Gearing a National Statistical System Towards the Measurement of the Impact of Climate Change: The Case of the Philippines[1]

by

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I. Introduction

Concern for climate change has been gaining greater attention in the political agenda of most countries. Such attention 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.

In its Fourth Assessment Report (AR4)[3], the IPCC concluded the following observed changes in earth's climate:

1.   Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level;

2.   Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases; and,

3.   There is medium confidence that other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.

Warming of the climate system according to the IPCC report is attributed to the observed increase in anthropogenic greenhouse gas (GHG) concentrations.[4]

Scientists have found out that global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. Furthermore, according to the report, the continued and unabated release of greenhouse gases from human activities at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century. Anthropogenic warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change.

1.1. Global Impacts of Climate Change on Growth and Development

The AR4 reports 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.

More specifically, the impacts (an impact describes a specific change in a system caused by its exposure to climate change. Impacts may be judged to be harmful or beneficial[5]) of climate change can be simplified as follows:

- a reduction in crop yields around tropical and sub-tropical regions;
- decreased water availability in areas already short of water;
- an increase in the spread of diseases such as malaria, dengue fever, schistosomiasis, and other viral diseases; and
- increased instances of flooding as intensity of rainfall increases and sea levels increase. But, the positive aspects of a small amount of global warming include:

  – increases in crop yields in some mid-latitude regions with temperature increases up to two to three degrees Celsius;
  – potential increase in timber supplies from managed forests;
  – increased water availability in regions such as southeast Asia; and,
  – reduced winter mortality in high latitude regions.

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.[6]

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

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Press, Cambridge, UK, 7-22.http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf. Date Accessed February 26, 2008.

[5] Schneider, S.H., S. Semenov, A. Patwardhan, I. Burton, C.H.D. Magadza, M. Oppenheimer, A.B. Pittock, A. Rahman, J.B. Smith, A. Suarez and F. Yamin, 2007: Assessing key vulnerabilities and the risk from climate change. *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, 779-810. Found at http://www.ipcc.ch. Date accessed March 4, 2008.

[6] IPCC, 2007: Summary for Policymakers.

international community has an obligation to support them in adapting to climate change. Without such support there is a serious risk that development progress will be undermined.

1.2. Climate Change Impacts in the Philippines

The Philippine archipelago will not be spared of the adverse impacts of sea-level rise and extreme climate events that are expected to happen in a warmer world.[7] Jabines and Inventor (2007)[8] considers the Philippines 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.

In his study, Amadore (2005)[9] summarized the climate change impacts that have occurred in the Philippines as follows:

Based on the IPCC Third Assessment Report (TAR), extreme climate events/variability, i.e., floods, drought, forest fires, and tropical cyclones have increased in temperate topical. These have been manifested in the Philippines through the more frequent occurrence of severe El Niño and La Niña events, as well as, deadly and damaging typhoons and other severe storms, floods, flash floods, landslides, drought, forest fires, etc.

There were 5 La Niña episodes and 7 El Niño episodes from 1970 to 2000 compared to only 3 La Niña episodes and 2 El Niño episodes from 1950 to 1970. The strong warm (El Niño) events were in 1972-73, 1982-83,1997-98, while the strong cold (La Niña) events were in 1973-74,1988-89 and 1998-99. There were seven (7) extreme tropical cyclone/southwest monsoon induced extreme events from 1991 to late 2004, namely, the Ormoc Catastrophe, 1991; Cherry Hill Tragedy, 1999; Payatas Garbage-slide, 2000; Baguio-La Trinidad landslides, 2001; Camiguin flashfloods, 2001; Southern Leyte-Surigao disaster, 2003; and the Aurora floods, 2004. These extreme events have one thing in common – persistent torrential rains, causing landslides and flash floods, killing people and destroying properties and the environment along its path.

The sector most affected by climate change, so far, is agriculture and food security. The sharpest fall in agricultural productions are experienced during strong El Niño events and after the occurrence of severe tropical cyclones. However, increases in rice and corn productions are attributed to favorable rainfall conditions during La Nina years. The highest typhoon damage was 1.17% of GDP and 4.21% of agriculture.

The climate change impacts on coastal zones and marine ecosystems observed in 1998 were massive coral bleaching in various reefs throughout the Philippines caused by the elevated sea temperature during the severe 1997-98 ENSO episode. Severe red tide outbreaks also occurred after the strong El Niño periods

[7] 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.

[8] 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.

[9] Amadore, Leoncio A. 2005. Crisis or Opportunity, Climate Change Impacts and the Philippines. Greenpeace Southeast Asia. Found at: http://www.greenpeace.org/seasia/en/asia-energy-revolution/climate-change/philippines-climate-impacts. Date accessed: February 26, 2006.

In the health sector, many of the biological organisms linked to the spread of infectious diseases are especially influenced by the fluctuations in climate variables. Among other factors, dengue fever and malaria are sensitive to such climate parameters as temperature, relative humidity and rainfall. Other climate-related diseases like cholera have been associated with extremes of precipitation, droughts and floods.

The Philippines ranks fourth in the global Risk Index for 2006[10]. The Germanwatch Global Climate Risk Index (CRI) identifies those countries most affected by extreme weather events in specific time periods, based on four indicators:

- total number of deaths,
- deaths per 100,000 inhabitants,
- absolute losses in million US$ purchasing power parities (PPP) and
- losses per unit GDP in %.

Such are the impacts of climate change in the Philippines. Notwithstanding the fact that the Philippines released only a minimal total equivalent amount of 100,738 ktons of CO_2 into the atmosphere in 1994 and projected to increase by 94% or 195,091 (annual growth rate of 4.8%.) ktons of equivalent CO_2 by 2008.[11] This is due to the combined effects of GHG emissions from the four sources of energy, industry, agriculture, and wastes, and the net uptake (sink) of GHGs from the land use change and forestry (LUCF) sector.

The alarming threat of the adverse effects of climate change in people's lives warrants a comprehensive strategic planning on the part of policy and decision makers. But planning can be truly effective only if it is based on high quality statistics. Unfortunately, environmental statistics and in particular, statistics on the climate change and its impacts are generally lacking both in terms of quantity and quality, particularly in developing countries. Part of the reason is that national statistical agencies have not been sufficiently involved in the generation of these statistics, not only because of resource constraints but also because of lack of subject matter expertise.

This paper thus presents the mechanisms and structures available that can strengthen the involvement of the Philippine Statistical System (PSS) in the measurement of the impacts of climate change, with particular attention to the social impacts. At the same time, it discusses the challenges facing the PSS in this direction. It also presents an initial framework on indicators on climate change plus some statistics that are already available, both official and non-official.

2.   The Present State of Social, Economic and Environment Statistics in the Philippines

2.1   The Philippine Statistical System (PSS)

2.1.1   Organizational structure

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[10] Harmeling, Sven. 2007. Global Climate Risk Index 2008. Germanwatch, December 2007. Found at: http://www.germanwatch.org/klima/cri.htm. Accessed date: January 15, 2008.
[11] Philippines' Initial National Communication on Climate Change. 1999. Found at
http://unfccc.int/resource/docs/natc/phinc1.pdf. Date Accessed: January 15, 2008.

