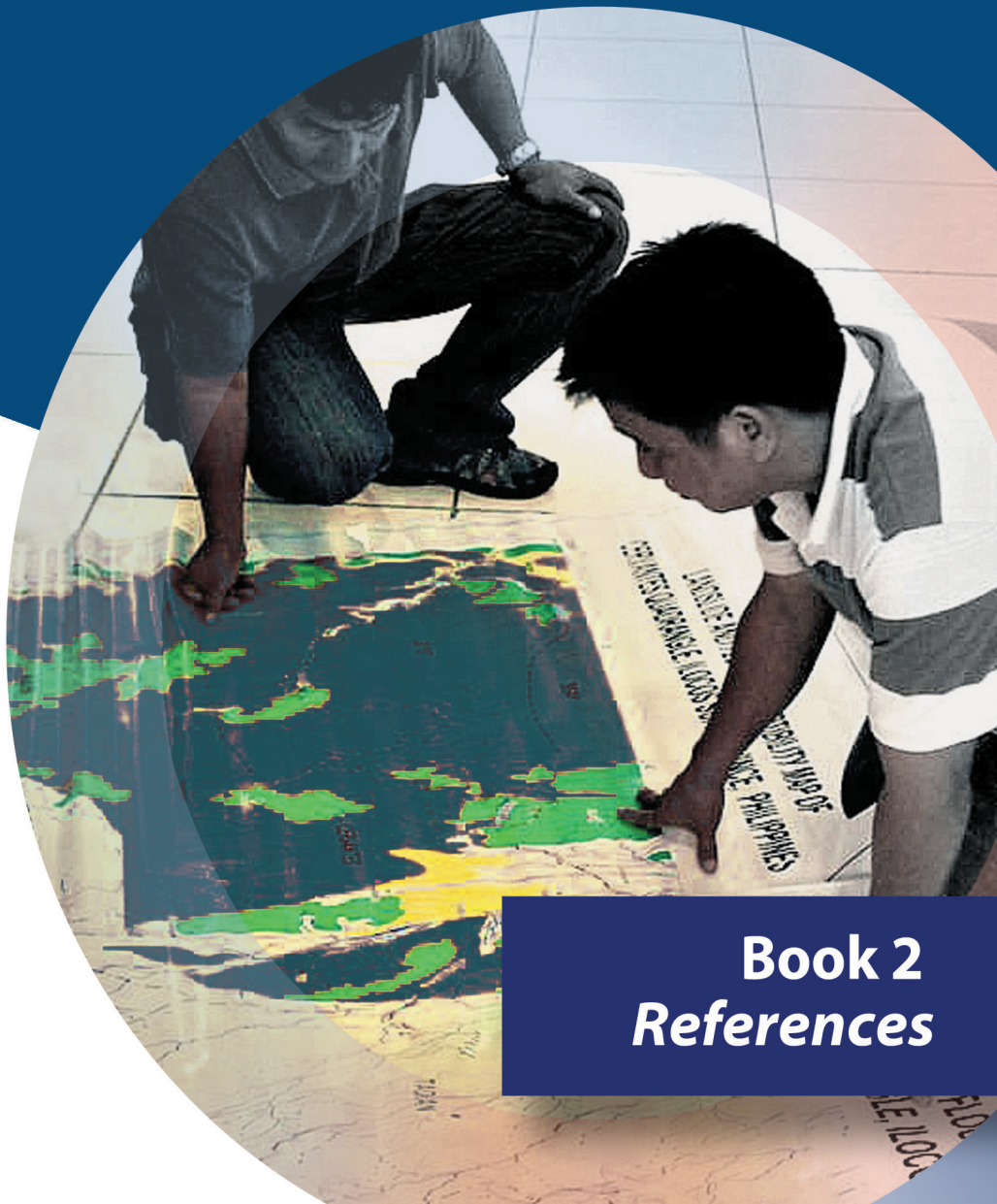
LGU GUIDEBOOK
on the Formulation of Local Climate Change Action Plan (LCCAP)



Book 2
References

LGU Guidebook on the Formulation of Local Climate Change Action Plan (LCCAP) Book 2

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A MESSAGE FROM THE SECRETARY OF THE INTERIOR AND LOCAL GOVERNMENT

No nation has been spared from the shifts in extreme weather that have brought death, damage and desolation in places affected by climate change. As we review our recent experiences in the Philippines, we are not only struck by the overwhelming impact such as events on the lives of our people, but the overriding imperative of perpetual readiness and vigilance.

RA 9729, otherwise known as Climate Change Act of 2009 and RA 10121, or the Philippine Disaster Risk Reduction Management Act both aim to instil in the public consciousness that meeting the challenges ahead demands organization, coordination and systematic responses at all levels of governance and community management.

The Department of Interior and Local Government and all allied national government agencies are working together to ensure the Philippines is ready for the future. The DILG, in particular, sees to it that relevant policies and programs are propagated, instilled and actually implemented among all local government units in the country.

It is in this context that I congratulate the Local Government Academy for coming up with the User's Manual for LGU's: Guidebook for the Formulation of Local Climate Change Action Plan. The manual is intended to be a reference material for all LGUs in the formulation of their LCCAPs, and is part of the DILG's efforts to empower and sustain communities to meet the growing threat of climate change.

We believe that robust local climate change action plans, implemented by dynamic and dedicated LGUs, are our way forward in building resilient local communities that would survive and thrive through the vagaries of climate change.

Using this material and a host of training programs on the LCCAP, the Department, through the Local Government Academy, seeks to empower the LGUs and enable them to find ways to learn how to live and sustain development despite climate change. There is no panacea for climate change as each LGU will face unique challenges as natural forces continue to shift overtime. We, however, believe that LCCAP formulation and implementation is the way forward to ensure that the country would not only be capable to survive climate change, rather it would continue to thrive into a prosperous nation that we are destined to be.

MAR ROXAS

Secretary and Chairperson,
LGA Board of Trustees

A MESSAGE FROM THE UNDERSECRETARY FOR LOCAL GOVERNMENT

In this day and age, there is a need for a particularly vulnerable country like ours to be more aware and steadfast in our efforts in learning to live with the unstoppable forces of nature overtime. And we must do so in a very scientific and practical manner.

The national government is looking to reinforce the country through various interventions across numerous agencies. However, we must translate all of these efforts on the ground effectively in order for it to have real impact on the adaptability of our countrymen as a whole. That is why it is imperative that the national efforts be channeled through the conduits closest to the people: the local government units.

The local government units are now given the task to be ready for Climate Change. They will have to formulate their Local Climate Change Action Plans and execute them. The question is how do they begin? What can they do to ensure that their LCCAP is realistic and potent overtime?

The Department, through the Local Government Academy, looks to answer that question with this USER'S MANUAL FOR LGUs: GUIDEBOOK FOR THE FORMULATION OF LOCAL CLIMATE CHANGE ACTION PLAN (LCCAP) along with the subsequent trainings on the formulation of the LCCAP nationwide.

Looking forward to a more Climate Change Adaptive Philippines means entails having LGUs that are well prepared for it. In adapting to Climate Change, we must have especially adaptive LGUs that can bridge the gap between science and action, between the national and the local, and between now and the future.

AUSTERE A. PANADERO

Undersecretary for Local Government
Department of the Interior and Local Government

A MESSAGE FROM THE LOCAL GOVERNMENT ACADEMY'S EXECUTIVE DIRECTOR

We are facing the deeply troubling reality of Climate Change. This inescapable phenomenon is one that is beyond our control but it does not prevent us from adapting to it and ultimately overcoming the effects it has on our daily lives. While Climate Change is all-encompassing and inevitable, man can still learn to live with it with the aid of scientific and practical planning and interventions.

As the training arm of the Department of the Interior and Local Government (DILG), the Local Government Academy (LGA) looks to empower Local Government Units to be ready for the continuous onset of Climate Change through its numerous programs and projects.

This USER'S MANUAL FOR LGU'S GUIDEBOOK FOR THE PREPARATION OF LOCAL CLIMATE CHANGE ACTION PLAN (LCCAP) is part of an array of said efforts by the Academy and the Department, as a whole.

It serves as a guideline that will aid LGUs take all the necessary steps and actions in the formulation of their LCCAP. It takes into account Disaster Risk and Vulnerability Reduction (DRVR) options that LGUs can utilize for a sustained path to Climate Change Adaptation. It contains various tools that will help local governments develop a realistic and effective LCCAP that is applicable to their needs. With sound scientific and technological principles, there is hope that local policies become sensitive to the Climate Change and the challenges it brings.

In the end, this material will be stagnant if not put into action. Rest assured, however, that where the limits of this knowledge material end, the actions of the Department with the full support of the Academy begin for a more Climate Change Adaptive Philippines.

MARIVEL C. SACENDONCILLO, CESO III
Executive Director
Local Government Academy

PREFACE

Climate change will continuously affect the country for years and will have great impacts on the lives and properties of the present and future generations to come. The need to adapt to climate change is imperative and renewed efforts should be done regardless of what has been accomplished on the mitigation front. Because of our exposure and relative vulnerability to natural hazards, effects of climate change serve as serious threats in achieving sustainable development, attaining the Millennium Development Goals (MDGs), and improving our Human Development Index (HDI). These threats directly impinge on the capacity of our local governments especially in coping with risks, hazards and vulnerabilities.

According to the Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), challenges for vulnerability reduction and adaptation actions are particularly high in regions that have shown severe difficulties in governance. Thus, there is a need to capacitate LGUs and enhance local efforts and interventions to minimize the climate impacts. As an initial response, the Department of Interior and Local Government (DILG) issued a Memorandum Circular in 2008, urging all local chief executives and policy-making councils to implement climate change adaptation (CCA) and disaster risk reduction (DRR) measures using the powers given by the Local Government Code (RA 7160) to LGUs to secure general welfare. A year after, the Climate Change Act of 2009 (RA No. 9729) was passed by Congress, which aims to mainstream climate change into policy formulation, development planning and poverty reduction programs. RA 9729 was further strengthened in 2010 by the formulation of Disaster Risk Reduction and Management (DRRM) Act of 2010 (RA No. 10121), which acknowledges the policy of the State on the need for building capacity of LGUs to institutionalize arrangements and measures for reducing disaster risks, including projected climate risks, and enhancing disaster preparedness. Section 11 of RA 10121 directly states that “LGUs shall ensure the integration of DRR and CCA into local development plans, programs and budgets as a strategy in sustainable development and poverty reduction.”

To further strengthen the above-mentioned endeavors, the Local Government Academy with the help of key institutions and agencies, prepared this **LGU Guidebook on the Formulation of Local Climate Change Action Plan (LCCAP)** to integrate the goals and objectives of the said undertakings in addressing vulnerability and adaptation to climate change. It is set to help communities plan better, take actions and provide a suite of tools on how to prepare and adjust to adverse effects brought by climate change by mainstreaming it in their respective local development plans and budget. The **LCCAP Book 1** of this guidebook contains the framework and the step-by-step process for the formulation of the Local Climate Change Action Plan (LCCAP). Session guides for each step are also given as well as matrix template for the different assessment process. Some tips and reminders for important portions are also given for guidance. On the last part of Book 1, a simple matrix for monitoring and evaluation of the process of the LCCAP implementation could be found and sample evaluation tools for pre and post trainings are also included. The **LCCAP Book 2** on the other hand, is a compilation of paper presentations, discussion guides, articles and best practices related to climate change mitigation and adaptation and disaster risk reduction and management. These papers are presented during previous trainings and workshops conducted for LCCAP formulation organized by the Local Government Academy and its partner institutions.

The LCCAP of LGUs will be science-and risk-based, since its formulation will consider the assessment of climate change impacts on the most vulnerable communities and areas, and the ecosystems and other resources within their territories. This natural scientific planning and operationalization will help reduce vulnerability and prevent loss of lives and livelihood, and damages to shelters and infrastructures. In so doing, this publication will seek to contribute in building climate change-adaptive and disaster-resilient communities in the country.

ACKNOWLEDGEMENT

The preparation of the LGU Guidebook on the Formulation of Local Climate Change Action Plan (LCCAP) has involved many individuals and organizations. The Department of Interior and Local Government- Local Government Academy (DILG-LGA) wishes to express their gratitude to contributors and sources that have made this endeavor possible.

We also recognize that the scope and examples contained in this guidebook are products of learning excerpts from a series of training programs conducted for regional and provincial CDP focal persons and DRRMOs and coaches from DILG Regions.

The LGA gratefully acknowledges the contributions and assistance of Climate Change Commission (CCC), Tanggol Kalikasan Inc., UN-HABITAT Philippines, Local Climate Change Adaptation for Development (LCCAD) and University of the Philippines-Los Banos that were involved in supporting climate change adaptation initiatives as incorporated in this knowledge product.

We are also thankful to the support extended by the Bureau of Local Government Development (BLGD) of the DILG and the Manila Observatory for allowing their materials and related publications to be used in developing this guidebook

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1. PROCEDURES IN LOCAL CLIMATE CHANGE ACTION PLANNING[1]

1.1 THE RATIONALIZED LOCAL PLANNING SYSTEM (RLPS) AND THE LOCAL CLIMATE CHANGE ACTION PLANNING: AN OVERVIEW

This Module presents the current state of local planning in the Philippines and the reasons for a rationalized local planning process. Planning is an integral part of governance and rationalizing local planning will enhance the LGU's capability in the performance of its dual functions - as a political subdivision and as a corporate entity (Slides 1-9).

The entry points for mainstreaming are - planning structure; planning mandates; planning process; and implementation instruments. The local planning structure is composed of both the political and technical components. The political component covers the local development council and the Sangguniang Bayan while the technical component covers the sectoral and functional committees and local special bodies (Slides 10-18).

The second entry point in the RPS is planning mandates of LGUs and the mandated plans. These include the Comprehensive Land Use Plan (CLUP) and the Comprehensive Development Plan (CDP) as stipulated in the Local Government Code. CLUP is the plan for the management of local territories, pursuant to the LGU's status as a political unit. CDP is the plan that the LGU prepares in its capacity as a corporate body. The term "comprehensive" in the CDP has to be understood in the sense of "multi-sectoral" development, i.e., social, economic, infrastructure, environmental, and institutional (Slides 19-27).

There are different approaches to mainstreaming DRR/CCA in the mandated LGU plans. The conventional approach involves integration of a finished plan into another finished plan document; or Sanggunian adoption through resolution. The alternative approach involves the integration into all the components of the local planning system. It becomes part of day to day governance systems and processes. Integrating DRRM/ CCA in the LGU Mandate CDP may include implementation instruments such as the Local Development Investment Plan

[1] Prepared by Dr. Aser B. Javier, CPAf, UPLB
for the Department of Interior and Local Government - Local Government Academy. Training Module on Formulation of Local Change Action Plan.

(LDIP) and Annual Investment Plan (AIP). In CLUP, integration may be detailed master plans area system, or thematic area. Regulatory measures, programs / projects, non-projects / services to integrate DRRM/CCA may be done in both CDP and CLUP (Slides 28-30).

On the simplified sectoral planning process, the basic steps are: 1) setting/re-visiting the LGU vision; 2) analyzing the LGU situation; 3) determining the vision-reality gap; 4) setting sectoral goals and objectives/targets; 5) identifying PPAs, legitimization; 6) investment programming; 7) budgeting; 8) implementing the plan; and 9) plan monitoring and evaluation. In analyzing the LGU situation (step 2), DRRM/CCA concerns are incorporated in the ecological profile and maps. This is done through risk identification and assessment; vulnerability analysis; capacity analysis; and identification of direct and indirect effects of disasters (determination of economic losses, social impacts, environmental impacts, etc). Ecological profile should contain population and social services; local economy; infrastructure and physical base; environment and natural resources; institutional capability; and hazard maps. PPAs, legislations, capacity development requirements (Step 5) may include programs/projects, hazard mapping, and rapid disaster risk assessment. To mainstream DRRM/CCA concepts and elements in the CDP process, sectoral project proposals must include DRRM/CCA PPAs and prioritized in the LDIP/AIP. They should also be given sufficient budgetary allocation (slides 31-41).

Lastly, on authority levers and tools for plan implementation – another entry point for mainstreaming DRRM/CCA includes taxation, e.g., special levy on property; regulations such zoning, building regulations, subdivision, and enforcement of environmental laws (slides 42-51).

1.2 HARMONIZING CLIMATE CHANGE ACT AND DISASTER RISK REDUCTION MANAGEMENT IN LOCAL GOVERNMENT CONTEXT[2]

1.2.1 RATIONALE

The onset of decentralization in the Philippines created among government agencies and other institutions a multi-actor environment that necessitates cooperation with each other for the effective delivery of local services. In doing so, cooperation has become essential for an integrated approach to the achievement of functional responsibilities.

Foremost among the cooperation principles is harmonization. Harmonization has become a buzzword for development nowadays. Not very far from harmonization are almost similar terms such as convergence, whole of government approach to name a few. This means that at the LGU level there exists the possibility of working with political nemesis and at the NGA level of cooperating with agencies with overlapping mandates. These institutional challenges are coupled with the enormities of the impact brought about by climate change and disaster in general.

Given the scale of the impact and the bigness of the required resources to address climate change and disaster, harmonization becomes unavoidable as an approach for local development.

1.2.2 UNDERSTANDING OF CCA AND DRR IN THE CONTEXT OF HARMONIZATION

The first topic in this session is the need to understand climate change adaptation and its link with disaster risk reduction.

The understanding of and planning for climate change adaptation and disaster risk reduction at the LGU level is often problematic. This is because the LGUs have many competing priorities that demand equal attention at the local level. Further to this problem, is the depth of understanding of local officials on the science of CCA and DRR, many of our LGUs focus on relief and rehabilitation

[2] Prepared by Dr. Aser B. Javier, CPAf, UPLB
for the Department of Interior and Local Government - Local Government Academy.
Training Module on Formulation of Local Change Action Plan.

References

Republic Act N0. 9729 of 2009, also referred to as the Climate Change Act. An Act Mainstreaming Climate Change into Government Policy Formulations, Establishing the Framework Strategy and Program on Climate Change, Creating for this Purpose the Climate Change Commission, and for Other Purposes. Manila Philippines.
DILG-BLGD. 2008. Ratioanalizing the Local Planning System, A Source Book, 1st edition
Republic Act No. 7160. The Local Government Code

as a post disaster action. In many cases, the planning for climate change and disaster risk is compliance to national agencies programs and policies. Further, planning for CCA and DRR by most LGUs is to expedite the release of the 5% disaster funds as mandated by law in RA 9729.

However, the situation in the Philippines on extreme events brought about by climate change is worrisome. The Philippines according to the 2009 Global Assessment Report ranks high in many of the disaster risks. The Philippines is second out of 153 countries in earthquake; second out of 189 countries in storms; fourth out of 162 countries in landslides.

What is worst is that the most hit by the effects of climate change are the poor who are exposed to danger as a result of climate change. In most cases, the poor lives in high risk areas making them vulnerable to extreme weather events. The vulnerability of the poor and marginalized is one issue in CCA that need an integrative solution including financial and livelihood assistance when affected by extreme events such as flooding, rain-induced landslide, sea level rise among others.

The link to harmonization of CCA and DRR is three-fold, common goal, climate variability and systems approach. There is need for harmonization primarily because CCA and DRR address similar goals of reducing climate vulnerability. Both CCA and DRR also have similar audience and they are those who will be hit by the impact of extreme events or those vulnerable communities.

Second, harmonization call for understanding that both CCA and DRR address climate variability. However CCA address current climate variability while, DRR address future climate variability. And last, harmonization calls for a holistic and multi-stakeholdership arrangements and structure and should be natural resource based. This means that current system of the LGU taking implementation on its own with assistance from few actors and institutions will not assist in adaptation. This absence of natural scientific basis in planning and implementation of programs at the local level aggravates rather than help reduce vulnerability. Thus in most situations, the focus has been on relief and rehabilitation.

This situation calls no longer for regular routine actions from agencies of government and civil society movements. This is a wake-up call for all actors to prioritize CCA in their plans, policies and program of work.

1.2.3 ENABLING ENVIRONMENT FOR IMPLEMENTATION

The enabling environment by which the LGUs and other actors address CCA and DRR is a contentious issue among the actors themselves. This is because each of the actors performs different mandates and responsibilities which may differ from a partner or collaborative institution but each is required to cooperate with each other.

From a legal standpoint, there is mandate for the integration of CCA and DRR by the state. Republic Act 9729 or An Act Mainstreaming Climate Change into Government Policy Formulations, Establishing the Framework Strategy and Program on Climate Change, Creating for this Purpose the Climate Change Commission, and for Other Purposes identifies that CCA and DRR are closely interrelated. The law is specific in saying that effective DRR will enhance climate change adaptive capacity and the State shall integrate DRR into CC programs and initiatives (Section 2, RA 9729).

However the working together of national government agencies to provide a common support framework for LGUs in CCA is still lacking even if there is already a law (RA 9729) that should supposed to enable its development. Further the "climate proofing" or the making of national government agencies mandate to be climate resilient makes also the LGUs to be dealing with each national government agencies. This situation is not a move towards creating an enabling environment for CCA and DRR.

1.2.4 ACCESS TO RESOURCES AND FUNDING

Successfully tackling climate change will cost trillions. How much will depend on the actions to be taken by institutions and countries. Bearing the brunt of this costs will be the international community, national governments, private firms, local governments and the households (World Development Report) themselves.

Thus part of the capacitation for understanding harmonization is accessing funds for CCA and DRR. The Philippines data of best practices in Local Financial Planning and Management however is less to be desired. Only 4.8% of all *Galing Pook* awardees are LFPM related (Galing Pook, 2009). This means that very few LGUs in the Philippines are raising funds on their own and are dependent on the national government for fiscal resources. Currently 79% of all LGUs are Internal Revenue Allotment (IRA) dependent.

Generating capacities to access international, national and private monies, understanding the grant-making process and generating its own-sourced revenues are three major needs of LGUs that will help address and access CCA and DRR related needs.

1.2.5 DRR/CCA INFORMATION COLLECTION, UTILIZATION AND DISSEMINATION SYSTEM

Integrated CCA and DRR Plans

The research process is one harmonization of functions that the LGU can prioritize. In most cases, many of the policies, plans and programs are not largely based on bridging the science of climate change but on what is the understanding of the Local Chief Executives or the designated officers, usually the DRRM Officer. This makes the situation more complicated as the communities affected and the other actors look upon the LGUs as the institution that will bring them out of vulnerability rather than a cooperation mechanisms for a multi-actor arrangement to reduce vulnerability.

This is where the information and communication process come into the picture. The information databases currently used by the LGUs are scattered into various databases such as the real property tax (RPT) databases, community based management systems (CBMS) among others. This makes decision making based on scientific information problematic. An integrate database is ideal. However it will start from the identification of data elements and indices needed by the locales. This is where the integrity of the data collection process becomes important. Second, the need for the LGU to be able to analyze the information collected is key to effective planning, budgeting and decision making. And last, dissemination of scientific information means that the LGUs need to bridge the science of climate change to the vulnerable communities. Popularization and going beyond political boundaries are key interventions needed.

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Republic Act N0. 9729. 2009. An Act Mainstreaming Climate Change into Government Policy Formulations, Establishing the Framework Strategy and Program on Climate Change, Creating for this Purpose the Climate Change Commission, and for Other Purposes. Manila Philippines

2. UNDERSTANDING KEY CONCEPTS AND CLIMATE CHANGE CONTEXT[3]

2.1 DEFINING CLIMATE CHANGE AND LCCAP

The Climate Change Act refers to "Climate Change" as a change in climate that can be identified by changes in the mean and/or variability of its properties and that persists for an extended period typically decades or longer, whether due to natural variability or as a result of human activity. The same law adopts IPCC (Intergovernmental Panel on Climate Change) definitions of climate variability and risk, in addition to other key concepts that are highly relevant to this training experience.

"The LGUs shall be the frontline agencies in the formulation, planning and implementation of climate change action plans in their respective areas..." (R.A.9729, Sec. 14) The Local Climate Change Action Plan (LCCAP) of LGUs will be science and risk-based, as its formulation will consider the assessment of climate change impacts on the most vulnerable communities and areas and the ecosystems and other resources within their territories.

The following are the basic concepts and terms associated with assessing disaster risk, vulnerability reduction and responding to climate change adaptation:

Adaptation – refers to the adjustment in natural or human system in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Adaptive Capacity – refers to the ability of ecological, social or economic systems to adjust to climate change, variability and extremes, as well as moderate or offset potential damages, and take advantage of associated opportunities (IPCC 2007). It also implies the ability to anticipate hazard or perturbation (UNDP 2010). It determines whether the system absorbs changes without damage or whether these changes will lead to negative consequences.

[3] User's Manual For LGUs: Guidebook for the Preparation of the Local Climate Change Action Plan". Department of The Interior and Local Government (DILG)-Local Government Academy (LGA) and Local Climate Change Adaptation For Development (LCCAD) Inc. pp. 15-17.

