogs, rats or other animals with prolonged immersion in water promoting the entry of the bacteria to open unhealed breaks in the skin, the eyes, or with the mucous membranes, cases of occurrence are higher by 57.5 percent during moderate La Niña years compared with moderate El Niño years at the national level in 1996 - 2008.(see Figure 9 and Table 11) This trend is similar in Ilocos, NCR and Bicol region.

During La Niña years, the amount of rainfall is usually high and flooding, particularly in NCR, occurs. Correlating rainfal with and the incidence of Leptospirosis in the NCR, it shows that as rainfall increase the incidenc of the disease also increases.

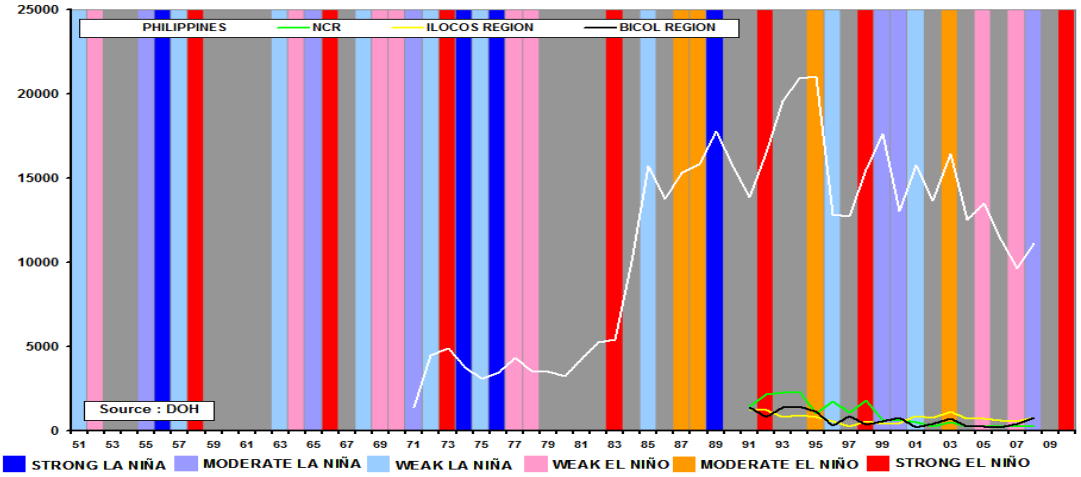
Figure 9: Leptospirosis (No. of Reported Cases)



C.3. T*yphoid, paratyphoid and other salmonella infections*

The average occurrence of typhoid, paratyphoid and other salmonella infections at the national level is 26.9 percent higher during strong El Niño as compared with strong La Niña for the years 1971 to 2008.

Figure 10: Typhoid / Paratyphoid Fever (No. of Reported Cases)



From the 1991 to 2008 regional data, this trend is replicated in Ilocos and NCR with 60.4 percent and 275.9 percent respectively at moderate ENSOs. For Bicol region, however, it is lower on the average by –17.9 percent. (see Figure 10 and Table 12)

D. Vulnerabilities to Climate Change

D.1. Poverty

In general, the sector that will be most affected by climate change will be the poor. The projected impacts of one-meter sea level rise in many areas of the country show vast

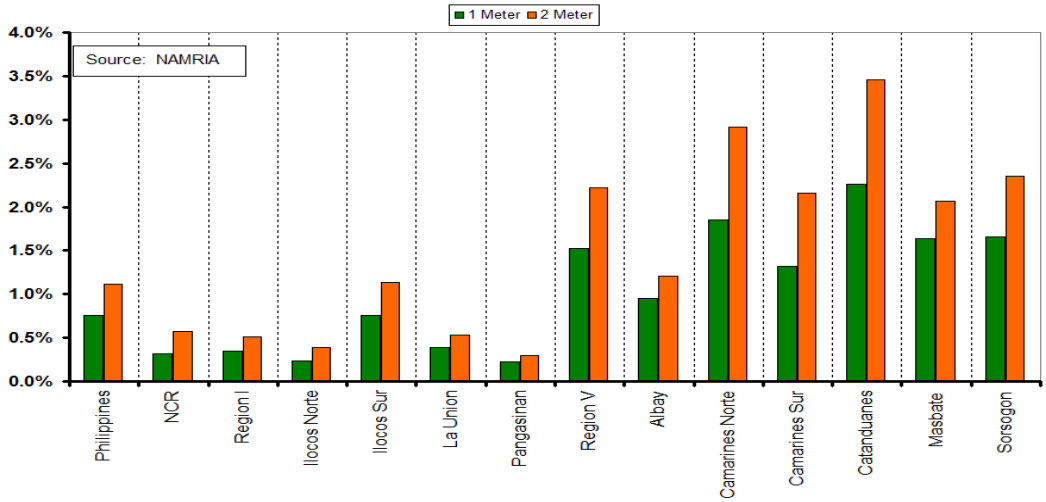
portions being inundated, affecting coastal settlements and livelihood. Based on the very preliminary estimates of NAMRIA (using Shuttle Radar Topography Mission, SRTM), a total of 4,521 hectares (0.4 percent of the total land area) will be affected by a one meter rise in Ilocos Region with Ilocos Sur having the largest area, 1,946 hectares (0.8 percent of its total land area) and La Union having the smallest area, 584 hectares (0.4 percent of its land area) to be affected (data source: NAMRIA). Albay will have 2,438 hectares (1.0 percent of its land area) of land to be affected (See Figure 11 and Table 13).

On the other hand, NCR will have 201 hectares or 0.3 percent of land to be inundated. But according to Tuason (2009), a one-meter rise in sea level will definitely submerge the perenially-flooded **Malabon** which is actually below sea level. Seaside **Navotas**, dubbed as the "Fishing Capital of the Philippines", is no different from neighboring Malabon's malady. The city is a long and narrow delta, with as much as two-thirds of it below sea level. Dagat-Dagatan area of Caloocan, which is 0.92 meters below sea level, will be lost.

In relation to the one and two meter sea level rise, Ilocos Sur, with a magnitude of poor population of 184,397 will be the most vulnerable among the provinces of Ilocos Region.

On the other hand, Albay, with a magnitude of poor population of 552,881, will be the least vulnerable to the one and two meter sea level rise among the provinces of Bicol Region.

Figure 11. Areas (In ha) Affected (In Percent) to Rise in Sea Level



With the new projection of a two-meter rise in sea level, the NAMRIA data pictures Ilocos Region to have 6,631 hectares or 0.5 percent of its area affected, Ilocos Sur 2,939 hectares or 1.1 percent of its area affected while La Union, 788 hectare or 0.5 percent of land affected. On the other hand, Albay's land area will be reduced by 39,217 hectares or 1.2 percent while NCR will have 367 hectares or 0.6 percent loss in land area.

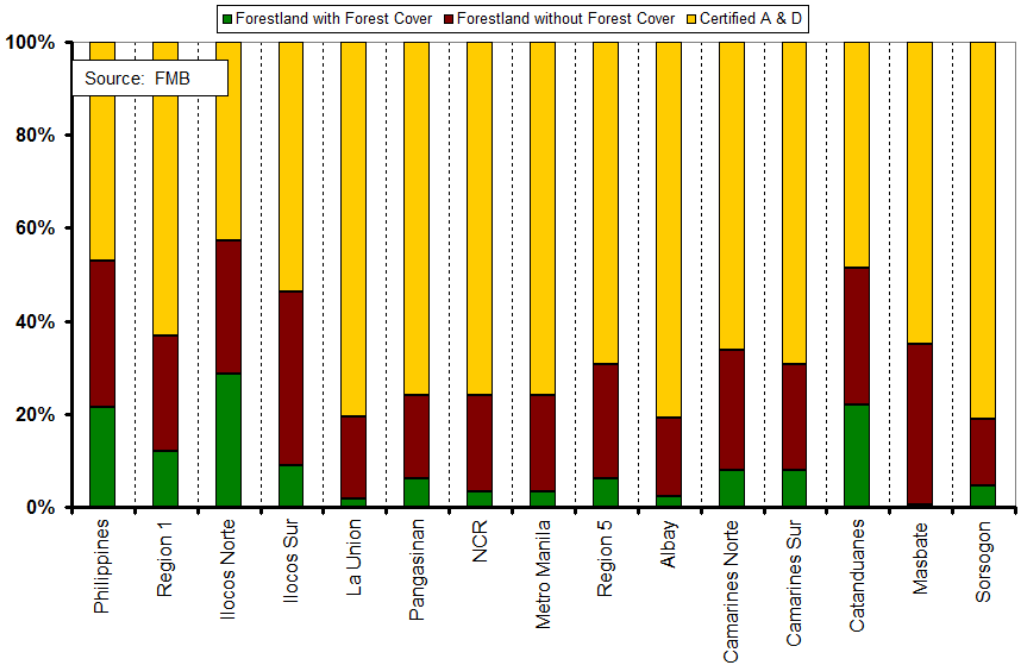
D.2. Environment

D.2.1. Forest and Forest Ecosystem

Forests function as habitats for organism, hydrologic flow modulators, carbon dioxide sink, and soil conserves. They are critical to a sustained growth in agriculture and other industries. Besides, forestlands are the main watersheds of rivers which provide water for

various uses. Soil erosion and hydrological deterioration of these watersheds cause losses in productivity and utility of infrastructures. Philippine forests continue to reel from many threats to forest resources, among which are: the tremendous pressure from an increasing population in search of land to till and forest resources to use, the loss of vital watershed functions, loss of biodiversity and inadequate forest development, management, and conservation efforts.

Figure 12. Land Classification and Forest Cover, 2003



Ilocos Region has a total land area of 1.3 million hectares classified as 810.9 thousand hectares (63.2 percent) certified alienable & disposable land (A & D) and 473.1 thousand hectares (36.8 percent) of forestland while Albay has a land area of 255.6 thousand hectares with 206.2 thousand hectares A & D and 49.1 thousand hectares forestland. NCR, on the other hand, has a land area of 63.6 thousand hectares classified as 48.2 thousand hectares A & D and 15.4 thousand hectares forestland. However, the forestlands of these areas have a forest cover of only 32.9 percent, 12.3 percent and 13.4 percent, respectively. (see Figure 12 and Table 14).

These forests sustain the watersheds, which contain the regions' freshwater supply. In Ilocos region, there are 10 proclaimed watershed with an aggregate area of 6,167 hectares or 4.0 percent of the forestland with forest cover. These can be found in Ilocos Norte, 3 proclaimed watersheds with 3,008 hectares, Ilocos Sur, 5 with an area of 1,609 hectares and la Union, 2 with an area of 1,550 hectare. Albay, on the hand, has one with an area of 810 hectares while NCR has the La Mesa Watershed Forest reserve with an area of 2,659 hectares and the primary the source of drinking water of Metro Manila residents. (see Table 15)

D.2.2. Biodiversity

According to the Conservation International (CI), the Philippines is considered as one of the world's biologically richest countries of the world. Many endemic species are confined to the forest-covered forestland of the country. It is difficult to estimate how many species of Philippine flora and fauna there are because there is no comprehensive or current inventory of even the major biological niches and ecosystems of the country. However, based on

available records, (many dating back to the early 1900s), at least 35,000 species of plants and animals are found in the archipelago (see [10]). Many of these species are in danger of being wiped out.

There are some faunal species found in Ilocos region, Albay province or even in Manila which are in danger of becoming extinct. According to the Protected Areas and Wildlife Bureau (PAWB), the Hawksbill Turtle which has been recorded in La Union and Albay is considered as a critically endangered species;* the bird black-faced spoonbill recorded in Manila and Pangasinan is critically endangered too; the Green turtle, Olive Ridley Turtle and Loggerhead Turtle recorded in Albay, La Union and Pangasinan are considered as endangered species;** the bird Yellow bunting recorded in La Union, Ilocos Norte are vulnerable species,*** and, the Gray's Monitor Lizard which was recorded in Albay and Manila are threatened(see [23]).****

With the projected increase of temperature and continued expansion of urban and rural areas and population these species may one day never be seen again.

Land/Soil Resources

Due to the geography of the different localities of the Ilocos, NCR and Albay, poor land use planning, waste disposal problem and other factors, some areas of these localities are vulnerable and susceptible to flooding and landslides. The geohazard map made by the Mines and Geosciences Bureau (MGB) of the Laoag quadrangle, Ilocos Norte will illustrate this fact (see Figure 18). The map shows the degree of vulnerability and susceptibility to floods and landslides of the said area. To date the MGB has completed geohazard mapping in at least 96 percent of the country.