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 (see Figure 1).
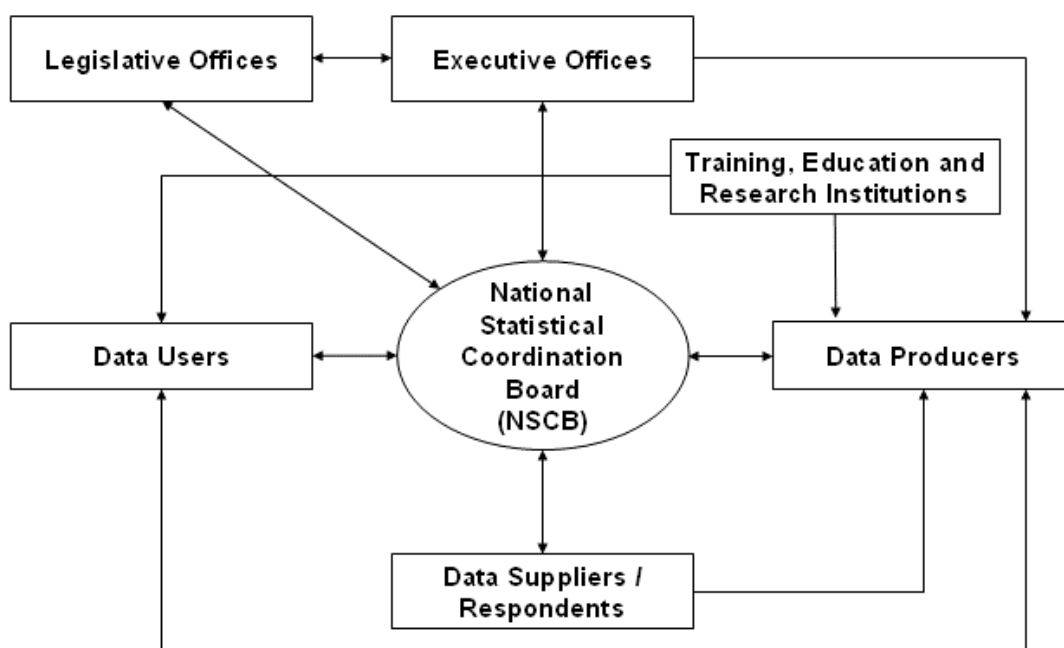

Figure 1. The Philippine Statistical System

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 highly decentralized administrative structure of the country raises complex demands on the statistical system which are difficult to respond to especially under severe resource constraints. Nonetheless, the PSS must exert best efforts to meet the challenge of generating statistics on the social impacts of climate change.

2.1.2 Existing coordination mechanisms in the PSS that would be useful in the generation of official statistics for measuring the social impacts of climate change

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.

a. 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 current PSDP 2005-2010 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. According to a review made on the 2004-2010 MTPDP to assess whether climate change has been integrated in the national development policies and programs, while no explicit mention of adaptation to climate change was made in the current MTPDP, there is a strong commitment to address the impacts of climate-related hazards. Hence, this would be a good starting point in mainstreaming climate change in the country[12]. Moreover, the current MTPDP is being updated to include programs concerning climate change. Once strategies of sustainable development have integrated environmental and climate change issues into the country's development plans and policies, the PSDP can easily be used as a vehicle to implement statistical programs and policies towards the provision of resultant environmental and socio-economic data.

b. System of Designated Statistics (SDS)

The SDS is a mechanism for the identification and generation of crucial statistics for administrators, planners, policy makers, and decision makers in the government and private sectors. It is also an important tool in addressing problems, such as data gaps, duplication, delayed release and inaccessibility of important sets of statistics, and as a framework for setting priorities in data production.

The designation of statistics includes the implementing agency and prescribed frequency of collection, geographic disaggregation and schedule of data dissemination. For the ENR sector, there are currently three designated activities, namely: (a) Generation of mineral statistics; (b) Generation of forest resources statistics; and (c) Generation of land area statistics. The SDS will be a useful tool to ensure the regular and timely generation of statistics and indicators that will be

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[12] Lasco, RD, Pulhin, FP, Jaranilla-Sanchez, PA, Garcia, KB and RV Gerpacio. 2008. Mainstreaming Climate Change in the Philippines. Working Paper nr 62. Los Banos, Philippines. World Agroforestry Centre. 23p.

required in measuring the social impacts of climate change. Initially, a core set of environmental indicators may be developed or recommended for designation.

c. Budget Review and Prioritization

One of the functions of the NSCB is to review budgetary proposals for statistical activities of agencies. For many years now, the annual Budget Call issued by the Department of Budget and Management (DBM) provides that the NSCB endorse agency budget proposals involving the SDS.

d. Statistical Survey Review and Clearance System (SSRCS)

The SSRCS involves the substantive review of 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. Recently, the scope of the SSRCS has been expanded to include administrative recording systems. The system aims to ensure the quality of the data to be generated from the inquiry, to avoid unnecessary duplication in data collection and to elicit the cooperation of data providers and respondents.

e. Statistical Standards and Classification Systems

The standard classification systems which are aligned with the international classification systems recommended by the UN Statistical Commission serve as instruments for promoting the comparability and consistency of statistics generated by data producers. They can also be used in the organization of databases and information systems.

Integration of the different data sets available in the PSS useful for the measurement of social impacts of climate change require that primary data sources be comparable, that is, adoption of uniform standard concepts and methods. The PSS can help in this area by prescribing statistical standard and classification system on environment.

f. Technical and Inter-Agency Committees on Statistics (TCs/IACs) and Task Forces (TFs)

The TCs/IACs/TFs are created (1) to assess and evaluate the quality, usefulness and timeliness of sectoral data and determine areas of duplication, discrepancies and gaps; (2) to review the concepts, techniques and methodologies used in the collection, processing and reporting of data; and (3) to recommend an 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 users from government, the private sector and the academic and research communities while TC's are also composed of members from the said sectors who have expertise the particular field or subject matter.

The Interagency Committee on Environment and Natural Resources Statistics (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 which is chaired by the Undersecretary for Policy, Plans and Programs of the Department of Environment and Natural Resources (DENR), 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-ENRS is composed of producers and users of environment statistics from government agencies as well as other stakeholders from the academe, non-government organizations and the private sector.

For social-related concerns, existing interagency and technical committees are the TC on Population and Housing Statistics, TC on Poverty Statistics, IAC on Agriculture, Fishery and Forestry Statistics and the IAC on Health and Nutrition Statistics.

g. Advance 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.

h. Focal Point on Statistics

A unit is designated in each agency to serve as the contact unit which stakeholders can contact regarding their data needs and other inquiry on statistical matters.

i. Sub national Coordination

Aware that the statistical problem areas and priority setting at the subnational level could be better attended to with the institutionalization of structures for coordinating statistical operations at the subnational level, Regional Statistical Coordination Committees (RSCCs) which are chaired by the Regional Director of the National Economic and Development Authority (NEDA)[13] were established by the NSCB, to provide direction and guidance to statistical development activities in the regions and to analyze, evaluate and recommend improvements on statistics needed in responding to local concerns. The RSCCs serve as the body for policy and issue resolution and statistical coordination at the subnational level. The NSCB Regional Units provide the technical and administrative support functions to the RSCCs.

Provincial Statistical Coordination Committees (PrSCCs) and City Statistical Coordination Committees (CSCC) were also created in some provinces and cities to serve as the highest policy-making and coordinating bodies on statistical matters at the subregional levels. TFs, TWGs and technical subcommittees were likewise created by the various RSCCs.

