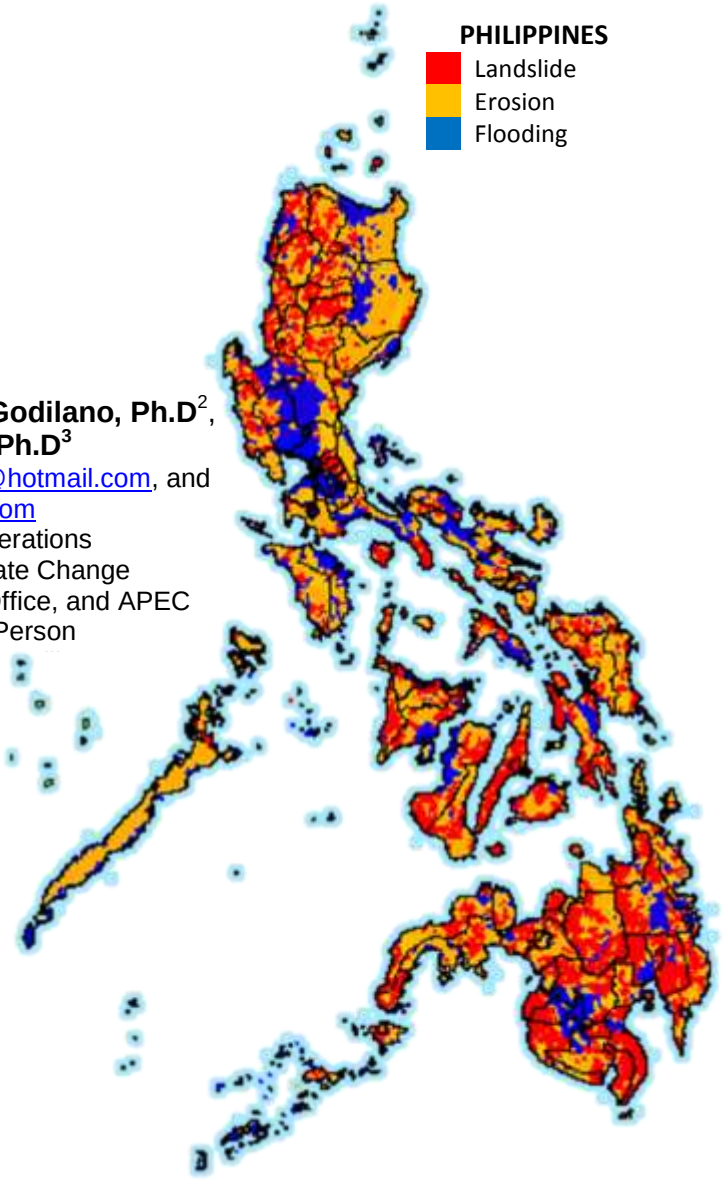
IMPLEMENTING CLIMATE SMART AGRICULTURE
Ridge - River - Reef: The Philippine Adaptation and Mitigation Initiative for Agriculture



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ACCRONYMNS and ABBREVIATIONS

ADB	Asian Development Bank
AMIA	Adaptation and Mitigation Initiative in Agriculture
ANR	Agriculture and Natural Resources
APEC	Asia - Pacific Economic Cooperation
ASEAN	Association of South East Asian Nations
AWD	Alternate-Wetting and Drying
BAI	Bureau of Animal Industry
BAR	Bureau of Agricultural Research
BFAR	Bureau of Fisheries and Aquatic Resources
BSWM	Bureau of Soils and Water Management
CSA	Climate Smart Agriculture
DA	Department of Agriculture
DAR	Department of Agrarian Reform
DENR	Department of Environment and Natural Resources
DRRM	Disaster Risk Reduction and Management
EFFS	Enhanced Farmers Field School
EMB	Environmental Management Bureau
EnRD	Environment and Rural Development
FAO	Food and Agriculture Organization (UN)
FSSP	Food Staples Sufficiency Program
GDP	Gross Domestic Product
GIZ	German International Cooperation
GIS	Geographic Information Systems
GHG	Green House Gas
GOP	Government of the Philippines
HMU	Hazards Management Unit (WB)
ICT	Information and Communication Technology
IFPRI	International Food and Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agri-biotech Applications
LGU	Local Government Unit
MDG	Millennium Development Goals
NAST	National Academy of Science and Technology
NCCAP	National Climate Change Action Program
NCI	National Convergence Initiative
NDRRMC	National Disaster Risk Reduction Management Council
NIA	National Irrigation Administration
NIS	National Irrigation Systems
NFS	National Frameworks Strategies
NSCB	National Statistical Coordinating Board
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Service Administration
RFU	Regional Field Units
SAFDZ	Strategic Agricultural Development Zone
SALT	Sloping Agricultural Land Technology
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDD	Small Diversion Dam
SFR	Small Farm Reservoir
SRD	Sustainable Rural Development
SSIP	Small Scale Irrigation Project
STW	Shallow Tube Well
SW-CCO	Systems Wide Climate Change Office
SWIP	Soil and Water Impounding Projects
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
WB	World Bank