IV. Some Adaptation and Mitigation Strategies of Albay Province that can be adopted by other other areas

Climate Change Adaptation and Mitigation Strategies: The Albay Experience

The local government unit in Albay recognizes the fact that due to its geography, tropical cyclones is a way of life. With climate change, cyclones and other extreme weather events may intensify.

The province of Albay, under the tutelage of Governor Joey Salceda, is very active when it comes to the issue of climate change. Being the first province in the country to mainstream climate change adaptation as a governing policy, it is wise to look at their adaptation and mitigation strategies and be able to learn from them especially its impacts on the social, economic and environmental aspects and how they interrelate with each other.

To mainstream climate change adaptation, Gov, Salceda adopted the development goal of “safe and shared development”. Safe means being “climate/disaster-proof” and shared development is defined as “compliance with the Millennium Development Goals and improvement in Human Development Index”. Under this development paradigm, Gov.

* A taxon that is facing an extremely high risk of extinction in the wild in the immediate future

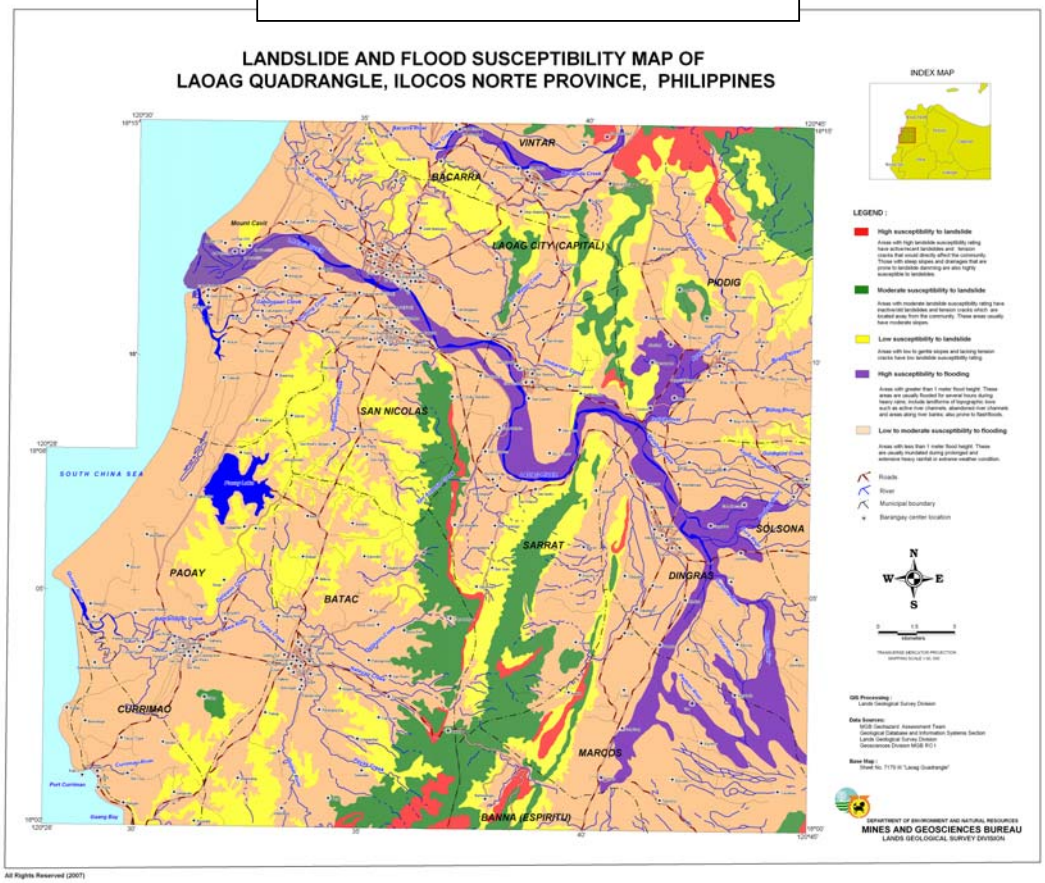
** A taxon that is not critically endangered but is facing a very high risk of extinction in the wild in the near future.

*** A taxon that is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium term future.

**** A general term to denote species or subspecies considered as critically endangered, endangered, vulnerable or other accepted categories of wildlife whose population is at risk of extinction.

Salceda outlined and implemented adaptation and mitigation strategies on climate change, among these are:

Figure 13. Sample Geohazard Map



Social

In a presentation of Gov. Salceda entitled *"Innovations in Responding to and Coping with Climate Change"*, the Bicol Regional Training and Teaching Hospital (BRTTH) was improved and modernized as an action in addressing the climate related health problem. A budget was allotted for new equipment, upgrading of facilities, and increase in maintenance and other operating expenses. This move is a preparatory action in countering/treating major diseases, e.g., dengue, malaria, etc., associated with climate change.

Economics

The provincial government of Albay recognizing the effects of the projected increase in temperature and extreme events that may occur vis-à-vis effect on agriculture, have collaborated with the Philrice Bicol Institute, a satellite of the Philippine Rice Research Institute (Philrice), with development of flood-resistant, drought-resistant and adaptive upland rice varieties.

Likewise, the governor also engaged his constituents in the ***Albay May Hanapbuhay*** strategy, a socio-economic development agenda that provides livelihood programs and concentrates on agriculture, forestry, and fisheries support. Its activities include cooperative promotion, organization and development; employment assistance services; non-formal

education skills training and the development project; and project planning, monitoring and evaluation.

Environment

Aiming for environmental sustainability, which is also one of the goals of MDG, the following are some strategies crafted by Albay:

- ► Lessen by half the number of people without sustainable access to safe drinking water.

- ► "Linis-Kalog" or Adopt a Creek where the main activity is to clean up rivers, canals, and shorelines. This will have a huge effect in the future and will also help in reducing illness or diseases that originate from wastes and polluted water.

- ► The Mangrove plantation (rehabilitation and reforestation) project aims to cushion the effects of storm surges and sea level rise.

- ► In terms of renewable energy, the province aims to be the biggest geothermal producer of the country. Another is the Cagraray Windfarm Project, which is being developed by Suweco Cagraray Island.

Information, Education and Communication Strategies (IEC) on Climate Change

People's awareness of what is happening around them and teaching young people regarding the impacts of climate change and what they can do to help in mitigating and adapting to it, is one of the important features of Albay's development agenda. Albay is utilizing the academe and the media to push for its IEC campaigns. The province of Albay, together with the University of the Philippines Los Baños (UPLB), signed a Memorandum of Agreement and Understanding for mainstreaming Climate Change into the curriculum of primary, secondary and tertiary education and for it to be replicated in other provinces of the country. Albay is also pushing for the "Climate Change Academy" and its main objective is to serve as a learning laboratory for other local government units to learn from the province's climate change adaptation and disaster risk management (see [1]).

V. Challenges in Measuring the Impact of Climate Change and the Way Forward

Given the present state of the PSS, the local statistical system and the issues/concerns that have to be addressed in measuring/monitoring the impacts of climate change, clear-cut strategies have to be planned and implemented.

5.1. Need to Mainstream Climate Change Statistics in the Local Development Plan and Programs

It is imperative that climate change be mainstreamed in the development plans and programs of the local government units. This is in recognition that the most effective way to address climate change impacts is by incorporating adaptation measures into the development strategies. However, the development strategies plans should be knowledge based. Corollary to this, climate change statistics should also be mainstreamed in the development agenda. Information about climate change impact will give policy makers more concrete planning basis and guidance in its implementation.

Need to enhance the Statistical Framework in Measuring Climate Change Impact.

In relation to the mainstreaming of climate change to the development plans of the RDCs and local government units, the draft of the statistical framework should be further develop and localized to suit the particularities of each area. The draft framework is still deficient in statistical variables that will measure adaptation and mitigation at the local levels. The "localized" framework will provide the set or sets of clearly defined indicators to measure the level of impacts, adaptation and mitigation of climate change at different points (temporal and spatial).

The RSCC 1 or the RDC-NCR/MMDA can organize a task force to study, enhance and localize the framework while TF HESSS of Region 5 can call its members to review on the framework and device ways to further its development.

5.2. Need to Improve Coordination Mechanisms at the Regional Levels and the Creation of Provincial/Municipal Level Coordination Mechanisms

Statistics on Climate change impact cuts across many sectors and sub-sectors at various geographical locations. A number of government agencies will be involved in the collection and compilation of data. The RSCCs should provide guidance in gearing regional development efforts in the planning and programming of the generation, compilation of climate change statistics in specific geographical areas. Likewise, provincial/municipal statistical coordination mechanisms should be created to discuss the generation of information related to climate change.

5.3. On Data Concerns

Need for the generation of data on climate change

Obviously, the present data systems/frameworks of the regional statistical systems are not aimed at climate change but on other concerns such as poverty reduction, economic indicators etc. The regional statistical agencies and its provincial/municipal counterparts therefore have to generate more data pertaining to climate change in consonance with the statistical framework.

Administrative based data of provincial/municipal units are rich sources of relevant information to operationalize the framework. To maximize the utilization of such data there is a need to systematically organize its generation and collation system. As such, a data generation system and database development for the compilation of the climate change information system should be pursued.

To facilitate usage of these data, data sharing scheme thru the use of the appropriate information technology software by these agencies should be encouraged. In relation to this, dissemination policies consistent with the policies approved by the NSCB Executive Board have to be formulated for better appreciation of stakeholders.

Need for delineation of institutional responsibilities in the generation of data

To avoid duplication in the data generation work of the regional statistical agencies and local government units, a local statistical development cooperation program that will document key data/capacity and deficiencies in the impact of climate change data generation and compilation, as well as the proposed/planned solutions, that can serve as a common reference for planning and coordination of local activities and resource mobilization is needed.

Need for capacity building in the processing and analysis of climate change data.

Since climate change and its impact is a relatively new field for regional statistical agencies, local government unit and other data producers, there is a need to equip them with the necessary training on climate change impact data processing and analysis. The RSCCs therefore should set policies on the training agenda at the regional, provincial and municipal levels.

5.4. Research and Training

An effective strategy for advancing the understanding of adverse impacts of climate change will require strengthening the academe and research institutions to conduct innovative research on the response of human and natural systems to multiple stresses at various levels and scales. State universities and colleges in the regions should give priority to research in measuring impacts of extreme events vis-à-vis agriculture and food security, Identification of the critical climate thresholds for various provinces, municipalities and sectors, etc.

In the conduct of these researches, the participation of statisticians will hasten the resolution of many statistical challenges that are currently not being tackled in climate science studies. Statisticians can advise on how best to combine data from different sources, how to identify and adjust for biases in different measurement systems, and how to deal with changes in the spatial and temporal coverage of measurements.

5.5. Continuing Advocacy for Investment in Statistics by both government and private sector

To realize the aforementioned objectives, the regional development councils, local government units as well as the private sector should recognize the importance of and invest in climate change statistics. Advocacy for statistics to inform decisions at all levels of the local governance must be pushed because the local government units cannot successfully compete against the knowledge-based countries without access to high quality statistics about key development concerns like the climate change.

REFERENCES

[1] **Albano,** Imelda. 2010. Albay: A Natural Laboratory for Climate-Change Adaptation. Business Mirror. August 18-19, 2010. Found at: (http://searca.webfactional.com/news/albay-a-natural-laboratory-for-climate-change-adaptation). Date accessed September 25, 2010.

[2] **Allison,** I, N.L. Bindoff, R.A. Bindschadler, P.M. Cox, N. de Noblet, M.H. England, J.E. Francis, N. Gruber, A.M. Haywood, D.J. Karoly, G. Kaser, C. Le Quéré, T.M. Lenton, M.E. Mann, B.I. McNeil, A.J. Pitman, S. Rahmstorf, E. Rignot, H.J. Schellnhuber, S.H. Schneider, S.C. Sherwood, R.C.J., Somerville, K. Steffen, E.J. Steig, M. Visbeck, A.J. Weaver. 2009. The Copenhagen Diagnosis, 2009: Updating the World on the Latest Climate Science. The University of New South Wales. Climate Change Research Centre (CCRC), Sydney, Australia, 60pp. Found at: http://www.ccrc.unsw.edu.au/Copenhagen/Copenhagen_Diagnosis_HIGH.pdf. Date accessed: July 30, 2010.