Autonomous Adaptation – refers to reactive, incremental or spontaneous adaptation, geared towards meeting present climate conditions or challenges

Anthropogenic causes – refers to causes resulting from human activities or produced by human beings

Climate – refers to average weather over long periods of time, typically at a 30-year average

Climate Change – refers to a statistically significant variation in the average condition of climate or in its variability that persists for decades, or longer, caused by both natural processes and human impacts, such as greenhouse gas emissions (World Bank 2010)

Climate Change Adaptation – refers to policies, actions, and other initiatives designed to limit the potential adverse impacts arising from climate variability and change (including extreme events), and exploit any positive consequences" (ADB 2005). Adaptation is geared towards reducing climate change adverse impacts and risks in order to reduce vulnerability

Climate Change Impact – refers to a change in natural and human systems, whether harmful or beneficial resulting from climate change (IPCC 2007). Climate change can impact on the agricultural system by introducing new stressors into the system, and/or exacerbating existing stressors. To illustrate, it has been projected that up to 30% of plant and animal species could go extinct if the global temperature increase exceeds 1.5-2.5°C, and crop yields in tropical zones could significantly decrease with even a modest temperature increase of 1-2°C (IUCN).

Climate Change Mitigation – refers to policies, actions and other initiatives that reduce the net emissions of greenhouse gases, such as CO2, CH4, N2O, and ozone that cause climate change through global warming. Examples of activities that mitigate or prevent greenhouse gases emissions are: a) use of renewable energy; b) clean fuel; c) reduction of emission through avoided deforestation and forest degradation; d) sustainable forest management; and e) conservation and enhancement of carbon stocks. Examples of activities that remove greenhouse gases from the atmosphere are reforestation and geo-engineering (ADB 2005).

Climate Extremes – refers to climate and weather events that occur rarely at a particular place and time of the year, with peaks and lows outside the range of expected distribution, such as extremely hot temperature or unseasonal rainfall.

Climate Hazards – refers to potentially damaging physical manifestations of climatic variability or change, such as droughts, floods, storms, episodes of heavy rainfall, long-term changes in the mean values of climatic variables, and potential future shifts in climatic regimes, among others (Brooks 2003).

Climate Mainstreaming – refers to integrating climate concerns and adaptation responses into relevant policies, plans, programs and projects at the national, sub-national and local scales. The long-term goal is to integrate CCA into public policy across sectors, weave it into organizational missions and routinely consider it in decisions about development. As climate change and its impacts are cross-cutting issues, adaptation measures are seldom undertaken solely in response to climate change, but superimposed into other ongoing initiatives and governance frameworks within the scope of development goals, such as CC adaptation in agriculture interwoven with initiatives of other sectors, namely: poverty alleviation, water supplies, public health, disaster risk reduction and management and biodiversity conservation (USAID 2009, IPCC 2007).

Climate Proofing – this involves: a) identifying risks to a development project, natural or human asset, as a consequence of current and future climate variability and change; b) ensuring that identified risks are reduced to acceptable levels through long-lasting and environmentally sound, economically viable, and socially acceptable changes; c) implementing changes at one or more of the following stages in the project cycle: planning, design, construction, operation, and decommissioning (ADB 2005).

Climate Resilience – refers to the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions (UNISDR 2009). Improved adaptation can help develop resiliency.

Climate Risk – refers to the product of climate and related hazards working over the vulnerability of human and natural ecosystems.

Climate Variability – refers to variations in climatic conditions (average, extreme events, among others) on time and space scales beyond individual weather events, but not persisting for extended periods (shorter term than climate change) (ADB 2005)

Disaster – occurs when adverse impacts produce widespread damage and cause severe alterations in the normal functioning of communities or societies (IPCC 2011)

Disaster Preparedness – refers to hazard assessment, documentation of risk areas and mapping, research and planning for crisis administration, education and training / drills in LGUs, road safety and technical assistance to cities, municipalities and barangay disaster coordinating councils as well as the various schools and universities and the business sectors. Developed warning criteria on floods, landslides and mudflows.

Disaster Mitigation – refers to a policy development, policy on geo-strategic interventions, short-term policy on setting of curfew, prohibition of human activities in the danger zones, disposition of relief and donations, integration of disaster risk reduction to CLUP, community training and public awareness on structural, non-structural disaster mitigation requirements.

Disaster Response Operations – refers to overall administration and coordination of disaster response activities such as execution of emergency plans, communication and information management, monitoring of disaster situation, stabilizing the crisis situation, provide ambulant services to the distress victims, command post and the likes.

Disaster Risk Index (DRI) – refers to the model developed to assess what countries are most at risk from hazards, such as droughts, floods, cyclones and earthquakes, based on observed past losses and their relation to population exposure and vulnerability. The DRI is used for the annual ranking of countries in terms of human vulnerability linked mostly with country development level and environmental quality.

Disaster Risk Index (DRI) – which aims at monitoring the evolution of risk, assessing what countries are most at risk requires considering various types of hazards, such as. Before assessing risk, these four hazards were modeled using GIS and overlaid with a model of population distribution in order to extract human exposure. Human vulnerability was measured by crossing exposure with selected socio-economic parameters. The model evaluates to what extent observed past losses are related to population exposure and vulnerability. Results reveal that human vulnerability is mostly linked with country development level and environmental quality.

Exposure – refers to the nature and degree to which a system is exposed to significant climatic variations (IPCC). It depends on frequency, magnitude, intensity and duration of climate stressor, such as El Niño, La Niña, temperature rise, sea level rise, tropical cyclone and other extreme events. For example, an intensifying cyclone may lead to the increased risks of climate-induced hazards such as floods and landslides, and their impacts.

Global warming – refers to the increase in the average temperature of the Earth's near-surface air and oceans that is associated with the increased concentration of greenhouse gases in the atmosphere.

Greenhouse Effect – refers to the process by which the absorption of infrared radiation by the atmosphere warms the Earth.

Greenhouse Gases – refers to constituents of the atmosphere that contribute to the greenhouse effect including, but not limited to, carbon dioxide, methane, nitrous oxide, hydroflourocarbons, perflourocarbons and sulfur hexaflouride.

Human Development Index (HDI) – refers to a composite statistic of life expectancy, education, and income indices to rank countries into four tiers of human development. It was created by economist MahbubulHaq, followed by economist AmartyaSen in 1990, and published by the United Nations Development Programme.

Mainstreaming – refers to the integration of policies and measures that address climate change into development and sectoral decision making.

Mitigation – within the context of climate change, refers to human intervention to address anthropogenic emissions by sources and removal by sinks of all GHG, including ozone-depleting substances and their substitutes.

Mitigation potential – refers to the scale of GHG reductions that could be made, relative to emission baselines, for a given level of carbon price

Planned adaptation – refers to anticipatory, pro-active and transformative adaptation based on awareness of long-term future changes in climate conditions.

Recovery – refers to damage assessment, rehabilitation planning and secure funding. Organizing of disaster recovery and development team through cluster approach.

Risk – refers to a measure of the likelihood of exposure to a hazard and the consequence/impact of that hazard such as the probability of being struck by flood and the magnitude of the impact of the flood measured in terms of cost of crop damage; the higher the probability of the occurrence of a hazard and the higher its impact, the higher the risk.

Sensitivity – refers to the degree to which a system is affected, either adversely or beneficially, by climate-induced hazards such as landslides, flashfloods or drought. More sensitive areas are likely to sustain more serious damage or impact.

Sea level Rise – refers to increase in sea level which may be influenced by factors like global warming through the expansion of sea water as the oceans warm and melting of ice over land, as well as other local factors such as land subsidence.

Vulnerability – refers to the extent to which a natural or human system is susceptible to sustaining damage resulting from climate variability and change, despite human actions to moderate or offset such damage, as a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (ADB 2005).

Vulnerable and marginalized groups – refers to groups or communities who face higher exposure to disaster risk and aggravated poverty including, but not limited to, children, elderly, differently-abled people and indigenous peoples.

Weather – refers to conditions of the atmosphere over a short period of time, the temperature, wind, humidity (rainfall) and cloudiness, among others experienced day to day.

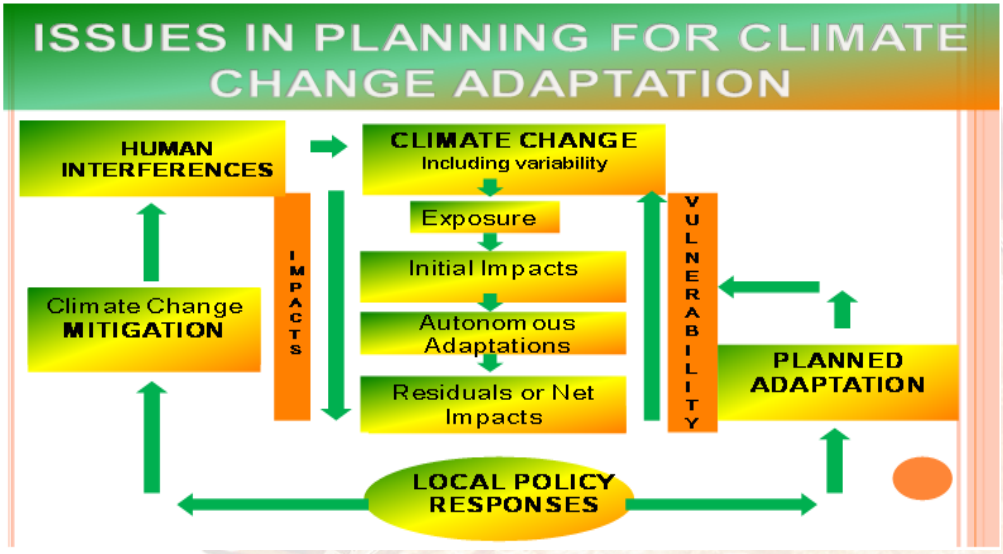

Figure 1. Issues in Planning for Climate Change Adaptation

LGUs are responsible for prioritizing local measures for adaptation and mitigation. All stakeholders in barangays, including businesses, non-governmental organizations, the academe, indigenous communities and the general public, under the leadership of the LGU, "shall be directly involved with municipal and city governments in identifying and implementing best practices and other solutions" to prevent and reduce the adverse impacts, and when possible, maximize the benefits from such opportunities.

WHY LOCAL GOVERNMENT UNITS?

Global warming and climate change are real and happening. It is a major threat to the environment, economic, social, and cultural development and to the attainment of achieving the Millennium Development Goals (MDGs) and to the improvement of the Human Development Index (HDI), which will make it very difficult for LGUs to eradicate poverty and corruption and promote transparency and environmental sustainability. The 1,700 LGUs in the Philippines are vulnerable to impacts of climate change like storm surges and accelerated sea level rise. In order to respond meaningfully to climate change issues at the provincial, city and municipality levels, LGUs must be ready to understand the disaster risk and vulnerability reduction to adaptation measures and strategies.

LGUs are more familiar with the community adaptation-based approach and their importance to community livelihoods, environment and homes. LGUs recognize the importance of **C**oastal, **H**ealth, **A**griculture, **W**ater, **F**orestry, **B**iodiversity and **E**nergy **(CHAWFBE)** and other ecosystems as they can cope and building community resiliency.

It is clear to the global and national community that LGUs stand at the frontline of defense to climate change and disaster impacts. The island groups of Luzon, Visayas and Mindanao, as well as the individual islands, may face different challenges such as possess varying views and perspectives of their situation and development directions and pace of growth. What they must all do, however, is to always prepare resources and make them available when needed.

The multiple interrelated problems associated with climate change also differ for children, the youth, persons with disabilities, the elderly, women and men, rich and poor, indigenous peoples, communities and stakeholders. The more vulnerable are usually also the poorest of the poor.

LGUs urgently need to focus on the formulation of the barangay contingency and recovery plans, conduct sectoral vulnerability assessment and undertake other anticipatory adaptation measures following the "bottom-up" approach to identify "no-regret" options for re-defining and calibrating the local development planning processes.

LGUs are better able to direct, command and mobilize people resources, wider access to local information, indigenous knowledge and communities for local actions, measures and activities. To capitalize on these strengths, LGUs must promote public and private partnership initiatives with identified community adaptation practitioners and local institutions or organizations for the purpose of achieving "horizontally and vertically aligned" or cross cutting climate change adaptation integration into local development planning processes.

Municipal and City planners can provide good basic local data and direction for climate-and disaster-proofing the annual investment plans (AIPs), comprehensive development plans (CDPs) and Comprehensive Land Use Plans (CLUPs), and ensure that such plans are integrated in provincial development investment plans (PDIPs), provincial physical framework and development plans (PPFDPs) at the meso level.

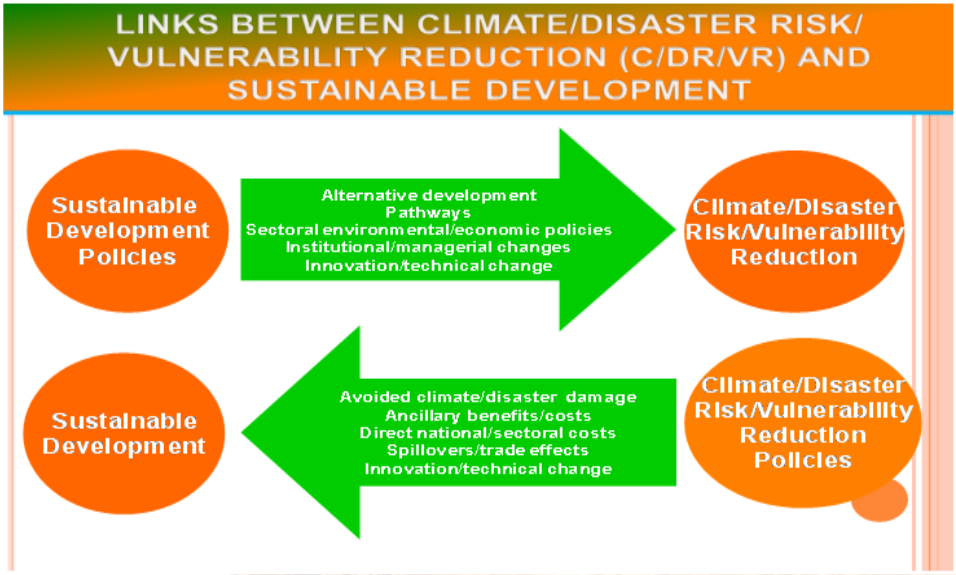

Figure 2. Links between Climate/Disaster Risk/ Vulnerability Reduction (C/DR/VR) and Sustainable Development

3. A REVIEW OF THE CLIMATE CHANGE SCIENCE; CLIMATE CHANGE AND EXTREME EVENTS[4]

3.1 WEATHER AND CLIMATE DISTINGUISHED

Weather refers to the present state of the atmosphere at a particular place and time. It can change from hour to hour, day to day, and season to season.

Climate is the long-term average condition of the atmosphere (weather) for a period of time over a locality. It ranges from months to thousands of years.

Weather may be referred to as the current weather, past and future weather, but it is instantaneous in nature (i.e., rainy in the morning and sunny in the afternoon). Climate is the pattern drawn from the daily weather conditions averaged over a period of time.

3.2 CLIMATE SYSTEM, CLIMATE CHANGE, CLIMATE VARIABILITY AND EXTREMES DEFINED

Climate System

The Climate System is a complex system of all natural processes present in the atmosphere (i.e., clouds, evaporation, condensation), space, sea, including human activities, land surface processes, run-off, etc.

Solar radiation powers the climate system. Under the greenhouse effect, the planet's surface absorbs part of the solar radiation, which makes the surface warm. Part of the solar radiation is reflected back to space, or absorbed and re-emitted in all directions by the GHG molecules and clouds. The effect is warming not just of the surface of the Earth but also that of the lower atmosphere.

[4] Prepared by Dr. Rosa Perez, The Manila Observatory, Ateneo de Manila University Campus for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

Climate Change

Climate Change is the long term (usually, for ten or more years) shift or alteration in the climate system of a specific location or region due to natural factors or human activities. It means major changes in temperature, rainfall, snow or wind patterns lasting for decades or longer. It is attributed to the dramatic increase in the greenhouse gases (GHGs) emissions into the atmosphere. GHGs trap the heat and create the greenhouse effects leading to global warming.

Extreme Events

Extreme Events include unusual, severe or unseasonal weather or climate, below or above the historical or climatological distribution—the range that has been seen in the past. Extreme weather occurs only 5% or less of the time. An increase in extreme weather events has been attributed to man-made global warming, with a 2012 study indicated an increasing threat from extreme weather.

Climate Variability

Climate Variability generally denotes deviation of climate statistics over a given period of time (such as a specific month, season or year) from the long-term climate statistics relating to the corresponding calendar period. Those deviations are usually termed anomalies.

Greenhouse Gases

Greenhouse Gases have the capacity to absorb more heat compared to other molecules. They are molecules composed of more than two component atoms, bound loosely enough together such that heat can come inside or in between spaces. Greenhouse gases include carbon dioxide, water vapor, methane, nitrous oxide, and a few other gases.

Some amount of greenhouse gases is necessary for life to exist on Earth—they trap heat in the atmosphere, keeping the planet liveable and in a state of energy balance. But this natural greenhouse effect is being altered as human activities (such as the combustion of fossil fuels) add more of these gases to the atmosphere, resulting in a shift in the Earth's temperature.

3.3 CAUSES OF CLIMATE CHANGE

Climate change can be attributed to natural factors and human-made activities.

Natural Causes:

The earth is driven by a continuous flow of energy. In like manner, climate is affected with the natural processes in the earth's orbit, sun's intensity, the circulation of the ocean and the atmosphere and volcanic activity. The first 3 (earth's orbit, sun's intensity, circulation of the ocean and the atmosphere) contribute to warming while volcanic activity contribute to cooling.

When Mt. Pinatubo erupted in 1990, the volcanic particles reached the earth's stratosphere and blocked the sun's radiation, thereby contributed to the cooling of the earth's atmosphere.

Human Causes:

The rapid global warming experienced at the present time cannot be explained by natural processes alone. Human activities contribute to global warming by the continued increasing concentration of greenhouse gases in the atmosphere due to burning of fossil fuels. Other human activities like cutting of trees and clearing forests for infrastructure development (developing land for farms, cities and roads) lead to land use change, which also causes climate change.

The link between greenhouse gases and temperature (1850 –2009)

Carbon dioxide as an example of greenhouse gas is linked to temperature increase. Over the years, from 1850-2009, temperature increased over time. Emissions of carbon dioxide, an important greenhouse gas, have been increasing since the Industrial Revolution. These emissions are causing carbon dioxide levels to build up in the atmosphere and global temperatures to rise. In particular, temperatures have gone up at an increased rate over the past 30 years. It is established that temperature increase happened at the same time as increase in carbon dioxide emissions occurred.

Concentrations and lifetime of major GHGs

Major greenhouse gases differ on how long they remain in the atmosphere (atmospheric lifetime) and their warming effects (global warming potential). Carbon dioxide can have 50-200 years atmospheric lifetime.

Methane gas has lesser lifetime compared to carbon dioxide with 12 years atmospheric lifetime. However, it is 23 times as much potent as carbon dioxide.

The same observation applies to nitrous oxide which is 296 times stronger than carbon dioxide. Other gases such as chlorofluorocarbon (CFC) gases have longer atmospheric lifetime.

3.4 HOW IS THE CLIMATE IN THE PHILIPPINES CHANGING?

Trends in Historical Climate

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) reports the climate trends using available observed data from 1951 to 2009 with the average for the period of 1971 – 2000 as the reference value (PAGAGSA-MDGF, 2011). The key findings are summarized as follows:

- The annual mean temperature has already increased by 0.57 °C;
- The increases in daytime and night time temperatures are 0.35 °C and 0.94 °C, respectively;
- Baseline average for tropical cyclone occurrence/passage within the Philippine Area of Responsibility (PAR) is 20 per year, with strong year to year variation. Trend analyses have not shown any indication of increase in the frequency, but with a very slight increase in the number of more intense tropical cyclones (with maximum sustained winds of greater than 150kph); and
- Trending extreme daily temperatures indicate significant increase in the number of hot days and decrease of cool nights. Similar analyses for extreme daily rainfall, the trends (extreme rainfall intensity and frequency) are not clear, both in the amounts and direction (whether increasing or decreasing), with very little spatial coherence. In this last item, the Manila Observatory (2012) tried to do a decadal trending. The extreme rainfall exhibited high year to year variability which is consistent to PAGASA's

findings. However. The dry months for the most recent decades indicate drier conditions than the past decades, while the wet seasons are wetter than the previous decades.

Future climate

For future climates in 2020 and 2050, outputs of the simulations under the mid-range scenario are presented in detail for the sole reason that future climates in the next 30 to 40 years will be greatly influenced by the greenhouse gas emissions already present in the atmosphere. The key findings are:

- Seasonal projections show that all areas of the Philippines will get warmer, with larger increases during summer months (April – May – June);
- Annual mean temperatures in all areas in the country are expected to rise by 0.9 °C to 1.1 °C in 2020 and by 1.8 °C to 2.2 °C in 2050;
- All seasonal mean temperatures will increases in 2020 and 2050. The quarterly increases during the four seasons (e.g., DJF, MAM, JJA and SON) are consistent in all the provinces;
- Seasonal rainfall changes have a large variation across space both in 2020 and 2050. Reduction in rainfall in most provinces in the country are expected during the summer season (MAM) making the usually dry season drier , while rainfall increases are likely in most areas of Luzon and Visayas during the southwest monsoon (JJA) and the SON seasons, making these seasons still wetter
- The northeast monsoon (DJF) season rainfall is projected to increase, particularly for areas in the Eastern sea board, characterized by Type II climate ("no dry season with a very pronounced maximum rainfall during the months of November and Dececember);
- During the southwest monsoon season (JJA), larger increases in rainfall is expected in provinces in Luzon (0.9% to 63%) and Visayas (2% to 22%) but generally decreasing trends in most of the provinces in Mindanao in 2050;
- However, projections for extreme events in 2020 and 2050 show that hot temperatures (indicated by the number of days with maximum temperature exceeding 35 °C) will continue to become more frequent, number of dry days (days with less than 2.5mm of rain) will increase in all parts of the country and heavy daily rainfall (exceeding 300mm) events will also continue to increase in number in Luzon and Visayas.

3.5 HOW IS CLIMATE CHANGE AFFECTING DISASTER RISK?

A changing climate is expected to lead to changes in extreme weather and climate events (IPCC-SREX 2012, thereby increasing disaster risks. Risks from weather and climate events depend on the intensity of the extreme (hazard) event, exposure and vulnerability of a system. Socioeconomic development also interacts with natural climate variations and human-caused climate change to influence disaster risk. Disaster Risk is defined by IPCC as the "likelihood of severe alterations in the normal functioning of a community or society due to weather or climate events interacting with vulnerable social conditions". Increasing vulnerability, exposure, or severity and frequency of climate events all contribute to increasing disaster risks.

3.6 CLIMATE CHANGE ACTIONS

Two categories of actions are identified to counteract climate change and its impacts. These are mitigation and adaptation. Mitigation is defined as a policy or action, measures or strategies to reduce or avoid GHG emissions or to increase GHG absorption. On th other hand, adaptation is the adjustments in natural or human systems to a new or changing environment.

Both climate change adaptation and disaster risk reductions are proactive ways of preventing or reducing the adverse effects of future climate change and the current disaster risks. There are many opportunities that currently exist to combine these two in a meaningful way and include as an important component into the development planning

An ADB (2009) study indicates that, initially, the investment cost could be large in order to mainstream adaptation into development, but the benefits will eventually be higher, in terms of disaster prevented and risk reduced.

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4. INTERNATIONAL, NATIONAL AND LOCAL POLICIES AND MANDATES

4.1 PHILIPPINE GLOBAL COMMITMENTS

This document was drafted to guide technical and planning staff of local government units (LGUs) in the formulation of the Local Climate Change Action Plan (LCCAP). As such, it will be useful in promoting the wide operationalization of the Philippines' commitments to the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity, and other global agreements and declarations that support sustainable and inclusive growth like the Millennium Development Declaration, Agenda 21, the Hyogo Framework for Action, and the ASEAN Agreement on Disaster Management and Emergency Response (AADMER).