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ABSTRACT

Based 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. In an analysis of natural disaster hotspots by the Hazard Management Unit (HMU) of the World Bank (WB 2005), the Philippines are 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.

We also recognize agriculture as a major user of freshwater and fossil fuels is also 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. 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. CSA gives attention to landscape approaches, for example, integrated planning of land, agriculture, forests, fisheries and water to ensure synergies are captured.

This paper provides preliminary results of the geospatial analysis on the impacts of climate change to Philippine Agriculture provides some examples of CSA practices by farmers and those that are promoted by the Department. It also examines key policy, technical, institutional, and financial responses required to achieve the transformation to CSA. Building on the DA National Frameworks Strategies (NFS) on climate change and policy directives based on existing laws. We 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, consistent on the integrated ecosystems management based on "ridge-rivers-reef".

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1. INTRODUCTION

Climate change threatens agriculture 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. We argue that agriculture must become central to future climate-change discussions, because it contributes a significant proportion of GHG emissions.

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. 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.

1.1 Agriculture as part of the solution

The Philippine economy is heavily based on agriculture; we believed that 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 national goals, and often compromises production and development in the longer term. Agriculture can be a part of the solution: helping our people to feed themselves and adapt to changing conditions while mitigating climate change. We need agriculture that will strengthen food and water security, adaptation and mitigation. We need agriculture that can contribute to sequestering GHG emissions and capturing carbon in the soil.

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).

1.2 **Climate-Smart Agriculture**

Climate-smart agriculture gives attention to landscape approaches, for example, integrated planning of land, agriculture, forests, fisheries and water to ensure synergies are captured. It includes proven practical techniques and approaches that can help

achieve a triple win for food security, adaptation and mitigation. 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 (Stapleton 2011).

CSA 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.

This paper provides preliminary results of the geospatial analysis on the impacts of climate change to Philippine Agriculture; offers some examples of CSA practices by farmers and those that are promoted by the Department of Agriculture. It also examines some of the key technical, institutional, policy and financial responses required to achieve the transformation to CSA that is consistent with the DA National Frameworks Strategies (NFS) on climate change and policy directives supported by existing laws. We 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 integrated ecosystems management based on “ridge-rivers- reef”.

2. 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. The recent WorldRisk Report 2011 (http://ihrrblog.org/2011/09/26/2011-un-world-risk-index) reported that the Philippines ranked third among the 173 countries in the world in terms of disaster risk index (**Table 1**). ASEAN countries are likewise included for comparison.

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% 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% 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.

Table 1. Top five countries and ASEAN ranking on vulnerability to disaster.

Rank	Country	Risk (%)
1	Vanuatu	32.00
2	Tonga	29.08
3	**Philippines**	**24.32**
4	Solomon Islands	23.51
5	Guatemala	20.88
7	Timor-Leste	17.45
9	Cambodia	16.58
14	Brunei Darussalam	14.08
28	Indonesia	11.69
34	Vietnam	11.21
57	Myanmar	8.54
85	Thailand	6.86
91	Malaysia	6.69
104	Lao PDR	5.80
153	Singapore	2.85

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 (World Bank 2005). Basic statistics on poverty incidence, of which 75% of those affected by poverty are in the rural areas, 41% are fishers and 37% are farmers, and these are the most vulnerable to the impacts of climate change (NSCB 2010). Farmers' income is compromised because livelihoods in the farm and fishing communities are threatened by the destructive effects of climate change

Climate change is one such risk that will complicate and compound existing development problems in the country such as population growth (**Box 1**), rapid urbanization, increasing competition for natural resources, environmental degradation and, most importantly, food insecurity. Already over the last fifty years the country has experienced a range of observed climate changes including declining precipitation, increasing water scarcity, rising average temperatures and growing frequency of extreme weather events such as storm and flood. During the last decade alone agriculture is incurring losses averaging of 189 million USD with average 600 loss of lives who are mostly farmers and fisherfolk that cannot be quantified in terms of economic losses. Extreme events even occurred twice a year. In the last four years alone, extreme event occured in Mindanao, which is considered to be the food basket of the country (**Table 2**).