[3] **Alojado,** Dominic (complied by). 2008. Lahars at Mayon Volcano, Albay, Philippines. Found at: http://www.maybagyo.com/stormstats/lahars.htm. Date accessed: September 14, 2010.

[4] **Alojado,** Dominic (complied by). 2010. Destructive Typhoons of the National Capital Region, 1947 - 2009. Found at: http://www.typhoon2000.ph/stormstats/DestructiveTyphoonsNCR.htm. Date accessed: September 9, 2010.

[5] **Alojado,** Dominic (complied by). 2010. Deadliest Typhoons of the Philippines, 1947 – 2009. Found at: http://www.maybagyo.com/25mostb.htm. Date accessed: September 9, 2010).

[6] **Alojado,** Dominic (complied by). 2010. Costliest Typhoons of the Philippines, 1947 – 2009. Found at: http://www.maybagyo.com/25mostb.htm. Date accessed: September 9, 2010.

[7] **Bureau of Agricultural Statistics.** Department of Agriculture.

[8] **Brookes,** Tom and Tim Nuthall. 2009. What did the Copenhagen Climate Summit Achieve? The European Climate Foundation. BBC News. Found at: http://news.bbc.co.uk/2/hi/science/nature/8424522.stm. Date accessed: September 13, 2010.

[9] **Capili** E.B., A.C.S. Ibay and J.R.T. Villarin, 2005. Climate Change Impacts and Adaptation on Philippine Coasts. Proceedings of the International Oceans 2005 Conference. 19-23 September 2005, Washington D.C., USA. Pp. 1-8. Found at: http://info.worldbank.org/etools/docs/library/230308/Session%202/Session%202%20Reading%201.pdf. Date accessed: February 26, 2008.

[10] **Conservation International.** __. Biodiversity Hotspots. http://www.biodiversityhotspots.org/xp/Hotspots/philippines/Pages/biodiversity.aspx . Date accessed: September 23, 2010

[11] **Department of Health**. (Various years). Philippine Health Statistics. National Epidemiology Center. Manila, Philippines.

[12] **Department of Health**. (Various years). Field Health Service Information System. Health Intelligence Service. Manila, Philippines.

[13] Epstein, Paul, R., Henry F. Diaz, Scott Elias, George Grabherr, Nicholas E. Graham Willem J. M. Martens, Ellen Mosley-Thopson and Joel Susskind. Biological and Physical Signs of Climate Change: Focus on Mosquito-borne Diseases. Bulletin of American Meteorological Society.

[14] Ilocos Region Information Sharing Network. 2009. RDC 1 Launches SocMob Program on Climate Change. September 18, 2009. Found at: http://ilocos.net.ph/index.php?option=com_content&task=view&id=151&Itemid=1. Date accessed: September 26, 2010.

[15] Intergovernmental Panel on Climate Change. 2007. Summary for Policymakers: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22. http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf. Date accessed February 26, 2008.

[16] Jabines, Abigail and Jasper Inventor. 2007. The Philippines: A Climate Hotspot. Climate Change Impacts and the Philippines. Greenpeace Southeast Asia, Climate and Energy Campaign. Found at: http://www.greenpeace.org/raw/content/seasia/en/press/reports/the-philippines-a-climate-hot.pdf. Date accessed: February 26, 2008.

[17] Climate Change Commission. 2010. National Framework Strategy on Climate Change, 2010 – 2022. Office of the President of the Philippines. Malacañang, Manila.

[18] National Mapping and Resource Information Authority. Department of Environment and Natural Resources, Philippines.

[19] National Statistical Coordination Board. 1992. NSCB Resolution Number 1 series of 1992. Creating the Regional Statistical Coordination Committees. NSCB website. Board Resolutions. http://www.nscb.gov.ph.

[20] National Oceanic and Atmospheric Administration. __. Cold and Warm Epidsodes by Season. Changes to the Oceanic Niño Index (ONI). Found at: http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml. Date accessed: June 30, 2010.

[21] Philippine Atmospheric, Geophysical and Aeronautical Services Administration. ___. El Niño-Southern Oscillation (ENSO). Found at: http://kidlat.pagasa.dost.gov.ph/cab/ensoadvi.htm. Accessed Date: April 30, 2010.

[22] Philippine Daily Inquirer. 2010. Dengue has killed 429 Filipinos since January. Philippine Daily Inquirer. September 1, 2010. Found at: http://archive.inquirer.net/view.php?db=1&story_id=289864. Date accessed: September 24, 2010.

[23] Protected Areas and Wildlife Bureau. 2003. 2003 Statistics on Philippine Areas and Wildlife Resources. Department of Environment and Natural Resources. Quezon City.

[24] Salceda, Joey S. (undated). In Innovations in Responding to and Coping with Climate Change. Albay in Action on Climate Change (A2C2). A powerpoint presentation presented in ___.

[25] Salceda, Joey S. (undated). DRR in Albay Province: The Practices of APSEMO. A powerpoint presentation presented in ___.

[26] Tuason, Miles. 2009. Elevation is no Guarantee for Protection in Metro Manila. Manila Flood Watcher website. http://www.manilaflood.com/elevation-is-no-guarantee-for-protection-in-metro-manila/. Posted October 9, 2009. Date accessed: June 4, 2010.

[27] Ubungen, Irenea B. 2008. Development of the Subnational Statistical System: The Region I Experience. Statistically Speaking. National Statistical Coordination Board Website. http://www.nscb.gov.ph/headlines/StatsSpeak/2008/120808_ibu_rss.asp. Posted December 8, 2008.

[28] United Nations International Strategy for Disaster Reduction Secretariat. 2009. ISDR (2009) Global Assessment Report on Disaster Risk Reduction. United Nations, Geneva, Switzerland. Found at: http://www.preventionweb.net/english/hyogo/gar/report/index.php?id=9413&pid:34&pil:1. Date accessed: September 20, 2010

[29] Virola, Romulo A. 2008. Some Things You Better Know About Typhoons in the Philippines. Statistically Speaking. National Statistical Coordination Board Website http://www.nscb.gov.ph/headlines/StatsSpeak/2008/081408_rav_typhoons.asp. Posted 11 August 2008.

[30] Virola, Romulo A. 2009. Climate Change – Will the Poor Suffer More. Statistically Speaking. National Statistical Coordination Board Website. http://www.nscb.gov.ph/headlines/StatsSpeak/2009/030909_rav_climatechange.asp. Posted 09 March 2009.

[31] Virola, Romulo A. 2009. The Devastation of *Ondoy* and *Pepeng*! Statistically Speaking. National Statistical Coordination Board Website. http://www.nscb.gov.ph/headlines/StatsSpeak/2009/110909_rav_mrsr_typhoons.asp. November 9, 2009.

[32] Vos, F, Rodriguez J. Below R, Guha-Sapir D. Annual Disaster Statistical Review 2009. The Numbers and Trends. Brussels: CRED; 2010. Found at: http://www.cred.be/sites/default/files/ADSR_2009.pdf. Date accessed: August 11, 2010.

[33] Tipayamongkholgul M, Fang CT, Klinchan S, Liu CM, King CC. 2009. Effects of the El Niño-southern oscillation on dengue epidemics in Thailand, 1996-2005. BMC Public Health. 2009 Nov 20;9:422. Found at: http://www.ncbi.nlm.nih.gov/pubmed/19930557. Date Accessed: September 24, 2010.

[34] World Health Organization. 2000. Workshop Report: Climate Variability and Change and their Health Effects in Pacific Island Countries. July 20 – 28, 2000, Apia, Samoa. Found at: http://www.who.int/globalchange/publications/en/islands.pdf. Date accessed: March 9, 2010.

[35] Wikipedia, 2010. El Niño-Southern Oscillation. Found at: http://en.wikipedia.org/wiki/El_Ni%C3%B1o-Southern_Oscillation. Date accessed: September 29, 2010.

ANNEX 1

DRAFT
STATISTICAL FRAMEWORK AND INDICATOR SYSTEM IN MEASURING/MONITORING CLIMATE CHANGE IMPACTS[2]

The challenge in measuring/monitoring climate change impacts is to capture the impacts within the timescale of climate change. To accomplish this, a statistical framework and indicator system is therefore needed. The framework will provide the set or sets of clearly defined information system(s) to measure the level of impacts/vulnerability, the coping mechanism of the socio-economic structure of society, the process drivers of climate change.

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) presented a schematic framework representing anthropogenic drivers, impacts of, and responses to climate change and their linkages (see Figure 1). The diagram presents the inter-relationship and interdependency of the earth system and the human system.

With increased understanding of these linkages, it is possible to evaluate the socio-economic-environmental development pathways and global emissions constraints that would reduce the risk of future impacts that society may wish to avoid. From the schematic diagram, a conceptual and statistical framework and indicator system can be developed.

The Philippine conceptual and statistical framework including the indicator system in measuring/monitoring climate change being developed takes off from the schematic diagram presented by AR4. The draft provides a systematic organization of the inter-relationship and the multi-disciplinary nature of climate change statistics. It focuses on the identification, description and presentation of data variables which are useful in tracing and verifying interrelationships and interdependency of the earth and human systems.

As in the diagram, the conceptual framework (see Table 1) provides information on the changes in the climate; impacts and vulnerabilities brought about by climate change to the earth resources and its ecosystems to include human society; the coping mechanisms (adaptation and mitigation) adopted by the socio-economic structure of human society; and, the different climate change drivers.

Climate Changes in the earth system (column 1 of Table 1), which include temperature change, precipitation change, and sea level rise and extreme events, directly affect the different components, both biotic and abiotic, of the ecosystem (e.g., water, land/soil, biodiversity, etc) and human system (e.g. health, food security, etc), thus producing impacts and vulnerability. The different impact and vulnerability in the ecosystem and human system, likewise will affect the earth systems by aggravating the changes occurring in the climate.

Climate change drivers (column 2 of Table 1) produces changes in the climate system/earth system.

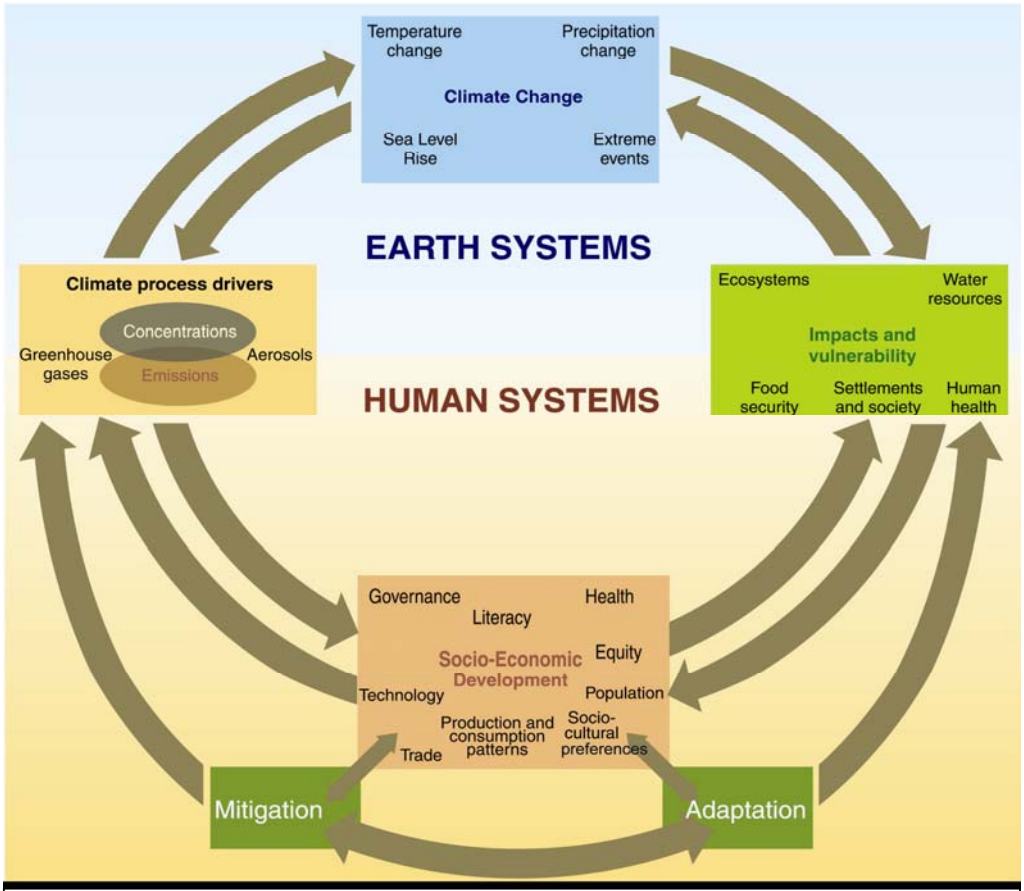
---

[2] This draft framework is an updated version of the one found in the Paper prepared for presentation to the Conference on Climate Change and Official Statistics organized by the United Nations Statistics Division in collaboration with Eurostat, the World Bank and Statistics Norway held at the Oslo Military Society, Oslo Norway on April 14 – 16 2008. The said paper can be downloaded at: http://unstats.un.org/unsd/climate_change/default.htm and http://www.nscb.gov.ph/download/NSCBTechPaper_ClimateChange.pdf

The impacts and vulnerabilities created by climate change (column 3 of Table 1) will definitely create changes in the socio-economic development of societies and therefore it is imperative for human to execute coping mechanism, i.e., mitigation or adaptation. Changes in technology, governance, production consumption patterns, socio-cultural patterns, etc are the playing field of man in its mitigation and adaptation mechanisms.