The UNFCCC, and its legally binding instrument, the Kyoto Protocol, seeks the stabilization of greenhouse gas concentrations in the atmosphere at a level that could prevent dangerous anthropogenic interference with the climate system. With scientific evidence of heightened climate change and global warming, negotiations for mitigation commitments continue. It has increasingly become critical that such a goal should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The Hyogo Framework for Action provides strategies and goals for building national and local resilience to climate change-related disasters. There is a growing realization among the general public as well as Philippine government leaders of how vulnerable the country and its local communities, particularly the poor, women, children, youth, local communities, indigenous peoples, persons with disabilities and the elderly, are to potential dangerous consequences of climate change. Recent experiences of hotter warm days and colder cold days, more frequent and/ or severe droughts, fires, floods, and storms, climate-related illnesses and diseases, damage to ecosystems and biodiversity loss are now related to climate change. The rise of sea levels caused by the accelerated

melting of glaciers and polar caps, and the changes in landscapes are expected to have adverse effects on the archipelago's environment, culture and economy. In this regard, the Philippines joins other ASEAN nations in their commitment under the AADMER, banking on its support for the national agenda and its complementation of capacities of Member States in the different aspects of disaster management for attaining the resilience of nations and communities to disasters within the region by 2015.

The United Nations Millennium Development Declaration set goals to combat extreme poverty and hunger, disease, illiteracy, environmental degradation, and discrimination against women through a global partnership for development by 2015. AGENDA 21, the voluntary plan of action for sustainable development that was adopted at the Earth Summit in 1989 and re-affirmed at the UN Conference on Sustainable Development in 2012, prescribes an action plan for attaining environmental integrity, economic development, and growth with equity at national, regional and local levels.

4.2 NATIONAL AND LOCAL GOVERNMENT MANDATES

Strong resolve to cooperate in the attainment of a global solution as well as local adaptation and mitigation targets is necessary to drive the implementation of a holistic strategy based on climate, disaster risk and vulnerability reduction and management.

Republic Act No. 9729 (Climate Change Act of 2009), as amended by R.A. No. 10174 (People's Survival Fund Act of 2012), and R.A. No. 10121 (Philippine Disaster Risk Reduction and Management Act of 2010), require climate and disaster-proofing of all government policies, plans and programs for the prevention of acute and chronic disasters.

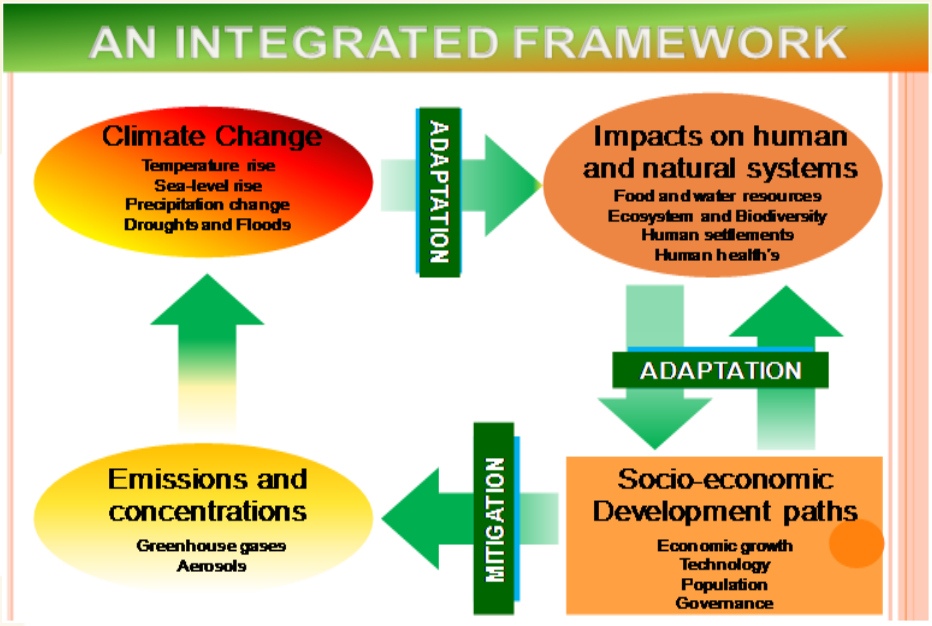

Figure 3. Integrated Framework on Climate Change Adaptation and Mitigation

Recognizing the huge task of stakeholders of vulnerable island economies to develop and practice science-based interventions for survival and development, the provisions of R.A. 7160 or the "Local Government Code", particularly Sections 16 and 24, which pertain to responsibility of the national government and local governments for disaster planning, must be strengthened. Hence, the Department of the Interior and Local Government (DILG), which is tasked to "formulate plans, policies and programs which will meet local emergencies arising from natural disasters…", has embarked on this training program for LGUs through the Local Government Academy (LGA).

With respect to disaster risk management, Joint Memorandum Circular No. 2013-1, which provides for the allocation and utilization of the Local Disaster Risk Reduction and Management Fund (LDRRMF), was recently signed by the DILG Secretary Manuel A. Roxas III, DBM Secretary Florencio B. Abad and DND Secretary/ NDRRMC Chairperson Voltaire T. Gazmin.

"User's Manual For LGUs: Guidebook for the Preparation of the Local Climate Change Action Plan". Department of The Interior and Local Government (DILG)-Local Government Academy (LGA) and Local Climate Change Adaptation For Development (LCCAD) Inc. pp. 11-13.

5. SUMMARY OF PHILIPPINE PLANS RELATED TO CCA and DRRM

Although the newly enacted laws mentioned above bolster the leadership of LGUs in building resilient communities, national and local government institutions are also required to mainstream CCA and DRR in their own frameworks and plans:

- **NFSCC** – refers to the National Framework Strategy on Climate Change formulated and adopted by the Climate Change Commission (CSC), with the President as Chairperson, within six months from the effectivity of the law. It will serve as the guide for a science and risk- based program for climate change planning, research and development, extension, and monitoring. Focused on climate change vulnerabilities, specific adaptation needs and mitigation potential, national priorities, and policy formulation, it highlights vulnerabilities of the Philippine archipelago to climate-related hazards, and in particular, the exposure of its population of over ninety (90) million to extreme weather events and long-term changes like intensifying tropical cyclones, drastic changes in rainfall patterns, accelerated sea level rise, and increasing temperatures. The NFSCC is the country's roadmap on climate change adaptation and mitigation;

- **NCCAP** – refers to the National Climate Change Action Plan formulated by the Commission, in consultation with various national agencies, to set goals and timetables for the program to assess the national impact, to identify the most vulnerable communities, areas, ecosystems and sectors, to assess and manage risk, vulnerability and opportunities for GHG mitigation, and to identify options and prioritize adaptation measures by national and local governments.;

  The NCCAP for 2011-2028 adopts the country's long-term climate change adaptation and mitigation agenda with its seven strategic priorities namely, food security, water sufficiency, ecosystem and environmental stability, human security, climate-smart industries and services, sustainable energy and knowledge and capacity development;

- Executive Order no. 888 of 2010, the Strategic National Action Plan on Disaster Risk Reduction 2009-2012, adopted as the country's road map, indicates the vision and strategic objectives for the next 10 years;

- NDRRMP for 2011-2028, refers to the National Disaster Risk Reduction and Management Plan which identifies the expected outcomes, outputs, key activities, indicators, lead agencies, implementing partners and timelines under each of the four distinct yet mutually reinforcing thematic areas of *Disaster Prevention and Mitigation; 2. Disaster Preparedness; 3. Disaster Response; and 4. Disaster rehabilitation and Recovery.*

- **PDP** – refers to the Philippine Development Plan for 2011-2015. In its goal to achieve inclusive growth, it recognizes the need to address climate change and disaster risk reduction and management concerns through promotion of strategies that will enhance resilience of natural systems, and improve the ability of communities to cope with environmental and climate related hazards. The PDP also notes the need to instill risk awareness in all sectors and to promote public recognition of local government units, private institutions, civil society organizations, academe, individual practitioners for exemplary climate change adaptation and mitigation and disaster risk reduction efforts worthy of wide replication and up scaling across the country; and

- **LCCAP** – refers to the city or municipal action plan to address local impacts of climate change that shall be drafted, adopted and implemented by the local government under the leadership of the local chief executive, and with technical and financial assistance from the national government.

Source:

"User's Manual For LGUs: Guidebook for the Preparation of the Local Climate Government Academy (LGA) and Local Climate Change Adaptation For Development (Lccad) Inc. pp. 13-14.

"Alternative Pathways To Climate Change Adaptation and Disaster Risk Reduction: Mainstreaming and Integration in Development Planning and Budgeting of Local Government Units".
Link: http://creativecommons.orglicenses/by-nc-sa/3.0/.

Box 1 Summary of Philippine Plans Related to CCA and DRR

International Frameworks on Development , CCA and DRR	National Frameworks on Development, CCA and DRR	Accompanying National Plans	Local Plans	Processes Employed	Outputs
Agenda 21	Philippine Agenda 21	Philippine Development Plan Philippine Investment Plan	Provincial Development and Physical Development Plan (PDPFP) Comprehensive Land Use Plan (CLUP) Comprehensive Development Plan (CDP) Local Development Investment Plan (LDIP) Annual Investment Plan (AIP) Local CC Action Plan (LCCAP) DRRM Plan	Harmonization, Integration, Mainstreaming, and Institutionalization through joint memorandum Circular no. series of 2007, RA 9729 and RA 10121	Sustainable Development, Compliant and CCA and DRR-Enhanced Annual Development and Expenditure Program (AIP, LCCAP, DRRMP, HRD Plan, Executive and Legislative Agenda, Productivity Plan, Annual Procurement Plan
Millennium Development Goals	Philippine Millennium Development Targets and Indicators				
UN Framework Convention on Climate Change Kyoto Protocol, Bali Pan of Action,etc.	RA 9729 Climate Change Law of 2009 People's Survival Fund National Framework Strategy on CC	National Climate Change Action Plan			
HYOGO Framework for Action	RA 10121 Philippine Disaster Risk Reduction and Management Law of 2010	National Disaster Risk Reduction and Management Plan			

6. ASSESSMENT OF CLIMATE AND GEOLOGIC HAZARDS[5]

In Part A, climate related hazards will be differentiated from geologic hazards and discussed why there is a need for assessment of climate-related hazards. In Part B the major concerns in the assessments of impacts of climate related hazards will be discussed as follows:

a) Why do we have to conduct an assessment, what is the purpose; is it for academic purposes? research? policy making? planning? or for immediate action?;

b) Scope of assessment – the scope of assessment should base on the purpose of assessment

c) Level of assessment – the hierarchical level of assessment should be defined base from the scope of assessment, whether it is global, regional, national, provincial, district, municipal, or barangay. This will determine the resource needed and data needed to be gathered for the assessment. This will also determine which approach to use, what methods and tools are needed.

Part C covers discussion of sample framework for assessing impacts of climate related hazard in the agriculture and forestry sector and how it was applied in case studies in Bicol, Benguet, Ifugao and Agusan del Norte.

The last part covers discussion of tools and methods that can be used in assessing impacts depending on the scale of analysis, e.g. GIS mapping at the national and provincial level while spot mapping for the barangay level; secondary data gathering for the socio-economic impact for the national level while Forms Group Discussions and Key Information Interview for the barangay level.

This will be wrapped-up with an exercise wherein participants will be doing their own hazard assessment.

[5] Prepared by: Dr. Jesusita O. Colladilla, School of Environment Science and Management (SESAM), UPLB for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

6.1 CLIMATE HAZARDS ASSESSMENT

Overview

This is a 45 minutes lecture divided into four parts:

a) definition of terms

b) major concerns in impact assessments

c) scale of assessment and framework for analysis, and

d) approaches, tools and methods for assessment.

Discussion of the topic

This topic covers 46 slides which are divided into five parts as follows:

These slides cover discussion on terminologies such as hazards, geologic hazards, climate related and climate-induced hazards. (Slides 2 to 4)

By virtue of its geographic location, the Philippines is prone to numerous hazards. These hazards can be categorized as either climate related or geologic. Climate related when the occurrence of hazard was induced by climate events e.g. flooding as induced by typhoon which is a climate event. Geologic hazards are those hazards occurring due to geologic activities like volcanic eruption. It may be geologic but it should not be taken lightly with the impending climate change because its impacts maybe aggravated by climate change events like in the case of Albay where municipalities were totally devastated because of occurrence of typhoon after the volcanic eruption. Settled lahar were eroded after the typhoon hence, affected areas widened.

Assessment of impacts of climate related hazard is therefore needed. This refers to the identification of climate-change-related hazards that may damage the locality and the analysis of the nature and behavior of the climate change event.

LGUs are mandated to prepare a local climate change action plan (LCCAP) and in any planning there must be some basis. First they must prove that there are concerns that need to be address and the action plan will able to address that concern. For the LCCAP, the issue is the climate change? So what if there is climate change? It is not a concern if we are not affected. But how are we going to know whether we are affected or not unless we look at it or do some preliminary studies. (Slides 5 to 24)

IPCC (2007) reported that Philippines, by virtue of its geographic location, is one of the most vulnerable nation to climate change related hazards. It is of this reason that developed countries, those considered as culprit in these entire *hullabaloo*, are pouring funds to affected countries to develop adaptation measures. This is to compensate the affected countries for the damage resulting from their wasteful way of life that promotes accumulation of greenhouse gases.

Funds are limited and should be allocated wisely to get optimum results from the adaptation funds that would be allocated. Where and whom to allocate is a national concern, hence, the need for hazard, impact and vulnerability assessment.

Before we can proceed with the climate hazard, impacts and vulnerability assessments, there are some concerns and issues that need to be addressed. First, why are we doing this assessment? what is our purpose? are we interested on the identification of climate related hazard and its anatomy? are we interested on its impacts? or are we interested on the affected sector or group? and the extent of damage? What is our purpose? is it for policy making? is it for research? for identification of people or sector who might be affected and needs help? Is it simply for compliance? or do we really care?

Whatever, this is a concern that needs to be defined before we engage in any climate hazard assessment.

Another concern is the **scope and scale of analysis.** The scope for analysis depends on the desired output. A more detail output requires data gathering at the lower level of institutional scale, and tools and methods that will capture more detailed information. This is quite costly but useful in the long run. The limitation is the availability of funds for the assessment.

Identification of parameters to gather is also a major consideration in assessment. This should be defined during the scoping. We may wish to include everything for future use but if we have limited funds for data gathering, data gathering for some parameters need to be set aside for the meantime.

Identification of experts who will help in the assessment is also critical in the identification of parameters to be included in the assessment. A multi-disciplinary team is recommended to have more holistic assessment results.

Scope and scale of analysis as well as the parameters to be gathered are the basis for selecting the tools and methods.

Slides 25 to 43 covers the framework, tools and methods used the UPLB Working Group for the Interdisciplinary Program on Climate Change lead by the now UPLB Chancellor Rex Victor O. Cruz for the NEDA-MDGF project entitled Assessment Of Climate Change Vulnerability, Impact And Adaptation Option For The Agriculture And Forestry Sector.

At the national scale, assessment of impacts of climate-related hazards should be done in collaboration with national line agencies like PAG-ASA-DOST, PHIVOLC-DOST, DA, NAMRIA-DENR, NEDA, DILG, EMB-DENR and others. Framework for analysis includes GIS as the major tool. Data needed includes historical and simulated weather data, bio-physical characteristics of each province, as well as its socioeconomic profile.

Different methods and tools for data gathering were used. At the national level, secondary data were used but for the municipal level, both secondary and primary data gathering were used.

For the socio-economic data, municipal and provincial profile were browsed as basis for the conduct of focus group discussion (FGD), key informant interview (KII) and formal field survey (FFS). Some of the tools used to elicit information include spot mapping, mind mapping, and timeline analysis.

For the bio-physical assessment of impacts, primary and secondary data were gathered and stored and analyzed using GIS tool.

Summary of all the topics discussed will be presented here. To summarize, the country is exposed to a lot of hazards because of its geographic location, but not all of this hazards are climate-related or climate induced but its impacts maybe aggravated by the impending climate change, hence the need for assessment. (Slide 44)

Climate Change Act of 2010 mandated everyone to prepare a climate change action plan – from the national level down to the Municipal level. Every plan needs some basis, hence the need for an impact assessment of climate related, climate induced and climate aggravated hazards.

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In spite of having an implementing rules and regulations for the Climate Change Act of 2010, LGUs are still at a lost in complying with this law. A number of concerns were identified such as time, space and institutional scale of assessment and the tools and methods to use. Another thing is the availability of baseline data. Data are supposed to be generated at the local level but LGUs are overwhelmed by the bulk of data needed, the manpower requirement, the tools and methods to use and the training needed to do the job. Hence, this training hopes to capacitate the participants in this area.

6.2 GEOLOGIC HAZARD ASSESSMENT[6]

1. Introduction

Climate change, involving both natural climate variability and anthropogenic global warming, has been a major worldwide concern, particularly with the publication of the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change. Considering the archipelagic nature of the Philippines and its being a very minor emitter of green house gases, adaptation to climate change has been the Government's national policy. The importance of expediting these climate change-related adaptation measures was highlighted by a string of geo-meteorologic-related disasters, specifically triggered by landslides and floods consequent to unusual weather conditions. Recognition of the pertinent issues and the extant challenges point to the urgent need for mainstreaming both geo-meteorological-related disaster risk management and climate change adaptation measures in the light of changing climate conditions.

2. The Philippine Setting

The complex tectonic makeup of the Philippines, as reflected in the variety of geomorphic expressions, is an underpinning control to the severity of how much the effects of weather disturbances can be amplified. The Philippines is a composite product of various tectonic processes that involve arc magmatism, ophiolite accretion, ocean formations and closures and arc-continent collisions. These processes are consequent to the position of the archipelago at one of the most complex collision boundaries between Sundaland and the Philippine Sea Plate. As a result, a wide range of geomorphic features that reflect these diverse tectonic systems characterize different areas of the country.

[6] Prepared by: Dr. Decibel V. Faustino-Eslava, SESAM, UPLB for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

Two subduction systems flank the N-S elongate Philippine Mobile Belt. At the west, the Manila-Negros-Sulu-Cotabato Trench system is the site of the eastward subduction of the South China, Sulu and Celebes Sea crusts. At the east, the East Luzon Trough-Philippine Trench system marks the entry of the Philippine Sea Plate beneath the archipelago. The net compressive effect of the two subductions and the PMB collision resulted in the development of the left-lateral Philippine Fault Zone. Along the length of the archipelago, volcanic belts of varying ages formed as a result of these subduction processes.

3. Geohazards

Geohazards are dangers or risks present in an area that may be triggered by various natural or anthropogenic activities such as earthquakes, ground shaking, volcanic eruptions or heavy rainfall. The likelihood for these hazards to manifest is also controlled by the underlying geology of an area. The Philippine archipelago is a tectonically active region frequently affected by numerous crustal movements at varying depths and magnitudes.

a. Earthquakes

When the crust moves along fault structures, energy is released and earthquakes or ground shaking occur. The risk of damage from such ground movements become greater when the energy released from the source is amplified by several factors. The amount of ground shaking at a particular site is influenced by: a) the earthquake's magnitude and duration, b) the site's distance from the source and c) various site effects including the nature of materials upon which the structures rest, structural designs and integrity and local topography. Hazards from earthquakes include ground rupture, ground shaking, subsidence, liquefaction, landslides and tsunami, among others.

The recommended engineering solutions include, among others:

- Adherence to the Structural Code of the Philippine guidelines, giving special attention to the stability of structures that can withstand the highest probable peak ground acceleration
- Engineering remediation to offset potential settlement and liquefaction
- Slope stabilization measures for the nearby hills which have been cut for road and other infrastructure developments

b. Volcanic Hazards

Volcanic hazards in the Philippines need to be considered by many regions in that there are 23 active volcanos across the country. The presence of these volcanic centers is a direct consequence of the archipelago's tectonic setting. Hazards associated with volcanic eruptions include pyroclastic and lava flows, volcanic earthquakes, toxic fumes, tsunamis, landslides, etc. The best line of defense against these hazards is knowledge of the volcanic activity, of safe distances from the volcanic centers, of evacuation protocols. There is no available technology that will allow us to stop a volcano from erupting, but we can at least get out of harms way if we adhere to safety protocols.

c Landslide susceptibility

The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. The occurence of landslides is a result of the interaction of both natural and anthropogenic factors. The inherent geologic character of an area may contribute to its susceptibility to mass wasting (i.e. landslide, debris flow, rock fall). Most common triggering mechanisms for mass movement of materials are ground shaking (earthquake or due to a volcanic eruption) and excessive rainfall. Sometimes preexisting landslide susceptibilities are exacerbated by human activities which include deforestation (e.g., brought about by "kaingin"), steepening of the slope following the road construction, and building of heavy infrastructures (e.g. houses, buildings, etc.) on slopes. There are several soft and hard mitigation measures for addressing landslide susceptibility. Knowing the best solution will require an indepth understanding of what the controling factors are in specific areas.

7. INFRASTRUCTURE[7]

OVERVIEW

Infrastructure is defined as the basic facilities, services, and installations needed for the functioning of a community or society, such as buildings, transportation system, water and power lines.

The Philippines' National Framework Strategy on Climate Change calls for climate-proofing of the country's infrastructures as a way to adapt to climate change. The need for climate-proofing is made much more important by the fact that the country does not even have adequate infrastructures in quantity and quality to meet global economic challenges.

The aim of this paper is to provide overview of the impacts of climate change on infrastructures and propose adaptation and mitigation measures. The ultimate intention is to assist local planners in assessing the impacts of climate change in their locality and promulgate action plans towards climate-proofing its infrastructures.

The discussion will be limited to the following infrastructures: buildings, transportation, ports and harbors, water supply, stormwater and drainage, wastewater systems, solid waste systems, power transmissions and distribution.

7.1 CLIMATIC VARIABLES AFFECTING INFRASTRUCTURES

The expected effects of climate change such as warmer temperature, increased rainfall variability, sea level rise and more intense typhoons.

According to the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) the country's average annual mean temperature is expected to increase up to 1.2°C by 2020 and up to 3°C by 2050.

Meanwhile, rainfall is expected to become more variable with changes ranging from -0.5 – 17.4% in 2020 and -2.4 – 16.4% in 2050. Luzon and Visayas are projected to have increased rainfall while Mindanao is projected to dry up.

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Associated with increase in temperature will be sea level rise, which have the potential to inundate coastal settlements and low-lying areas, and more intense typhoons, which pack more devastating winds.

7.2 BUILDINGS

Buildings refer to residential dwellings, commercial, industrial and institutional buildings.

7.2.1 Impacts

The following are the likely impacts of climate change on buildings:

- Increased residential, commercial and industrial property damage
- Increased maintenance, repair and replacement of residential, commercial and industrial buildings
- Reduction in capacity of businesses to operate due to property damage
- Reduction in use of buildings and facilities due to inundation, flooding, ground movement and structural integrity

Buildings in coastal and low-lying areas are particularly vulnerable to the effects of climate change. Thus, evaluation of the potential local impacts has to consider local conditions.

Assessment of specific impacts of climate change such as increased intensity of typhoons on integrity of building structures would require specialized types of analysis like the use of mathematical models. In such analysis, wind intensities can be inputted into the model to determine the reaction of the structure and thus its resiliency. Such analysis is carried out by structural engineers.

7.2.2 Adaptation Measures

The following are some of the proposed adaptation measures in order to minimize climate change impacts and strengthen buildings and make them more climate-proof:

- Locate new settlements away from vulnerable areas this will require proper land use planning to avoid siting buildings on river flood plains and low lying coastal areas maps of vulnerable areas are a good guide in identifying appropriate settlement sites

- Improve building design such as the use of climate change resilient materials (e.g. water resistant materials), stronger roof fixing connections, installation of essential vulnerable equipment on higher elevations and designing aerodynamically efficient structures (e.g. employing curved corners)
- Protect coastal buildings from storm surges through construction of hard structures like seawall and promotion of beach nourishment to maintain existing land occupation
- Adopt formal asset management approach that can effectively consider climate inputs to maintain buildings (least cost adaptation strategy e.g. retrofitting)

7.2.3 Mitigation Measures

The following are some of the mitigation measures to minimize production of greenhouse gases in buildings:

- Promotion of green buildings such as buildings with energy efficient designs (natural lighting and ventilation), use of photovoltaic glazing
- Adopt alternative and more efficient construction methods e.g. pre-fabrication and off-site construction
- Increase density of homes and mixing uses to minimize transportation requirement

7.3 TRANSPORTATION

Transportation infrastructure refers to roads, highways and bridges.

7.3.1 Impacts

The following are the likely impacts of climate change on transportation infrastructure:

- Increased roads, highways and bridges damage and deterioration
- Increased maintenance, repair and replacement of roads, highways and bridges
- Reduction in use of transport infrastructures due to inundation, flooding, ground movement and structural integrity

Studies would need to be conducted to be able to relate rates of deterioration of transport facilities to changes in climatic conditions based on specific site conditions.