Box 1. Philippine Population Projection

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.

Table 2. Destructive typhoons of more than 1 B PhP (25 M US$) annual total damage (sources: http://www.pagasa.dost.gov.ph/; www.da.gov.ph; http://www.ndrrmc.gov.ph/)

No	Months/Dates	Year	Name	Damage (B PhP)		Affected Regions
				Total	Agri	
1	Oct 2 to 6	1993	Kadiang	8.75	7.19	NCR, CAR, regions I to IV
2	Oct 30 to Nov 4	1995	Rosing	10.8	9.04	NCR, CAR, Regions I to V and VIII
3	Oct 20 to 23	1998	Loleng	6.79	3.7	CAR, Regions I to VI and VIII
4	Jun 20 to 23	2008	Frank	13.5	3.2	NCR, Samar, Bicol, Mindoro, and Iloilo
5	Sep 25 to 27	2009	Ondoy	11	6.77	NCR, Central Luzon, Calabarzon
6	Oct 2 to 10	2009	Pepeng	27.3	6.53	CAR, Pangasinan, Tarlac, Ilocos
7	Oct 18 to 21	2010	Juan	8.49	7.55	NCR, CAR, Regions 1, 2, 3, Rizal, Cavite
8	Sep 26 to 28	2011	Pedring	15	4.19	NCR,CAR, Regions 3, 4, 5
9	Dec 16 to 17	2011	Sendong	2.07	1.00	Cagayan de Oro, Iligan, Dumaguete, Negros Or.
10	Dec 2 to 9	2012	Pablo	36.95	26.53	Davao Or., Compostela, CARAGA, Palawan
Total (PhP)				140.65	75.7	
Average (PhP)				14.065	7.57	
Total (USD) Billion				3.52	1.89	Exchange rate: 1 USD to 40 Pesos
Average (USD) Million				351.63	189.3	

Food security is compromised by the impacts of climate in view of the changes in weather patterns, pest and disease incidence, production areas are threatened by floods, landslides, droughts, sea level rise, soil erosion, etc. Results of the preliminary spatial analysis of the three predicted consequnces (landslides, drought and flooding) of climate change showed approximately 67% (20 M hectares) of the country total areas will be severely affected by climate change. For agriculture alone, 86% will be affected by the various impact of climate change (GIS analysis, E.C. Godilano, 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 fisherfolk.

The coincedence of the three events to occur: i.e. drought + flooding + landslide to occur in one geographic location and could make this areas unhabitable is approximately 264,000 ha. Overlaying the coincidence map of the three events to the Strategic Agricultural and Fishery Development Zone (SAFDZ) maps resulted in approximately 10.2 million hectares or 34% of the country total area (**Table 3**). 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.

Table 3. Impacts of climate change to Philippine Agriculture.

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

On the other hand, many have been blaming climate change and other factors to poverty and food insecurity in the country; we should also factor in land conversion as part of the problem. Illustrated in **Figure 1**, is the land conversion data of the country in 1970 to 2000. Forest cover has been continually decreasing over the years, from 26% in 1970 to only 18% in 2000. This implies that forest land conversion into other land uses such as agricultural, residential, commercial, and industrial uses have been very rapid in the last three decades. Increasing agricultural production based on increasing cultivated areas is no longer an option.

We can no longer look at food security, poverty, population growth, social justice, and climate change separately. The world needs a form of growth that is socially and environmentally sustainable that takes resource limits and climate change into account. Positive GDP in developing countries will still be necessary to enhance living standards, reduce poverty, and cope with growing populations. But we know that growth per se is not enough. Green and inclusive growth policies in the agricultural sector need to be fully integrated into the countries' overall development strategies and assessed in terms of their contribution to development and wellbeing.