The coping mechanisms (column 4 and 5 of Table 1) adopted by man will in turn affect, reduction or increase, the climate change drivers. The reduction or increase of climate change drivers likewise, will affect the socio-economic development of societies and thus its coping mechanisms.

Figure 1. Schematic Framework representing Anthropogenic drivers, impacts of, and Responses to Climate Change, and their Linkages



Source: Inter governmental Panel on Climate Change, Fourth Assessment Report. Climate Change 2007, Synthesis Report

To operationalize the conceptual framework, a statistical framework (Table 2) has to be developed. The statistical framework start with the topics/items identified in the conceptual framework and proceeds to the identification of specific relevant variables and their corresponding units of measurement needed to quantify the earlier discussed concepts. Observations can show that there have been changes in weather, and it is the statistics of changes in weather over time that identify climate change.[3] Likewise, as the science of

[3] Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather, 2007: Historical Overview of Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the*

climate change progress, detection and attribution research will venture into more sophisticated statistical analyses that will examine the complex patterns of climate change.

The indicators identified in the framework benefited from the existing indicators and variables found in the Philippine Framework for the Development of Environment Statistics (PFDES), System of Environmental-Economic Accounting (SEEA), Poverty Statistics, Health Accounts, Disaster Management Information System (DMIS). The indicators/variables that are relevant in measuring/monitoring climate change impact, adaptation and mitigation were included in the statistical framework. Suffice it to say, the draft climate change framework is a multi indicator system composing of the different existing indicators systems.

The information categories, socio-economic activities and natural events and environmental impacts of activities-events indicators of the different environmental components of the PFDES serve as indicators for the impact and vulnerability of climate change framework. The physical asset and emission accounts of the SEEA provide indicators for the climate change drivers and impact and vulnerability, respectively. While the indicators found in the three phases of the Disaster Management Indicator System and the response to environmental impacts of PFDES serve as indicators of on adaptation and the mitigation of the social and economic development indicator system of the climate change framework. The conceptual and statistical framework, however, needs further development as researches on climate change and its impacts become available.

Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

CONCEPTUAL AND STATISTICAL FRAMEWORK ON CLIMATE CHANGE IMPACT

Table A. Conceptual Framework

Climate Change	Climate Process Drivers	Impacts and Vulnerability	Socio-Economic Development	
			Mitigation	Adaptation
Temperature Change **Precipitation Change** **Sea Level Rise** **Extreme Events**	**GHG Emissions/ Concentration sources** • Industries: (transport, Cement, metal and non metal production, chemical and chemical products, paper and pulp, etc) **Agriculture/Forestry** • Crop production • Agricultural Residue Burning • Grassland/Forest burning/fire • Agricultural soils **Energy/electricity** • Fossil Fuel Production • Biomass burned for energy • Grassland Burning/Kaingin (slash and Burn)	**Ecosystem (terrestrial and Marine)** • Proliferation, depletion and extinction of species • Depletion/growth of growth resources • Introduction of exotic species • Changes of habitat/ ecosystem **Water Resources (fresh and marine water)** • Water Depletion • Water quality **Food Security/Safety** • Food Production (crops and fishery) • Occurrence of Harmful Algal Blooms (HABS) • Nutritional food Intake • Occurrence of crop/fishery disease and infestation	**Health** • Improved safe water and sanitation **Technology** • Clean Energy Development Mechanism (energy generation, transport, etc) **Production and Consumption Pattern** • Agriculture/Forestry **Trade** • Carbon trading **Socio-Cultural preferences**	**Health** • Improved safe water and sanitation **Technology** • Clean Energy Development Mechanism (energy generation, transport, etc) **Production and Consumption Pattern** • Agriculture/Forestry **Trade** • Carbon trading **Socio-Cultural preferences**

Table A. Conceptual Framework, (continued)……

Climate Change	Climate Process Drivers	Impacts and Vulnerability	Socio-Economic Development	
			Mitigation	**Adaptation**
	Waste • Solid wastes Domestics and Commercial Waste • Water Industrial Wastewater • Hazardous Waste • Human Sewage	**Human Health** • Occurrence of Vector borne Diseases • Occurrence of Skin Diseases • Respiratory Diseases • Diarrheal Cases **Settlements and Society** • Coastal Settlements • Settlement in hazardous geologic areas	**Population / Settlements / Infrastructure** • Population Control Mechanism • Energy Generation **Equity** • Poverty Incidence • Poverty level **Literacy** **Governance** • RURBAN land used Planning • Ecological Waste Management Policies • Water Resource Management • Disaster Management Mechanisms	**Population / Settlements / Infrastructure** • Population Control Mechanism • Energy Generation **Equity** • Poverty Incidence • Poverty level **Literacy** **Governance** • RURBAN land used Planning • Ecological Waste Management Policies • Water Resource Management • Disaster Management Mechanisms

CONCEPTUAL AND STATISTICAL FRAMEWORK ON CLIMATE CHANGE IMPACT

Table B. Statistical Framework

Table B1. Climate Change

Topic	Variables	Measurement
Temperature Change		
Land and Sea Surface Temperature (time series)	Climatological Normal (temperature mean, maximum and minimum)	^{o}Celcius
	`- National	
	`- Regional	
	`- Provincial	
	Temperature, deviation from seasonal mean	^{o}Celcius
	Rate of Change	
Precipitation Change		
	Amount of rainfall	Millimeter
	`Annual, monthly	
	` National, regional, and provincial	
	Precipitation, deviation from seasonal mean	mm, km^2
Sea Level Rise		
	Sea level increase (normal - high tide and low tide)	Meter
	deviation from normal	Meter
Extreme Events		
	El Niño and La Niña	Number of occurrence
	Typhoon, hurricane, tornado, location, population/areas affected	Typhoon signals, Quantity
	Floods, flash floods, location, population/areas affected	m, h, $km^{2,}$ quantity
	Landslides, location, population/areas affected	m, h, km2, quantity
	Tidal Waves, location, population/areas affected	km^2, quantity

Table B2. Climate Process Drivers Change

Topic	Variables	Measurement
GHG Emissions / Concentration sources		
Industries:		
Transport, Cement, Metal and non-metallic production, Chemical and chemical products, paper and pulp, Energy/Electricity, etc	Total emissions by type of vehicles Total/type of emissions by industry Toxic air contaminants	tons/year tons/year tons/year
Agriculture/Forestry		
Crop (rice, corn, etc) production	Crop production (rice, corn, vegetable, etc) Area of production (provincial, municipal) Total Ghg emission from crop production	tons/year Gg Hectare
Agricultural Residue Burning	Area burned/kaingin areas	Hectare
Forest/Grassland Burning	Forest Fires	**Hectare**
Energy/electricity		
Fossil Fuel Production	Energy resources production (by sector, by utility) Depletion of energy resources Energy conversion (by plant, utility)	By capacity (gwh) Volume (thousand metric tonnes) By capacity (gwh)
Biomass burned for energy	Energy Consumption (by sector, source)	by capacity (gwh)
Waste		
Solid wastes		Tons per year, kilogram per capita
Domestics and Commercial Waste Water]	Solid waste disposal/ generation/quantity and type of Emission	Tons per year, kilogram per capita
Industrial Wastewater]	Toxic waste generated] Waste disposal in landfill	Tons per year, kilogram per capita Tons per year, kilogram per capita
Human Sewage	Volume of human sewage	Tons per year, kilogram per capita
Hazardous Waste Production	Volume of hazardous waste	

Table B3. Impacts and Vulnerability

Topic	Variables	Measurement
Ecosystem (terrestrial and Marine)		
Proliferation, depletion and extinction of species	Number/types of extinct, endangered, vulnerable, etc species Number/types of introduced species Number/types of migrant species	
Depletion/degradation resources	Forest area cleared for agricultural production Area harvested/used in kaingin Volume of log production Area of change Fish Production (marine, inland municipal and aquaculture) Areas affected by soil erosion	Hectare Hectare Cubic meter/year Percent change Tons, kg Hectare
Changes of habitat/ecosystem	 Mangrove areas converted for aquaculture production Loss of Seagrass Beds Coral areas bleached	Hectare, km^2, pesos Hectare, km2 Hectare, km2
Water Resources (fresh and Marine water)		
Water Depletion *(can be sourced from environmental accounts)*	Amount of surface (by source, rivers, lakes) and groundwater abstraction Amount of surface (by source, rivers, lakes) and groundwater abstraction for use in irrigation, commercial, domestic and industrial Average streamflow Number of sites used for inland, municipal fishery)	Cubic meters per year, liters per second Cubic meters per year, liters per second Cubic meters per second Number of sites
Water quality	Water quality of receiving water bodies Number of rivers, lakes, open waters affected by sedimentation Salt water intrusion (aquifers affected)	Concentration (mg/l) Number of rivers and lakes affected Number of surface water (lakes, rivers, stream, etc.) and aquifers affected

Table B3. Impacts and Vulnerability (continued)…..

Topic	Variables	Measurement
Food Security/Safety		
Food Production (crops and fishery)	Volume of crop (rice/corn, etc) production Volume of fish production (inland, marine and aquaculture	Kilograms, tons Kilograms, tons
Occurrence of Harmful Algal Blooms (HABS)	Number of occurrence and location Number of occurrence, type of disease and infestation	
Nutritional food Intake		Calorie
Crop/Livestock/fishery disease and infestation	Damage to crops (due to pests/diseases, drought, etc)	Kilograms, tons
Human Health		
Occurrence of Vector borne Diseases	Number of occurrence/cases, type, location	Number of cases/occurrence
Occurrence of Skin Diseases	Number of occurrence/cases, type, location	Number of cases/occurrence
Respiratory Diseases	Number of occurrence/cases, type, location	Number of cases/occurrence
Diarrheal cases	Number of occurrence/cases, type, location	Number of cases/occurrence
Other Water Borne and soil borne Diseases	Number of occurrence/cases, type, location	Number of cases/occurrence
Industry, Settlements and Society		
Coastal Settlements	Population size, density, dissagregation (male and female)	Number
Settlement in hazardous geologic areas	Population size, density, dissagregation (male and female), location	Number
Energy Demand	Energy Consumption by type of energy source or mixed, (household consumption, industry, etc)	kwh, mmboe
Population Relocation/Migration	Number of Household Relocated/migrated	Number
Health		
Improved Safe Water and Sanitation	Household with access to safe water and sanitation	Number

Table B.4. Socio-Economic Development - Adaptation

Topic	Variables	Measurement
Agriculture		
Irrigation Development	Number of irrigated farms	Hectare
Land Conversion	Land converted to agricultural uses	Hectare
Crop Production	Crops planted/harvested by type of crops	Kilogram, tons, hectare
Population/Settlements		
Population in coastal areas and hazard prone areas	Population in coastal areas	Number
	Population in hazardous areas (landslide, flood, other hazard, etc., prone areas	Location/number of hazardous areas (by type of hazard)
Population Growth/Density	Population relocated/migrated	Number
Infrastructure		
Flood Control measures	Flood control infrastructure constructed	Km
Land Reclamation	Area of Reclaimed lands	Hectare
Transport		
Land transport infrastructure	Bridges and road Built	Km
Energy		
Use of alternative/renewable energy	Private and public utility vehicle using alternative fuel, by type of alternative fuel used	Number
	Energy generation using alternative renewable source, by type	Megawatts, gigawatts