7.3.2 Adaptation Measures

The following are the climate change adaptation measures for the transportation infrastructure:

- Locating major transport infrastructure away from vulnerable areas, e.g. coastal areas
- Improve transport infrastructure design such as higher road embankment elevation, use of elevated roads, walkways, pathways and thicker pavement
- Ensure new settlements are accessible by all weather roads
- Improve traffic management such as park-and-ride system and car sharing, creation of no-vehicles areas and/or time-zones
- Adopt formal asset management approach to maintain transport infrastructure assets at lower cost possible

7.3.3 Mitigation Measures

The following are the suggested mitigation measures to minimize greenhouse gas production of the transport sector:

- Planning for efficient transport system to minimize trip generation
- Promotion of electric vehicles
- Anti-smoke belching campaign
- Encourage fuel switching e.g. conversion to compressed natural gas (CNG) and biofuels
- Encourage non-motorized transport i.e. cycling and walking
- Improve public transport infrastructure by developing railway system, electric vehicles, CNG bus

7.4 PORTS AND HARBORS

Operation of ports and harbors is crucial to the Philippines being an island-nation. As such it is important that its associated structures are able to withstand the impacts of climate change.

7.4.1 Impacts

The following are the expected impacts of climate change to ports and harbors:

- Increased frequency and length of port closures which leads to reduction in port through-put and decreased productivity
- Increased property damage
- Increased maintenance, repair and replacement of port infrastructure due to extreme events (flooding, extreme wind)
- Increase preventive expenditure on measures to mitigate sea level rise
- Increased corrosion of metallic components

Locally, there is a need for studies to correlate climatic variables and specific site conditions to extent of damage to ports and harbors structures such as levels of corrosion on metallic components.

7.4.2 Adaptation Measures

The following are the suggested adaptation measures to minimize impacts of climate change on ports and harbors:

- Locating major port infrastructure away from areas considered most vulnerable to climate stress
- Improve port infrastructure design, e.g. use of climate change resilient material (e.g. corrosion resistant materials)
- Adopt formal asset management approach that can effectively consider climate inputs to maintain port infrastructures

7.4.3 Mitigation Measures

The following are the suggested mitigation measures to combat climate change through reduction of greenhouse gases emission from ports and harbors:

- Optimization of port operation
- Encourage use of green materials in port construction

7.5 WATER SUPPLY

Water supply infrastructure includes sources of water, reservoirs, treatment facilities, transmission and distribution lines. As water is crucial to man's existence, climate-proofing this infrastructure is of utmost importance.

7.5.1 Impacts

The following are the likely impacts of climate change on the water supply system:

- Reduction in available water for consumptive use-potable, commercial and industrial
- Declining water quality leading to higher treatment costs
- Accelerated degradation and increased failure of water distribution infrastructure (i.e. pipe breakage due to increased ground movement)
- Increase in water cost per unit of production

The above listed impacts are general impacts of climate change on water supply system. Thus there is a need to localize the analysis in order to determine site-specific effects of climate change. Water balance analysis can be conducted on local water sources (aquifer, rivers, lakes) using hydrologic models to determine changes to their storage in relation to climatic variable changes such as change in rainfall patterns and intensities, increasing temperature, etc.

7.5.2 Adaptation Measures

The following are the suggested adaptation measures in order to protect the water supply system:

- Develop watershed management programs to protect catchment areas
- Improve aquifer recharge by promoting design that allows infiltration/ percolation
- Encourage water use efficiency and conservation (technology, behavioral and pricing solutions and incentives)
- Develop and implement rainwater harvesting systems
- Promote water reuse and/or recycling
- Locating critical water supply infrastructure away from vulnerable areas
- Adopt formal asset management approach that can effectively consider climate inputs to maintain water supply infrastructures

7.5.3 Mitigation Measures

One way to mitigate the impact of climate change in the field of water supply is through the use of water supply systems with minimal contribution to climate change, e.g. gravity over pumped systems, which does not require power.

7.6 STORMWATER AND DRAINAGE

Stormwater and drainage infrastructures are very important in conveying flood water from settlements and thereby preventing flooding. It is thus crucial that these facilities are strengthened in the face of climate change.

7.6.1 Impacts

The following are the typical impacts of climate change on stormwater and drainage systems:

- Increased stormwater flows
- Increased flood occurrence
- Wider areas of inundation

The impacts however would differ from one locality to another depending on the conditions such as topography (low-lying or in upper ground), land cover, rainfall intensity, etc. In order to determine the specific impacts of climate variability on stormwater and drainage facilities, hydrological and hydraulic modeling can be performed. These types of analyses yield depth of flooding and extent of inundation, which can then be used to prepare adaptation measures.

7.6.2 Adaptation Measures

The following are the suggested adaptation measures to combat the ill-effects of climate change on stormwater and drainage systems:

- Develop and implement flood plain zones
- Improving natural and artificial drainage system
- Improve drainage infrastructure design such as accounting for increased rainfall intensities in design flow calculations
- Create and develop flood and storm shelters
- Develop locally specific flood protection programs
- Water river management by avoiding bank erosion and creating buffer zones
- Improve coastal management such as sea wave protection, mangrove conservation and rehabilitation
- Adopt formal asset management approach that can effectively consider climate inputs to maintain stormwater system infrastructures

7.6.3 Mitigation Measures

The following is the proposed mitigation measure to minimize production of greenhouse gases in stormwater and drainage facilities:

- Prioritize drainage system options with minimal contribution to climate change e.g. gravity over pumped systems

7.7 WASTE WATER SYSTEMS

Wastewater systems are those infrastructures that deal with the collection, conveyance and treatment of wastewater or sewage generated from households, commercial and industrial establishments and including institutional establishments.

7.7.1 Impacts

The following are the likely impacts of climate change of wastewater systems:

- Increased wastewater flows due to inflow/infiltration, which would require larger sewer lines and treatment facilities, thus more expensive facilities
- Increased damage to pipes and appurtenances due to flooding, ground movement and structural integrity, which would require higher maintenance costs

Evaluation of site-specific impacts of climate variability on wastewater system requires in-depth analysis of the interplay between hydrological events, soil properties, pipeline condition, etc. Such analysis can be done using combinations of hydrologic and hydrodynamic models.

7.7.2 Adaptation Measures

The following are the proposed adaptation measures to make wastewater systems climate-change resilient:

- Locating major wastewater infrastructure away from vulnerable areas. Example of this is situating certain components such as electrical and electronic equipment in higher elevations to avoid damage by flooding
- Improve wastewater infrastructure design to account for climate change e.g. increase design flows
- Adopt formal asset management approach that can effectively consider climate inputs to maintain wastewater infrastructures

7.7.3 Mitigation Measures

In order to mitigate the impacts of climate change with respect to wastewater systems, the following is suggested:

- Prioritize wastewater system options with minimal contribution to climate change such as conveying wastewater by gravity as opposed to pumped systems
- Construction and operation of energy-neutral wastewater treatment facilities

7.8 SOLID WASTE SYSTEMS

Solidwaste systems refer to solid waste disposal facilities.

7.8.1 Impacts

The following are the likely impacts of climate change on solid waste systems:

- Higher generation rate of methane due to increasing temperature; methane is more potent greenhouse gas than carbon dioxide
- Increased leachate production due to increased rainfall intensities, thereby higher requirement for leachate treatment and higher potential for groundwater contamination
- Increased occurrence of waste slide especially in ill-designed and operated landfill garbage dump sites due to increased rainfall intensities

Studies are required to relate landfill gas generation, leachate production and propensity of waste slides to climatic variables in order to establish localized effects.

7.8.2 Adaptation Measures

The following are the suggested adaptation measures to minimize impacts of climate change on solid waste systems:

- Full implementation of proper solid waste management program in order to minimize waste dumping and have properly constructed and operated

landfill facilities

- Improve landfill design such as minimizing rainfall infiltration and thereby leachate production, avoid waste slides
- Reserve local sites to accommodate waste sorting, recycling and reuse; locate sites away from climate change vulnerable areas

7.8.3 Mitigation Measures

Since landfills and or waste dumpsites produce, as by-product, methane, the best way to mitigate the impact of climate change is to minimize the production and thereby release of this gas to the atmosphere. One way to do this is to promote best practices in solid waste management e.g. waste reduction, reuse, recycling.

7.9 POWER SYSTEMS

This infrastructure largely refers to transmission and distribution systems.

7.9.1 Impacts

The following are the impacts of climate variability on power systems:

- Damage to transmission and distribution lines resulting in increased blackouts
- Reduced network capacity
- Accelerated deterioration and depreciation of assets due to highly variable climate
- Potential blackout due to increased demand especially in areas where temperature is increasing thus increased air-condition units use

7.9.2 Adaptation Measures

The following are the adaptation measures to make power systems climate resilient:

- Improve power infrastructure design such as use of climate change resilient material (e.g. steel towers over wooden poles), changes of design parameters (such as wind intensities)

- Use of locally sourced energy (e.g. solar) to minimize transmission infrastructure
- Adopt formal asset management approach that can effectively consider climate inputs to maintain power infrastructures

7.9.3 Mitigation Measures

One of the basic strategies to mitigate the impacts of climate change on power systems is to promote alternative energy sources that will minimize need for transmission and distribution infrastructure. This will therefore minimize need for transmission and distribution.

7.10 CONCLUDING REMARKS

This article has presented the potential impacts of climate change on various infrastructures, including some proposed adaptation measures to make the infrastructures climate-resilient. Likewise presented are mitigation measures aimed towards minimizing production of greenhouse gases from the different infrastructures.

It should be noted however that the impacts of climate variability on infrastructure would likely differ from one place to another due to differences in local conditions. It is therefore important that before proposing any adaptation and/or mitigation measure, local studies be conducted in order to determine site-specific impacts and thus come up with a more local solution to the climate change problem.

Assessing specific and local impacts of climate change on infrastructure is typically done using mathematical models, which are carried out by specialists. As such, local planners could look into agencies like PAGASA, Mines and Geosciences Bureau (MGB), National Disaster Risk Reduction Management Council (NDRRMC), Department of Science and Technology (DOST), Department of Public Works and Highways (DPWH), local universities, among others, to help them assess locally the possible impacts of climate change. As such, adaptation and mitigation measures that are promulgated are suited to local requirements

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8. EXPOSURE, VULNERABILITY and ADAPTIVE CAPACITY ASSESSMENT[8]

8.1 ADAPTIVE CAPACITY ASSESSMENT

Robust vulnerability and adaptive capacity assessment are required in order to come up with successful local climate change action plan that is responsive to the needs of the community. While vulnerability varies widely across communities, sectors and regions, these diversity of the "real world" has been the starting point for vulnerability assessment undertaking (Downing and Patwardhan 2008). According to these authors, vulnerability assessments at the national level, contributes to setting development priorities and monitoring progress.

Sectoral assessments provide more detail and targets for strategic development plans, while at the local or community level, vulnerable groups can be identified and coping strategies implemented, often employing participatory methods. Thus, vulnerability and capacity assessment will include analysis of exposure, sensitivity and adaptive capacity of households, community and institutions. It will take into consideration the physical and outcome risks, the socio-economic condition of the population, and their resilience as well as the various climatic events that could affect the locality.

This module will present methodologies for vulnerability and adaptive capacity assessment in order to evaluate the propensity of human and ecological systems to suffer harm and their ability to respond to stresses brought about by climate change and variability. This will also include identification of sectors that may be affected by climate change events (e.g. typhoon, flood, sea level rise, drought, etc.) based on past and present climate variability. It will discuss various factors affecting vulnerability of households, communities, and other sectors under climate change related events.

Various tools or a combination of assessment methods/tools will be discussed. These tools are ways by which participation of the community or stakeholders are enhanced, hence promoting more useful local climate change action plan. Some

[8] Prepared by: Dr. Leonardo M. Florece, SESAM, UPLB for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

important tools that could be useful in this exercise includes socio-economic and ecological profiling using rapid rural systems appraisal, livelihood analysis, transect or eco-walk, ranking and institutional analysis.

8.1.1 Concepts and Definitions

The word 'adaptation' was infrequently used in relation to climate change or other environmental risks before 1992 (Schipper and Burton 2009). This scientific concept, however was largely associated with the Darwinian theory of evolution and the process of natural selection (Burton 2009). Though the word has long been used in a social context social scientists tended to avoid using it because of controversial or negative connotations. In 1992, however, the Intergovernmental Negotiating Committee working on the draft of the United Nations Framework Convention on Climate Change (UNFCCC) went back to the word 'adaptation'. The text of the Convention as agreed in Rio de Janeiro in 1992 established to categories of response to climate change: mitigation and adaptation. This is shown in Figure 5.

Mitigation refers to those actions designed to reduce emissions of greenhouse gases in order to achieve 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UNFCCC Article 2).

Adaptation as defined by Huq and Reid (2009) is the process of coping with the potential impacts of climate change. Accordingly, it can be characterized in different ways:

1. Anticipatory adaptation vs. reactive adaptation: Anticipatory adaptations are ones which are taken in anticipation of expected climate change impacts, while reactive adaptation occurs after the impacts have taken place.

2. Adaptation to climate change vs. adaptation to climate variability: The former refers to adaptation to anticipate human-induced climate change, whereas the latter refers to adaptation to naturally occurring climate variability

Figure 4. Responses to climate change and impacts (Smit 1993).

Smithers and Smit (2009) suggest that adaptation involves change in a system in response to some force or perturbation like climate change, and that adaptation analyses can begin by addressing the attributes of the perturbation, the characteristics of the impacted system, or the nature of the response (Figure 5). This represents the dimensions of adaptation and together serves as a framework for adaptation research.

"Adaptive capacity is the ability of a community (or country) to adapt to climate change (Huq and Reid 2009). One key distinction between generic adaptive capacity and specific adaptation: generic adaptive capacity refers to the inherent or existing capacity of a community or country as a whole to cope with climate impacts. This is a function of levels of income, education and development, etc. of the whole community or country. Specific adaptive capacity refers to the capacity of the community or country to cope with the impacts of climate change based on an understanding of the anticipated impacts of human-induced climate change".

"Adaptive capacity is the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability, or future climate conditions (Brooks and Adger 2004). In practical terms, adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards".

8.1.2 Indicators of Adaptive Capacity

It is not possible to provide a list of "off the shelf" indicators to capture universal determinants of adaptive capacity that are useful at the project level. Appropriate indicators for assessing adaptive capacity must be tailored to each case. These may be identified by asking the following nine questions (Brooks and Adger 2004):

1. What is the nature of the system/population being assessed?
   Example: Groups most vulnerable to flooding

2. What are the principal hazards faced by this system/population?
   Example: Flooding, inundation, landslides

3. What are the major impacts of these hazards and which elements/groups of the system/population are most vulnerable to these hazards?
   Example: Crop losses/farmers

4. Why are these elements/groups particularly vulnerable?
   Example: No other source of livelihood

5. What are the major impacts of these hazards and which elements/groups of the system/population are most vulnerable to these hazards?
   Example: Crop losses/farmers

6. Why are these elements/groups particularly vulnerable?
   Example: No other source of livelihood

7. What measures would reduce the vulnerability of these elements/groups?
   Example: Diversification of livelihood

8. What are the factors that determine whether these measures Rare taken?
   Example: Willingness of stakeholders to adapt

9. Can we assess these factors in order to measure the capacity of the system population to immplement these measures?
   Example: Assign values to quantify capacity

10. What are the external and internal barriers to the implementation of these measures?
    Example: External – new land for relocation; Internal – lack of awareness to flooding

11. How can capacity constraints be removed from key barriers to adaptation?
    Example: IEC, training, financial assistance (seed money), etc.

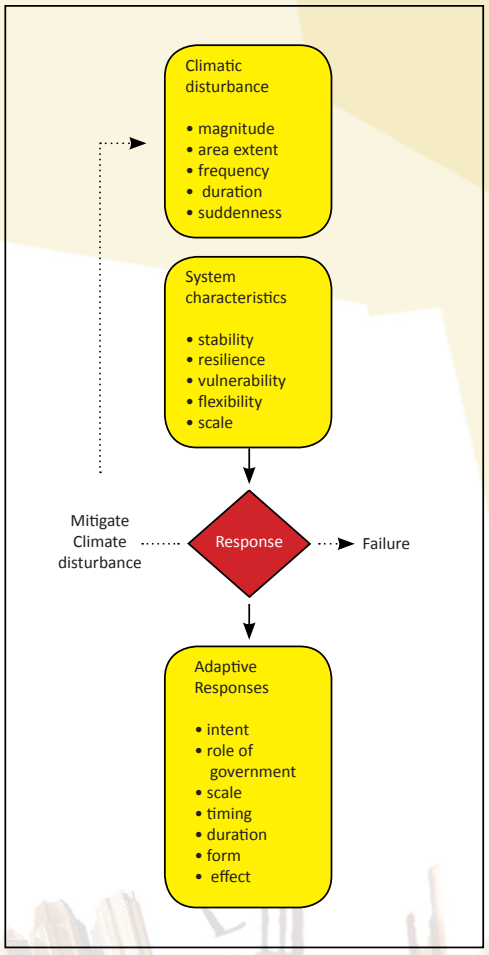

Figure 5. Dimensions of adaptation (Smit 1993)

8.1.3 Guide Questions in Assessing Adaptive Capacity

1. What is the adaptive capacity priority of the project, and what is the specific capacity enhancement goal?
2. What adaptive capacity already exists to reduce current vulnerability to recurrent hazards?
3. What capacity will societies have to adapt to future hazards?
4. What measures, policies and strategies enhance adaptive capacity and encourage autonomous adaptation?
5. How can efforts to enhance adaptive capacity be sustained and improved over time?

8.1.4 Types of Adaptation Measures (Niang-Diop and Bosch 2004):

1. Sectoral measures relate to specific adaptations for sectors that could be affected by climate change. In agriculture, for example, reduced rainfall and higher evaporation may call for the extension of irrigation. For infrastructure, sea level rise may necessitate improved coastal protection or relocation of population and economic activities. In most cases, measures will mean a strengthening of existing policies, emphasizing the importance of basing climate change policies on existing coping mechanisms and the necessity of integrating them into national development plans.

2. Multi-sectoral measures relate to the management of natural resources that span sectors – e.g., water management or river basin management. Integrated coastal zone management is also considered an appropriate framework to consider technical adaptation measures such as dike building, beach nourishment, etc. The ecosystem approach to climate change adaptation involves the integrated management of land, water and other resources that promotes their conservation and sustainable use in an equitable way.

3. Cross-sectoral measures can span several sectors and include the following:

   Education and training: Introduction of climate change issues at different levels of the educational system is an ongoing process that can help to build capacity among stakeholders to support adaptation in the future, and can help to develop appropriate research activities and a greater awareness among citizens.

Public awareness campaigns: Such campaigns can raise awareness and disseminate information in order to increase the concern and involvement of the broad array of stakeholders. These campaigns can also be an opportunity for adaptation decision makers to better understand the perception and views of the public on climate change and adaptation.

Strengthening/changes in the fiscal sector: Public policies may encourage and support adaptation of individuals and the private sector, particularly through the establishment of fiscal incentives or subsidies.

Risk/disaster management measures: These measures include the development of early warning systems, in particular for extreme events like cyclones (that can be predicted only a few hours before), and for droughts, floods, El Niño-Southern Oscillation (ENSO) (that can be predicted several months before). Emergency plans, extreme events relief and recovery measures also belong to this type of measure. Generally, the success of these measures depends upon good communication systems and a certain level of trust among users.

Science, research and development (RandD) and technological innovations: RandD and innovation are needed to enable responses to climate change in general, and to enable specific responses to climate change vulnerability, including economic valuation of adaptations, technological adaptations (development of drought- or salt-resistant crop varieties), and investigations of new sources of groundwater and better resource management. It may also be necessary to adapt existing technologies to fit with the adaptation demands – e.g., the development of more energy-efficient air conditioning systems, low-cost desalination plants, and new technologies to combat saltwater intrusion.

Monitoring, observation and communication systems: These systems may have to be created or strengthened, particularly for climate-related parameters, but also for other indicators of climate change and impacts (e.g., sea-level rise, changes in species composition of ecosystems, modification of piezometric levels, etc.). This monitoring will allow policy-makers to adjust the adaptation strategy based on confirmed changes in the climate.

8.1.5 Tools/Methods for Adaptation Assessment

The tools/methods for assessing vulnerability and adaptation is shown in Table 1. It is suggested that the tool that can elicit active participation of the local community is the most preferred.

Table 1. Toolkit for vulnerability /adaptation assessments (Downing and Patwardhan 2004).

Applications Tools	Present vulnerability	Problem definition	Development adaptation	Evaluation of adaptation	Strategic planning	Multi stakeholder analysis	Stakeholder participation
1. Agent-based simulation modeling			X		?	X	?
2. Bayesian analysis				X			
3. **Brainstorming**	X	X	X	X	X	X	X
4. Checklists/multiple attributes	X			X		X	X
5. Cost-effectiveness			X	X			
6. Cross-impact analysis			X	X			
7. Decision conferencing			X	X			
8. Decision/probability trees				X			
9. Delphi technique	X		X	X		?	?
10. (Strategic) environmental impact assessment			X	X	X		?
11. Expert judgment	X	X	X	X	X	X	
12. Focus groups	X	?	X	?		?	X
13. Indicators/mapping	X		?			?	?
14. Influence diagrams/ mapping tools	X		X		X		X
15. Monte Carlo analysis				X			
16. Multi-criterion analysis				X			

17. Ranking/dominance analysis/pairwise comparison	X		X	X			X
18. Risk analysis			?	X			
19. Scenario analysis	?	?	X	?	X	X	X
20. Sensitivity/robustness analysis			X	X			
21. **Stakeholder consultation**	X	X	X	X		X	X
22. Stakeholder Thematic Networks	X	?	X		?	X	
23. Uncertainty radial charts				X			
24. Vulnerability profiles	X	?	?			X	X

Tool Annotations

Agent-based simulations modeling – formalism of agents and their interactions at multiple levels

Bayesian analysis – used to reassess probabilistic data in light of new data; statistical analysis

Brainstorming – free flowing lists/diagrams of all ideas and options

Checklists – matrix

Cost effectiveness/cost benefit/expected value – econometric techniques

Cross impact analysis – used to robustness of risk assessment and dependencies between events

Decision conferencing – quantitative analysis of options incorporating the uncertainties in interactive modes

Decision/probability trees – charts of relationships between decision modes; helpful for generating expected value

Delphi technique – range of views of experts through interactive written correspondence.

(Strategic) environmental impact assessments – mental impacts taken into account before deciding on development

Expert judgment – the assessment of experts in the field on specific propositions

Focus groups – groups of stakeholders that discuss their opinions on certain topics

Indicators/mapping – compilation of indicators into aggregate indices, often mapped

Influence diagrams/mapping tools – graphic identification of options when there are a number of decisions

Monte Carlo analysis – computer based analysis that explicitly assesses uncertainty

Multi-criterion analysis – scoring and weighting of options using indicators and more than one decision criteria

Ranking/dominance analysis/pairwise comparisons – preference of options

Risk analysis – approaches to decision uncertainty including hedging and flexing, regret, minimum and maximum

Scenario analysis – fuller picture of implications of uncertainty gained through simultaneous variation of key uncertainties

Sensitivity analysis/robustness analysis – identification of variables contributing most to uncertainty

Stakeholder consultation – consultation with individuals and/or groups affected by future processes

Stakeholder Thematic Networks (STN) – mapping of the key actors and their interactions

Uncertainty radial charts – assessment of the potential uncertainty of options

Vulnerability profiles – mapping of the different indicators of vulnerability for different groups

8.1.6 Concepts to Action: Enhancing resilience and adaptive capacity of communities

The core elements required in determining the type and kinds of interventions to enhance adaptive capacity of communities include the following (Moench 2009):

1. Diversification of livelihood activities, assets and financial resources particularly into non-farm and other activities that have low levels of sensitivity to climatic variability or extremes events;

2. Mobility and communication, particularly the ability of goods, people, information and services to flow between regions in ways that enable local populations to access markets, assets, the media and other resources beyond the likely impacts of specific climatic events;

3. Ecosystem maintenance, particularly maintenance of the basic ecosystem services (such as drinking water) without which local populations cannot survive;

4. Organization, particularly the social networks, organizations and institutional systems that enable people to organize responses as constraints and opportunities emerge;

5. Adapted infrastructure, particularly the design of physical structures (e.g. for water, transport, communication, etc.) in ways that can maintain their basic structure and function regardless of changes in climatic systems;

6. Skills and knowledge, in particular the ability to learn and the basic educational skills required to shift livelihood strategies as required;

7. Asset convertibility, the development of assets or markets that enable populations to transform the nature of assets and their use as conditions evolved; and

8. Hazard-specific risk reduction, the development of early warming, spatial planning, implementation of building codes, establishment of community DRR organizations and other systems to reduce exposure and vulnerability to known climate-related hazards.

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9. VULNERABILITY AND ADAPTATION TOOLS FOR THE HEALTH SECTOR[9]

VULNERABILITY ASSESSMENT

Health impact assessment has been defined as "a combination of procedures, methods and tools by which a policy, project or hazard may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population" (WHO). Methods are being improved to quantify health impacts to create risk management strateties especially for vulnerable groups.