2.1.3. 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) and Gross Domestic Product (GDP). The PSNA is maintained by the NSCB with data inputs coming from various agencies including private institutions. Other indicator

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[13] The National Economic and Development Authority (NEDA), as mandated by the Philippine Constitution, is the country's independent economic development and planning agency. It is headed by the President as chairman of the NEDA board, with the Secretary of Socio-Economic Planning, concurrently NEDA Director-General, as vice-chairman. All Cabinet members, as well as the Central Bank Governor, are members of the NEDA Board. The NSCB is one of the attached agencies of NEDA.

systems that are maintained by the NSCB include the System of Leading Economic Indicators, Foreign Investments Information System, Gender and Development Indicators, Poverty Statistics, 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)[14], which was based on the UNFDES, is a systematic organization of the interdisciplinary nature 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 solve the inadequacy 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 would be a rich data source for assessing the social impacts of climate change, specifically the component on Environmental Impacts of Activities and Events.

b. Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) system[15]

The PEENRA system is a satellite account of the Philippine System of National Accounts (PSNA) which is being compiled by the NSCB. The PEENRA covered 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.

In recognition of the usefulness of the PEENRA system in generating macro-indicators that reflect the relationships and interactions between the natural environment and the economy, E.O. 146 was issued on 21 March 1997 *Institutionalizing the PEENRA System and Creating Units Within the Organizational*

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[14] The PFDES was initiated by the Technical Assistance of the Asian Development Bank (ADB) through RETA 5555 "Institutional Strengthening and Collection of Environment Statistics in Selected Developing Member Countries". Through the project, the compilation of the PFDES was institutionalized at the NSCB.

[15] This section is an excerpt from the Country Report – Environmental Accounting: The Philippine Experience and Future Plans presented by Estrella V. Domingo during the International Workshop on Environmental and Economic Accounting 18-22 September 2000, Manila, Philippines

Structure of the DENR, National Economic and Development Authority (NEDA), and NSCB. Per said E.O., the NSCB PEENRA Unit shall mainly be responsible for the compilation of the environmental accounts, and studying and formulating viable approaches and methodologies for the PEENRA; the DENR PEENRA Unit will be responsible in the compilation of sectoral resource accounts, in studying and formulating viable approaches and methodologies in coordination with the NSCB, and in conducting studies and researches in support of policy development related to PEENRA; and, the unit at NEDA shall be designated to coordinate ENRA activities. Further, Section 2 of the E.O. requires that the NSCB designate the required environment and economic statistics while the concerned agencies/bureaus shall be responsible for generating such data. To provide directions for the coordinated functioning of the PEENRA Units, the PEENRA Steering Committee (PEENRA-SC) was created. Unfortunately, the creation of the NSCB PEENRA unit has not been provided with the required budgetary support.

2.2 Philippine Statistics/Indicator System useful in the measurement of the potential socio-economic impacts of climate change

2.2.1. Potential Socio-economic impacts of Climate Change

As mentioned in the early section of the paper, climate change threatens the basic elements of life for people around the world - water, food, health, and use of land and the environment. The following are some of the social impacts of climate changes in Asia and the Philippines as compiled from previous studies and researches.

2.2.1.1 Agriculture and food security

Because of high temperature, severe drought, flood condition, and soil degradation associated with climate changes, agricultural productivity in Asia is likely to suffer severe losses, thus increasing the risk of hunger and water resource scarcity. Likewise, future changes in ocean currents, sea level, sea-water temperature, salinity, wind speed and direction, strength of upwelling, the mixing layer thickness and predator response to climate change have the potential to substantially alter fish breeding habitats and food supply for fish and ultimately, the abundance of fish populations in Asian waters [16]. In the Philippines, the sharpest fall in gross value added (GVA) and in volume of production in agricultural sector was in 1982-1983 and 1997-1998, the occurrence of the two strongest El Niños in the country. There was a decline in GVA and in volume of production of 4 principal crops (rice, corn, sugarcane and coconut). Increases in GVA in rice and corn production are attributed to favorable rainfall conditions during La Nina years[17].

Food safety is likewise at risk as shown by the following:

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[16] **IPCC**, 2001. Climate Change 2001. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken and K.S. White, Eds., Cambridge University Press, Cambridge, 1032 pp.

[17] **Amadore**, Leonico A. 2005.

o Several studies have confirmed and quantified the effects of high temperatures on common forms of food poisoning, such as salmonellosis.[18]

o Contact between food and pest species, especially flies, rodents and cockroaches, are also temperature-sensitive. Fly activity is largely driven by temperature rather than by biotic factors[19]

o Harmful algal blooms (Chapter 1, Section 1.3.4.2) produce toxins that can cause human diseases, mainly via consumption of contaminated shellfish. Warmer seas may thus contribute to increased cases of human shellfish and reeffish poisoning (ciguatera) and pole ward expansions of these disease distributions[20]

2.2.1.2   Human settlements and society

The most widespread direct risk to human settlements from climate change is flooding and landslides, driven by projected increase in rainfall intensity and, in coastal areas, sea level rise. (IPCC-TAR findings).   The Philippines, being an archipelago, has substantial number of families living in coastal areas making them specially susceptible to storm surges. The use of non-durable building materials largely account for the huge number of houses being totally or partially destroyed by strong typhoons.[21]

Likewise, migration is expected in the coming decades as a consequence of climate-related interference on human populations. "*Circular migration patterns, such as those punctuated by shocks of migrants, following extreme weather events, could be expected. Such changes would likely affect not only internal migration patterns, but also migration movements to other western countries.*"[22]

While the world's poorest, numbering 3 billion around the world, are the least responsible for climate change, they will be hardest hit by climate change as they are more dependent on natural resources and have less of an ability to adapt to a changing climate[23] due to their limited access to information, technology and other capital assets which make them highly vulnerable to climate change.   Those at greater risk include, in all countries, the urban poor, the elderly and children, traditional societies, subsistence farmers, and coastal populations (high confidence). Poorer communities, particularly slum dwellers, are more likely to live in flood-prone areas.[24]

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[18] **Schmidlhuber**, Josef, and Francesco N. Tubiello. 2007. Global Food Security under Climate Change. PNAS _ December 11, 2007**.** vol. 104, no. 50. Found at: http://www.pnas.org/cgi/content/full/104/50/19703. Date accessed February 26. 2008.

[19] **Confalonieri**, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich and A. Woodward, 2007: Human health. 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, 391-431. Found at http://www.ipcc.ch. Date accessed March 4, 2008.

[20] **Confalonieri,** et. al. 2007.

[21] **Amadore,** Leoncio A, 2005.

[22] Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, 2007: Asia. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506. Found at http://www.ipcc.ch. Date accessed March 4, 2008.

[23] The Nature Conservancy. Climate Change Impacts: Feeling the Heat. Climate Change and Poverty. Found at: http://www.nature.org/initiatives/climatechange/issues**.** Accessed Date: February 18, 2008.