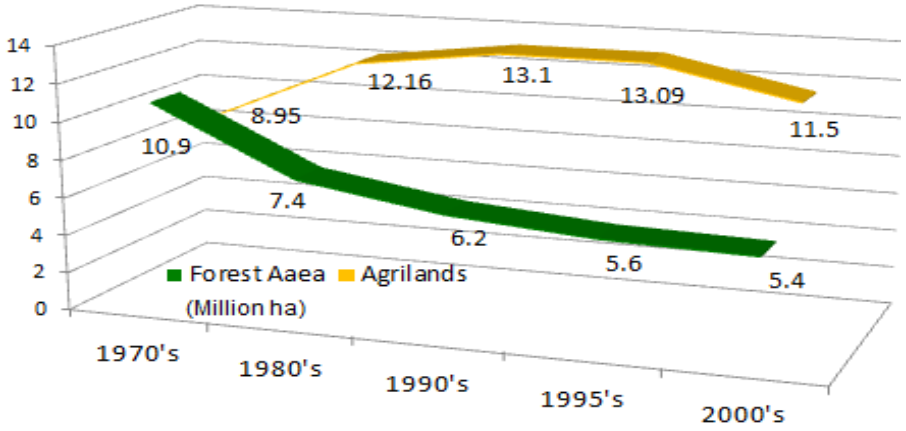

Figure 1. Changes in forest and agricultural lands in the Philippines. (source: DENR-EMB 2010).

Rationalizing land use and responding to climate change as foundations for achieving sustainable rural development and inclusive growth are priority topics being discussed under the Philippine Development Forum's Working Group on Sustainable Rural Development (SRD) which is co-chaired by GIZ/Dr. Walter Salzer and DA/Undersecretary Segfredo Serrano. Ensuring food security in a changing climate is one important subject.

3. FARMERS AND DA INITIATIVE ON CLIMATE SMART-AGRICULTURE

The Agri-Pinoy Program is one of the banner components of the Department; 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).

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. On the other hand, 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 Filipino farmers' CSA strategies (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[1] (Farmers Scientist) network have developed early-maturing rice varieties which

[1] MASIPAG **(**Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura or Farmers Scientist) is a farmer-led network of people's organizations, non-government organizations and scientists

are harvested before the main typhoon season starts, and they do staggered planting and use diverse crops to help reduce crop failure risks.

(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. 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 (**Box 2**).

Box 2: The DA SALT Program

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 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 where 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. This diversification has increased incomes, improved nutrition, built resilience to shocks and minimized financial risks.

(5) **Rice intensification in the farm** 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. Rainwater storage tanks were constructed made of wire-framed ferro-cement, with capacities varying from 2 to 10 m^3. 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** (SRI) 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 (http://sri.ciifad.cornell.edu/). 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 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

working towards the sustainable use and management of biodiversity through farmers' control of genetic and biological resources, agricultural production and associated knowledge (http://masipag.org/cms/).

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%. (Bouman *et al*. 2007 and Wassman, R. 2012). Even IPCC recognize the benefits of AWD (**Box 3**).

Box 3: IPCC on AWD

According to the revised IPCC methodology (IPCC 2007), '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.

(9) **Farmers using biotechnology** additional income from planting Genetically Modified (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) **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. 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.

(11) **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. Farmers are making their own weather observations and use these and other agrometrological information in taking farming decisions (DA-ATI 2010).

(12) **Aquasilviculture**. 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 regions of the country. Each mariculture park is established with a purpose as a breeding facility, tourism destination or research and development area. Activities in these parks include integration of research results and business trends for sustainable ventures for local community development (DA-BFAR 2008).

(13) **Livestock Industry:** The DA Bureau of Animal Industry (BAI) is focusing on strategic research such as: (1) breeding and screening for heat tolerant livestock

and poultry, indigenous species and breeds will be evaluated for their adaptability and climate resiliency, (2) novel feed formulations that will reduce the production of CH_4 from livestock and from livestock waste, (3) systems to efficiently and cost effectively capture GHG from farm wastes and converted into an energy source to replace more carbon-intensive fuels such as firewood, coal, and kerosene.

(14) **Agroreforestation** integrates perennial and annual crops in a two canopy or multi-canopy production system. 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.