Methodologies to assess vulnerability include Disability Adjusted Life Years (DALYs) and Disease Cost Effectiveness Analysis; Epidemiological Model; Breteau Index; Climate Change Impact Modeling; and Vulnerability Map.

Disability Adjusted Life Years [DALYs] is a proposed effective tool in determining health impact e.g., environmental health impact assessment. It is estimated through the following equation:

DALY = YLL + YLD

Where:

YLL = amount of time in years lost due to premature death from a specific disease

YLD = the period of time someone has to live suffering from a disability bought about by a specific disease

Based on historical data in Bangladesh, a major storm event may result in approximately 290 DALY per 1000 population, including both deaths and injuries, compared to a current all-cause rate of about 280 per 1000 in the region (Nelson, 2003] (Slides 7-9).

[9] Prepared by Dr. Jet Lorenzo, Institute of Health Policy and Development Studies, UP Manila for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

Cost Effectiveness Analysis is illustrated in the case of malaria and interventions include prevention, early diagnosis and preventive treatment. In Palawan, for instance, cost of morbidity from malaria in the community is estimated at P219,792,993. Cost averted by insecticide treated bed nets (ITN) is P139,079,959. Early diagnosis and treatment averted cost by P127,763,635 (slides 10-12).

The Epidemiologic Model is a predictive model to extrapolate the relationship of climate and disease in time (e.g. monthly temperature and incidence of diarrhea in a population by year) to estimate change in temperature-related disease cases under future climate change. The occurrence of outbreaks in the Philippines is influenced by time, space and population factors. Time factors include day-to-day weather, extreme events, seasonal cycles and interannual variability. Space factor includes topography, geography, access to services and infrastructure; and resources. Population factors include current health status, economic development, demography, cultural factors and governance. Two potential types of analysis can be proposed:

- Logistic Regression: to determine the relative contribution of different independent variables with declared epidemics (individual diseases or collectively for all diseases being studied) per year
- Survival analysis (Proportional Hazards Model): to determine the effect of selected factors on the rate of the occurrence of outbreaks of each type of disease

Another approach is to extrapolate the relationship of mapped climate and diseases (or vectors) in time and space to estimate change of distribution of disease (or vector) with future change in climate (slides 13-18).

Breteau Index measures the number of containers positive for mosquito larvae per 100 houses inspected. It is generally considered the best of the commonly used indices (such as the House Index or the Container Index), since it combines dwellings and containers and is more qualitative besides having epidemiological significance. It has been linked with the transmission level of the dengue fever and can be used as a warning indicator of this disease (Wei-Chun et al, 2008). When the Breteau index is above 50 (i.e. density level >6), it is regarded as highly dangerous in terms of transmission of the disease according to the definition provided by the WHO; above 20 (i.e. density level >4), it is considered to be sensitive, meaning that a dengue fever epidemic could break out anytime; under 5 (i.e. density level <2), this means that the disease will not be transmitted (slides 18-20).

Climate Change Health Impact Modeling aims to assess health and climate change data whether appropriate for impact modeling; develop CC health impact models to be used by local health officers, municipal development planners, NEDA and DOH planners in projecting the impact of climate change; and recommend data gathering improvement measures that will be useful for impact modeling. It can be done by simple graphical or statistical modeling. Examples are shown in the cases of malaria, dengue, cholera in Pangasinan, Palawan and Rizal. (slides 21-31).

Vulnerability map is a visual representation of vulnerable areas or "hotspots". It is designed to provide local and national planners with a visual reference for areas that are more vulnerable to the changes in the environment, including the health sector, brought about by climate change. Two methods involve mapping software technology (i.e., ArcGIS, Manifold) or the traditional (manual) method using acetate or similar materials (slides 32-38).

Adaptation Assessment Tools

Adaptation evaluation criteria includes effectiveness/efficiency; economic efficiency; political feasibility; and technical feasibility/capability. Cost Effectiveness Analysis is a tool in evaluating effectiveness/efficiency; economic efficiency. Examining Policy Mandates, Programs is a tool to assess Political Feasibility. Technical Feasibility checklist is needed in assessing technical capability. Examples of adaptation strategie that could be assessed using the criteria are vector control; decanting; fogging/spraying; use of larvicides; and use of treated beds/nets (slides 39-41).

10. EVALUATION AND SELECTION/PRIORITIZATION OF APPROPRIATE CLIMATE CHANGE ACTIONS[10]

The detailed discussion of the topic will provide the concept of MCA and other related tools and a step-by step procedure on the use of MCA in the evaluation and selection of appropriate adaptation options for integration in the local development plan. Specifically, the following topics will be discussed:

- Adaptation assessment challenges and characteristics
- Decision-support tools for adaptation assessment
- Concept and main steps for MCA in the context of climate change adapdation
- Example cases on the use of MCA
- Take home message

[10]Prepared by Dr. Juan M. Pulhin, CFNR, UPLB

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United States Agency for International Development – USAID. 2007. Adapting to Climate Variability and Change: A Guidance Manual for Development Planning. Washington, DC, USA.

11. PARTICIPATORY RAPID APPRAISAL[11]

The detailed discussion of the topic will provide a step-by step procedure on the use of the following PRA tools customized for conducting V and A assessment:

- Historical time line analysis
- Participatory Impact Assessment of Climate Variability and Extremes
- Participatory Mapping of Vulnerable People and Places
- Participatory Identification of Adaptation Practices/Strategies

[11] Prepared by Dr. Juan M. Pulhin, CFNR, UPLB and Dr. Florencia B. Pulhin, World Agroforestry Centre

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12. CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES
(PER SECTOR/AREA)

12.1 AGRICULTURE[12]

Overview

The challenge for agriculture is how to feed the world 9 billion people in 2050. To meet the challenge, experts are predicting that global food production must rise by at least 70 % by 2050. Without strong adaptation and mitigation measures climate change will reduce food crop yields by 16% worldwide and by 28% in Africa over the next 50 years. Climate change in South and South-east Asia is expected to reduce agricultural productivity by as much as 50% during the next three decades. On the other hand, the Philippine population stands at 90 Million. Anchored on a 1.8% annual population growth target, by 2050 (when climate impacts may be at their worst) we would have grown to 180 Million.

The paper provides understanding climate change and examples of Climate Smart Agriculture (CSA practices by farmers, examines some of the key technical, institutional, policy and financial responses required to achieve the transformation to "climate-smart" agriculture. Building on the Department of Agriculture (DA) National Frameworks Strategies (NFS) on climate change, the paper also outlines a range of practices, approaches and tools aimed at increasing the resilience and productivity of agricultural production systems as drivers for Green Growth, anchored on ecosystems planning based on “ridge-rivers to reef” or watershed approach.

[12] Prepared by: Dr. Esteban Celeste Godilano, Department of Agriculture for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

INTRODUCTION

The world's governments now accept that climate change poses a serious long-term threat to their nations' economic and social health. But who caused the problem? Who should address it and how? And who should pay for the measures required both to limit climate change and to help people adapt to its impact?

Agriculture and fishery are the basic activity by which humans live and survive on the earth. Specifically, assessing the impacts of climate change on agriculture is a vital task. In both developed and developing countries, the influence of climate on crops, fisheries and livestock persists despite advances in science and technology and the "green revolution". The continued dependence of agricultural production on light, heat, water and other climatic factors, the dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create the need for a comprehensive consideration of the potential impacts of climate on global agriculture in general and the Philippines in particular.

The climate change analysis was based from IPCC 2007 (Intergovernmental Panel on Climate Change) assessment report wherein it concluded that it is "unequivocal" that Earth's climate is warming due to anthropogenic sources of pollution. In summary, the IPCC predicts that, based on a range of scenarios, by the end of the 21st century climate change will result in: (1) a probable temperature rise between 1.8°C and 4°C, with a possible temperature rise between 1.1°C and 6.4°C ----some scientists believe for instance that crop yields will decline 10 percent for each degree rise in temperature, (2) a sea level rise most likely to be 28-43cm, (3) arctic summer sea ice disappearing in second half of century, (4) an increase in heat waves being very likely, and (5) a likely increase in tropical storm intensity. A recent study by MIT (USA) and the US-based Sustainability Institute calculated that the Copenhagen's proposals will likely leave the world 3.9 degree warmer by 2100. Likewise the IPCC recent assessment suggests that a business-as-usual approach could push temperature by more than 6 degrees by 2100. Impact of which are the following: (1) burning of the Amazon forest, (2) melting of the polar ice cap, and (3) sea level rise of 7 meters.

Illustrated in Figure 7 are predicted impacts of climate change with particular emphasis in the Philippines. We also put importance on the three aspects of abating impacts through adaptation, mitigation, and anticipation, and focusing our efforts on poverty, food and water security, and social justice. Listed in Table 2 is a brief description of each impact that could happen in the Philippines.

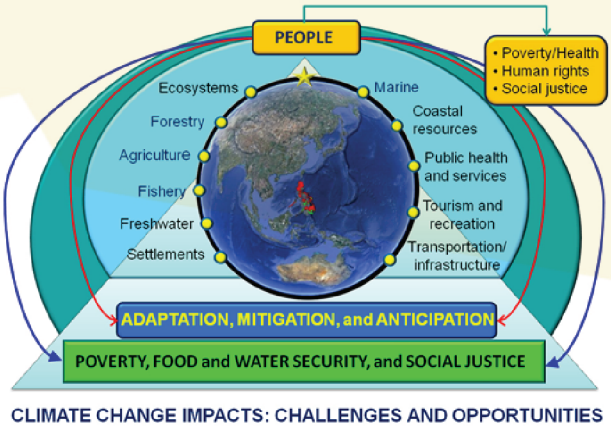


Figure 6. Predicted impacts of climate change in the Philippines.

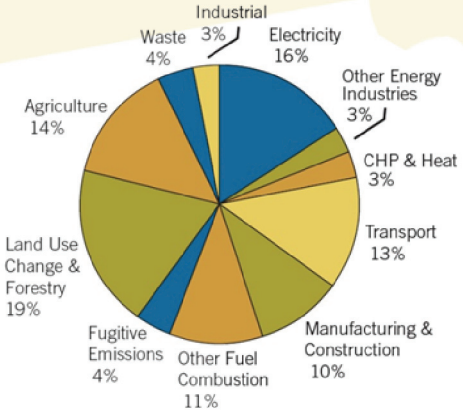
Table 2. Sample of sectors and projected impacts of a changing climate.

Sector Impacts	Sector Impacts
Ecosystems	• Failure of ecological systems to provide the wide range of benefits on which societies rely for their continued existence. • Failure of ecosystems to adapt and reestablish themselves. • Changes in soil characteristics and disturbance regimes (e.g., fires, pests, and diseases), which would favor some species over others and thus change species composition. • Loss of biodiversity in fragile environments.
Freshwater resource	• Salinazation of freshwater; water table/aquifer depletion; increased runoff and pollution of freshwater sources, thus affecting the quality of drinking water and impact public health. • Alter the quantity and quality of available fresh water and increase the frequency and duration of floods, droughts, and heavy precipitation events.

Sector Impacts	Sector Impacts
Agriculture	• Changes in yields due to precipitation and temperature extremes. • Increases in pests and disease; salinazation of irrigation water. • Decrease in livestock production and spoilage --- increase temperature. • Increase frequency of weather extremes storms/ floods/ landslide/ droughts). • Loss of fertile coastal lands caused by rising sea levels and storm surge. • More unpredictable farming conditions.
Fishery	• Dwindling fish catch, fish kills in fresh water aquaculture. • Changes in lakes ecosystems due to sea water intrusion. • Increased rainfall could also wash more agricultural fertilizer and municipal sewage into coastal waters, creating more low-oxygen “dead zones” in major coastal waters.
Coastal resources	• Inundation of low-lying areas from storm surges, sea level rise, stronger and high intensity tropical storms. • Infrastructure damage and submergence of dwellings. • Wetland and rice lands losses, and loss of habitat; and human displacement.
Marine resources	• Coral bleaching and decrease fish catch. • Frequent and wide coverage of red tides, • CO2 dissolves in the oceans forms carbonic acid and increases the acidity (lowers the pH) of the ocean water • Reduces carbonate in the oceans makes it harder for shell-forming organisms to grow.
Forestry	• Forest loss to drought, wildfires, infestation, diseases, species migration and loss.

Sector Impacts	Sector Impacts
Tourism and recreation	• Shorter recreation season due to severe typhoons and longer drought periods. • Submergence of small island tourism due to sea level rise. • Loss of beaches to tropical storms and storm surges
Public health and health services	• Increased levels of heat stress, respiratory illness, chronic disease, human displacement (short-term and long-term), infectious disease, and premature death. • The populations at greatest risk are those with the least ability to adapt: (the elderly, the infirm, and the poor). • As sea level rises, the number of people at risk for flooding from storm surges rises.
Human Settlement	• Destructions due to landslides, flooding, and sea level rise causing climate induced environmental refugees. • Coastal communities are at high risk of submergence.
Transportation infrastructure	• Damage from sea-level rise, erosion, flooding, landslides, and temperature extremes. • Flooding and heavy rainfall may overwhelm local water infrastructure and increase the level of sediment and contaminants in the water supply

The greenhouse gas (GHG) emissions that are causing global warming come from a wide range of sources, including cars and trucks, power plants, farms, and more (Figure 8). Because there are so many sources of these gases, there are also many options for reducing emissions, including such readily available steps as improving energy efficiency and changing industrial processes and agricultural practices. (www.pewclimate.org.)



Source: Pew Center on Global Climate Change, *Climate Data: A Sectoral Perspective*

Figure 7. Worldwide GHG emission sources.

We should also acknowledge that the agricultural and fishery sectors are contributing in gas emissions and land use effects thought to contribute to climate change. In addition to being a significant user of land and consumer of fossil fuel, agriculture and fishery contributes to greenhouse gas increases through land use in five main ways: (1) CO2 releases linked to deforestation, (2) methane releases from rice cultivation, (3) methane releases from enteric fermentation in cattle, (4) nitrous oxide releases from fertilizer application, and (5) inefficient fishing gears and vessels.

Together, these agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use. According to the IPCC Report, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture.

As evidence accumulates, we are already witnessing the early signs of global climate change. The need to communicate this issue to policymakers, scientists, Local Government Units (LGUs) and the general public in the forms of maps becomes ever more urgent. The challenge facing generalists is that the subject is complex and often highly specialized. Much of our understanding of climate change comes from sophisticated computer-based models, data sets and theoretical insights. Decision-makers, however, need practical yet infallible evidence into such scientific information if they are to craft and implement effective solutions.

Without dramatic mitigation and adaptation of GHG emissions, the impacts and costs caused by climate change are going to increase on a frightening scale. Those who are responsible for most GHGs emissions in the atmosphere already have the capacity and finance necessary to avoid most loss of life and livelihood from those impacts, but the world's poor who are least responsible for the emissions of greenhouse gas emissions are much less fortunate.

On the other hand, predicting the consequences of global climate change is made possible by the information revolution that is reshaping the modern world. Among the innovations it has placed in the hands of scientists concerned with agriculture and other land uses is a set of tools referred to as Geographic Information Systems (GIS) and technology. These are computer-based programs that bring together and analyze information from diverse sources and present the results in map form. When linked with computer models simulating changes over time and space in crops, landscapes, weather and other complex systems, GIS offers a powerful means of predicting and visualizing likely futures for plants, people and places. The maps produced by GIS provide an early warning as to which of these are at greatest risk and where.

Where we are at present

The world's governments now accept that climate change poses a serious long-term threat to their nations' economic and social health. Agriculture and fishery on the other hand, are the basic activity by which humans live and survive on the earth. Specifically, assessing the impacts of climate change on agriculture is a vital task, in both developed and developing countries. The influence of climate on crops, fisheries and livestock persists despite advances in science and technology and the "green revolution". The continued dependence of agricultural production on light, heat, water and other climatic factors, the dependence of much of the world's population on agricultural activities, and the significant magnitude and rapid rates of possible climate changes all combine to create the need for a comprehensive consideration of the potential impacts of climate on global agriculture in general and developing countries in particular. The fundamental reality about climate change and the reason adaptation is so important, that even if we achieve the emission reductions of the Kyoto Protocol, we will still be living in a world with twice the historic averages of CO2 between 2020 and 2050. In fact, the real goal of the emission reduction targets of the Kyoto Protocol is not to reduce total emissions, but merely to delay the doubling of the historic averages by twenty years. Regardless of when we hit the two times CO2 level, this alteration of our atmosphere will drive climate change to unprecedented levels.

Climate change threatens production's stability and productivity. In many areas of the world where agricultural productivity is already low and the means of coping with adverse events are limited, climate change is expected to reduce productivity to even lower levels and make production more erratic (Stern Review 2006; Cline 2007; Fisher et al. 2002; and IPCC 2007). Long term changes in the patterns of temperature and precipitation, that are part of climate change, are expected to shift production seasons, pest and disease patterns, and modify the set of feasible crops affecting production, prices, incomes and ultimately, livelihoods and lives. Climate change impacts include increased floods and droughts, soil degradation, water shortages and possible increases in destructive pests and diseases. According to Prof. Gordon Conway, agriculture must become central to future climate-change discussions, because it contributes a significant proportion of global carbon dioxide and nitrous oxide emissions.

Without dramatic mitigation and adaptation of GHG emissions, the impacts and costs caused by climate change are going to increase on a frightening scale. Those who are responsible for most GHGs emissions in the atmosphere already have the capacity and finance necessary to avoid most loss of life and livelihood from those impacts, but the world's poor who are least responsible for the emissions of GHGs emissions are much less fortunate.

Agriculture as part of the solution

Agriculture can be a part of the solution, helping people to feed themselves and adapt to changing conditions while mitigating climate change. We need agriculture that will strengthen food security, adaptation and mitigation. We need agriculture that can contribute to sequestering GHG emissions and capturing carbon in the soil.

The Philippine economy is heavily based on agriculture. The development of the agricultural sector is the most efficient poverty reduction measure. Yet agricultural expansion for food production and economic development which comes at the expense of soil, water, biodiversity or forests, conflicts with other global and national goals, and often compromises production and development in the longer term.

Farmers are under the greatest threat from climate change, but they could also play a major role in addressing it. It is possible for agriculture to actually sequester—or absorb—carbon into the soil rather than emitting it. This can be done without the trade off with productivity and yields. It is possible to have higher yields, more carbon in the soil and greater resilience to droughts and heat.

This is called the `triple win' interventions that would increase yields (poverty reduction and food security), make yields more resilient in the face of extremes (adaptation), and make the farm a solution to the climate change problem rather than part of the problem (mitigation). These triple wins are likely to require a package of interventions and be country- and locality specific in their application. This method of practicing agriculture is called `Climate Smart Agriculture' (World Bank 2011).

Climate-Smart Agriculture

As a major user of freshwater and fossil fuels, a significant producer of GHG and a frequent trigger to deforestation, agriculture has tended to be seen as part of the climate change problem rather than an agent of mitigation. The concept of Climate Smart Agriculture (CSA) seeks to reverse that pattern, albeit with different emphases according to the current levels of agricultural development.

Climate-smart agriculture includes proven practical techniques and approaches that can help achieve a triple win for food security, adaptation and mitigation. For example, by increasing the organic content of the soil through conservation tillage, its water holding capacity increases, making yields more resilient and reducing erosion. Promoting soil carbon capture also helps mitigate climate change. Another example is integrated soil fertility management that can lower fertilizer costs, increase soil carbon and improve yields. Other proven techniques includes mulching, intercropping, integrated pest and disease management, conservation agriculture, crop rotation, agroforestry, integrated crop-livestock management, aquaculture, improved water management at different scales, and better weather forecasting for farmers including innovative practices, such as early warning systems and risk management, including insurance to the benefit of farmers. CSA encourages the use of all available and applicable climate change solutions in a pragmatic and impact-focused manner. Resilience will be key, but 'climate smart' is broader and underscores the need for innovation and proactive changes in the way farming is done to not only adapt but also mitigate and increase productivity and sustainably. Climate-smart agriculture gives attention to landscape approaches, for example, integrated planning of land, agriculture, forests, fisheries and water to ensure synergies are captured (Stapleton 2011).

These can be further strengthened by adding better weather forecasting, more resilient food crops and risk insurance to cover losses when the vagaries of weather strike. If yields increase through such practices and become more stable, it results in improved farm incomes. A more stable income helps enhance the adaptive capacity of farmers.

COUNTRY VULNERABILITY TO CLIMATE CHANGE AND LEVEL OF POVERTY

The Philippines is an archipelago surrounded by the Philippine Sea and Pacific Ocean in the east and the Philippine Sea in the west with a land area of 300,000 sq km and an estimated population of 94 Million in 2010. Among the most vulnerable countries in the world the Philippines ranked 6th as of 2010 (www.newscientist.com/). This is six notches higher during the 1990-2008 ranking where the Philippines ranked 9th. (http://www.aneki.com). The recent WorldRisk Report 2011 reported that the Philippines ranked third among the 173 countries in the world in terms of disaster risk index (Table 3)[13].

The Philippines due to its location and natural attributes, is prone to natural hazards. It is situated in the Pacific Ring of Fire where two major tectonic plates of the world, It is located along the typhoon belt on the Western North Pacific Basin where 66 percent of tropical cyclones enter or originate. Typhoons average 20 events per year; five to seven of which can be very destructive. Flooding has become the most prevalent disaster since 2000. Areas along the over 17,000 km coastline are vulnerable to tidal surges due to high population density. According to the United Nations International Strategy for Disaster Reduction (UNISDR)—reports that "the Philippines topped the disaster league of 2011 with 33 major reported events, affecting 12.5 percent of the population. The People's Republic of China, United States and India ranked a distant 2nd, 3rd, and 4th with 21, 19 and 11 disasters, respectively (The CRED/OFDA-International Disaster Database tables). In terms of Sea Level Rise (SLR) the Philippines is no.5 affecting 14 M people.

Rank	Country	Risk (%)
1	Vanuatu	32.00
2	Tonga	29.08
3	Philippines	24.32
4	Solomon Islands	23.51
5	Guatemala	20.88
6	Bangladesh	17.45
7	Timor-Leste	17.45
8	Costa Rica	16.74
9	Cambodia	16.58
10	El Salvador	16.49
11	Nicaragua	15.74
12	Papua New Guinea	15.45
13	Madagascar	14.46
14	Brunei Darussalam	14.08
15	Afghanistan	14.06

Table 3. Top 15 Countries Vulnerable to Disaster

In an analysis of natural disaster hotspots by the Hazard Management Unit of the World Bank (World Bank 2005), the Philippines is among the countries where large percentages of population reside in disaster-prone areas. Many highly populated areas are exposed to multiple hazards; 22.3% of the land area is exposed to three or more hazards and in that area, 36.4% of the population are exposed. Areas where two or more hazards are prevalent comprise 62.2% of the total area where 73.8% of the population are exposed.

The flooding and landslides in many parts of the country is estimated to have caused damages estimated at 2.7 percent of the 2009 Gross Domestic Products (GDP). Add to that the damages of the El Niño phenomenon to rural communities estimated by the DA as of June 2010, at about P20 billion, exceeding estimates under a "moderate" scenario.

Code	Description	Hectares	Percent of Country
1	Drought + Flooding + Landslide + SAFDZ	162,098.58	0.54
2	Drought + Landslide + SAFDZ	397,715.25	1.33
3	Flooding + Landslide + SAFDZ	151,605.21	0.51
4	Drought + Flooding + SAFDZ	2,597,893.53	8.66
5	Drought + SAFDZ	3,358,360.89	11.19
6	Flooding + SAFDZ	2,720,264.80	9.07
7	Landslide + SAFDZ	729,550.58	2.43
8	Drought + Flooding + Landslide	101,732.60	0.34
9	Drought + Landslide	703,825.30	2.35
10	Flooding + Landslide	155,947.01	0.52
11	Drought + Flooding	1,129,297.76	3.76
12	Dry Land Only	4,549,601.28	15.17
13	Flooding Only	1,560,165.01	5.2
14	Landslide Only	1,723,463.33	5.74
15	SAFDZ only (not affected)	4,248,134.32	14.16
	Total	24,289,655.44	80.97

Table 4. Impacts of climate change to Philippines

Results of the spatial analysis of the three predicted consequnces (landslides, drought and flooding) of global climate change showed seven possible combinations. Approximately 67 percent (20 million hectares) of the country total areas will be severely affected by climate change. For agriculture alone, 86 percent will be affected by the various impact of climate change (GIS analysis, E.C. Godilano,

[13] The WorldRisk Report was conducted by the Brot für die Welt, Medico International, Misereor, Terre des Hommes and Welthungerhilfe in cooperation with the United Nation University – Institute for Environment.

2009, 2010), i.e. production areas, farm to market roads, warehouses, post harvest facilities, irrigation infrastructure, industries, mariculture parks, and fish ports. This also entails collateral damage to farm equipment and fishing gears if not the loss of lives of our farmers and fisherfolks.