[24] (IPCC working group 2, p. 393 - very high confidence)

2.2.1.3 Human health

Based on the report of the Inter governmental Panel on Climate Change Working Group 2, climate change currently contributes to the global burden of disease and premature deaths.   Projected trends in climate-change-related exposures of importance to human health will:

- increase malnutrition and consequent disorders, including those relating to child growth and development (high confidence);
- increase the number of people suffering from death, disease and injury from heat waves, floods, storms, fires and droughts (high confidence);
- continue to change the range of some infectious disease vectors (high confidence);
- have mixed effects on malaria; in some places the geographical range will contract, elsewhere the geographical range will expand and the transmission season may be changed (very high confidence);
- increase the burden of diarrheal diseases (medium confidence);
- increase cardio-respiratory morbidity and mortality associated with ground-level ozone (high confidence);
- increase the number of people at risk of dengue (low confidence);

The above findings point to disease monitoring system as the essential basic data source in measuring the health impacts of climate change. In fact, prevalence and death rates associated with malaria are indicators used to measure progress in attaining Goal 6 of the MDG, namely, to combat HIV/Aids, malaria and other diseases.

2.2.2 <u>Statistics and indicators in the PSS that would be useful in the assessment of social impacts of climate change</u>[25]

2.2.2.1 Agriculture and food security

Due to the potential adverse effects of climate change on crop, livestock and fishery productivity and consequently to food supply, regular monitoring of agricultural production as well as food supply and demand is imperative.

The Bureau of Agricultural Statistics (BAS) is the major source of agricultural statistics which it collects through its various surveys on crops, livestock, poultry and fishery.   For agricultural crops, quarterly estimates are produced on area planted/harvested to palay and corn and corresponding volumes of production, while for livestock, poultry and fishery, quarterly estimates are produced on volume and value of production. Production data for other agricultural crops in terms of volume and value are available through the quarterly monitoring system.

The Census of Agriculture and Fisheries (CAF), which is one of the statistical activities covered by the SDS, is conducted by the National Statistics Office (NSO) every ten years with the 2002 census being the latest. Tabulated on a national, regional, provincial and municipal levels are data on characteristics of farms such as number and use of farms classified by use, size, type and tenure of operator; cultivated area by crop planted; farm operators and farm workers and other farm

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[25] This section drew largely from the following chapters of the PSDP 2005-2010: (a) Agriculture and Agrarian Reform; (b) Population and Housing; (c) Poverty; (d) Health and Nutrition.

inputs. Other data items relates to equipment, machineries, facilities and other farm tools including data on selected agricultural activities such as bee culture/honey production, mushroom culture, orchid growing for sale and other related activities.

The Sugar Regulatory Administration (SRA) generates monthly data on sugarcane while the Philippine Coconut Authority (PCA) collects data on the number of hectares planted to coconut, planting density and distribution of coconut trees. The Bureau of Fishery and Aquatic Resources (BFAR) generates information on the following: number of licensed commercial fishing vessels (by type of gear and tonnage class); number of fishermen by fishing ground; area of fishponds in operation, swamp lands available for development; amount of investment and employment in fishponds; data on imports and exports of fish and fishery products cleared by BFAR and classified by kind, quantity, value and by country of origin and destination; and, local trade reports on gathered fishery products by kind, quantity, and value, source and kind of transport used.

The NSCB, on the other hand, compiles the Food Balance Sheet (FBS) which provides estimates of the overall food supply situation in the country available for consumption of the populace and shows the trends in the levels of the country's food supply and changes in its composition and in the type of food available for consumption which are needed in the formulation of national food production and trade programs to satisfy the dietary and nutritional needs of Filipinos. Important indicators produced are the following: (a) Daily per capita food, calorie, protein and fat supply by food group and commodity per year and per day; (b) Domestic utilization (i.e. feed, seed, processed for food, waste and food) and non-food utilization by food group and commodity; (c) Gross and net domestic supply (by source, i.e. production, change in stocks, imports, and exports) by food group and commodity; and (d) Per capita food intake per day compared with per capita supply.

To rationalize the production of statistics for the agriculture, fishery and forestry sectors in all aspects, including collection, processing, analysis and dissemination, the IAC on Agriculture, Fishery and Forestry Statistics (IAF-AFFS) was created in 1995. One of the most important functions of the IAC is to serve as a forum for the discussion and resolution of issues concerning the generation and dissemination of agriculture, fishery and forestry statistics.

2.2.2.2 Human settlements and society

The primary sources of population data are censuses and registration of certain events as collected and compiled by the National Statistics Office (NSO). Population censuses are conducted every 10 years while mid-decade censuses are conducted every five years. In the absence of actual data during the inter-censal years, annual population projections and the implied growth rate are considered estimates of actual population size and growth. The NSO continues to process data on births, deaths and marriages as required by law through the civil registration system.

The Commission on Filipinos Overseas (CFO), for its part, conducts pre-departure registration for Filipino migrants. The CFO provides information on the number/volume of registered immigrants by country of destination, and by major demographic characteristics. The Bureau of Immigration (BI) supervises aliens' immigration into and emigration from the country, and regularly collects and processes the Arrival/Departure (A/D) Forms accomplished by Filipinos entering and leaving the country. The survey on Overseas Filipinos is a major source of statistics

on Filipinos who left the country within the last five years including Overseas Filipino Workers.

Housing statistics are sourced primarily from the Census of Population and Housing (CPH) undertaken by the NSO in coordination with various government agencies in the housing sector. The housing module of the CPH provides valuable statistics on the structural characteristics of a housing unit. Meanwhile, other housing agencies like the National Housing Authority (NHA), Government Service Insurance System (GSIS), Social Security System (SSS), Home Development Mutual Fund (HDMF), National Home Mortgage Finance Corporation (NHMFC), Housing and Land Use Regulatory Board (HLURB) and Home Guaranty Corporation (HGC) collect and compile statistics related to housing finance and production as part of their administrative functions.

A major source of information for household expenditures is the Family Income and Expenditure Survey (FIES) conducted by the NSO every three years. It provides information on the total family expenditures and percentage distribution by major expenditure items that include rental of occupied dwelling unit and house maintenance and minor repair by region, by province, and by urban-rural classification.

The NSCB releases official poverty statistics consisting of the food and poverty thresholds, the subsistence and poverty incidence, the income gap, the poverty gap, and the severity of poverty index. Except for the food and poverty thresholds that are estimated annually, the other official poverty statistics are estimated every three years after the results of the FIES of the NSO have become available. The Annual Poverty Indicators Survey (APIS) is conducted by the NSO in years when the FIES is not conducted and is aimed to supplement current poverty statistics through the use of non-income indicators. This survey provides information on the socio-economic profile of families and other characteristics relating to their living conditions. The Human Development Index (HDI) serves as a measure of how the country has performed, not only in terms of real income growth, but also in terms of: (a) people's ability to lead a long and healthy life; (b) to acquire knowledge and skills; and (c) to have access to the resources needed to afford a decent standard of living. The computation of the HDI was institutionalized at the NSCB in collaboration with the Human Development Network[26] starting with the 1997 series.

A summary list of potential indicators in measuring the impacts of climate change on human settlements and society is laid out in Appendix A. Information on the frequency/periodicity, manner of dissemination and source agency are also provided.