(15) **Non-conventional irrigation programs**: The BSWM is pursuing the development of water resources in the country for Small-Scale Irrigation Projects (SSIPs) including, Small Water Impounding Projects (SWIPs), Small Diversion Dams (SDDs) Small Farmer Reservoir (SFR) and Shallow Tube Wells (STW). These provide supplemental irrigation to about 8,100 hectares of rainfed rice-based area that benefited more than 5,500 farmers that are not within the coverage of the National Irrigation Administration (NIA) (http://bswm.da.gov.ph/).

4. THE DA NATIONAL FRAMEWORK STRATEGY ON CLIMATE CHANGE ADAPT AND MITIGATION

The Government of the Philippines (GOP), 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 including enabling laws.

4.1 Legal Basis

1. Climate Change Act of 2009 (Republic Act 9729) - An Act Mainstreaming Climate Change into Government Policy Formulations. Sec. 2. *It is hereby declared the policy of the State to systematically integrate the concept of climate change in various phases of policy formulation, development plans, poverty reduction strategies and other development tools and techniques by all agencies and instrumentalities of the government.* The National Climate Change Action Plan (NCCAP) strategic priorities are: *(1) food security, (2) water sufficiency, (3) human security, (4) sustainable energy, (5) green industries and services, (6) capacity development, and (7) ecosystem and environmental stability.*
2. Disaster Risk Reduction Act of 2010 (Republic Act 10121). An Act Strengthening the Philippine disaster risk reduction and Institutionalizing the National Disaster Risk Reduction and Management (DRRM). *Sec. 2 (g) Mainstream disaster risk reduction and climate change in development processes such as policy formulation, socioeconomic development planning, budgeting, and governance…*
3. Agriculture and Fisheries Modernization Act of 1997 (Republic Act No. 8435). An Act Prescribing Urgent Related Measures to Modernize the Agriculture and Fisheries Sectors of the Country. *Chapter 2, Sec. 16. Global Climate Change. - The Department, in coordination with the Philippine Atmospheric, Geophysical and Astronomical Service Administration (PAGASA) and such other appropriate government agencies, shall devise a method of regularly monitoring and*

considering the effect of global climate changes, weather disturbances, and annual productivity cycles for the purpose of forecasting and formulating agriculture and fisheries production programs.

4. President Aquino's Social Contract (E.O. 43, May 13, 2011), namely: (1) Transparent, accountable and participatory governance. (2) Poverty reduction and empowerment of the poor and vulnerable. (3) Rapid, inclusive and sustained economic growth. (4) Just and lasting peace and the rule of law. (5) Integrity of the environment and climate change adaptation and mitigation.

4.2 The DA CC Policy and Strategic Initiative in Addressing Climate Change

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 fisherfolk adapt to already unavoidable impacts. The DA therefore have devised appropriate adaptation and/with mitigation measures to respond to projected increases in the intensity of weather events.

In an Asia and Pacific Economic Cooperation (APEC) seminar on climate change adaptation and mitigation potential in agriculture hosted by the Philippines in 2012, the resolution was signed in which one of the major recommendation is the launching of the Adaptation and Mitigation Initiative in Agriculture (AMIA). The AMIA objectives are: (1) to reduce the risks posed by climate change to project activities, stakeholders and results, (2) to ensure that project or program activities maximize their contribution to adaptive capacity of target populations and do not inadvertently increase vulnerability to climate change, and (3) to build resilience while achieving development goals.

To further strengthen AMIA and the above policy framework, the DA Secretary Hon. Proceso J. Alcala issued a Memorandum Order dated 25 January 2013 on *"Mainstreaming Climate Change in the DA Programs, Plans and Budget"*. The DA Secretary approved four strategic objectives and the seven systems-wide programs.

4.2.1 The four strategic objectives

1) To increase the adaptive capacity and productivity potentials of agriculture and fisheries livelihood by modifying commodity combinations to better meet weather issues and natural resource endowments.
2) To redefine or remap Strategic Agricultural Fisheries Development Zone (SAFDZ) by including climate change vulnerabilities as part of mapping variables.
3) To redefine the agriculture development planning framework as basis for agricultural planning by including key factors/variables associated with climate change, and
4) To develop a new framework and plan for the provision of "new" government agriculture services towards the accelerated development of climate smart agriculture and fisheries industries.