Table B5. Statistical Framework, Socio-Economic Development – Mitigation

Topic	Variables	Measurement
Energy		
Use of alternative/ renewable/efficient energy	Private and public utility vehicle using alternative fuel, by type of alternative fuel used	Number
	Energy generation using alternative renewable source, by type	Megawatts, gigawatts
Agriculture		
Use of Agrochemicals	Production of chemical fertilizers and pesticides	kg
Use of organic fertilizers	Production of organic fertilizers	kg
	Agricultural farms using organic fertilizers for different crops (by type of crops)	Hectares
Forestry/Forest		
Afforestation and Reforestation	Aforestation and Reforestation projects launched	Hectares
Population/Settlements		
Population in coastal areas and hazard prone areas	Population in coastal areas relocated	Number
	Population in hazardous areas (landslide, flood, other hazard, etc.) prone areas relocated	Number
Infrastructure		
Flood Control measures	Flood control infrastructure constructed	Km
Land Reclamation	Area of Reclaimed lands	Hectare
Waste		
Waste Disposal	Sanitary landfill constructed	Number
	Material Recovery Facility constructed	Number
	Waste disposed in Sanitary Landfill	tons per year
	Waste Transported and segregated in Material Recovery facilities	tons per year

TABLE 1. YEAR BY TYPE OF EL NIÑO-SOUTHERN OSCILLATION (ENSO)
1950 to 2009

Year			ENSO Type
1950	to	1951	WL
1951	to	1952	WE
1952	to	1953	
1953	to	1954	
1954	to	1955	ML
1955	to	1956	SL
1956	to	1957	WL
1957	to	1958	SE
1958	to	1959	
1959	to	1960	
1960	to	1961	
1961	to	1962	
1962	to	1963	WL
1963	to	1964	WE
1964	to	1965	ML
1965	to	1966	SE
1966	to	1967	
1967	to	1968	WL
1968	to	1969	WE
1969	to	1970	WE
1970	to	1971	ML
1971	to	1972	WL
1972	to	1973	SE
1973	to	1974	SL
1974	to	1975	WL
1975	to	1976	SL
1976	to	1977	WE
1977	to	1978	WE
1978	to	1979	
1979	to	1980	
1980	to	1981	
1981	to	1982	
1982	to	1983	SE
1983	to	1984	
1984	to	1985	WL
1985	to	1986	
1986	to	1987	ME
1987	to	1988	ME
1988	to	1989	SL
1989	to	1990	
1990	to	1991	
1991	to	1992	SE
1992	to	1993	
1993	to	1994	
1994	to	1995	ME
1995	to	1996	WL

Table 1. Conitnued…

Year			ENSO Type
1996	**to**	**1997**	
1997	**to**	**1998**	SE
1998	**to**	**1999**	ML
1999	**to**	**2000**	ML
2000	**to**	**2001**	WL
2001	**to**	**2002**	
2002	**to**	**2003**	ME
2003	**to**	**2004**	
2004	**to**	**2005**	WE
2005	**to**	**2006**	
2006	**to**	**2007**	WE
2007	**to**	**2008**	ML
2008	**to**	**2009**	
2009	**to**	**2010**	SE

Note:

WL – Weak La Niña
ML – Moderate *La Niña*
SL – Strong *La Niña*
WE – Weal El Niño
ME – Moderate El Niño
SE – Strong El Niño

Source:
http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml. (Accessed date: June 30, 2010)

TABLE 2. DISTRIBUTION OF TROPICAL CYCLONES BY CATEGORY IN THE PHILIPPINE AREA OF RESPONSIBILITY (PAR), 1948-2009

Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Annual			
	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	Total
1948	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	1	0	0	1	0	3	0	2	0	0	4	1	1	1	0	2	10	4	6	20
1949	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	3	1	0	1	1	1	2	0	0	3	0	2	1	0	0	2	3	5	14	22
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	0	0	0	1	1	1	0	0	2	1	0	0	2	0	0	1	2	7	5	14
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	2	0	2	0	0	2	0	0	1	0	0	1	0	0	2	2	0	11	13
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	1	0	0	3	1	2	1	0	1	3	0	0	4	1	2	2	4	7	16	27
1953	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	4	0	0	2	1	0	1	0	2	1	1	1	0	2	5	11	18
1954	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	2	2	2	0	0	2	1	0	2	0	0	3	0	1	0	3	4	11	18
1955	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	2	0	0	1	1	1	2	0	0	1	0	0	1	2	4	9	15
1956	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	2	1	1	0	1	3	1	0	4	0	0	1	1	0	4	2	0	1	6	3	16	25
1957	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0	0	3	0	2	1	0	0	1	0	0	0	2	3	10	15
1958	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	1	2	1	0	2	0	0	2	2	0	1	0	0	0	3	1	13	17
1959	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	1	1	0	1	3	1	0	2	0	0	2	1	5	12	18
1960	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	2	1	2	3	0	1	0	0	0	3	0	0	0	0	0	2	2	5	12	19
1961	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	2	1	1	1	2	2	2	0	0	0	1	3	0	1	0	0	1	0	1	0	1	6	8	9	23
1962	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	3	1	1	4	2	0	2	0	0	1	0	0	3	0	0	0	4	4	13	21
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	1	1	2	1	0	1	0	1	2	0	0	1	0	0	0	0	2	0	2	6	8	16
1964	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	4	1	4	1	2	2	0	1	4	0	1	2	0	2	1	1	0	1	7	8	15	30
1965	1	1	0	0	1	0	0	1	0	0	0	0	0	0	2	0	1	1	1	1	4	1	0	1	0	1	2	1	0	0	0	0	1	0	0	0	4	6	11	21
1966	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	0	1	3	2	2	0	0	1	0	1	2	1	1	0	0	2	0	1	0	1	6	6	10	22
1967	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	0	1	0	2	2	2	2	1	0	0	0	0	0	2	0	0	3	0	1	0	3	7	11	21
1968	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	2	1	0	0	3	0	0	1	0	0	3	0	0	0	0	5	10	15
1969	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	2	0	0	2	1	1	2	0	0	1	0	1	0	0	0	1	3	3	9	15
1970	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	2	1	2	1	0	2	2	1	0	1	1	0	0	6	6	9	21
1971	1	0	0	0	0	0	0	1	0	0	2	1	1	1	1	0	0	3	1	0	3	0	1	1	0	1	2	0	4	1	1	0	1	0	0	0	4	10	13	27
1972	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1	1	1	0	1	3	1	0	1	0	0	0	0	1	0	0	1	9	2	6	17
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	2	1	0	1	0	0	0	3	0	1	0	0	0	0	3	4	5	12
1974	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	2	1	1	3	0	1	1	0	0	1	4	0	2	0	1	1	0	4	12	7	23

Table 2. continued….

Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Annual			
	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	Total
1975	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	3	0	1	2	1	0	1	1	0	0	3	2	9	14
1976	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	3	0	2	1	2	1	1	0	0	0	0	0	2	1	2	0	6	6	10	22
1977	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	3	0	2	0	1	1	2	1	1	0	1	0	1	0	0	2	5	6	8	19
1978	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	1	3	3	1	3	2	1	1	0	3	1	0	1	1	0	0	10	7	8	25
1979	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	2	1	0	2	0	1	2	1	1	2	0	1	1	0	1	1	3	6	13	22
1980	0	0	0	1	0	0	0	1	0	1	0	0	1	1	1	1	1	0	1	0	3	2	0	1	0	0	2	0	1	1	2	0	1	0	1	0	9	5	9	23
1981	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	3	0	1	1	2	1	0	2	0	1	1	0	1	2	0	0	2	5	7	11	23
1982	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	2	2	1	0	0	4	0	2	2	1	0	1	0	0	0	0	1	1	3	6	11	20
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	1	1	1	2	1	4	1	0	2	2	1	2	0	3	11	9	23
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	3	2	2	1	0	0	2	0	2	0	0	3	0	0	1	6	4	9	19
1985	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	1	0	1	2	1	2	1	0	1	2	0	0	0	0	0	1	2	5	10	17
1986	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	1	0	1	2	0	0	2	0	0	1	1	2	1	0	2	1	0	0	3	2	7	12	21
1987	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	0	0	3	1	0	1	0	0	2	0	1	1	0	0	1	2	1	13	16
1988	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	2	0	1	0	0	0	0	3	0	1	1	4	0	0	2	0	1	0	3	7	10	20
1989	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	3	2	1	1	0	0	0	0	2	0	1	2	0	0	2	1	0	0	5	5	9	19
1990	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	2	0	2	0	0	3	0	0	0	4	0	0	1	1	0	1	0	1	0	4	8	8	20
1991	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	1	3	1	0	1	0	0	4	0	0	2	0	2	0	0	0	1	1	5	13	19
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	1	2	0	1	0	0	0	3	0	0	2	0	0	0	3	4	9	16
1993	0	0	0	1	0	0	0	0	0	2	0	0	1	0	0	1	0	1	2	3	0	0	3	2	1	2	3	1	1	2	0	2	0	1	0	3	10	11	11	32
1994	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	1	3	2	1	0	3	2	1	0	0	0	3	0	0	1	0	0	1	6	5	13	24
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	2	1	0	3	1	1	1	2	0	0	0	0	2	0	2	9	5	16
1996	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	2	0	2	0	1	0	3	1	0	1	1	0	1	0	0	0	3	6	8	17
1997	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	2	0	1	1	1	1	0	0	0	0	0	1	0	1	1	0	0	1	4	4	6	14
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	1	2	0	0	2	0	1	0	0	0	1	4	2	5	11
1999	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	1	0	2	0	1	1	0	0	1	1	0	2	0	0	0	0	5	8	3	16
2000	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3	0	1	0	1	1	0	2	1	0	0	3	0	1	1	1	0	0	5	5	8	18
2001	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	2	2	1	0	0	0	2	0	1	0	0	1	1	1	0	1	0	6	7	4	17
2002	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	2	1	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	6	13

Table 2. continued….

Year	Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec			Annual			
	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	TD	TS	TY	Total
2003	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	2	1	1	1	2	3	2	1	1	1	1	1	0	1	1	1	0	0	8	8	9	25
2004	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	0	1	3	0	1	0	0	1	2	1	1	2	0	0	3	2	1	1	1	0	0	5	7	13	25
2005	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	2	0	1	1	0	1	2	0	2	1	0	0	2	0	0	1	0	0	11	1	5	17
2006	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	3	0	2	1	0	0	2	1	1	1	0	0	2	0	1	1	3	6	11	20
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2	1	0	1	2	0	1	1	0	1	2	0	0	0	0	5	8	13
2008	0	0	0	0	0	0	0	0	0	0	1	0	0	2	2	0	0	1	1	0	2	1	1	1	0	1	3	0	0	0	3	1	0	0	0	1	5	6	10	21
2009	1	0	0	1	0	0	0	0	0	0	0	0	1	0	2	0	1	0	1	3	0	0	1	0	1	3	0	0	0	4	2	0	0	0	1	0	7	9	6	22
TOTAL	**10**	**9**	**8**	**8**	**8**	**3**	**2**	**9**	**6**	**7**	**7**	**14**	**17**	**21**	**27**	**17**	**27**	**50**	**55**	**53**	**96**	**45**	**60**	**88**	**35**	**55**	**95**	**24**	**37**	**96**	**27**	**35**	**70**	**20**	**22**	**41**	**267**	**343**	**594**	**1204**

TD - Tropical Depression - maximum winds from 40 to 63 kph near the center
TS - Tropical Storm - Maximum winds from 64 to 117 kph near the center
TY - Typhoon - maximum winds of 118 kph or more near the center
Source: PAGASA & www.maybagyo.com