The Technical Committee on Population and Housing Statistics (TCPHS) was created in 1988 to coordinate population-related activities and to promote the orderly development and maintenance of a system for population and housing statistics that will provide timely, accurate and useful data for the government and the public, especially for planning and decision-making,

Executive Order No. 352 designated the formulation of the poverty estimation methodology to the Technical Working Group on Income Statistics (which became

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[26] The Human Development Network Foundation Inc. (HDN) is a non-stock, non-profit organization whose mission is to propagate and mainstream the concept of sustainable human development through research and advocacy. The United Nations Development Programme (UNDP) has been providing financial and technical assistance to the HDN for the preparation of the Philippine Human Development Reports and advocacy activities since 1994.

the Technical Working Group on Income and Poverty Statistics (TWG-IPS) under the Interagency Committee on Labor, Income, and Productivity Statistics), and the estimation of poverty statistics to the NSCB. Later, thru NSCB Memorandum Order No. 008, Series of 2003, the TWG-IPS was elevated to a Technical Committee giving rise to the present Technical Committee on Poverty Statistics (TC-PovStat). Among other functions, the TC-PovStat is tasked to review and assess the current issues and problems on the poverty statistics and other related indicators being produced by the PSS and to provide expert advice in the development of an efficient system of poverty estimation, taking into consideration the best practices in the generation of official poverty statistics in different countries.

2.2.2.3   Health statistics

The PSS generates information on status, resources and services for both health and nutrition. However, in the assessment of social impacts of climate change, data on health status would be the most relevant statistics.

The Department of Health (DOH) is the major source of data for the health sector. Some of the most relevant health statistics (associated with climate change) generated by the DOH through its administrative reporting forms are prevalence and death rates associated with malaria, incidence of specific notifiable diseases, and causes of morbidity, which are released regularly on an annual basis. Other morbidity statistics generated by the DOH are listed in Appendix A.

The NSO, on the other hand, produces vital health statistics from its civil registration function as mandated by the Civil Registry Law, such as births, deaths, infant deaths, foetal deaths, maternal deaths, and mortality by leading causes.

A list of potential indicators in measuring the health impacts of climate change that are available in the PSS is provided in Appendix A. Information on the frequency/periodicity, manner of dissemination and source agency are also shown.

To strengthen the system of compilation and dissemination of national and local health statistics for purposes of monitoring the state of health of the people and to serve as inputs in the formulation of health programs and policies and its corresponding budget appropriations, the IAC on Health Statistics (IAC-HS) was created in 2002. The IAC-HS was reconstituted and expanded in 2007 to become the present IAC on Health and Nutrition Statistics (IAC-HNS). Members include users and producers of health and nutrition statistics from various government agencies, the academe, private sector and non-government organization. The primary function of the IAC-HNS is to formulate and recommend appropriate statistical policies that will improve the system for health and nutrition statistics.

3. Issues/Challenges in the Generation of Data/Indicators in Measuring/Monitoring Climate Change Impacts – Philippine Setting

In general, climate change science and the study of climate change impacts in the Philippines are in its formative years. A plethora of issues and problems provide the challenges in the generation of statistics and indicators on climate change and its impacts.

3.1   On Framework and Indicator Systems

- *Need for a Climate Change Framework and Indicator System*

Climate change is a relatively new area for statistical agencies to deal with. Despite the urgent need for statistics on climate change, its development has not progressed as fast because of the lack of a framework/guide on the collection of data and measurement on climate change. The framework sets the statistics/indictors, definitions, methods and statistical practices and standards as guide in organizing, developing and collecting statistics on climate change. It covers statistics/indicators provided by other disciplines like environmental scientists, meteorologist, biologist, geophysicists, chemists, statisticians, etc., from other government and private organizations.

- *Need to pursue and update Disaster Management Indicator System, PEENRA system, and other existing statistical frameworks relevant to the measurement/monitoring, adaptation and mitigation climate change and its impact*

The Disaster Management Indicator System (DMIS) was crafted to serve as basis in the rehabilitation efforts of the government. The framework identified three phases of a disaster namely: disaster preparedness/mitigation phase, disaster phase, and post disaster phase. With climate change and more specifically the scenarios painted in AR4, the DMIS has to be updated to prepare the Philippines on the possible catastrophic effect, mitigation and adaptation measures on climate change.

Likewise, environmental accounting which measures the emissions of economic activities and the depletion of natural resources has to be aggressively pursued using the updated/revised framework of UNSEEA. Similarly, the other information systems, such as the FHSIS, National Epidemic Sentinel Surveillance System, housing statistics with urban and rural disaggregation has to be updated since these are possible inputs to the indicator system on the impact of climate change.

- *Data Problems*

Data on climate change are few and face a number of challenges – the lack of a statistical framework, cuts across different sectors and requires different expertise, costly, etc. Climate change data exhibits certain properties that makes it difficult to deal with such as the need to be more specific with regards to location and time of observations, data must typically span longer time intervals for observations. More importantly it requires a set of standards to measure the level of impact, adaptation and mitigation of climate change.

3.2.   On Institutional Coordination, Linkages and Capability Building

- *Need to mainstream and strengthen Institutional Linkages*

Obviously, the present data systems/frameworks are not aimed at climate change but on other concerns such as sustainable development. The PSS therefore has to mainstream and strengthen institutional linkages to address issues and challenges pertaining to the development of statistics on climate change.

The IAC-ENRS has to give priority to planning and programming the generation, collection, compilation, reporting and dissemination and utilization of climate change statistics. It has to put forward to the NSCB Board the necessary statistical activities on climate change, designation, the researches to be conducted and funds to be allocated.

- *Insufficient coordinating structure at the sub national level for the generation, collection, compilation, reporting, dissemination and utilization of climate change and impact statistics*

Climate change impact statistics 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. However, some national agencies do not have sub national offices (regional provincial, or municipal) e.g., PAGASA, NWRB, etc. To provide guidance, a high power inter agency body consisting of high-level officials has to be established. Such body will be helpful in gearing regional development efforts in the planning and programming of the generation, compilation of climate change statistics in specific geographical areas. Unfortunately, due to budget constraints, the NSCB is not yet present in all regions of the country and has insufficient personnel in regions where it is present to handle all the challenges/coordination at the sub national level.

- *Need to strengthen capability of statistical personnel to undertake and handle statistical researches and other activities related to climate change and its social impact.*

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. The PSS therefore has to formulate a training agenda at the national and sub-national levels related to the topic.

Likewise, statistical agencies and other data producers have to recognize the importance of undertaking researches which would serve as basis for continuously improving climate change and impact statistics in terms of the data being produced, the methodologies and techniques used and dissemination of data.

In this regard, the Philippines and other developing countries in the Asia Pacific region looks forward for support from the UN agencies, particularly the Statistical Institute for Asia and the Pacific (SIAP) to enhance the capacity of the PSS to measure the impact of climate change.

- *Need for an Advocacy Program to create Awareness on Climate Change and its Impacts among Statistical Agencies*

Understanding climate change will help statistical agencies and other data producers to identify the relevant data to measure/monitor the change and its impact. It will serve as the springboard in the formulation of a statistical framework and indicator system for climate change impact statistics.

3.3. *Resources (manpower and financial)*

The PSS given its character and coordinative advantage to undertake the generation of climate change statistics lacks the required resources to address the

issues and challenges presented on a more permanent basis. With the possible catastrophic effect that climate change can bring, data for this has to be planned and programmed in a more holistic manner. The national and the subnational levels of the government should draw a comprehensive study on programs and projects that need funding.

And, as the IPCC puts it, 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, therefore, has an obligation to support them in adapting to climate change.

4. The Way Forward: Integrating Climate Change and Related Statistics into the Philippine Official Statistics

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

4.1. Integration of Climate Change Issues into National and Local Development Plan and Policies

In May 1991, the Philippine government created an Inter Agency Committee on Climate Change[27] (IAC-CC) that have the following functions: formulate polices and responses related to climate change; determine the national information requirements relevant to negotiations for the adoption of a central instrument at the UN Conference for Environment and Development; and, establish working groups to monitor and assess local climate change and its environmental and socio-economic impact in coordination with international agencies.