4.2.2 The seven systems-wide programs on climate change

1) Mainstreaming AMIA, which aims to minimize DA's institutional risks and protect government investments and adjust development programs/projects and approaches to address CC risks.
2) Climate Information System (CIS), which has the objective of having a common database to generate timely and reliable data for disaster risk reduction, planning, and management through the conduct of vulnerability and risk

assessments of productive areas, and the establishment of agro-meteorological stations in highly vulnerable areas.

3) Philippine Adaptation & Mitigation in Agriculture Knowledge Toolbox that will inventory, generate, and disseminate adaptive tools, technologies, and practices, which users can readily use through the extension services of the country, while research will pursue new tools and knowledge in partnership with the scientific community.
4) Climate-Smart Agriculture Infrastructure, that will support the development of new designs and construction protocols for agricultural infrastructure to withstand adverse effects of extreme weather events, repair of existing systems to enhance resilience where necessary and improvement of the design and management of irrigation systems to reduce leakage and optimize water use. Likewise, production and postharvest facilities, including fishery infrastructure, will be made more climate-resilient.
5) Financing and Risk Transfer Instruments that will develop new innovative financing schemes to help the agriculture producers obtain financing, insurance, and guarantees for climate change related projects and events especially vulnerable stakeholders in the agriculture and fishery sector. A quick response fund will be set up to provide emergency support to farmers in affected production areas.
6) Climate-Smart Agriculture and Fisheries Regulations where regulatory agencies will redesign their services to take into consideration new technologies towards the promotion/development of climate-smart agriculture. This is to ensure, among others, that new kinds of pesticides, fertilizers and other inputs, as well as genetically modified crops and organisms, that may be created or brought in to address the changing weather patterns will comply with effectiveness and safety standards, and
7) Climate-Smart Agriculture Extension Systems, under the leadership of ATI and in partnership with the LGUs, SCUs, NGOs, and the private sector, that will mobilize the entire agriculture and fishery extension infrastructure to develop and implement a national extension system that will educate and equip the stakeholders to deal with climate change including adaptation and mitigation measures available for the agriculture and fishery industries.

These core system's wide programs will allow the Department to better address climate change vulnerabilities and risks in crafting and implementing the nation's agriculture and fisheries modernization programs. The systems-wide program also addresses the five key principles in the social contract of President Aquino as enumerated above.

4.2.3 Adopt a Watershed[2] Management Framework

To address the impacts of climate change 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".

[2] (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 National Convergence Initiative (NCI) compose of the DA, DENR, and Department of Agrarian Reform (DAR) and headed by the DA Secretary adopted the watershed and ecosystem management approach in the implementation of the NCI project. The GIZ strongly supports the NCI in adopting the integrated ecosystem management approach through the Environment and Rural Development (EnRD) Program.

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 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 2** is a holistic framework on watershed management that includes the coastal and marine ecosystems (from ridge-rivers-reef) and catchment basin. The framework can be divided into three major pillars. Pillar one 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 Local Government Units (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. Responsible mining is being advocated.