TABLE 3. 29 MOST INTENSE TROPICAL CYCLONES IN THE BICOL REGION, 1947-2006

NAME	PERIOD OF OCCURRENCE	HIGHEST WIND SPEED RECORDED (in km/hr.)	DISTANCE FROM NAGA CITY (in km.)
1. STY REMING (Durian)	Nov. 26 - Dec. 1, 2006	320	15 - SOUTH
2. STY SENING (Joan)	Oct. 11 - 15, 1970	275	DIRECT HIT
3. STY ROSING (Angela)	Oct. 30 - Nov. 4, 1995	260	40 - NORTH
4. STY ANDING (Irma)	Nov. 21 - 27, 1981	260	30 - NE
5. STY LOLENG (Babs)	Oct. 15 - 24, 1998	250	35 - NNE
6. STY SISANG (Nina)	Nov. 23 - 27, 1987	240	30 - SW
7. STY SALING (Dot)	Oct. 15 - 20, 1985	240	70 - NORTH
8. STY HERMING (Betty)	Aug. 07 - 14, 1987	240	70 - SSW
9. STY YAYANG (Vera)	Nov. 04 - 07, 1979	240	90 - NE
10. TY HARRIET	Dec. 28, 1959 - Jan. 02, 1960	225	DIRECT HIT
11. TY TRIX	Oct. 16 - 23, 1952	215	22 - NORTH
12. TY UNSANG (Ruby)	Oct. 21 - 26, 1988	215	100 - NE
13. TY WARLING (Orchid)	Nov. 17 - 27, 1983	205	180 - NE
14. TY WELMING (Emma)	Oct. 31 - Nov. 08, 1967	205	20 - SW
15. STY YOLING (Patsy)	Nov. 17 - 20, 1970	200	90 - NORTH
16. STY DINDO (Nida)	May 13 - 19, 2004	185	117 - ENE
17. STY KADING (Rita)	Oct. 25 - 27, 1978	185	90 - NORTH
18. TY HUANING (Ruby)	Jun. 22 - Jul. 02, 1976	185	70 - NE
19. TY MILENYO (Xangsane)	Sep. 25 - 30, 2006	180	30 - SW
20. TY DINANG (Lee)	Dec. 23 - 28, 1981	175	60 - SOUTH
21. TY YONING (Skip)	Nov. 03 - 12, 1988	175	150 - SW
22. TY MONANG (Lola)	Dec. 02 - 07, 1993	170	35 - NORTH
23. TY DIDANG (Olga)	May 12 - 27, 1976	150	200 - NORTH
24. TY FRAN	Dec. 27, 1950 - Jan. 01, 1951	150	30 - NORTH
25. TY JEAN	Dec. 22 - 29, 1947	150	DIRECT HIT
26. TY UNDING (Muifa)	Nov. 14 - 21, 2004	130	5-10 - EAST
27. TY KONSING (Ora)	Jun. 23 - 25, 1972	130	20 - SW
28. TY BEBENG (Vera)	Jul. 12 - 16, 1983	130	30 - SW
29. TY SALING (Dan)	Oct. 06 - 13, 1989	120	15 - SW

Legend:
STY - Super Typhoon
TY - Typhoon
TS - Tropical Storm
Revised: Wednesday, 11 June 2008,
Source:
http://www.maybagyo.com/25mostb.htm (Accessed September 9, 2010)

TABLE 4. DEADLIEST TROPICAL CYCLONES IN THE PHILIPPINES, 1947-2009

NAME	PERIOD OF OCCURRENCE	DEATHS
1. URING (Thelma)[A]	November 2-7, 1991	5,101 (*8,000*+)*
2. NITANG (Ike)	August 31–September 4, 1984	1,363 (*3,000*)*
3. TRIX	October 16-23, 1952	995
4. AMY	December 6-19, 1951	991
5. SISANG (Nina)	November 23-27, 1987	979
6. FRANK (Fengshen)[B]	**June 18–23, 2008**	**938 (1,501)***
7. ROSING (Angela)	October 30 – November 4, 1995	936
8. UNDANG (Agnes)	November 3-6, 1984	895
9. SENING (Joan)	October 11-15, 1970	768
10. REMING (Durian)[C]	November 26–December 1, 2006	754 (*1,200*)*
11. RUPING (Mike)	November 10-14, 1990	748
12. TITANG (Kate)	October 16-23, 1970	631
13. YOLING (Patsy)	November 17-20, 1970	611
14. KADIANG (Flo)	September 30 - October 7, 1993	576
15. PEPENG (Parma)[D]	**September 30–October 11, 2009**	**492**
16. ONDOY (Ketsana)[E]	**September 24–27, 2009**	**464**
17. KADING (Rita)	October 25-27, 1978	444
18. ANDING (Irma)	November 21-27, 1981	409
19. WINNIE[F]	November 28–30, 2004	407
20. INING (Louise)	November 15-20, 1964	400

Notes:

A - Only a **Tropical Storm** . The unusual number of deaths was attributed to massive flashfloods in Leyte and Negros Occidental. Majority of deaths came from Ormoc City, Leyte in Nov. 5, 1991 after being submerged in a 10-feet flood spawned by a torrential rainfall for 10-18 hrs (140mm in 6 hours).

B - Simultaneous record-breaking floods in Panay plus the capsizing of ferry liner M/V Princess Of The Stars and widespread sinking of fishing fleets in the Visayan Sea contributed to the high number of fatalities.

C - Saturated volcanic material at Mayon Volcano's slopes by the Southwest Monsoon and four earlier typhoons, were mobilized by REMING sending lahars at populated villages on its slopes burying thousands.

D - A slow-moving typhoon criss-crossed Northern Luzon three times sending landslides in the Cordilleras and flooding in Pangasinan and Cagayan Valley for two weeks.

E - Only a **tropical storm** as it crossed Central Luzon, but record-breaking rainfall of 455mm in 24 hours fell over the NCR, Rizal, Bulacan and Laguna catching millions unprepared and marooned in widespread flooding.

F - A **tropical depression** only by PAGASA and JMA, sent muddy and log-laden floodwaters from the Sierra Madre and swamped coastal towns of Real, Infanta, Gen.Nakar (Quezon), and Dingalan (Aurora).

* Italicized numbers in parenthesis are UNOFFICIAL death tolls from various agencies other than NDCC where missing persons are included as fatalities.

Note: Typhoons DIDANG (Olga) of May 12-17, 1976 {Rank #18}; MONANG (Lola) of Dec. 2-7, 1993 {Rank #19}; and WELING (Nancy) of Oct. 11-15, 1982 {Rank #20} was removed from the list, as new entries (shown in **BOLD FONTS**) with higher casualties were reported

> Information for this summary was taken from NDCC publications, and various historical archives.

Compiled by Dominic Alojado with additional information by David Michael V. Padua of Typhoon2000.com.

This edition (2010) was updated and uploaded on July 28, 2010.

Source: **http://www.maybagyo.com/stormstats/DeadliestPhilippineTyphoons.htm (Accessed September 9, 2010)**

TABLE 5. DESTRUCTIVE TROPICAL CYCLONES IN THE NATIONAL CAPITAL REGION, 1947-2009

NAME	PERIOD OF OCCURRENCE	AREA TRAVERSED*	REMARKS
1. JEAN	December 22-29, 1947	Southern NCR	Major wind damage to Las Piñas and Parañaque
2. DADING *(Winnie)*	June 26-30, 1964	Direct Hit	Left thousands homeless; severe damage to infrastructure especially Manila.
3. WELMING *(Emma)*	October 31-November 8, 1967	Southern NCR	Major wind damage to Las Piñas and Parañaque.
4. SENING *(Joan)*	October 10-15, 1970	Southern NCR	Massive damage mostly to billboards and glass buildings.
5. YOLING *(Patsy)*	November 17-20, 1970	Direct Hit	Wind speed of 200 kph was recorded at Manila Int'l Airport (now NAIA) before the anemometer conked out.
6. SISANG *(Nina)*	November 23-27, 1987	Indirect (Batangas-Cavite)	Major wind damage to Las Piñas and Parañaque.
7. ROSING *(Angela)*	October 30-November 04, 1995	South-Central NCR	Widespread and massive wind damage all over NCR.
8. MILENYO *(Xangsane)*	September 25-30, 2006	Southern NCR	Destruction of billboards and flying debris caused fatalities.
9. FRANK *(Fengshen)*	June 18-23, 2008	Quezon City, Marikina, Pasig	Major flooding at CAMANAVA.
10. ONDOY *(Ketsana)***	September 24-29, 2009	Indirect (Central Luzon)	Record-breaking rain and floods kill mostly from Marikina, Pasig, Quezon City and those along major rivers and creeks.

** - **AREA TRAVERSED** is identified with Manila City as the point of reference.*
*** - Only a Tropical Storm (TS) when it passed north of NCR or over Central Luzon.*
***CAMANAVA** - Caloocan, Malabon, Navotas and Valenzuela. NCR's most frequently flooded cities.*
> Data are taken from different news reports, NDCC, JTWC, & PAGASA summaries.
Compiled by Dominic Alojado, MD. with additional information by David Michael V. Padua of Typhoon2000.com, Published: 07.31.10
Source: http://www.maybagyo.com/stormstats/DestructiveTyphoonsNCR.htm
(Accessed September 9, 2010)

TABLE 6. COSTLIEST TROPICAL CYCLONES IN THE PHILIPPINES, 1947-2009

	NAME	PERIOD OF OCCURRENCE	DAMAGE IN PESOS* (in Billion Php)
1.	***PEPENG (Parma)***	***September 30-October 11, 2009***	**27.195**
2.	***FRANK (Fengshen)***	***June 18-23, 2008***	**13.321**
3.	***ONDOY (Ketsana)*****	***September 24-27, 2009***	11.121
4.	RUPING (Mike)	November 10-14, 1990	10.846
5.	ROSING (Angela)	October 30-November 04, 1995	10.829
6.	KADIANG (Flo)	September 30-October 7, 1993	8.752
7.	LOLENG (Babs)	October 15-24, 1998	6.787
8.	MILENYO (Xangsane)	September 25-30, 2006	6.61
9.	UNSANG (Ruby)	October 21-26, 1988	5.636
10.	ILIANG (Zeb)	October 7-18, 1998	5.375
11.	REMING (Durian)	November 26-December 1, 2006	5.086
12.	NITANG (Ike)	August 31-September 4, 1984	4.1
13.	REMING (Xangsane)	October 26-November 1, 2000	3.944
14.	FERIA (Utor)	July 2-7, 2001	3.586
15.	HARUROT (Imbudo)	July 19-23, 2003	3.24
16.	NANANG (Lingling)	November 6-9, 2001	3.2
17.	MAMENG (Sybil)	September 27-October 1, 1995	3.17
18.	TRINING (Ruth)	October 16-31, 1991	3.072
19.	YONING (Skip)	November 5-8, 1988	2.767
20.	MONANG (Lola)	December 2-7, 1993	2.463

Not adjusted to current inflation rate of the Philippine Peso.
**ONDOY was a Tropical Storm when it crossed Luzon, making it the only non-typhoon system on this list.
Bold font indicates new entries.
This summary is taken from NDCC publications, and historical archives.
Source: http://www.maybagyo.com/stormstats/CostliestPhilippineTyphoons.htm. Date Accessed: September 17, 2010
Compiled by Dominic Alojado, MD. with additional information by David Michael V. Padua of Typhoon2000.com
This edition (2010) was updated & uploaded on July 28, 2010.