To enhance the function of the IAC-CC, the Presidential Task Force on Climate Change (PTFCC) was created in 20 February 2007[28] that seeks to address and mitigate the impacts of climate change in the country. Among the functions of the PTFCC are: undertake/initiate strategic approaches and measures to prevent or reduce GHG emissions in the Philippines; design concrete risk reduction and mitigation measures and adaptations responses, especially short-term vulnerabilities, on sectors and areas where climate change will have the greatest impact; and, cause the integration and mainstreaming of climate risk management into the development policies, plans and programs of government, national and local. It is expected that statistical agencies and other government agencies will be involved in the generation of data pertaining to the work of the task force.

The Philippines is in the process of undertaking an improved national GHG inventory and preparing the country's Second National Communication (for submission to the Conference of the Parties (COP) of the UNFCCC.[29]

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[27] Thru Administrative Order No. 220 signed by President Corazon C. Aquino. May 8, 1991.

[28] Thru Administrative Order No. 171 signed by President Gloria M. Arroyo. February 20, 2007

[29] Environment and Environmental Bureau. Clean Development Mechanism - Philippines. Country and Convention. Found at: http://www.cdmdna.emb.gov.ph/cdm/public/cdm-country.php?main=about&sub=country. Date Accessed: March 11, 2008.

The enactment of the bill, An Act Establishing the Framework Program for Climate Change, Creating the Climate Change Commission, Appropriating Funds Therefor, and for Other Purposes or the Climate Change Act[30], filed November 20, 2007 in the Philippine Senate is envisioned to serve as the coup de grace for the integration of climate change issues in the development planning system of the Philippines.

Some of the components of the Framework Program are:

a. Local database development and vulnerability assessment to assist communities to identify, understand, and be prepared for the risks brought about by extreme impacts of climate change;
b. Capacity building for DENR, other national agencies, and their regional counterparts in training communities for community-based vulnerability assessment, data gathering and analysis, planning and decision making; and
c. Training on vulnerability assessments, data gathering and monitoring, planning and decision making for risk management of vulnerable communities.

Climate change is multi-disciplinary and inter disciplinary in nature. Policymakers need an objective source of information about the causes of climate change, its potential social, economic and environmental consequences and the adaptation and mitigation options to respond to it. To know the impacts of climate change, what is needed is a national statistical development cooperation program that will document key data/capacity and deficiencies in the impact of climate change data generation and compilation, both at the local and national levels, as well as the proposed/planned solutions, that can serve as a common reference for planning and coordination of national activities and resource mobilization is needed.

4.2. Development of a Statistical Framework and Indicator System in Measuring/Monitoring Climate Change Impacts
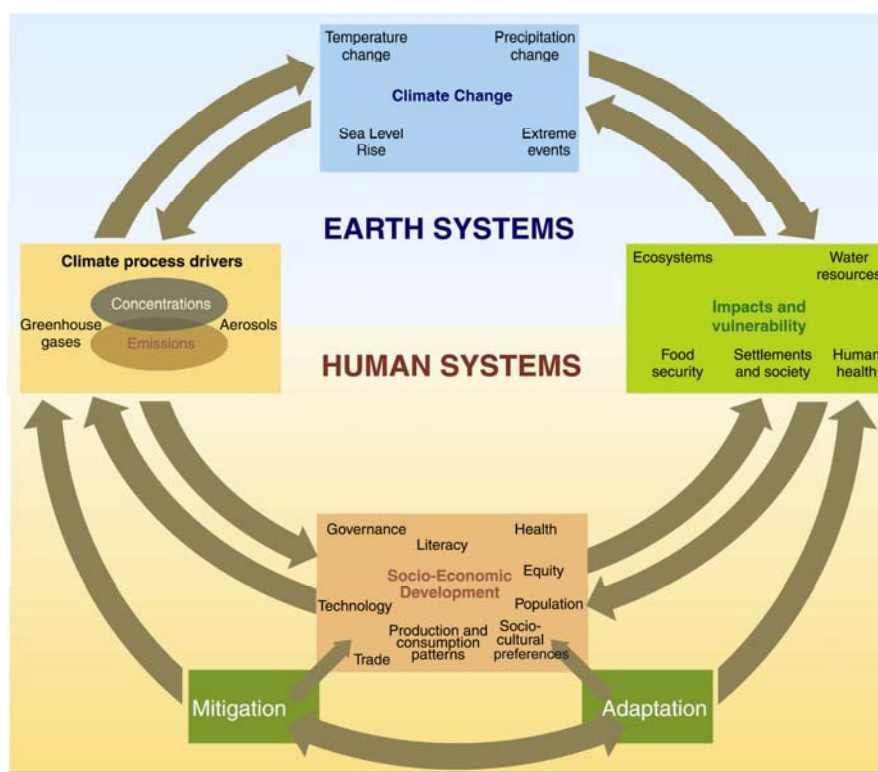
The challenge in measuring/monitoring climate change impacts is to capture the impacts within the timescale of climate change. To accomplish this, a statistical framework and indicator system is therefore needed. The framework will provide the set or sets of clearly defined indicators to measure the level of impacts, adaptation and mitigation of climate change at different points.

AR4 presented a schematic framework representing anthropogenic drivers, impacts of, and responses to climate change and their linkages (see Figure 2). According to AR4, "at the time of the Third Assessment Report (TAR) in 2001, information was mainly available to describe the linkages clockwise, i.e. to derive climatic changes and impacts from socio-economic information and emissions. With increased understanding of these linkages, it is now possible to assess the linkages also counterclockwise, i.e. to evaluate possible development pathways and global emissions constraints that would reduce the risk of future impacts that society may wish to avoid."[31] From the schematic diagram, a conceptual and statistical

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[30] Senate Bill Number 1890, An Act Establishing the Framework Program for Climate Change, Creating the Climate Change Commission, Appropriating Funds Therefor, and for Other Purposes or The Climate Change Act. Introduced by Senator Loren Legarda, Filed in November 20, 2007, First Regular Session of the Fourteenth Congress of the Philippines.
[31] IPCC, Fourth Assessment Report, Climate Change 2007 Synthesis Report.

framework and indicator system can be developed. A rough draft of a conceptual and statistical framework is presented in Table 1.

Figure 2. Schematic Framework representing Anthropogenic drivers, impacts of, and Responses to Climate Change, and their Linkages

The draft of the Philippine statistical framework on climate change provides a systematic organization of the interdisciplinary nature of climate change statistics and focuses on the identification, description and presentation of data variables which are useful for tracing and verifying interrelationships and interdependency of the earth and human systems.

The draft pictures the changes in the earth system triggered by climate process drivers (concentration of greenhouse gases and the emissions brought about by human activities), the impacts and vulnerability of earth ecosystems and human system due to climate change, and the coping mechanism (mitigation and adaptation) of the human system to climate change. (Table 1)

Changes in the earth system include temperature change, precipitation change, and sea level rise and extreme events. Climate process drivers include the emissions of industries, agricultural production, energy/electricity production and consumption and waste generation. On the other hand, impacts and vulnerability attempts to quantify the effects (positive and negative) of climate change to the different natural ecosystems, food security/safety, human settlement and human health. Man's various attempts to curb and adapt to climate change give rise to the socio-economic development category. This may include technology, health, trade, population, trade, equity, literacy, socio-cultural preferences and governance.