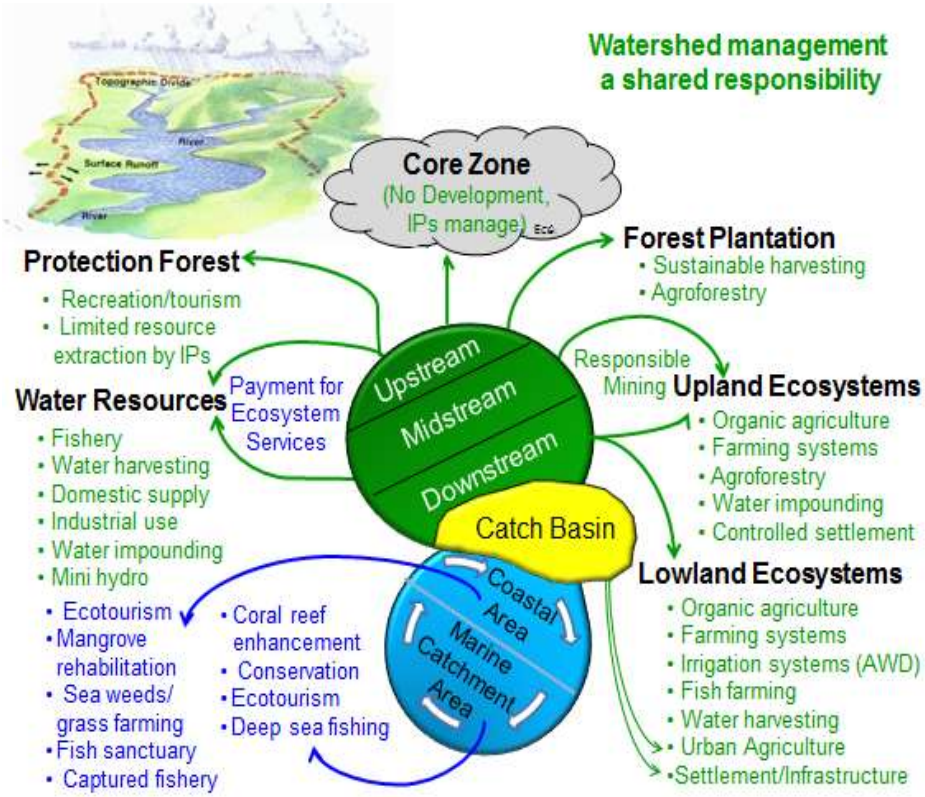

Figure 2. Watershed management framework (source: Godilano, E.C. 2009, 2011)

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.

5. CONCLUSION

This paper has demonstrated that in the agriculture and fisheries sectors, many mutually re-enforcing synergies and benefits exist among mitigation and adaptation actions and overall development goals. But we have also recognized that the Agricultural and Natural Resource (ANR) 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. Opportunities exist 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 CSA, 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 poor farmers—will require enhancing their adaptive and institutions to deal with uncertainties in their local settings through the testing and scaling down the outputs 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 it should be “married with scientific findings”. Adaptation strategies have long lead times and need to start NOW.

6. MOVING FORWARD

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 CO_2 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).

6.1 Climate-Smart Agriculture – A Forward-Looking Perspective in the ASEAN

The following are suggested and important commitments and actions that can be undertaken among the ASEAN member countries to tackle the challenges of food and

water security, nutrition, poverty, climate change, sustainable development, environmental sustainability, and CSA.

- **Policy Reforms**

(1) Enhance integrated, systems based approaches, strategies and institutional arrangements that span across different sectors, ministries and intergovernmental organizations;
(2) Address the sustainable management of oceans for food security and livelihoods, including addressing illegal, unreported and unregulated fishing;
(3) Promote international cooperation and avoid unilateral measures, such as export bans;
(4) Encourage private sector investment by reducing or insuring gain-risk (for example, through funding transitional programs that enable eventual private sector investment.
(5) Support low income food importing countries, with particular attention for vulnerable families and children.

- **Research and Development**

(1) Address the scientific, technical and socio economic aspects of adaptation and mitigation in agriculture and their synergies, within international food security and climate change processes, for example through further work under the UNFCCC SBSTA.
(2) Investing in the research and development of non-proprietary plant varieties and breed with the require nutritional, productivity, and diseases and climate resistant traits needed by different producers;
(3) Partnerships between the private sector and farmers/farmer groups and cooperative to promote the production of high quality products. Partnership that can enhance knowledge sharing between stakeholders, including scientist, farmers, private sector, civil society and governments, with participatory agenda setting, for example, through initiatives such as the Global Research Alliance.

- **Extension and Education**

(1) Strengthen the knowledge base on sustainable practices, as well as on financial and policy options that would enable countries and communities to meet their food, water and nutritional security and development goals;
(2) Improve farmers' access to and awareness of knowledge services, finance, agricultural inputs, rights (for example, land tenure rights) as well as increase the availability of these resources.
(3) Implement and scale-up innovative successful programs and best practices that combine sustainable agriculture and land use, forestry and sustainable fisheries and aquaculture, through local, regional, sub regional, and national programs and institutions, as a matter of priority;
(4) Sharing existing technologies off the shelf and into the hands of (small holder) farmers, thereby improving their access to information, technical knowledge, for example ICT options;
(5) Creating platforms/learning hubs (such as CSA knowledge platforms) and bringing together farmer groups/associations at the grassroots level to facilitate dialogue and knowledge sharing, and to building capacity to innovate and adopt CSA practices.

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