The coincidence of the three events to occur i.e. drought/dryland + flooding + landslide to occur in one geographic location and could make this areas unhabitable is approximately 264,000 hectares or 1 percent of the country total area. Overlaying the coincidence map of the three events to the SAFDZ maps resulted in 15 possible combinations. At the national level, SAFDZ affected areas by this three events in combination or in a single event is approximately 10.2 million hectares or 34 percent of the country total area (Table 4). This bleak scenario will affect approximately 85% of the country SAFDZ areas. The co-occurrence of the three events with SAFDZ is estimated to be 162,000 hectares.

Food security, poverty and climate change are closely linked and should not be considered separately. As of 2009, the official poverty incidence in the Philippines is 20.9 %, which is equivalent to 3.86 million poor families or 23.1 million poor individuals. On the other hand, the reduction, if not the eradication, of poverty is at the center of all development efforts but it has many dimensions. A recent study, "Philippine Poverty: Situations, Trends and Comparisons" on income-based poverty observes "that the country's performance against income-poverty between 1985 and 2006 has been erratic and, on the whole, unsatisfactory, with a distinct success period (1985-1997) and a failure period (1997-2006).

As part of the response to the need for further locating the poor, the NSCB, in collaboration with the National Anti Poverty Commission (NAPC) estimated poverty in what is called the basic sectors of Philippine society. Because of data constraints, only 8 out of 14 basic sectors were included: namely, women, youth, children, senior citizens, urban population, migrant and formal sector, farmers, and fisherfolk (the sectors are obviously not mutually exclusive). Table 5 show that information based on the 2003 and 2006 FIES.

Base on ADB's and IFPRI (2009) studies on "Economics of Climate Change in Southeast Asia" the benefits from avoided damage in agriculture and the coastal zones of Vietnam, Thailand, Indonesia, and the Philippines could reach 1.9% of GDP by 2100, as compared to the adaptation cost of 0.2% of GDP.

Table 5. Disparities between the basic sectors (source: NSCB 2006: Poverty Statistics for Basic Sectors)

Sectors and Rank	Population poverty incidence (2003)	Population poverty incidence (2006)
All Philippines	**30.00%**	**32.90%**
1. Fisherfolk	43.60%	49.90%
2. Farmers	42.40%	44.00%
3. Children	38.80%	40.80%
4. Women	29.00%	30.10%
5. Youth	23.50%	25.40%
6. Senior Citizens	18.40%	20.30%
7. Migrant and formal sector	18.40%	19.50%
8. Urban population	15.90%	16.10%

FARMERS CLIMATE SMART-AGRICULTURE STRATEGIES

Recent empirical studies indicate that farmers in the Philippines are already practicing CSA adapted to the existing climates that they face by choosing crops, livestock or some mix of them to match their climate. By studying mitigation and adaptation, researchers can help farmers and policy makers identify efficient strategies that will maximize future income in new climate conditions. The heterogeneity of farming systems will require geographically targeted interventions to support farmers in adapting to and mitigating the effects of climate change. The following are some of the farmers' CSA strategies in the Philippines (www.da.gov.ph).

(1) **Climate resilience rice.** This is the use of drought, submergence, and saline-tolerant rice varieties. Farmers participated in the selection of these rice varieties, paving the way for a need-based selection of rice varieties and promoting faster adoption of these varieties in the farming community (www.philrice.gov.ph).

(2) **Review and adjustment of cropping calendar**. Farmers in the MASIPAG [14] (Farmers Scientist) network have developed early-maturing rice varieties which are harvested before the main typhoon season starts, and they do staggered planting and use diverse crops to help reduce crop failure

[14] Masipag (magsasaka at siyentipiko para sa pag-unlad ng agrikultura) is a farmer-led network of people's organizations, non-government organizations and scientists working towards the sustainable use and management of biodiversity through farmers' control of genetic and biological resources, agricultural production and associated knowledge.

risks. Pursuing, among other things, a holistic approach to development, community empowerment, and people's control over agricultural biodiversity as a contribution in the over-all effort of improving the quality of life of small farmers (http://masipag.org/cms/).

(3) **Using SALT.** (Sloping Agricultural Land Technology) promotes contour farming and other soil conservation measures in sloping lands, i.e., using tree legumes to improve the fertility and stability of agricultural soils. It provides a means for resource-poor farmers to achieve sustainable production without the use of expensive, and often unavailable, chemical fertilizers. SALT is a form of alley farming in which field and perennial crops are grown in bands 4-5 m wide between contoured rows of leguminous trees and shrubs. The latter are thickly planted in double rows to form hedgerows.

The Department of Agriculture used SALT as the basis for its extension effort on sloping uplands. The Department of Environment and Natural Resources (DENR) endorsed the concept for its social forestry pilot projects. A significant training effort for extension personnel was launched by the Philippine Government and demonstration plots of SALT were installed on farmers' fields throughout the country (Tacio, H.D. 1991).

(4) **Farm diversification** in the rainfed and upland ecosystems, farmers are intercropping corn with cassava, because the 2nd cropping of corn is no longer successful. Cassava is harvested after 10 months. In addition, many farmers are diversifying their production systems, growing other cereals, vegetables and rearing fish and animals (such as swine and chickens). The residues and waste from each system are being composted and used on the land, thereby reducing the need for external inputs. This diversification has increased incomes, improved nutrition, built resilience to shocks and minimized financial risks.

(5) **Rice intensification in the Farm** or Palamayanan refers to an integrated farming system for rice and vegetable components, as well as fish and livestock. It also integrates crop-management system to improve productivity, profitability and environment safety. This technology is widely adapted by farmers in irrigated rice ecosystems. http://www.gardeninthecity.net/philippine-urban-garden-planting-uide/

(6) **Rain water harvesting** that provide irrigation water during the dry season and at the same time slowing down inundation of lowland areas during extreme rainfall events. The rainwater harvesting program was initiated in 1989 in Capiz Province in central Philippines with the assistance of the Canadian International Development Research Centre (IDRC). About 500 rainwater storage tanks were constructed made of wire-framed ferro-cement, with capacities varying from 2 to 10 m^3. The construction of the tanks involved building a frame of steel reinforcing bars (rebar) and wire mesh on a sturdy reinforced concrete foundation. The tanks were then plastered both inside and outside, thereby reducing their susceptibility to corrosion relative to metal storage tanks (http://www.unep.or.jp/Ietc/Publications/Urban/UrbanEnv-2/9.asp).

(7) **The System of Rice Intensification** known as SRI which is a methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. SRI leads to healthier soil and plants supported by greater root growth and the nurturing of soil microbial abundance and diversity. In simplest terms, SRI involves: (1) careful planting of young seedlings (8-12 days old) singly and with a wide spacing (25 cm or more), (2) keeping the soil moist but well-drained and well-aerated, and (3) adding compost or other organic material to the soil as much as possible. A local group SRI-Pilipinas, an Oxfam-assisted organization, records an average of 6.4 tons per hectare, which is a yield gain of around 114 % over the current national average; and higher returns on investment (Oxfam 2011).

(8) **Mitigating methane emissions** through new irrigation schemes. The implementation of a water-saving technology called Alternate-Wetting and Drying (AWD) which was developed by the International Rice Research Institute (IRRI) in cooperation with the Philippine Rice Research Institute (PhilRice). The visible success of AWD in pilot farms, as well as specific training programs for farmers, was able to dispel the widely held perception of possible yield losses from non-flooded rice fields. The adoption of AWD facilitated an optimum use of irrigation water, so that the cropping intensity could be increased from 119% to 160%. Moreover, according to the revised IPCC methodology (IPCC 2006), 'multiple aeration', to which the AWD corresponds, potentially reduces methane emissions by 48% compared to continuous flooding of rice fields. AWD therefore generates multiple benefits related to methane emission reduction (mitigation), reducing water use (adaptation where water is scarce), increasing productivity and contributing to food security (Bouman et al. 2007 and Wassman, R. 2012).

(9) **Farmers using biotechnology.** In the Philippines, additional income from planting GM corn is approximately US$ 107.8 million covering 125,000 small farmers (Halos, S. 2012). "Farmers had additional income because Bt corn yielded more compared to the traditional varieties per hectare, the average yield is at around 6 to 7 metric tons," said Dr. Randy A. Hautea, Global Coordinator and Southeast Asia Center director of International Service for the Acquisition of Agri-biotech Applications (ISAAA). Experts led by National Scientist Dr. Emil Javier, president of the National Academy of Science and Technology (NAST), say that the additional income gained by farmers from Bt cotton could have reached 2 to 3 billion in 2009 (http://www.agriculture-ph.com/2009_02_01_archive.html).

(10) **Women in Seed Banking.** Deep in the mountains of Davao City in Southern Philippines lives the Matigsalog (near the river) Tribe of Central Mindanao. For generations, women are called upon to be the keepers of the seeds as the men were out hunting. It is said that because women are left to care for the home and the children, they are the bearers of life, and as such must ensure the tribe's survival. The seeds are entrusted to their care because they know how crucial it is in the fabric of their lives. When their daughters marry, the mothers give them different varieties of seeds as part of the dowry. The daughter is then expected to keep the seeds for the next generation. They have rice varieties that can be planted during the dry season, that even if it does not rain for three to four months, the seeds remain in the soil and if it is not eaten by birds or other pests, it will grow once the rains come (Cabusao, M. 2012).

We contend however, that most of what has been presented are mainly autonomous adaptation[15] strategies employed by farmers. The adaptive measures have some limitations in the context of the current phase of rapid climatic changes, recurrent extreme weather events and disasters, their increasing intensity, and the lack of resources available to poor farmers. Existing best practices should be viewed as providing a source of tactical responses (short-term) to a changing environment as opposed to an acceptance of untested strategic responses (longer term). The reason for this is because climate impacts and response mechanisms in the near-term future are likely to be similar to those of the recent past, barring any abrupt changes in the atmospheres local to global climate characteristics. The characteristics of change and impacts in the future, on the other hand, are more uncertain (Glantz, M.H., R. Gommes, and S. Ramasamy 2009). If widely adopted, however, autonomous adaptations, singly

[15] Also referred to as spontaneous adaptation (IPCC 2007). Autonomous adaptation is the ongoing implementation of existing knowledge and technology in response to the changes in climate experienced (IFAD 2008).

or in combination, have substantial potential to offset negative climate change impacts and take advantage of positive ones.

While autonomous adaptations have the potential for considerable damage avoidance from climate changes, there has been little evaluation of how effective and widely adopted these adaptations may actually be, given: (1) the complex nature of farm decision-making in which there are many non-climatic issues to manage, (2) the likely diversity of responses within and between regions in part due to possible differences and uncertainty in climate changes, (3) the difficulties that might arise if climate changes are non-linear or increase climate extremes, (4) time-lags in responses, and (5) the possible interactions between different adaptation options and economic, institutional and cultural barriers to change. For example, the realizable adaptive capacity of poor subsistence farming and/or herding communities is generally considered to be very low (Leary et al., 2006 and Nair 2010). These considerations also apply to the livestock, forestry and fishery sectors.

We believe that autonomous adaptation practices need to be complemented by scientific know-how. Pro-active and anticipatory adaptation approaches should be taken that address the short-term impacts of increasing climate variability but also help farmer prepare for the long-term impacts, which may emerge gradually or arrive abruptly when certain thresholds are reached. When localized projections of climate change impacts are not available, "no-regrets" options – adaptive practices and actions that will be beneficial even if future impacts are not certain and climate change threats do not occur exactly as anticipated – can be adopted.

The Philippine Department of Agriculture CSA Initiative

(1) Food Staple Sufficiency Program. The Agri-Pinoy Rice Program is one of the banner components of the DA it integrates government initiatives and interventions for the agriculture sector, namely: food security and self-sufficiency, sustainable resource management, support services from farm to table, and broad-based local partnerships. The program plays a key role in the Food Staples Sufficiency Program (FSSP), the central focus of the country's food security policy from 2011 to 2016 and beyond. The FSSP aims to achieve self-sufficiency in food staples. Self-sufficiency means satisfying domestic requirements for food, seeds, processing, and feeds through domestic production. The three key strategies are concentrated

in the following: (1) raising farmers' productivity and competitiveness, (2) enhancing economic incentives and enabling mechanisms, and (3) managing food staples consumption (www.da.gov.ph).

(2) Promotion of organic agriculture. Farmers are now encouraged to shift to organic agriculture by virtue of the Organic Agriculture Act of 2010. According to Muller (2010), adaptation and mitigation based on Organic Agriculture (OA) can build on well-established practice as OA is a sustainable livelihood strategy with decades of experience in several climate zones and under a wide range of specific local conditions. Given the large fraction of rural population living on farming, the potential of this strategy to adapt to the adverse effects of climate change and at the same time contribute to the reduction of GHG emissions and to carbon sequestration is huge.

(3) Enhanced Farmers Field School (EFFS). The aim of the EFFS is to build farmers' capacity to analyze their production systems, identify problems, test possible solutions and eventually adopt the practices and technologies most suitable to their farming system. The DA Agricultural Training Institute (ATI) have encourage farmers to build up their knowledge, skills and climate response by making close observations and experimenting on the farm on various aspects of agriculture – crop response to various types of nutrients and amounts of water, soil and water management, how to build organic matter in soil, pest-predator relationship and growth cycles for ecological pests control (ATI 360 Farmer Field Schools). Farmers are making their own weather observations and use these and other agrometrological information in taking farming decisions (DA-ATI 2010).

(4) Aquasilviculture. Another environmentally-friendly and GHG mitigating mariculture system is aquasilviculture, the integration of aquaculture and mangrove forestry. This constitutes the integration of mangrove ponds and pens for fish and crabs (Primavera, 2000). Such systems not only sequester carbon, but they are also more resilient to shocks and extreme events and also lead to increased production due to improved ecosystem services.

There are more than 50 mariculture parks distributed in fourteen (14) regions from north to south and east to west. Each mariculture park includes a combination of cage and business models of high value commercial fishes like grouper, milkfish, siganids, seaweeds, and mud crabs and some cold storage and processing plants. Each mariculture park is established with a purpose as a breeding facility, tourism destination or research and development area. Because of the advent of climate change and globalization, most of our fishery scientists and researchers are now

also into challenging work on fishery development and business within mariculture parks. Activities in these parks include integration of research results and business trends for sustainable ventures for local community development (DA-BFAR 2008).

(**5) Agroreforestation:** Agroforestry as a management system that integrates perennial and annual crops in a two canopy or multi-canopy production system. This guarantees better exploitation of light, water and soil nutrients and protects soil more effectively from erosion and leaching. It leads to a more diversified and sustainable production system than many treeless alternatives and provides increased social, economic and environmental benefits for land users. The DA is aggressively promoting tree-based farming systems as part of a low carbon emissions development pathway and adaptation strategy. In the watershed areas of the Soil and Water Impounding Projects (SWIP) of the DA Bureau of Soil and Water Management (BSWM), indigenous agroforestry species are planted to provide watershed protection and additional source of food to the farming community.

SCALING UP

What has been presented constitute a considerable knowledge gaps relating to the suitability and use of these production systems and practices across a wide variety of agro-ecological and socio-economic contexts and scales. There is even less knowledge on the suitability of different systems under varying future climate change scenarios and other biotic and abiotic stresses. However, in many cases even existing knowledge, technologies and inputs have not reached many farmers. For this to be achieved there is a need for polices, infrastructures and considerable investments to build the financial and technical capacity of farmers (especially smallholders) to enable them to adopt climate-smart practices that could generate economic rural growth and ensure food security. Early action is needed to identify and scale up best practice, to build capacity and experience, and to help clarify future choices.

The search for viable and sustainable solutions to address the challenges of climate change in the developing countries should brought into focus a diverse range of approaches and policy options, one of which is improving access to and use of knowledge, science, technology and innovation.

THE DA NATIONAL FRAMEWORK STRATEGY ON CLIMATE CHANGE ADAPT AND MITIGATION

The Government of the Philippines, through its national agencies, specialized committees, and task forces, continue to excerpts efforts to address climate change and its challenges. As such, there have been programs and projects in place as well as climate change-related studies and researched conducted. There are also expected activities to improve the country's capacity through the adoption of the best management and conservation practices.

It is clear that continued poverty reduction will be severely hindered unless the impacts of climate change will be address with proactive attention to help our farmers and fisherfolks adapt to already unavoidable impacts. The DA therefore must devise appropriate adaptation and/with mitigation measures to respond to projected increases in the intensity of weather events. Failure to do so will result in severe social costs and threaten the country poverty reduction efforts. The DA policy framework on climate change consists of seven (7) major thrusts.

1. All DA programs and projects shall take into consideration the risks of climate change to agriculture and fisheries production and to the rural families, especially the poor, women, children and other disadvantaged sectors, that live on these vulnerable areas.
2. As enunciated in the National Framework Strategy (NFS) on Climate Change, the DA policy and program on climate change is anchored on two pillars, mitigation and adaptation with adaptation as the anchor strategy and mitigation measures as a function of adaptation. Adaptation includes anticipatory measures and strategies on impacts of climate change.
3. Also as clearly stated in the NFS, the program is risk-based. The agriculture and fisheries sector is no stranger to the risks of climate change as weather disturbances are familiar causes of disruption of food production.
4. Both short and long term measures in climate change mitigation and adaptation engaging various sectors representing consumers and producers shall be adopted.
5. The science and technology sector shall be fully engaged and supported to spur innovation in developing tools, technologies and best practices of local communities for climate change mitigation and adaptation.
6. The practice of providing agricultural inputs through centralized procurement shall cease as this practice breeds corruption and severely limits the implementation of the program.

7. Financing mechanism that are not debt creating and cost transfer strategies are of overriding importance in the DA action plans in adaptation with mitigation potentials.

Adaptation Strategies

Adaptation strategies refer to tools, technologies and practices that if widely adapted will help minimize the adverse effects of climate change to agriculture and fisheries. These adaptation strategies include disaster risk reduction and including early warning systems, water conservation, water use management and efficient water storage and delivery systems, precision agriculture, climate change adaptive crops, aquaculture species and livestock breeds including early maturing crops and fishes, climate resilient agri-fishery infrastructures and urban agriculture.

Mitigation Strategies

Mitigation strategies refer to tools, technologies and practices that if widely adapted will help reduce carbon emissions from food production or provide carbon sinks to reduce the volume of greenhouse gasses that rise into the atmosphere. Reduction of direct and indirect GHG emissions from food production may be achieved through the following: (1) organic farming practices, (2) soil conservation practices and changes in crop cultural management practices, (3) novel feed formulations, (4) intermittent irrigation for paddy rice, (5) farm waste management, (6) biotech crops, (7) biological inputs such as bio-pesticides, and (8) energy-efficient and green agri-fishery machineries including transport vehicles. The provision of carbon sinks includes the marine ecosystem and agro-reforestation with perennial fruits and multipurpose tree species including but not limited to coconut, malunggay (moringa), and seaweed farming.

Adaptation with Mitigation Potentials

Distinguishing between mitigation and adaptation remains useful especially in organizing responses and measuring results. However, it does not speak to the need for combining efforts when a strong synergy exists between mitigation and adaptation actions. Many interventions can be made to simultaneously reduce emissions and increase climate resilience. It is in this context that the DA strategies on climate change are generally geared towards adaptation with mitigation potentials. On both counts, more integrated approaches are of utmost importance, and have to be implemented soonest. The DA is aggressively facilitating a more integrated climate change solutions in the agricultural and fishery sectors.

Policy Implementation

Considering that adaptation and mitigation measures to climate change will be effective only if adopted widely by the producing sectors, the Department shall employ the following policy instruments to ensure rapid and wide adaptation (www.da.gov.ph).

(1) Climate information system for agriculture and fisheries,

(2) Research and development for adaptive and mitigation tools, technologies and practices,

(3) Fully engaged extension system,

(4) Role of women and other sectors,

(5) Repair and modernizing of irrigation systems and establishment of SWIPs and SFRs, (6) climate resilient agriculture and fishery infrastructures,

(7) Regulations to ensure effectiveness and safety, and

(8) Windows for financing and instruments for risk transfer

12.2 ADOPT A WATERSHED MANAGEMENT FRAMEWORK [17]

The ecosystem based approach requires watershed as the planning domain. This is embodied in Chapter 18 of the Agenda 21 for States Government: "Protection of the quality and supply of freshwater resources: Application of integrated approaches to the development, management and use of water resources".

The National Convergence Initiative (NCI) compose of the DA, DENR, and DAR and headed by the DA Secretary adopted the watershed and ecosystem management approach in the implementation of the NCI project. A watershed approach in agriculture and natural resources (ANR) will allow stakeholders to focus on issues that transcend administrative boundaries and greatly increase their understanding of poverty and environment challenges. A watershed approach is needed because planning and management decisions in one part of a watershed can have significant impacts on natural resources elsewhere. Watershed and ecosystem management is holistic, collaborative, multiple use and sustainable management of all resources within a watershed

A watershed blueprint would incorporate and integrate individual natural resource management plans. It would set priorities for the watershed as a whole, consistent with national and provincial policies, and in line with the specific areas for action promoted by DENR water policy. It would enable communities and the local government to reconcile competing demands for natural resources and balance long-term environmental outcomes and social and economic aspirations. Ideally, responsibility for preparation of a watershed blueprint will be given to a watershed management organization that transcends administrative boundaries and understands the implications of competing or conflicting use of the watershed total resources.

Figure 8. Framework on Watershed Management (source: Godilano, E. C. 2003)

A successful community stewardship of a watershed requires "top down" interventions such as (1) policy, (2) funding, (3) institution building, and (4) technical support, and (5) enforcement. Illustrated in Figure 9 is a holistic framework on watershed management that includes the coastal and marine ecosystems (from ridge to rivers to reef) and catchment basin. The framework can be divided into three major pillars. Pillar 1 deals with the green economy (land based), Pillar 2 deals with urban development where settlement and urban agriculture could co-exist, and Pillar 3 on the blue economy (coastal and marine ecosystems). For each pillar, major zones are identified and the possible interventions that the community and LGUs can implement. One of the major benefits that the stewards can derive is on the water rights which could provide income to the community. Green mining is being advocated.

[17](1) Watershed or catchment or basin or drainage area refers to any topographically delineated area that can collect water and is drained by a river system with an outlet. It includes all land areas extending from the ridge down to the stream for which water is collected (Brooks, et al., 1981). (2) A watershed is the land drained by a stream or fixed body of water and its tributaries having a common outlet for surface runoff (PD 705 Revised Forestry Code of the Philippines).

The Green Pillar could be divided into six major components namely: (1) core zone, (2) protection forest, (3) plantation forest, (4) upland ecosystems where green mining could be located, (5) lowland ecosystems, and (6) water resources particularly sources of fresh water for domestic consumption. We anticipate the critical issues on water rights once the watershed is sustainably managed by the communities. The yellow pillar consists of settlements in the urban and rural areas that form the catch basin of a watershed. They are most vulnerable to impacts of sea level rise, storm surge, and coastal erosion. The blue pillar consists of the coastal and marine ecosystems. We believed that the survival of the communities living in the coastal areas as well as the ecosystems is dependent on a well managed watershed.

CONCLUSION

Climate change and the related extreme events have been occurring too rapidly, and the poor and the marginalized farmers and fisherfolk who have been generally resilient to ecological changes, are finding it hard to cope with the rapid changes. The overall challenge for climate policy is to find an efficient mix of mitigation and adaptation solutions that limit climate change and its impacts. This paper has shown that in the agriculture, forestry and fisheries sectors, many mutually re-enforcing synergies and benefits exist among mitigation and adaptation actions and overall development goals. But we have also recognize that the agriculture and natural resource sectors are also major contributors to GHG emissions. Without a significant contribution from these sectors, it will be impossible to realize the global climate change mitigation target. The ANR sectors offer high potential for climate change mitigation, mainly through carbon sequestration but also through reducing GHG emissions. Opportunities exist in agriculture sectors for capturing the synergies among climate change adaptation, mitigation, food and water security and sustainable development.

To conclude, there's no silver bullet when it comes climate smart agriculture, a broad set of technical skills will be needed to plan for and respond to a wide range of unpredictable contingencies, and the backbone of these efforts will be improved knowledge, coordination, collaboration, information exchange, and institutional responsiveness. Building resilience— especially among the poor— will require enhancing the adaptive capacity of our farmers and institutions to deal with uncertainties in their local settings through the testing and scaling down the output of research. In addition, a large scale climate literacy program is necessary to prepare farmers, who are today bewildered by the rapid fluctuations in weather conditions that affect their livelihood. Their traditional knowledge

does not help them to manage these recent anthropogenic changes. Adaptation strategies have long lead times and need to start NOW.