Within each information category are statistical topics which form the basis in identifying relevant statistical variables to be included in the framework.

To operationalize the conceptual framework, the statistical framework for the entire category in the framework will be developed (see Tables 2A to 2D). The statistical framework starts 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. The conceptual and statistical framework, however, needs further development as researches on climate change and its impacts become available.

The Indicators system can commence with existing indicators and variables found in the PFDES, SEEA, poverty, health accounts, etc. that are relevant in measuring/monitoring climate change impact, adaptation and mitigation. 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 can serve as indictors for the impact and vulnerability of climate change framework. The emission accounts (physical) of the SEEA can provide indicators for the climate change drivers. While the indicators found in the three phases of the Disaster Management Indicator System and the response to environmental impacts of PFDES can serve as indicators of on adaptation and the mitigation of the social and economic development indicator system of the climate change framework.

The IAC-ENRs or PTFCC can organize a task force to study and develop the framework.

4.3. Designation of Climate Change Statistics

With the urgency of the need to formulate plans and programs to mitigate and adapt to climate change, the list of designated statistics has to be reviewed for inclusion of climate change statistics/indicators.

The current designated statistical activities, i.e., Energy and Water, Land Area Statistics, Field Health Service Information System (FHSIS) etc, have to be updated to include salient or important climate change impact statistics. It is high time to expand the designated statistics on environment and natural resource statistics. The statistical framework and indicator system to measure and monitor climate change and its impacts that will be developed can guide the IAC-ENR and the NSCB Executive Board on what statistics should be designated.

4.4. Standards and Classification System

The standardization of concepts and definitions is a basic requirement towards generation and improvement of quality climate change statistics. There are various Philippine environmental laws, e.g. Clean Air Act, Ecological Waste Management Act, etc., that contain definitions of terms used for the purpose of the laws. The IAC-ENRS can select the terms which have statistical bearing and recommend these to the NSCB Executive Board for adoption as official climate change/environment and natural resources terms to be used for statistical purposes.

TABLE 1. Conceptual Framework On Climate Change Impact

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-metallic production
	  Chemical and chemical paper and pulp
	  etc
	
	Agriculture/Forestry
	  Rice and corn 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 Nutritional food Intake
		  Occurrence of crop/fishery disease and infestation
			Health
			
			Technology
			  Clean Energy Development Mechanism
			
			Production and Consumption Pattern
			
			Trade
			  Carbon trading
				Health
				
				Technology
				  Clean Energy Development Mechanism
				
				Production and Consumption Pattern
				
				Trade
				  Carbon trading

			Socio-Cultural preferences	Socio-Cultural preferences

	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
			  Population in coastal areas (with gender)
			  Population Growth/Density
			  Population control Mechanism
			
			Equity
			  Poverty Incidence
			  Poverty level
			
			Literacy
			
			Governance
			  RURBAN land used Planning
			  Ecological Waste Management Policies
			  Water Resource Management
			
			  Disaster Management Mechanisms
				Population
				  Population in coastal areas (with gender)
				  Population Density/Density
				  Population control Mechanism
				
				Equity
				  Poverty Incidence
				  Poverty level
				
				Literacy
				
				Governance
				  RURBAN land used Planning
				  Ecological Waste Management Policies
				  Water Resource Management
				
				  Disaster Management Mechanisms

Table 2A. Statistical Framework, Climate Change

Topic	Variables	Measurement
Temperature Change		
	Climatological Normal (temperature mean, maximum and minimum) `- national `- regional	^{o}Celcius
	Temperature, deviation from seasonal mean	^{o}Celcius
	Rate of Change	
Precipitation Change		
	Amount of rainfall `annual, monthly ` national, regional, and provincial	millimeter
	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, locaton, population/areas affected	typhoon signals, Quantity
	Floods, flash floods, locaton, population/areas affected	m, h, km^2, quantity
	Landslides, locaton, population/areas affected	m, h, km2, quantity
	Tidal Waves, locaton, population/areas affected	km^2, quantity

Table 2B. Statistical Framework, Climate Process Drivers Change

Topic	Variables	Measurement
GHG Emissions / Concentration sources		
Industries:	(can be sourced from environemental accounts)	
Transport	total emissions by type of vehicles	tons/year
Cement	total emissions by type of industry	tons/year
Metal and non-metallic production	toxic air contaminants	tons/year
Chemical and chemical products		
paper and pulp		
etc		
AgricultureForestry		
rice and corn production	Rice and corn production	tons/year
	Area of production (provincial, municipal)	Gg
	Total Ghg emission from rice and corn produciton	hectare
Agricultural Residue Burning	Area burned/kaingin areas	hectare
Grassland Burning	Forest Fires	hectare
Agricultural soils		
Energy/electricty		
Fossil Fuel Production	energy resources production (by sector, by utility)	by capacity (gwh)
	Depletion of energy resources	volume (thousand metric tonnes)
	Energy conversion (by plant, utility)	by capacity (gwh)
Biomass burned for energy	Energy Consumption (by sector, source)	by capacity (gwh)
Waste		
Solid wastes	solid waste disposal/ generation	tons per year, kilogram per capita
Domestics and Commercial Waste Water	toxic waste generated	tons per year, kilogram per capita
Industrial Wastewater	waste disposal in landfill	tons per year, kilogram per capita
Human Sewage	Volume of human sewage	tons per year, kilogram per capita
Hazardous Production	volume of hazardous waste	tons per year, kilogram per capita

Table 2C. Statistical Framework, Climate Change Impact 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	
Depletion/growth of growth 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)	Hectare Hectare Cubic meter/year Percent change Tons, kg
Changes of habitat/ecosystem	Mangrove areas converted for aquaculture production Loss of Seagrass Beds	Hectare, km^2, pesos
Water Resources (fresh and Marine water)		
Water Depletion	Amount of surface (by source, rivers, lakes) and groundwater abstraction	Cubic meters per year, liters per second
	Amount of surface (by source, rivers, lakes) and groundwater abstraction for use in irrigation, commercial, domestic and industrial	Cubic meters per year, liters per second
	Average stream flow *(Can be sourced from environmental accounts)* Number of sites used for inland, municipal fishery	Cubic meters per second Number of sites
Water quality	Water quality of receiving water bodies Number of areas affected by flood Number of rivers, lakes, open waters affected by sedimentation	Concentration (mg/l) Number, hectares, depth Number of rivers and lakes affected

Table 2. C. Con't

Food Security/Safety		
Food Production (crops and fishery)	Volume of rice/rice production	kilograms, tons
	Volume of fish production (inland, marine and aquaculture	kilograms, tons
Occurrence of Harmful Algal Blooms (HABS)	Number of occurrence and location	
Nutritional food Intake		calorie
Crop/fishery disease and infestation	Number of occurrence, type of disease and infestation	
Human Health		
Occurrence of Vector borne Diseases	number of occurrence/cases, type, location	
Occuence of Skin Diseases	number of occurrence/cases, type, location	
Respiratory Diseasea	number of occurrence/cases, type, location	
Diarrheal cases	number of occurrence/cases, type, location	
Human Settlements		
Coastal Settlements	Population size, density, dissagregation (male and female)	
Settlement in hazardous geologic areas	Population size, density, dissagregation (male and female), location	

TABLE 2D. Statistical Framework, Socio-Economic Development - Mitigation and Adaptation

Topic	Variables	Measurement
Health		
Technology Clean Develoment Mechanis		
Production and Consumption Pattern		
Trade Carbon trading		
Socio-Cultural preferences		

Population
  Population in coastal areas (with gender)
  Population Gorwth/Density		

Equity
  Poverty thresholds
  Poverty level		

Literacy		

As data generation and research on climate change progress, the PSS thru the NSCB executive Board can lay down the standard methodologies and techniques in data collection, processing and presentation to ensure comparability of statistics produced by the government.