TABLE 7. AMOUNT OF RAINFALL BY MONTH AND BY SELECTED STATION, 1993 to 2009, (in millimeter)

Sampling Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Rank
Laoag City, Ilocos Norte														
Normals (1971-2000)	6.6	1.7	3.1	21.5	164.4	275.7	411.4	556.6	377.9	143.6	30.4	5.0	**166.5**	
1993			2.7		83.8	76.3	332.3	393.0	443.4	124.5	10.4	8.2	**163.8**	14
1994	3.7	18.0		48.4	262.3	291.3	943.8	727.3	604.4	101.3		0.0	**300.1**	1
1995	0.0			0.0	156.5	261.5	409.3	695.7	295.3	52.6	9.0	6.5	**188.6**	8
1996	12.2	3.2	0.0	20.2	101.4	99.6	883.8	617.6	488.4	169.1	205.3	0.0	**216.7**	5
1997	10.2	0.0	0.0		230.6	172.0	266.8	576.4	66.3	56.9	19.1	1.2	**127.2**	16
1998	60.0	0.0	4.6	26.4	321.0	74.5	154.0	201.0	389.4	260.3	26.5	4.9	**126.9**	17
1999		0.0	23.2	31.0	55.5	418.6	225.5	425.9	645.5	211.2	6.3	9.1	**186.5**	11
2000	0.0	0.0	34.5	6.6	341.2	156.5	848.4	513.8	371.2	192.2	17.2	12.3	**207.8**	6
2001	0.0	22.5	51.0		325.9	553.5	806.3	276.2	1029.9	3.7	10.4	2.4	**280.2**	4
2002	0.0	12.8	12.9	0.0	505.6	348.1	800.5	117.2	197.0	38.7	12.6		**185.9**	12
2003	8.9	0.0	0.0	7.6	301.7	626.4	137.7	544.1	213.2	39.7	56.8	0.0	**161.3**	15
2004	0.3		0.0	0.0	224.7	724.9	133.7	678.5	270.9	10.7	16.9	5.8	**187.9**	9
2005		0.0	0.4	0.0	139.3	418.0	213.2	521.8	718.9	36.6	13.0	2.2	**187.6**	10
2006	24.0	0.0	19.0	0.0	123.6	88.9	835.3	281.4	558.6	60.6	43.3	3.8	**169.9**	13
2007	0.2		3.8	0.4	245.0	198.3	90.3	1,064	253.2	62.8	123.7		**204.1**	7
2008		2.0	0.0	0.1		36.2	1,505	821.8	478.1	38.5	68.4	0.0	**295.0**	3
2009			0.1	200.6	122.7	210.5	1,004	216.3	355.9	860.4	11.1	0.0	**298.1**	2
Average	**10.0**	**4.9**	**10.1**	**24.4**	**221.3**	**279.7**	**564.1**	**510.1**	**434.1**	**136.5**	**40.6**	**3.8**	**205.2**	
Rank	**10**	**11**	**9**	**8**	**5**	**4**	**1**	**2**	**3**	**6**	**7**	**12**		

Table 7. continued…

Sampling Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Rank
Dagupan City, Pangasinan														
Normals (1971-2000)	8.0	6.1	17.6	52.8	204.4	331.8	535.8	608.6	362.2	200.6	53.4	10.4	**199.3**	
1993	0.0	4.4	6.4	81.6	52.7	392.9	309.0	264.9	376.7	353.5	86.3	7.5	**161.3**	15
1994	15.1	13.4	1.0	25.2	130.9	202.1	908.8	203.2	326.6	72.0		2.0	**172.8**	13
1995	0.0	0.0	0.6	4.0	246.5	216.0	512.6	395.0	328.3	82.1	30.0	24.9	**153.3**	16
1996	7.2	0.0	3.4	51.3	141.0	95.7	683.5	538.9	442.7	130.8	103.8	0.0	**183.2**	11
1997	6.0		11.6	91.5	371.6	230.8	333.1	842.4	333.3	83.3	8.6	0.0	**210.2**	8
1998		0.0	0.0	197.0	175.2	83.4	111.7	188.3	1063.1	515.5	105.8	40.0	**225.5**	7
1999	0.0		80.4	58.9	150.3	418.3	472.9	1070.7	271.7	349.1	50.9	14.7	**267.1**	4
2000	1.0	38.8	77.4	39.3	318.1	211.0	1191.7	648.9	321.5	519.5	17.0	44.7	**285.7**	2
2001		36.5	131.1	94.6	106.5	383.6	605.7	328.6	328.2	21.2	4.8	1.3	**185.6**	10
2002		21.1	0.0	5.2	310.6	221.3	1289.2	216.9	329.3	266.6	14.7	51.6	**247.9**	6
2003	0.4	0.0	15.4	13.2	939.3	534.0	297.7	1030.2	391.1	139.0	47.0	0.0	**283.9**	3
2004		88.5	12.2	3.8	332.4	616.4	261.4	1184.0	111.7	37.6	72.5	93.6	**255.8**	5
2005	3.8	0.0	5.3	38.5	177.5	279.7	187.8	332.7	324.8	163.3	88.6	21.5	**135.3**	17
2006	79.8	0.0	18.9	42.6	53.9	165.7	792.7	546.7	354.1	212.8	105.2	13.3	**198.8**	9
2007	6.6	4.0	10.5	64.2	134.1	241.9	237.4	709.9	197.4	142.6	194.8	1.2	**162.1**	14
2008	5.0	27.0	47.4	86.2	426.3	208.1	319.3	615.3	371.2	35.9	28.7	0.0	**180.9**	12
2009	0.8		26.1	221.7	285.9	547.0	488.5	394.0	531.9	807.2	3.0	0.0	**300.6**	1
Average	**9.7**	**16.7**	**26.3**	**65.8**	**256.0**	**296.9**	**529.6**	**559.4**	**376.7**	**231.3**	**60.1**	**18.6**	**212.3**	
Rank	**12**	**11**	**9**	**7**	**5**	**4**	**2**	**1**	**3**	**6**	**8**	**10**		

Table 7. continued…

Sampling Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Rank
Port Area (MCO), Manila														
Normals (1971-2000)	19.0	7.9	11.1	21.4	165.2	265.0	419.6	486.1	330.3	270.9	129.3	75.4	**183.4**	
1993		0.2	1.0	0.5	7.0	219.2	217.3	437.6	284.2	249.4	206.2	146.0	**160.8**	13
1994	41.2	1.6	12.0	22.4	168.7	241.8	761.7	367.8	276.4	80.7	44.7	96.3	**176.3**	8
1995	3.4	23.0	6.8	4.0	110.8	225.8	342.1	538.2	493.6	335.5	264.7	142.7	**207.6**	6
1996	6.6		4.9	30.6	172.7	156.2	413.7	257.5	483.8	54.0	150.1	12.0	**158.4**	14
1997	10.4	24.0		20.4	520.9	240.0	438.7	679.8	184.7	121.4	24.4	32.9	**208.9**	5
1998	6.4	0.0	14.4	2.8	126.7	120.6	167.2	195.7	704.9	356.9	84.1	315.9	**174.6**	9
1999	18.0	11.0	46.0	125.9	98.5	327.9	477.4	654.8	383.6	308.3	106.7	182.4	**228.4**	3
2000	25.5	48.4	23.5	49.6	513.8	213.0	893.1	340.3	443.2	499.9	242.0	155.8	**287.3**	1
2001	34.0	54.5	26.3	39.0	174.2	182.1	388.6	465.4	121.4	183.4	74.6	88.7	**152.7**	15
2002	7.5	11.3	7.8	15.4	71.2	37.4	1468.8	363.3	277.7	212.4	140.1	29.3	**220.2**	4
2003	8.5	8.3	1.2	18.4	408.1	232.1	333.5	425.3	366.7	114.1	129.6	11.4	**171.4**	11
2004	1.2	40.5	0.0		225.3	260.2	150.6	426.3	173.3	75.6	152.8	41.3	**140.6**	17
2005	9.8	8.9	15.8		60.1	312.9	175.1	262.4	328.8	296.0	33.8	87.2	**144.6**	16
2006	56.1	17.4	79.9	0.0	50.6	191.5	569.3	246.4	515.4	199.0	63.7	105.9	**174.6**	10
2007	1.2	15.0	28.0	27.2	107.3	41.4	186.6	620.2	400.8	212.1	279.9	45.4	**163.8**	12
2008	58.5	20.7	19.9	40.1	218.4	233.4	365.0	547.3	388.9	125.1	127.8	54.6	**183.3**	7
2009	10.3	26.1	60.9	111.6	294.6	386.9	598.8	307.4	839.2	243.4	64.8	2.2	**245.5**	2
Average	**18.7**	**19.4**	**21.8**	**33.9**	**195.8**	**213.1**	**467.5**	**419.7**	**392.2**	**215.7**	**128.8**	**91.2**	**188.2**	
Rank	**12**	**11**	**10**	**9**	**6**	**5**	**1**	**2**	**3**	**4**	**7**	**8**		

Table 7. continued…

Sampling Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Rank
Legaspi City, Albay														
Normals (1971-2000)	321.9	209.7	185.0	161.0	170.5	259.5	279.0	236.1	261.6	353.8	486.3	562.5	**290.6**	
1993	161.1	112.2	150.5	35.9	119.4	216.9	393.5	375.4	293.7	366.7	702.0	847.6	**314.6**	8
1994	590.4	76.0	169.0	277.7	134.2	195.7	377.2	65.1	253.8	170.5	127.9	464.2	**241.8**	15
1995	274.5	92.6	45.2	113.4	136.6	197.8	348.0	372.0	392.9	261.1	843.5	1649.4	**393.9**	2
1996	461.5	158.9	569.8	590.7	149.1	323.6	206.9	124.8	153.1	284.7	546.1	356.5	**327.1**	6
1997	85.1	250.1	93.3	15.4	163.4	192.0	354.1	120.8	333.5	126.3	285.9	404.5	**202.0**	16
1998	161.6	16.9	118.6	78.5	246.3	62.2	184.6	260.6	278.9	555.5	305.5	895.9	**263.8**	12
1999	869.5	322.6	426.0	197.2	151.9	191.4	155.4	239.1	113.3	351.1	547.3	774.8	**361.6**	4
2000	365.0	847.4	481.6	263.7	106.7	170.5	221.0	184.4	210.2	466.1	623.6	757.8	**391.5**	3
2001	325.5	472.8	285.0	103.6	144.0	235.9	214.1	282.0	247.4	485.5	446.6	505.0	**312.3**	10
2002	261.7	203.0	129.0	112.1	147.5	70.4	363.5	243.4	306.2	181.0	467.5	514.2	**250.0**	14
2003	216.0	95.3	124.5	105.3	195.9	281.5	191.3	159.4	267.9	256.3	276.8	198.9	**197.4**	17
2004	230.2	149.4	294.9	73.5	447.6	293.4	171.6	303.8	142.5	236.6	393.5	302.6	**253.3**	13
2005	192.2	85.5	111.7	38.3	102.6	231.7	265.9	172.3	681.4	335.4	332.2	1208.1	**313.1**	9
2006	453.2	364.9	330.6	151.5	239.2	232.8	135.1	238.1	445.5	197.0	689.6	520.5	**333.2**	5
2007	345.4	16.5	233.6	105.2	268.0	90.6	171.8	217.0	531.2	450.7	579.1	599.1	**300.7**	11
2008	323.0	1082.0	287.8	516.8	423.7	234.8	261.9	249.9	297.0	256.2	440.6	502.7	**406.4**	1
2009													**326.1**	7
Average	**332.2**	**271.6**	**240.7**	**173.7**	**198.5**	**201.3**	**251.0**	**225.5**	**309.3**	**311.3**	**475.5**	**656.4**	**305.2**	
Rank	**3**	**6**	**8**	**12**	**11**	**10**	**7**	**9**	**5**	**4**	**2**	**1**		

Notes:

1. **Normals refer to the period averages for a uniform and relative long period comprising at least 3 consecutive 10-year periods.**
2. means trace
3. means data is missing

Source: *Philippine Atmospheric, Geophysical, and Astronomical Services Administration.*

TABLE 8. ENSO BY AVERAGE ECONOMIC PERFORMANCE (AT CONSTANT PRICES)

NATIONAL ACCOUNTS INDICATORS	ENSO TYPE				% DIFFERENCE		
	STRONG LA NIÑA YEARS	OTHER YEARS	STRONG EL NIÑO YEARS	TOTAL YEARS	SE / SL	SE / OTHER	SL / OTHER
Philippines (1951-2009)							
GDP	450,942	612,570	528,348	593,047	17.2	-13.7	-26.4
AFF	112,427	137,484	123,394	134,352	9.8	-10.2	-18.2
Industry	164,746	211,916	189,119	206,399	14.8	-10.8	-22.3
Services	173,769	263,170	215,836	252,295	24.2	-18.0	-34.0
NCR (1975-2009)							
GDP	178,359	259,638	229,828	252,438	28.9	-11.5	-31.3
AFF	0	0	0				
Industry	86,889	105,995	100,303	104,416	15.4	-5.4	-18.0
Services	91,470	153,642	129,525	148,022	41.6	-15.7	-40.5
Region I (1987-2009)							
GDP	20,435	29,118	24,446	28,335	19.6	-16.0	-29.8
AFF	8,730	12,273	10,436	11,960	19.6	-15.0	-28.9
Industry	3,304	4,479	3,991	4,386	20.8	-10.9	-26.2
Services	8,402	12,366	10,019	11,989	19.2	-19.0	-32.1
Region V (1975-2009)							
GDP	18,377	25,028	22,956	24,471	24.9	-8.3	-26.6
AFF	7,842	9,248	8,521	9,105	8.7	-7.9	-15.2
Industry	3,542	5,520	5,160	5,377	45.7	-6.5	-35.8
Services	6,992	10,260	9,274	9,989	32.6	-9.6	-31.9