MOVING FORWARD

Climate Smart Agriculture (CSA) will only be attractive to farmers if its adoption is incentivized either in terms of high-level financial incentives or in terms of significant gains in productivity. CSA practices will not be adopted without these gains or incentives being spread throughout the community of smallholder farmers and for that there is a need for an enabling environment, encompassing everything from strong governance, better infrastructure and access to markets and better access to inputs including finance, seeds and systems of extension.

Policies need to be developed to incentivize and reward climate smart practices, including carbon sequestration. Education, training and knowledge will also be critical - including early warning systems to alert farmers to weather changes, along with support and promotion through farm extension services and insurance. In addition, we need increased support for research, development and technologies, to ensure wider availability of CSA.

For agriculture and fisheries to be effective however, a positive incentive-based approach to be part of the solution to mitigate and adapt to climate change is urgently needed. This could be done through the establishment of the right incentive mechanisms, supported by an international carbon accounting framework that recognizes the sequestration capacity of agricultural activities. This is meant to support farmers in bearing the cost of climate mitigation and adaptation. An incentive-based approach to climate mitigation and adaptation, as opposed to a penalty-based approach, will have a positive long-term effect on the modernization and sustainability of the agricultural sector **(Box 2)**.

Climate policy should take into account the need to support global and national food security by promoting synergy between food and water security, research, poverty, social justice, and climate mitigation and adaptation. Three broad policy efforts would foster low carbon technologies. Firstly, government funding for RandD would support the development and improvement of a wide array of possible long-term technologies for GHG reduction. Secondly, a market-based climate policy, such as cap and trade, would put a price on GHG emissions. Finally, complementary policies are needed to address barriers to the use of climate friendly technologies **(Box 3)**.

Given the growing demands for food and water, we believe that rather than pursuing blanket reduction targets for GHG emissions in agriculture, governments should commit to climate change adaptation with mitigation through improved and sustainable agricultural productivity across multiple factors including water use, carbon efficiency, improved nutrient use efficiency, and land-use intensity.

Box 2: Agriculture Mitigation Potential

The mitigation potential of agriculture is estimated to reach 5.5-6 Gt of CO2 equivalents per year by 2030, which is enormous relative to its emissions which represent 13.5% of global anthropogenic GHG emissions, 89% of this potential can be accounted for by soil carbon sequestration, while 70% of the total mitigation potential can be realized in developing countries (IFAP, 2009).

Box 3: Policy Imperative

Without additional policies in agricultural, N2O and CH4 emissions are projected to increase by 35-60% and ~60%, respectively, up to 2030, thus increasing more rapidly than the 14% increase on non-CO2 GHG observed from 1990 to 2005 (Smith 2007).

We believed that CSA measures need to be integrated into the overall development approaches and agenda. Adaptation and mitigation measures, which require poverty reduction and food security, must be customized to benefit the neediest of the needy and at the same time must benefit the most vulnerable communities without harming the environment. Every ton of carbon added to, and stored in, plants or soils removes 3.6 tons of CO2 from the atmosphere. Furthermore, biomass from the agricultural sector can be used to produce biofuels or biocharcoal, which can substitute for a portion of the fossil fuels currently used for energy and household cooking (PEW 2009). CSA measures to meet ecological, economic, and socially sustainable goals towards achieving food security and poverty reduction have been identified by the World Food Summit, the Millennium Development Goals (MDGs), and the United Nations Framework Convention on Climate Change (UNFCCC).

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12.3 COASTAL ZONES [18]

Overview

This Module discusses how the coastal zones are affected by climate change through an impact chain analysis of the different climate change stimuli and the resulting impacts. A Vulnerability Assessment Framework based on the 4th Assessment Report of the IPCC (IPC-AR4, 2007) is presented. A case study on the vulnerability of Manila Bay area to the impacts of relative sea level rise is presented .

The coastal zone is a dynamic area where different forces of nature act to shape what it is now. These are also one of the most productive areas in a given locality where majority of people find settlement and economic opportunities. For these reasons alone, the coastal zone area is one of the most vulnerable sectors, particularly in a developing country like the Philippines.

The human and natural systems along the coasts may be impacted by sea level rise and increase in storm intensity Rising seas may contribute to enhanced coastal erosion, coastal flooding, loss of coastal wetlands, and increased risk of property loss due to storm surges.

Coastal inundation is likely to seriously affect the aquaculture industry and infrastructure, particularly in heavily-populated megadeltas. Stability of wetlands, mangroves and coral reefs is likely to be increasingly threatened.

Wetlands loss is estimated could mean food security threat particularly to island system. Between 24% and 30% of the coral reefs in Asia is likely to be lost during the next 10 and 30 years, respectively (IPCC, 2007). The Philippines is included in the coral triangle area in the Asia Pacific where the highest marine biodiversity is found.

The present module discusses the biogeophysical effects of sea level rise, which will depend on the system's susceptibility (or sensitivity) to those effects, and its natural capacity to cope with these effects [resilience and resistance (adaptive capacity)]. The expected impacts are increased flooding that could lead to permanent inundation of low-lying areas and salinization through saltwater intrusion. On marine resources, it is expected than warmer temperature would

[18] Prepared by Dr. Rosa Perez, The Manila Observatory, Ateneo de Manila University Campus for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

damage or kill corals. Higher CO2 in atmosphere can disrupt carbonate chemistry and can make shell and bone formation difficult. These biogeophysical impacts translate to socio-economic impacts, which include the following, among others:

- Loss of property and land
- Increased flood risk/loss of life
- Damage to coastal protection works and other infrastructure
- Loss of renewable and subsistence resources
- Loss of tourism, recreation, and coastal habitats
- Impacts on agriculture and aquaculture through decline in soil and water quality

Vulnerability and adaptation assessment in the coastal zone starts by answering the question of who are/what are vulnerable to what? A proper analysis of socioeconomic vulnerability to sea level rise requires a prior understanding of how the natural system will be affected. Hence, analysis of coastal vulnerability starts with the natural system response. In addition, other climatic and non-climatic stresses should be acknowledged in a vulnerability analysis, because sea level rise is not happening in a vacuum and coastal systems will evolve because of factors other than sea level rise. Major categories of management goals common to adaptation programs in coastal areas include:

- Maintain functioning and healthy coastal ecosystems.
- Reduce exposure and vulnerability of the built environment.
- Strengthen governance frameworks for coastal adaptation.
- Maintain livelihood opportunities and diversify options.
- Reduce risks to human health and safety.

Why do we then need to adapt to climate change?

- Future impacts are inevitable.
- Planned adaptation is cost-effective.
- Choices need to be based on potential future conditions, not the past.
- Natural resources systems will change.

Take home message:

Adaptation is meaningless if taken by different sectors as standalone efforts. An ecosystem-based approach should take into considerations the actions being done in the upland and forest ecosystems, the lowlands and the coastal zones, in an integrated way.

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13. CROP MODELING[19]

Climate change is now a reality and has profound effects and impacts on agriculture, livelihood, and socio-economic conditions in the Philippines. There is need to objectively assess the impacts of climate change to be able to identify and plan out appropriate adaptation measures in the most vulnerable areas in the country. There are a number of approaches and methods which can be used to estimate the effects and impacts of climate change. The resource person-trainor will present the different approaches and procedures involving modeling in assessing the vulnerability of agricultural production systems, evaluate the effects and impacts of climate change on crops and livestock, and estimate the crop damages and losses due to extreme climate events. Simple illustrative examples or case studies from past studies will be presented. Lessons and experiences from these projects will also be discussed.

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19 Prepared by Dr. Felino P. Lansigan, CAS UPLB for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan.

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14. INTEGRATED WATER RESOURCES MANAGEMENT AND THE ROLE OF LGUs[20]

14.1 WHY WATERSHED?

A watershed refers to any topographical area that can collect water and is drained by a river system with an outlet (Brooks et al., 1991). It is synonymous to catchment basin and drainage area. It includes all land areas extending from the ridge down to the stream from which water is collected (Cruz, 1997).

Watershed as a hydrologic system contains one or more ecosystems. Its properties are considered products of the interventions between its several components believed to be influenced by numerous factors. Since watershed properties and behaviors affect climate and human including their activities and vice versa, an integrated approach is the best option among other approaches to sustain the watershed and its resources.

Nowadays, watershed degradation in the Philippines is becoming severe and alarming. This condition may perhaps affect livelihoods especially for those who depend on farming and forestry activities. With the increasing population the pressure on natural resources is also increasing, thus, a higher menace on deforestation, soil erosion, poor water quality and low water supply.

With the destructive interventions of humans in the watershed and the abusive use of watershed resources, there is a need for integrated watershed management. And this could only be attain if there will be available watershed information, which will serve as basis in formulating researches, policies and technologies leading to conservation of the watershed and its resources.

[20] Prepared by Dr. Rex Victor O. Cruz and Dr. Edwin A. Combalicer, College of Forestry and Natural Resources (CFNR), UPLB for the Local Government Academy-Department of Interior and Local Government. Training Module on Formulation of Local Change Action Plan

14.2 WHY INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)?

IWRM is a comprehensive planning and implementation tool for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of ecosystems for future generations (Rahaman, Varis, 2005). An IWRM approach is a flexible process, bringing together all stakeholders and decision-makers that impact water resources, to set policy and make sound, balanced decisions in response to specific water challenges faced.

A watershed is the continuum of interrelated ecosystems from headwaters in the forestlands, the downstream areas or lowlands, to the coastal base and adjacent bays (IEMSD, 1997). Aside from upland or a mountainous landform, watershed may occur in lowlands and the area may be a residential, agricultural, industrial, educational, or experimental site. Watershed has a discrete geographical unit capable of providing water, timber and non-timber products, as well as intangible goods and services such as aesthetics and leisure.

The country is rich in water resources. It has 421 principal river basins with drainage area varying from 41 to 27,280 km2. Out of these 421 principal river basins, 20 are considered as major river basins, with each one having at least 990 km2 basin area. These major river basins cover a total area of 111,269 km2 equivalent to 37.1% of the total land area of the Philippines.

Based on a set of biophysical and socioeconomic criteria, watersheds in the country were prioritized by the DENR to serve as the basis for identifying the watersheds with the most urgent need for protection, development and

14.3 IWRM: WATERSHED AS A PHYSICAL FRAMEWORK

Reasons for the adoption of watershed as a physical framework of Integrated Water Resources Management are as follows:

- Over the years water is becoming scarce, polluted and becoming more saline, and expensive to develop. Among the Southeast Asian countries, the Philippines rank second to the lowest with 1,907 cu. meter per year.

- The loss of agricultural productivity increased every year. In the Philippines, the National Water Resources Board (NWRB) reported that about 16 million cubic meters of soil due to erosion from the major river basins in the country covering about 4.7 million cu. meter of watershed area contribute to the sedimentation of the National Irrigation Systems and hydraulic structures (NWRB, 2004 as cited by Ella, 2010).

- The income per capita in Asia has doubled in recent years but ironically, living conditions have deteriorated. The situation is exacerbated by extreme events and natural disasters like floods and landslides. Thus, the sustainability of growth is threatened. The Asian Development Bank (ADB) estimates that one billion people face water-related problems by 2050. The report further estimates that the cost due to climate change will reduce GDP in Asia by 7%.

- Water-related disasters are intensifying. The Philippines is naturally exposed to water-related disasters because of the country's geographical location. This natural vulnerability made the country one of most susceptible countries in the world in terms of weather disturbances. The occurrence of weather disturbances in recent years had been increasing and their intensities and destructive powers also increased. For the last 20 years, there had been 27 weather disturbances including 19 typhoons which inflicted the deadliest and costliest natural calamities.

14.4 WHY RIVER BASIN APPROACH?

Water from watersheds underpins security of human well-being, agriculture and fishery, public health, commerce and industry, ecology, energy and transport, recreation and tourism.

14.5 DRIVERS AND IMPACTS OF WATERSHED DEGRADATION

In the Philippines, the watershed management implications are attributable to a wide range of physical and socio-economic factors that are often complex and localized in nature. A typical problem tree of many watersheds in the country depicts the relationship of various drivers and its impacts. Climate change and deforestation are large multipliers of the watershed degradation which are typically blamed for flooding and water shortage in the downstream and agricultural lands.

Given the ecological importance of our watersheds and the extent of human dependence on the services, watershed degradation has potentially enormous environmental and socio-economic costs. Efforts to develop and use the services provided have not really been well integrated with efforts to protect and manage watershed ecosystems. An example is how vital economic resources like water are usually managed with policies, institutions, and practices that are disconnected from, or are even in direct conflict with, those designed to protect forests and other watershed resources. The result is putting watersheds at increased risk of degradation, hence jeopardizing water supplies and other vital ecosystem services beneficial to human societies.

The direct drivers of watershed degradation in the Philippines are briefly described below.

- **Deforestation and removal of natural vegetation**

  The latest forestry statistics (DENR-FMB, 2009) placed the large portion of forest cover to open forest with 4,030,588 ha or 56.23% of the total forest cover. A closed forest has the second highest coverage with 35.72% or 2,560,872 ha of the total forest cover. While plantation has the lowest area which is only 5% of the total forest cover.

  Forest cover in most watersheds in the Philippines have dwindled so much that only watersheds in Regions II, IV, VIII and XI have more than 30% of land area covered with forests. Regions V and VII have the least forest cover (Figure 3). Over exploitation of the forest resources and inappropriate land use practices have disrupted the hydrologic condition of watersheds, resulting in accelerated soil erosion, siltation of rivers and valuable reservoirs, increased incidence and severity of flooding and decreasing supply of water.

- **Upland agriculture**

  These include a wide variety of practices, such as absence or poor maintenance of erosion control measures, improper crop rotations, shortening of the fallow period in *kaingin* cultivation, insufficient or excessive use of fertilizers, and overuse of irrigation water. The expansion of cultivation into the uplands that are usually of inferior productivity potential and/or high vulnerability to soil erosion often leads to nutrient loss, water pollution (by sediment, pesticides, fertilizers) and general decline in the income from the use of land.

- **Forest resources utilization**

  Illegal logging continues to thrive in the Philippines because of poverty and weak enforcement of forestry laws. Hundreds of thousands of people in or near forest areas rely on illegal logging, *kaingin* or forestland conversion, firewood gathering and charcoal making for lack of alternative means of livelihood. Illegal loggers, along with *kaingineros*, firewood gatherers, charcoal makers and upland settlers, account for 80-90% of forest depletion. Normally, trees are cut indiscriminately, immature stands are harvested and there is no provision for reforestation.

- **Inefficient water resource management**

  Over extraction of water (for irrigation, urban and industrial use) from rivers and other surface water sources has led to reduced downstream availability. Where water is returned after use, it may have a higher salt content and/or be polluted from agro/industrial-chemicals and human wastes. Inefficient irrigation practices, wasteful urban/industrial water use and leakages from water delivery systems all contribute to water shortage problems, as does over-pumping of the aquifers. In many lower watershed areas, the intensive use of tube wells has led to abstraction of water in excess of natural recharge by rainfall and river seepage and a progressive lowering of the water table. In coastal areas, over-extraction of groundwater has resulted in salt water intrusion into the freshwater aquifer (a growing problem in parts of Cebu).

- **Unregulated land conversion**

  Uncontrolled land development for agricultural, residential, commercial and/or industrial purposes may contribute to degradation should such land uses or the management practices followed is unsustainable. Farm households affected by the conversion of agricultural lands to commercial, industrial, residential, and recreational purposes may be forced to seek land elsewhere, which in the land scarcity situation prevailing in the Philippines usually means moving into marginal uplands areas.

- **Pollution**

  Pollution coming from residential, commercial, industrial and agricultural areas has degraded the quality of water resources in many rivers in the country. Due to excessive pollution 16 rivers are usually biologically dead during summer months.

Indirect causes of watershed degradation are underlying reasons why inappropriate types of land use and management practices usually relate to the socio-economic circumstances of the land users and/or the social, cultural, economic and policy environment in which they operate.

The following are of particular importance in the Philippines:

- **Population growth and development**

  A growing population in the lowlands with its needs for increased urbanization and industrial development leads to an ever-expanding demand for water, electricity, timber, agricultural crops, recreation facilities, may lead to over-exploitation of watershed resources in the uplands.

- **Land tenure**

  The absence of long-term security of tenure for major stakeholders in the forestlands and the conflicts in the coverage and entitlements of various tenure instruments create confusion among tenure holders on which uses of the land and resources are legal and not. Aggravating these problems are policies with inconsistent provisions on land classification allocation and use. In particular, the provisions of PD 705 Mining Act of 1997, IPRA and NIPAS Law on jurisdiction and uses of watershed areas clash with one another leading to confusion in strategies and programs being undertaken. The multiplicity of land tenure instruments being issued such as IFMA, SIFMA, CCFS, CSC, CBFMA, CADT, CALT and CLOA under RA 7881 and 7950 also adds to the confusion of land-use within many watersheds.

- **Poverty and absence of viable livelihoods**

  Poverty is the underlying cause of much watershed degradation in the Philippines. The upland and mountain areas of the country are generally the poorest and least developed. The on-site users of watershed resources are predominantly rural. Lack of alternative income generating activities is dependent on unregulated farming and forestry activities for their survival.

- **Conflicting institutional mandates**

  There are no less than 30 government agencies that are invariably mandated to be responsible for usually very limited aspect of water resources development and management. As a result, the programs and thrusts

of these agencies that include DENR, DA, DAR and the LGUs are usually independent of each other and uncoordinated. There is a need to clarify the jurisdiction and scope of responsibilities among the various agencies as provided for in various legislations such as PDs 705, 1159, EOs 192, 223 and 224 of 1987, 258 of 1995, RAs 4850 amended by PD 813, RA 8371, LOIs 845 and 1002, and the Provincial Water Utilities Act of 1973.

Executive Order 216 of July 6, 2009 declared that the River Basin Control Office (RBCO) under the DENR is the lead government agency for the integrated planning, management, rehabilitation and development of the country's river basins. Under the leadership of RBCO it is hoped that the independent and uncoordinated programs of the more than 30 government agencies can be harmonized into a concerted effort with long lasting impacts on the sustainability of watershed and water resources.

- **Underpricing of watershed resources**

Several studies had been conducted on the valuation and pricing of water and other watershed resources (Cruz et al., 1997; Calderon et al. 2000; and Francisco et al., 2000). There is now a need to test which of the pricing and valuation systems work and which ones do not under certain set of conditions.

14.6 NEEDED INTERVENTION

Disconnect watershed and LGU boundaries

The four policy areas correspond to the four generalized land use areas within any given political/administrative unit or territory, i.e. areas for living (settlements), areas for making a living (production), areas taken up by infrastructures to connect and support the two areas (infrastructure), and the life support systems (protected areas).

LGU territorial jurisdiction

The concept and interpretation of the LGU territorial jurisdiction recognizes the following property domains: private, public, and ancestral. The private domain includes areas that are classified as alienable and disposable and have been titled to private owners or claimants. The private domain is completely under the authority of the LGU to regulate. Public domain lands such as

forests, national parks and similar reservations which are also embraced within the territorial limits of the LGU are traditionally the preserve of the national government and LGUs usually do not have anything to do with those areas.

Now, the national government intends to involve LGUs in the management of these areas and resources. Section 3(i) of the LGC declares that the LGUs "… shall share with the national government the responsibility in the management and maintenance of ecological balance within their territorial jurisdiction".

A third property domain that may occur within the territory of an LGU is the ancestral domain. The Indigenous People's Rights Act (RA 8371) declares these areas as exclusively for the use and occupancy of particular ethnic and cultural group that had occupied the area since time immemorial. The management plans of ancestral domains/lands, nevertheless, shall be integrated into the CLUP of the LGU having territorial jurisdiction over them (Part II, Sec. 2d, Rules and Regulations Implementing RA 8371).

14.7 THE ROLES OF LGUs

In the context of IWRM, identified roles of LGUs must be as follows:

- Strictly enforce zoning ordinances, CLUP – monitoring and transparency required
- Lead the conservation of uplands
- Enforce environmental laws
- Engage in an environmental monitoring system
- Mobilize and unite all stakeholders
- Lead multistakeholder planning and management

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15. BUILDING ALLIANCES, SOCIAL MOBILIZATION AND LEVERAGE SUPPORT[21]

Development concerns have been regarded to encompass social, economic and environmental dimensions of well-being, over time and space. Such diversity and complexity necessitates appreciation of development contexts, issues and solutions from various perspectives. Climate change is one development concern that vividly portray the importance of melding various disciplines and resource contributions from different actor groups in effectively responding to consequent climate-related development outcomes.

This Module tackles multi-stakeholder participation and the investment program in addressing climate change challenges. It solicits discussions on why participation is necessary, who gets involved, what is the task to be done, where and when action is situated, and how much and who moves forward the climate action agenda.

15.1 CONTEXT AND KEY CONCEPTS

Complex development issues such as climate change require multi-faceted solutions and the idea of partnership and social mobilization is inescapable. The science of this phenomenon has shown that it is best pursued when impact, cause and consequences to ecosystems and sectors, over time and space are pursued from various disciplines. The key questions to ask are why is there need for action? Who are responsible for what? Where and when is action most needed? How much and who will move actions forward?

Republic Act 9729 otherwise known as the Climate Change Act 2009 provides the policy framework in undertaking climate-related actions in the Philippines, foremost directing the creation of a Climate Change Commission and the crafting of a framework and strategy to guide related development initiatives. Sections 14, 15 and 16 of RA 9729 assert the distinctive but complementary role of different actors – government, non-government and business, with local governments at the forefront - in carrying-out the climate change action plan.

[21] Training Module on Formulation of Local Climate Change Action Plan. Local Government Academy-Department of Interior and Local Government with the Univeristy of the Philippines Los Baños Foundation, Inc. and College of Public Affairs and Development, U.P. Los Baños

Thus, social mobilization, partnership and leveraging support are key concepts that underpin climate change work defined/described below as:

Partnership / Alliance

The concept describes a relationship that is based on an affinity in interests, nature, or qualities.

Social mobilization

A broad scale movement to engage people's participation in achieving a specific development goal through self-reliant efforts (UNICEF).

Leverage support

The advantageous condition of having a relatively small amount of cost yield a relatively high level of returns; the ability to influence a system, or an environment, in a way that multiplies the outcome of one's efforts without a corresponding increase in the consumption of resources (The Business Dictionary).

15.2 TASKS AND ACTORS

Climate change impact is complex as consequences may manifest differently across sectors, location and time, much more pronounced across a wider geographic space but may also be true within small localities. It affects the natural as well as the social ecosystem in various ways and the nature and extent of these implications may require short to long term responses, involving practical to technical solutions.

Against this backdrop, RA 9729 aptly reckons that as many people get involved not only in understanding the phenomenon but in identifying appropriate responses to address its consequences. There is no one actor group who has monopoly in addressing climate change; each has a distinct role to play. This augurs well with Principle 7 of the Earth Charter on "having common but differentiated responsibility."

In the local government context, the planning process provide anchor to better understand and clarify roles and responsibilities for climate change action**. The 9-Step Simplified Planning Process** of the DILG walks through different stages of the planning exercise where each stage is a potential entry point for stakeholders

to get involved in climate change actions. The local government serves to play a lead role in moving forward its local plan – in this case, the local climate change action plan (LCCAP). The step runs through the revisiting of a locality's vision and situation which sets the context for the LCCAP, the determination of objectives, strategies and targets, the programming, budgeting and implementation, and finally, the monitoring and evaluation of the plan.

The present challenge for local governments is to sharpen sensitivity of the planning exercise in detecting climate change impact and challenges; to refocus existing plans and action towards greater climate change responsiveness; to identify critical areas for new activities and investments, where necessary; and to see how these may complement with related initiatives of other stakeholders' so that actions that augur support to climate impact in the locality are better coordinated and tighter in focus. In the end, the desire is to see more climate sensitive plans and investment programs.

Who should be involved?

The diversity of overlapping motivations for climate change action necessitates a system of organizing stakeholders. RA 9729 categorizes actors broadly in terms of development orientation – government, business, civil society (others). Another way of classifying climate change actors is how these actors are directly or indirectly involved with respect to undertaking the climate change action. In such case, internal stakeholders are those who are immediately involved on the plan preparation and those accountable for its execution. External stakeholders are those who will be engaged in the actual implementation of plan activities. There could be other ways of categorizing stakeholders. What is important to emphasize is the need for mapping and categorizing the diversity of actors involved, characterizing their problems, expectations, motivations, and their possible contributions to the climate agenda.

Contributions from actors may be of two forms: tangible and intangible. Tangible resources are those that are commonly seen (people, equipment, material, money; and environment/natural assets like land) while intangible resources are those that are not seen physically but have important bearing on the implementation of climate actions (knowledge, skills, values, culture, systems, policies and procedures). The availability as well as quality of these resources vary across actor groups and locations as climate effects also vary across area. Thus, complementation is necessary to ensure that the endowment of one actor group may be used to support constrained resource in another such that

Some advantages to joint contributions are as follows:

- Ensure alignment and consistency of purpose and strategy between and among stakeholder groups;
- Tap into wider networks of stakeholders and develop useful partnerships/ collaboration;
- Expand the base for external fund sources to augment or complement locally generated/available funds;
- Create efficiencies of scale resulting in saved time and money; sharing/ deepening expertise;
- Enable the development of broad-based response action and replication to achieve wider impact

Where is the arena for interaction?