4.5. Partnership Among Government Agencies, Academe and Research Institutions for Continuous Improvement of Climate Change Statistics

According to Zwiers, et. al. (2004)[32], "statistical concepts and methods are necessary in all facets of climate science. Statistical analysis is needed to interpret observations, from either the real world or the artificial world of climate model, in a proper framework. Statistical methods allow one to deal explicitly with the effects of uncertainty on inferences and to quantify its effects on forecasts, projections, etc."

Zwiers, et al have the impression that the discussion about statistical methodology in the climate sciences is generally not very deep and that straightforward craftsmanship is pursued in many cases. As a consequence, much of the statistical practice in climate science is of a homegrown nature. It is often *ad hoc*, and is sometimes not well informed or supported by statistical theory. Moreover, Zwiers, et al suggests that the link between climate and the statistical sciences should continue to be improved with additional efforts such as the Geophysical Statistics. Better communication between statisticians and climatologists requires a better understanding by statisticians of the specifics of climate science, and a greater effort by climatologists to communicate the specifics of open problems to statisticians.

The American Statistical Association[33] supported Zwiers et al suggestion and strongly urged statisticians to collaborate with other scientists in order to advance their understanding of the nature, causes, and impacts of climate change.

The base for future climate change studies is designing future social development scenarios by various models and projecting future regional and local change in climate and its variability, based on those social development scenarios so that the most plausible impacts of climate change could be assessed. The inaccurate description on future scenario of socio-economic change, environmental change, land-use change and technological advancement and its impacts will lead to incorrect GHG emissions scenarios. These factors affecting design of social development scenarios need to be more carefully examined to identify and properly respond to key uncertainties.

The design of social development scenarios needs intensive research. Capili et. al[34] recommends "that research institutions and the academe in coordination with statistical agencies may provide technical assistance to the implementors by gathering baseline information and monitoring changes, give recommendations based on scientific findings, and assist in providing technical expertise for capacity building. They may be the ones to provide timely information and current useful and

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[32] **Zwiers,** F. W. and Hans Von Storch. 2004. On the Role of Statistics in Climate Research. International Journal of Climatology. Found at: http://geography.uoregon.edu/amarcus/geog620/Guest-Readings/zwiers-IntJClim-2004.pdf. Date Accessed: January 18, 2008.
[33] **American Statistical Association,** 2007. ASA's Statement On Climate Change. Found at: http://www.amstat.org/news/index.cfm?fuseaction=climatechange. Accessed date: January 17, 2008.
[34] **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.

relevant scientific findings for decision-makers and the public. These can be done by conducting studies that include patterns, projections and consequences of both climate variability and change. Generation of localized models for predicting local/regional climate considering topography, land-use patterns, and the surface hydrologic cycle is deemed important as basis for decision-making."

4.6. Research and Training

The Statistical Research and Training Center (SRTC) can develop a comprehensive and integrated research and training program on theories, concepts and methodologies in climate change and its impact. 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. Key specific research related priorities should deal on the following:

- Measuring impacts of extreme weather events such as disasters from flood, storm surges, sea-level rise, human diseases, plant diseases and insect pests;
- Identification of social vulnerability to multiple stressors due to climate change and environmental change;
- Adaptation researches concerning agro-technology, water resources management, integrated coastal zone management; pathology and diseases monitoring and control and, adaptation and vulnerability in policy formulation; and,
- Identification of the critical climate thresholds for various regions, provinces, municipalities and sectors.

More so in the conduct of these researches, the increased participation of statisticians and the academic community in the conduct of climate change studies continues to offer many statistical challenges that are currently not being tackled and many opportunities for collaboration with geoscientists. 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*. The climate science community often requires regular fields of geophysical variables, such as surface temperature, which must be derived from irregular and heterogeneous observations. Evaluating the advantages and disadvantages of different interpolation approaches (referred to as infilling in climate applications) could be very helpful. This research area contains many opportunities for the development and fitting of sophisticated *space-time models to sparse data.*

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APPENDIX A

POTENTIAL KEY INDICATORS FOR MEASURING SOCIAL IMPACTS OF CLIMATE CHANGE

Indicator	Manner of Data Dissemination	Frequency	Data Source/Agency
AGRICULTURE AND FOOD SECURITY			
1. Supply and demand of agricultural commodities	Publication, website, press release	Annual	NSCB (FBS)
2. Food sufficiency ratio by type of food commodity			
3. Area planted/area harvested to palay, corn and other crops	Publication, website	Quarterly, Annual	BAS
4. Productivity (e.g., yield per hectare) - Palay, Corn, etc.			
5. Livestock and Poultry Volume of Production and Growth Rates			
6. Fishery Value of Production and Growth Rates			
HUMAN SETTLEMENTS AND SOCIETY			
7. Population count	Web release, Publication, CDs, Public Use Files	Every census year	NSO (CPH)
8. Age and sex structure			
9. Population density			
10. Population in urban and rural areas			
11. Population growth rate by province			
12. Rates of in- and out-migration			NSO (NDHS)
13. Net migration rate			NSO (Survey of Overseas Filipinos)
14. Origin-destination matrix by province	Web release, Publication, CDs, Public Use Files		
15. Rates of emigration and immigration			Special Subject Survey on Migration
16. Net international migration			
17. No of overseas Filipinos			Migration Information Centers in the LGUs
18. Countries of origin and destination			
19. Proportion of families with housing units made of strong materials	Publication/Website	Every three years	NSO - FIES
	Publication/Website	Every non-FIES year	NSO - APIS
	Publication/Website	Every 10 or 5 years	NSO – CPH

Indicator	Manner of Data Dissemination	Frequency	Data Source/Agency
20. Proportion of households living in makeshift housing	Publication/Website	Every three years	NSO - FIES
		Every non-FIES year	NSO - APIS
		Every 10 or 5 years	NSO - CPH
21. Proportion of families/households with access to safe water supply		Every three years	NSO - FIES
		Every non-FIES year	NSO - APIS
		Every 10 or 5 years	NSO - CPH
22. Proportion of families with access to sanitary toilet facilities		Every three years	NSO - FIES
		Every non-FIES year	NSO - APIS
		Every 10 or 5 years	NSO - CPH
23. Subsistence incidence		Every 3 years	NSCB
24. Poverty incidence			NSCB
25. Human development index (HDI)			NSCB/HDN
HEALTH			
26. Life expectancy	Publication	Annual	NSO
27. Crude death rate			
28. Infant mortality rate	Web release, Publication, CD, Diskette	Every 5 years	NDHS, NSO
29. Child mortality rate			
30. Under-five mortality rate			
31. Maternal mortality ratio	Publication	Varying	NDHS, NSO
32. Incidence of specific notifiable diseases		Annual	DOH
33. Causes of morbidity			
34. Prevalence and death rates associated with malaria			
35. Prevalence and death rates associated with tuberculosis			