Table 9. Continued…

PRODUCTION INDICATORS	ENSO TYPE				% DIFFERENCE		
	STRONG LA NIÑA YEARS	OTHER YEARS	STRONG EL NIÑO YEARS	TOTAL YEARS	SE / SL	SE / OTHER	SL / OTHER
Corn Production (In 000 MT) (1970-2009)							
Philippines	3,254	4,209	3,432	4,059	5.5	-18.5	-22.7
Region I	36	129	89	118	145.2	-30.9	-71.8
Ilocos Norte	5	21	14	19	179.9	-36.1	-77.2
Ilocos Sur	3	17	7	15	143.2	-58.4	-82.9
La Union	1	6	3	6	209.2	-55.9	-85.7
Pangasinan	28	84	65	78	137.3	-22.0	-67.1
Region V	107	114	106	113	-0.8	-7.0	-6.2
Albay	54	46	53	47	-1.7	16.0	18.0
Camarines Norte	2	2	2	2	-17.7	7.9	31.0
Camarines Sur	18	36	26	34	46.5	-28.5	-51.2
Catanduanes	0	0	0	0	-28.6	-31.2	-3.7
Masbate	30	28	23	28	-23.7	-18.0	7.6
Sorsogon	2	1	1	1	-23.3	-2.2	27.6
Fish Production (In 000 MT)							
Philippines (1971-2009)	1,681	2,699	2,193	2,569	30.4	-18.8	-37.7
NCR (1990-2009)	133	182	231	179	74.0	27.0	-27.0
Region I (1990-2009)	88	79	52	78	-41.2	-34.9	10.7
Region V (1990-2009)	163	156	105	152	-35.8	-32.8	4.7

TABLE 10. MODERATE ENSO BY AGRICULTURAL PRODUCTION INDICATORS

PRODUCTION INDICATORS	ENSO TYPE				% DIFFERENCE		
	MODERATE LA NIÑA YEARS	OTHER YEARS	MODERATE EL NIÑO YEARS	TOTAL YEARS	ME / ML	ME / OTHER	ML / OTHER
Fish Production (In 000 MT) Philippines (1971-2009)							
NCR (1990-2009)	133	175	231	179	74.0	31.6	-24.3
Region I (1990-2009)	88	81	52	78	-41.2	-36.6	7.7
Region V (1990-2009)	163	159	105	152	-35.8	-34.1	2.7

TABLE 11. ENSO BY AVERAGE NUMBER OF REPORTED CASES BY DISEASES

PRODUCTION INDICATORS	ENSO TYPE				% DIFFERENCE		
	STRONG LA NIÑA YEARS	OTHER YEARS	STRONG EL NIÑO YEARS	TOTAL YEARS	SE / SL	SE / OTHER	SL / OTHER
Philippines							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1971-2008)	8,336	11,460	10,576	11,120	26.9	-7.7	-27.3
Diarrhea (1971-2008)	429,042	607,097	632,362	595,700	47.4	4.2	-29.3
Dengue Fever (1971-2008)	1,160	7,997	14,009	8,090	1107.6	75.2	-85.5
Leptospirosis (1996-2008)	397	196	54	231	-86.4	-72.4	103.0
NCR							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	528	945	1,985	991	275.9	110.1	-44.1
Diarrhea (1991-2008)	69,258	75,190	91,394	76,002	32.0	21.5	-7.9
Dengue Fever (1991-2008)	1,607	2,840	3,443	2,702	114.3	21.2	-43.4
Leptospirosis (1996-2008)	172	75	38	95	-77.9	-49.6	128.4

Source of Basic Data : DoH

Table 11. Continued….

	ENSO TYPE				% DIFFERENCE		
	STRONG LA NIÑA YEARS	OTHER YEARS	STRONG EL NIÑO YEARS	TOTAL YEARS	SE / SL	SE / OTHER	SL / OTHER
Region I							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	562	773	902	752	60.4	16.7	-27.3
Diarrhea (1991-2008)	39,141	41,015	58,876	42,687	50.4	43.5	-4.6
Dengue Fever (1991-2008)	273	411	1,026	456	275.2	149.5	-33.5
Leptospirosis (1996-2008)	55	8	0	18	-100.0	-100.0	556.0
Region V							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	709	684	582	677	-17.9	-14.9	3.7
Diarrhea (1991-2008)	46,510	50,549	58,067	50,711	24.8	14.9	-8.0
Dengue Fever (1991-2008)	304	528	1,288	575	323.1	143.7	-42.4
Leptospirosis (1996-2008)	4	1	2	2	-50.0	50.0	200.0

Source of Basic Data : DoH

TABLE 12. MODERATE ENSO BY AVERAGE NUMBER OF REPORTED CASES BY DISEASES

DISEASES	ENSO TYPE				% DIFFERENCE		
	MODERATE LA NIÑA YEARS	OTHER YEARS	MODERATE EL NIÑO YEARS	TOTAL YEARS	ME / ML	ME / OTHER	ML / OTHER
AVERAGE							
Philippines							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1971-2008)							
Dengue Fever (1971-2008)							
Leptospirosis (1996-2008)	397	189	54	231	-86.4	-71.4	110.6
NCR							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	528	976	1,985	991	275.9	103.4	-45.9
Dengue Fever (1991-2008)	1,607	2,940	3,443	2,702	114.3	17.1	-45.3
Leptospirosis (1996-2008)	172	69	38	95	-77.9	-45.2	148.4
Region I							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	562	735	902	752	60.4	22.7	-23.5
Dengue Fever (1991-2008)	273	392	1,026	456	275.2	161.5	-30.3
Leptospirosis (1996-2008)	55	9	0	18	-100.0	-100.0	483.1
Region V							
Typhoid & Paratyphoid Fever and Other Salmonella Infection (1991-2008)	709	642	582	677	-17.9	-9.3	10.4
Dengue Fever (1991-2008)	304	568	1,288	575	323.1	126.6	-46.4
Leptospirosis (1996-2008)	4	1	2	2	-50.0	45.5	190.9

Source of Basic Data: DoH

TABLE 13. LOW-LYING AREAS VULNERABLE TO 1 METER SE A LEVEL RISE IN THE PHILIPPINES VS POVERTY

Region / Province	Areas (ha) with		Total Area (ha) as of 2003	Areas (ha) Affected to		% Area Affected		General Population	Magnitude of Poor Population	% to Population per Region		Cummulative % to Population per Region	
	1 meter elevation	2 meter elevation		1 meter Sea Level Rise	2 meter Sea Level Rise	1 meter Sea Level Rise	2 meter Sea Level Rise	2006	2006	General Population	Poor Population	General Population	Poor Population
Philippines	227,861	107,144	30,000,000	227,861	335,005	0.8%	1.1%	86,972,500	27,616,888				
NCR	201	166	63,600	201	367	0.3%	0.6%	10,944,300	1,156,313				
Region I	4,521	2,110	1,284,019	4,521	6,631	0.4%	0.5%	4,777,900	1,464,245				
Ilocos Sur	1,946	993	257,958	1,946	2,939	0.8%	1.1%	655,700	184,397	13.7%	12.6%	13.7%	12.6%
La Union	584	204	149,309	584	788	0.4%	0.5%	758,100	229,739	15.9%	15.7%	29.6%	28.3%
Ilocos Norte	783	524	339,934	783	1,307	0.2%	0.4%	570,500	112,835	11.9%	7.7%	41.5%	36.0%
Pangasinan	1,208	389	536,818	1,208	1,597	0.2%	0.3%	2,793,600	937,274	58.5%	64.0%	100.0%	100.0%
Region V	26,851	12,366	1,763,249	26,851	39,217	1.5%	2.2%	5,289,500	2,643,799				
Catanduanes	3,415	1,817	151,148	3,415	5,232	2.3%	3.5%	239,100	105,075	4.5%	4.0%	4.5%	4.0%
Camarines Norte	3,912	2,245	211,249	3,912	6,157	1.9%	2.9%	525,700	256,708	9.9%	9.7%	14.5%	13.7%
Sorsogon	3,541	1,489	214,144	3,541	5,030	1.7%	2.3%	740,300	395,434	14.0%	15.0%	28.5%	28.6%
Masbate	6,639	1,708	404,769	6,639	8,347	1.6%	2.1%	802,500	487,672	15.2%	18.4%	43.6%	47.1%
Camarines Sur	6,926	4,454	526,682	6,926	11,380	1.3%	2.2%	1,758,400	846,030	33.2%	32.0%	76.9%	79.1%
Albay	2,438	653	255,257	2,438	3,091	1.0%	1.2%	1,223,500	552,881	23.1%	20.9%	100.0%	100.0%

Note:
1\. Preliminary Estimates and not validated in the ground
2\. Taken from Shuttle Radar Topography Mission (SRTM)
Source: NAMRIA and NSCB

TABLE 14. STATUS OF LAND CLASSIFICATION AND FOREST COVER, 2003, in hectare

Region/Province	Total area	Certified A & D	% A & D	Forestland	% Forestland	Forest cover within Forestland	% Forest Cover vs Land Area	% Forest Cover within Forestland	Forest Cover w/in A & D	% Forest Cover within A & D	Mangrove Forest Cover
Philippines	30,000,000	14,145,078	47.2	15,854,922	52.8	6,431,630	21.4	40.6	736,770	5.21	153,577
Region 1	1,284,019	810,922	63.2	473,097	36.8	155,485	12.1	32.9	34,316	4.23	85
Ilocos Norte	339,934	144,948	42.6	194,986	57.4	97,547	28.7	50.0	24,878	17.16	-
Ilocos Sur	257,958	138,412	53.7	119,546	46.3	22,815	8.8	19.1	4,173	3.01	-
La Union	149,309	120,443	80.7	28,866	19.3	2,630	1.8	9.1	1,225	1.02	-
Pangasinan	536,818	407,119	75.8	129,699	24.2	32,493	6.1	25.1	4,040	0.99	85
NCR	63,600	48,232	75.8	15,368	24.2	2,057	3.2	13.4	763	1.58	-
Metro Manila	63,600	48,232	75.8	15,368	24.2	2,057	3.2	13.4	763	1.58	-
Region 5	1,763,249	1,222,060	69.3	541,189	30.7	110,424	6.3	20.4	46,052	3.77	6,698
Albay	255,257	206,205	80.8	49,052	19.2	6,027	2.4	12.3	9,800	4.75	321
Camarines Norte	211,249	140,030	66.3	71,219	33.7	17,010	8.1	23.9	4,997	3.57	1,968
Camarines Sur	526,682	365,551	69.4	161,131	30.6	42,398	8.1	26.3	14,789	4.05	1,346
Catanduanes	151,148	73,325	48.5	77,823	51.5	33,296	22.0	42.8	8,844	12.06	-
Masbate	404,769	263,384	65.1	141,385	34.9	1,616	0.4	1.1	1,244	0.47	1,616
Sorsogon	214,144	173,565	81.1	40,579	18.9	10,077	4.7	24.8	6,378	3.67	1,447

Source: Philippine Forestry Statistics 2003, Forest Management Bureau

TABLE 15. WATERSHED FOREST RESERVES BY PROVINCE, 2003,in hectare

Region/Province/Name of Reservation	Location	Number	Area (ha)	Proclamation No.	Proclamation Date
Philippines		128	1,517,412		
National Capital Region		1	2,659		
La Mesa Watershed Forest Reserve			2,659	1,336	07\25\2007
Region 1		10	6,167		
Ilocos Norte		3	3,008		
Ilocos Norte Metropolitan Forest Reserve	Pasuquin		2,815	731	09\27\34
Magnuang Watershed Forest Reserve	Batac		152	220	07\02\67
Tanap Watershed Forest Reserve	Burgos		41	803	02\01\71
Ilocos Sur		5	1,609		
Bigbiga Spring Watershed Forest Reserve	Narvacan		135	431	08\16\39
Libunao Spring Watershed Forest Res.	Sinait		47	410	10\02\31
Lidlidda Watershed Forest Reserve	Lidlidda		1,228	79	09\17\36
Santa Watershed Forest Reserve	Santa		25	844	09\26\35
Sta. Lucia Watershed Forest Reserve	Sta.Lucia		174	333	10\18\38
La Union		2	1,550		
Lon-oy Watershed Forest Reserve	San Gabriel, Santol		1,460	378	05\11\94
Naguilian Watershed Reservation	Naguilian Maconacon, Divilacan		90	52	04\11\36
Region 5		11	37,725		
Albay		1	810		
Mt. Masaraga Watershed Forest Reserve	Polangui, Oas, Ligao, Tabaco		810	84	10\27\92

Source: Philippine Forestry Statistics 2003, Forest Management Bureau