When actor groups and resources have been fully scoped, it will be important to know where social mobilization, joint contributions, partnerships and leveraging will best flourish. Each actor group will likely align climate change actions along its own organizational interest as it seeks out avenues for cooperation in areas where it can further its strengths and augur support for its weaknesses. In examining such opportunities, typical categories where climate change actions may converge may be useful. Commonly, climate related actions are appreciated along three broad categories (and sub-category examples) below:

Program area:	Sector:	Issue:
• Climate Science	• Agriculture, Forestry and natural Resources	• Poverty
• Climate Impacts	• Health	• Gender
• Climate Policy and Law	• Water	• Equity and justice
• Climate Politics	• Industry	• Financing
• Climate Economics		
• Climate Ethics		

Using these broad categories, various actor groups are evaluated against best fit of organizational interest and resource capacity to surface areas of distinctive (dis)advantage as a basis for scoping joint contributions, collaboration and partnerhips for climate change actions. Among others, government stakeholders leverage on their access to local resources including those from bureaucracy (e.g. technical assistance, extension services, data); non-government actors have the advantage of skill in terms of organizing and advocacy; while the private

sector have more financial flexibility in undertaking research and other support activities. All these contributions are salient indication of how the different actor groups may augur support for implementation of the LGU's LCCAP.

15.3 REVISITING THE INVESTMENT PROGRAM

The investment program of the LGU is a critical expression of how the LCCAP is likely to turn reality since this is where resource requirement and source of financing for identified strategies, programs, projects and activities (PPAs) are revealed. In the revisiting of PPAs included in the investment program, special additional consideration is made on the climate-responsiveness of current efforts, addition of new initiatives for emergent needs, dovetailing of closely linked activities, dropping of redundant actions, among others.

Revisited PPA's are then further classified as ongoing (those currently implemented); new (those with most likely firm funding ready for implementation); and pipeline (those still without firm funding including those which are still in the process of review or compliance to other requisite conditions). Regardless of the PPA classification, the investment program already provide indication of the extent of financing gap, given internal and external sources available. This also provides basis for indicating areas where leveraging support from other actor groups may come in useful.

There are a number of local government financing options available from local sources (internal revenue allotment, local taxes), national government and private sector (grants), government financial institutions (e.g. LBP, DBP), government-private sector arrangements (Build-Operate-Transfer), and official development assistance (ODA) from bilateral (e.g. GTZ, CIDA, AusAid) and multilateral sources (e.g. WB, ADB, JBIC).

To assist LGUs in promoting climate change action with other partners, two useful guides are presently worth exploring:

1. PPP Manual for LGUs – Developing PPP in Local Infrastructure and Development Projects (available at http://ppp.gov.ph; and
2. Climate Change Adaptation Menu of Investment Options (available at www.undp.org.ph)

As the LGU has its own framework, process and mechanics for developing and reviewing its investment program, other actor groups undergo the same exercise. This Module asserts that local actions for climate change, as spearheaded by the LGU, is best ushered when other actor groups are able to leverage on common areas of interest, share in resources to move actions forward sustainably in the future since in the end - Together Everyone Achieves More!

16. CASE STUDIES AND BEST PRACTICES

16.1 OVERALL POLICIES AND STRATEGIES ON CLIMATE CHANGE OF ALBAY PROVINCE [22]

The Province of Albay gives priority to the enhanced provision of services to improve the climate change resiliency of its vulnerable communities. Local CCA is the battle cry of Albay CIRCA. Through CCA and mitigation measures that also provide means for attaining food security, water sufficiency, human health and security, sustainable energy, climate-smart industries and services, Albay hopes to prepare its communities for the intensified impacts of climate change.

For climate change adaptation, a cross-cutting, science and ecosystem-based approach that considers equity and social justice, the people's health, the state of coastal, water and forest resources/biodiversity, and agriculture, is being developed for the assessment of Environmental/ Ecological Stability. The release of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2007 informed the world of existing evidence showing discernible influence on many physical and biological systems of anthropogenic warming and the need for mitigation measures to prevent new emissions and adaptation to address impacts of past emissions.

For Albay, the usual point of land entry of tropical storms on the eastern Pacific seaboard of Luzon, this scientific information was vital to the conceptualization of the local policy and strategic response to intensifying meteorological events being experienced at the time.

The Albay experience helped bring about wide acceptance of DRR as the first line of defense. Innovative policies and strategies must be adopted to address the deadly combinations of impacts of volcanic eruptions, earthquakes, and climate change on the well-being and economic condition of communities. The building of resilient communities became the priority concern of the government.

[22] Climate Change Adaptation Best Practices in the Philippines. Promotion of Green Economic Development (PGED). Link: http://www.greeneconomy.ph/index.php?option=com_contentandid=149

SOCIO-POLITICAL ADVOCACY FOR GREEN ECONOMY

Armed with the global climate change premise, Albay initiated dialogue and collaboration with the scientific/research and academic communities, the government, business, religious, diplomatic and donor sectors, public intellectuals for the benefit, primarily of Alabayanon, for all vulnerable Filipino communities, and for the rest of the developing world. It was clear to the Provincial Governor that the threats were of such magnitude and intensity that the response could not be less than comprehensive and integrated at all levels.

Albay's socio-political advocacy sought to influence key national and local policy and decision makers in government to consider climate and disaster risks and concerns in socio-economic development planning and implementation. As a result, two very important declarations were formulated namely, the Albay Declaration in 2007 and the Manila Declaration in 2009, which were instrumental in the passage of the Climate Change Act (RA 9729) and National Disaster Risk Reduction and Management Act (RA 10121) and the creation of the Climate Change Commission and the NDRRMC.

Box 4. Socio-Political Advocacy For Green Economy

MAINSTREAMING DRR/CCA INTO LOCAL DEVELOMENT PLANNING PROCESSES FOR INTEGRATED PHYSICAL FRAMEWORK

Through the leadership of Governor Jose Ma. Clemente Salceda, all 15 municipalities and three cities comprising of 720 barangays in the province conducted assessment of the extent to which the existing CLUPs can respond to current and future natural and anthropogenic threats to development and public safety and identify areas for improvement for responsiveness to all threats and factors affecting local sustainable development goals. The effort also included the drafting of protocols for CLUPs preparation, review and revision and the adoption of final guidelines and procedures for nationwide implementation.

As a result, an integrated and watershed-based assessment and planning framework for comprehensive treatment of all development concerns and issues in the context of a changing climate and science-based protocols for DRR/CCA-sensitive decision-making were finalized.

Box 5. Mainstreaming DRR/CCA Into LDPP

16.2 SORSOGON CITY CLIMATE CHANGE VULNERABILITY ASSESSMENT [23]

The Province of Sorsogon where the City is located has been identified by a study of the Manila Observatory and the Department of Environment and Natural Resource to be at a Very High Risk category relative to combined Climate Disasters. Previous disaster events caused massive destruction in Sorsogon City with the most recent of them Super Typhoons Milenyo (September 2006) and Reming (November 2006) which took place in the last quarter of 2006.

Facing this challenge all the more becomes difficult for the city as it year-on-year continue to face climate induced disasters which does not only affect physical structures but more so social infrastructures that dampens its momentum in achieving sustainable urbanization. With the growing discourse on and concern about what climate change impacts could further bring, Sorsogon City took on the challenge of starting an initiative that would help the city learn and analyze what climate change could bring them given that indeed climate has changed and that what they initially thought of to be just a global or national issue, is really a local issue as the city (citing Reming and Milenyo experience) is at the front line of bearing the impacts and at the core of actions towards addressing them.

Given the city's established partnership with the United Nations Human Settlements Programme (UN- HABITAT), Sorsogon City worked with the said agency in a "learning by doing approach" to conduct a Climate Change Vulnerability and Adaptation Assessment (VandAA) using participatory approaches and processes. The Cities and Climate Change Initiative, a key component of UN-HABITAT's Sustainable Urban Development Network (SUD-Net), promotes enhanced climate change mitigation and adaptation in developing country cities. The general aim of this partnership is to provide insights on climate change adaptation and mitigation capacity in cities in developing and least developed countries. The assessment used a participatory Vulnerability and Adaptation process looking into the city's exposure, sensitivity, and adaptive capacity of the area vis-à-vis projected climate scenario, previous climate related disaster events and more importantly people's account of the past events and observations. A major outcome of the initiative was the development of a set of tools for mitigation and adaptation and the dissemination of the methodologies that would guide city managers and practitioners in a better position to cope with climate change.

[23] Mias-Mamonong, Adelaida Antonette and Yen Flores. "Sorsogon City Climate Change Vulnerability Assessment". United Nations Human Settlements Programme (UN-HABITAT). www.unhabitat.org.
Link: http://www.unhabitat.org/downloads/docs/10377_1_594134.pdf

MAINSTREAMING CLIMATE CHANGE IN THE PHILIPPINE EDUCATIONAL CURRICULUM

Training of Trainers (TOT) in August 2008 at Bicol University and Legazpi City for selected key teachers, principals, supervisors and superintendents of DepEd in the four Albay Divisions; drafting, reviewing, redrafting of all lesson exemplars through writeshops in collaboration with DepEd Central Office, UPLB and IPCC experts and scientists; TOT – Teaching demonstration simulation of final outputs; and reproduction and distribution to Albay schools. The product of these activities is a compendium of demonstrated lesson exemplars for all levels.

Box 6. Maintstreaming Climate Change in Philippine Educational Curriculum

Source: Climate Change Adaptation Best Practices in the Philippines. Department of Environment and Natural Resources. Link: http://climatechange.denr.gov.ph

HOT SPOT MAPPING

Sorsogon city undertook a hot spot mapping process as part of the vulnerability and adaptation assessment facilitated by the CCCI. Innovative mapping tools were used to integrate technical information with the local community observation in order to identify the effects of climate-related hazards such as sea level rise. Following this, a hotspot mapping process was undertaken to identify especially vulnerable areas. Maps displaying different hazards were overlayed; areas that displayed a multitude of different hazards could then be identified as climate hotspots. This information was then used by the stakeholder group to identify five priority hot-spot Barangays that will be the focus of demonstration projects. Local knowledge will also be employed and disseminated in the implementation process. Refer to the Participatory Vulnerability Adaptation Assessment toolkit (published by UN-Habitat) for more information and examples of the maps produced.

More info: http://www.unhabitat.org.ph/tools-andptechnologies/253-vaa-toolkit

Box 7. Hot Spot Mapping

COMMUNITY MAPPING

As part of the Cities and Climate Change Initiative (CCCI) project, the assessment team in Sorsogon City facilitated a participatory mapping exercise to support their climate vulnerability assessment. In this mapping initiative, community members shared their knowledge and mapped hazards in a low-lying neighborhood or Barangay. The workshops were designed to collect information on people's actual experiences and possible indigenous methods of observing and recording changes in temperature, rainfall, sea level and storm frequency. Information was confirmed by the project planning team and will be used to help update the existing City Land Use Plan and support policy work at the city's Disaster Coordinating Unit. This project was the basis for a vulnerability assessment toolkit published by UN-HABITAT. This guide is available through UN-HABITAT and contains valuable information about this and other important vulnerability assessment process.

More info: http://www.unhabitat.org.ph/tools-andptechnologies/253-vaa-toolkit

Box 8. Community Mapping

Source: Planning for Climate Change: A Strategic, Values-Based Approach for Urban Planners. UN-HABITAT.

16.3 CAMARINES SUR PROVINCE' EL VERDE COMMUNITY BASED APPROACH TO SEEDLING PRODUCTION[24]

The Provincial Government's El Verde Program aims to bring back the original rainforests and to create viable and productive farm agriculture in harmony with nature-with the objective of ending poverty, feeding everyone, protecting the environment and ensuring the productivity of the land for future generations. The program is a ridge-to-reef biodiversity conservation, economic development and climate change adaptation strategy in reversing the rate of deforestation in the province.

El Verde utilizes the "rain forestation" technology as its main tool in the rehabilitation process across all ecosystems. It focuses on the production and utilization of native tree species that ensure a more diverse stable ecosystem. Community-based nurseries and plantation adopt the Food-for-Tree Package Scheme. Communities are encouraged to set up their nurseries and the Program

[24] Climate Change Adaptation Best Practices in the Philippines. Department of Environment and Natural Resources. 2012. pp 63-66. Link: http://climatechange.denr.gov.ph

pays them 1 kilo of rice for every eight seedlings they produce. In plantation development including maintenance and protection work, partners are given a kilo of rice for every 25 seedlings that they can plant in any of the priority areas. Partners were also given orientation and skills development training on forest rehabilitation and other benefits such as educational assistance and Philhealth coverage as incentives.

After a year of implementation, the El Verde Movement was able to plant around 5.8 million trees of indigenous species, 3.4 Million of which are planted in mangrove areas. The number of trees planted on the onset already represented 44% of the total target of 12 million trees. Aside from contributing to the rehabilitation of the denuded forest, El Verde has provided food for more that 7,000 families who are partners in the said efforts. The program was also able to maximize indigenous learning and experiences on native species and their uses. By combining scientific approaches and local knowledge, El Verde has identified and produced, in a large scale, at least 60 native species of forest and fruit trees.

16.4 PISTA Y ANG KAGUEBAN (FEAST OF THE FOREST) OF PUERTO PRINCESA CITY, PALAWAN[25]

Considered as the country's "Last Frontier" for having been the last area in this part of the world to be ravaged by man, Puerto Princess and Palawan boast of mountains and valleys of lush virgin forests with century old trees of various species, softwood and hardwood alike. Its flora and fauna are the image of God's perfect creation, teeming with wildflowers and wildlife that are endemic in Palawan alone.

However, the forest cover of Palawan, including Puerto Princesa City, was reduced tremendously from 75% in 1976 to 50% in 1992. Some parts of the city soon began to experience flash floods during heavy monsoon rains. To rehabilitate the denuded areas, the City Government embarked on a massive reforestation scheme dubbed as "Pista Y and Kagueban" or Feast of the Forest. Community organizing, the use of mass media and the people's natural penchant for festivities or "pistas" have kept the tree planting culture alive.

[25] Climate Change Adaptation Best Practices in the Philippines. Department of Environment and Natural Resources. p. 283. Link: http://climatechange.denr.gov.ph

Having successfully mobilized thousand of people from all walks of life every year, Pista has greatly succeeded not only in terms of the number if trees actually planted but also in inculcating the proper attitude among the Puerto Princessans toward tree planting and conservation, making it the "in" thing to do.

Coupled with conservation and protection efforts, Puerto Princesa City achieved a 2,088.3-hectare increase in its forest cover. The environmental consciousness of the Puerto Princesans is considered the highest in the country and the city was recognized as "carbon-negative" after a greenhouse gas inventory was conducted using the guidelines from the Intergovernmental Panel on Climate Change (IPCC).

Pista Y Ang Kagueban is now believed to be Asia's oldest and most dynamic tree-planting festival and the centerpiece of the Puerto Princesa's environmental, cultural and social evolution.

16.5 GREEN POLICE VOLUNTEER PROGRAM OF PASIG CITY[26]

Lack of opportunities in the provinces has attracted people from the countryside to migrate to Pasig City, thereby creating socio-economic and environmental pressures and challenges for the City. Development in the city required improved environmental conservation and protection. The City Administration in 2007 crafted the Pasig Green City Program through the creation of 700 Green Police volunteers from the 30 barangays who were trained as enforcers and implementers of environmental and climate change mitigation and adaptation projects. They receive meal and clothing allowance from the City Government. The Green Police volunteers conduct monitoring on enforcement of pertinent ordinances such as the banning of the use of plastics and styrofoam, anti-littering, anti-smoking and implementation of recycling programs.

Pasig city took a paradigm shift so that its development would be sustainable. The city supported its City Environment and Natural Resources Office in leading the consultations in different communities using multi-sectoral, multi-disciplinary and top-to-bottom and bottom-up approaches.

[26] Climate Change Adaptation Best Practices in the Philippines. Department of Environment and Natural Resources. p. 290. Link: http://climatechange.denr.gov.ph

As a result, the city was able to plant 50,000 trees to promote absorption of carbon dioxide and air pollutants. Over 60,000 advocacy campaign materials were distributed to school officials, business establishments and other key stakeholders. These materials did not only emphasized proper environmental conservation messages but also the health hazards brought about by improper practices against the environment. The outcome was a heightened people's awareness on proper environmental protection and management. Also, about 90% decrease of environment violations has been recorded because of the awareness campaign and visibility of the Green Police.

16.6 PARADIGM SHIFT FROM LIVELIHOOD TO ENTREPRENEURSHIP: THE CASE OF SURIGAO DEL NORTE-DEL CARMEN, SIARGAO ISLAND[27]

The municipality of Del Carmen uses a framework for development based on the concept of ecosystem balance. The Ecotown Framework is about the convergence of various efforts to ensure that the whole community is sustained to support the next generations. Programs of various agencies and private organizations are all pooled together to achieve a goal of equipping the town and its people with the ability to adapt to climate change.

The paradigm shrift from livelihood to entrepreneurship involved changing the practice of producing only raw materials to producing product with longer shelf life and using small packages and focused marketing. The practice started in 2011 and is continuing up to present.

Through the support of the Department Trade and Industry, Department of Agriculture, Department of Science and Technology and the Department of Labor and Employment, the program was able to demonstrate that community resources can create year-round business ventures supported by the whole community. They were also able to make the supply chain climate resilient—from production of raw materials to distribution of end products.

To accomplish these, the Local Government of Del Carmen ensured that the community was able to develop a climate resilient business plan. Education and capacity building for the community partners were important components of the program. The barangay units and people's organizations have been educated on the concept of entrepreneurship that is "green" and sustainable and can generate income for the community so that it will be prepared to face climate change and other risks, decrease dependency on the local government and attain sustainable development.

27 Climate Change Adaptation Best Practices in the Philippines. Department of Environment and Natural Resources. p. 351. Link: http://climatechange.denr.gov.ph

16.7 INTEGRATED RICE-DUCK FARMING SYSTEM (IRDFS) IN ZAMBOANGA DEL SUR[28]

The climate change adaptation initiative of the province is its modest way of responding to the global call in mitigating global warming. The main practice introduced support the basic strategy "Go Organic: Live Long, Live Life" and addresses the immediate concerns on food security for the people of Zamboanga del Sur.

Current practice in rice production requires the intensive use of agro-chemicals which are harmful to the environment, as they eventually find their way into water bodies, and worse, get deposited in animals and human being, in toxic proportions. This practice involves self-sufficient community-based organic rice production through integration of rice and duck farming systems. Rice and ducks are reared in the same area to complement each other's production requirements. In the process, making use of natural weeding and pest control measures discourages long-term use of agro-chemicals. This environment-friendly practice effectively reduces or eliminates the use of insecticides, herbicides and inorganic fertilizers; thus, addressing climate change and related issues.

The first project was implemented in 2008 to 2011 by establishing a Central Techno Demo Farm at R. Magsaysay, Zamboanga del Sur and is now being replicated in various areas in the province.

16.8 SUSTAINABLE SHELTER IN AN AGE OF CLIMATE CHANGE AND DISASTER: THE CASE OF THE FISHERMEN'S VILLAGE HOUSING PROJECT IN SAN FERNANDO CITY

The City of San Fernando, a coastal city that has a shoreline of almost 20 kilometers stretching to 14 barangays, is no stranger to the impacts of the changing climate having been frequently visited by typhoons and storm surges. Dwellers along coastal areas, mostly informal settlers whose houses are made of light, wooden or makeshift materials, rely on the existing system of rescue, evacuation and rehabilitation in times of calamity. The City often doled out relief

[28] Ibid, 378

goods and extended services including house repairs of the affected families. This was a cycle that developed a culture of dependency on the government and donor institutions.

To break this cycle and to address the impacts of climate change, the City initiated a housing project, the Fishermen's village, which relocated families, particularly fishermen families along the shoreline to a safer area with houses that can withstand the effects of the changing climate. To ensure the sustainability of the housings project, the City aimed for relocation also along the shoreline so as not to deprive the fishermen of their livelihood.

The primary strategy was partnership. First, there is a well-defined development orientation or convergence driver: from the goal of relocating the beneficiaries from a risky situation to safety. Second, the mechanisms for the partners' involvement is well defined. Third, the clearly defined operational processes are in place. The City Government also enacted clear policies, and capacity building activities were instituted to ensure that even after partners leave the project, the beneficiaries would have both the physical infrastructure and the capability to manage them. Most importantly, the project implemented a cost-recovery scheme to change the mindset of the beneficiaries from dole-out to stakeholdership. To ensure that the fishermen would be able to pay contributions, local government through the support of partners provided livelihood opportunities for them.

The Fishermen's village is now livable and happily occupied by the identified beneficiaries. Collection rate for amortization is increasing steadily and the community is now a model for housing projects not only in San Fernando City but also in other areas.

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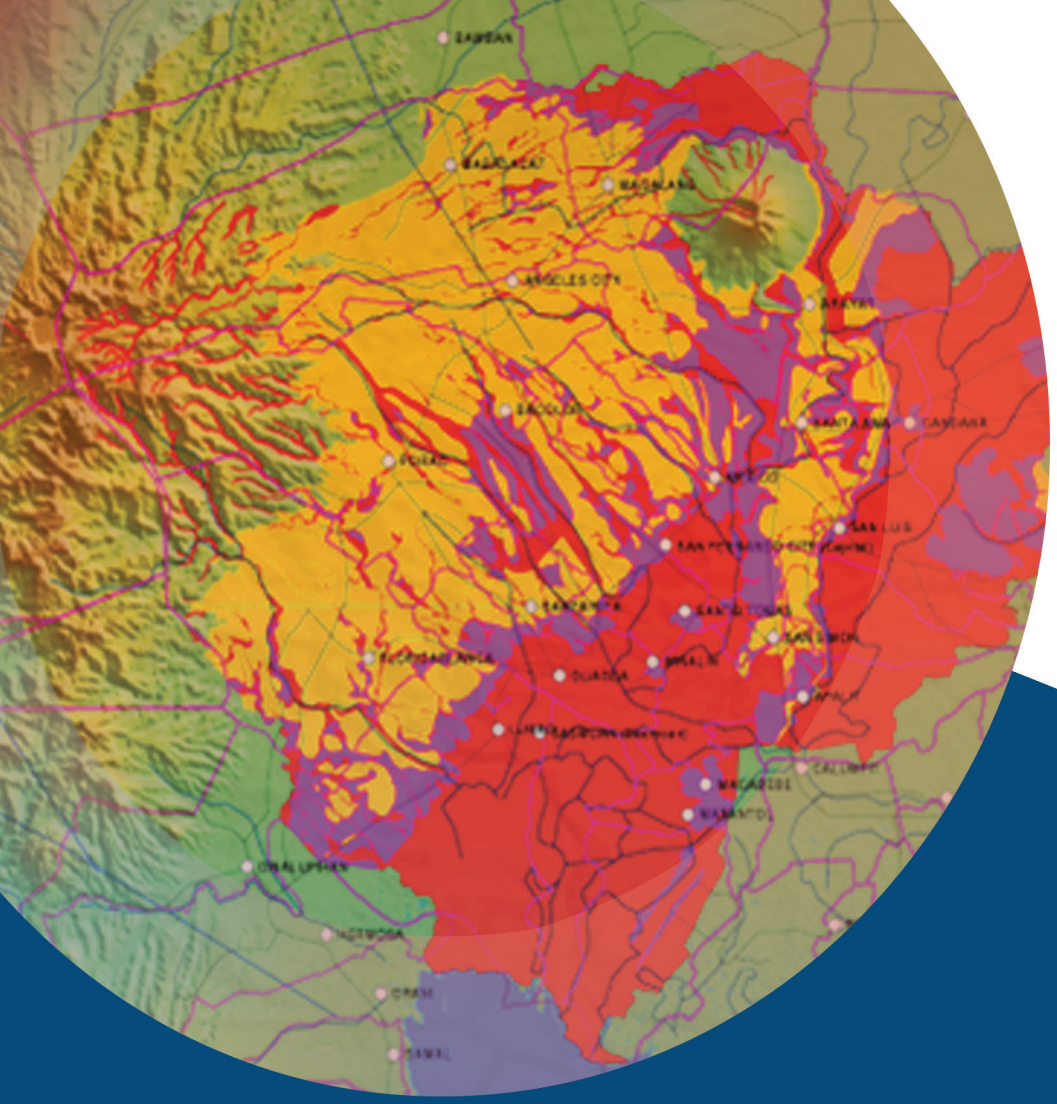
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