**Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) TCP/PHI/3203**

# FINAL REPORT


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| | | |
|---|---|---|
| APSEMO | - | Albay Public Safety and Emergency Management Office |
| AWS | - | Automatic Weather Station |
| BDRRMC | - | Barangay Disaster Risk Reduction and Management Council |
| BMG | - | Mines and Geoscience Bureau |
| BU | - | Bicol University |
| CBDRM | - | Community Based Disaster Risk Management |
| CBSUA | - | Central Bicol State University of Agriculture |
| CCA | - | Climate Change Adaptation |
| CLP | - | Coconut Leaf Pruning |
| DA | - | Department of Agriculture |
| DA-RFU V | - | Department of Agriculture Regional Unit No. V |
| DCCs | - | Disaster Coordinating Councils |
| DENR | - | Department of Environment and Natural Resources |
| DRR/M | - | Disaster Risk Reduction/Management |
| DRRMCs | - | Disaster Risk Reduction and Management Councils |
| DOST | - | Department of Science and Technology |
| ECLAC | - | Economic Commission for Latin America and the Caribbean |
| EFP | - | Existing Farmers' Practice |
| EFV | - | Existing Farmers' Variety |
| EMRV | - | Early Maturing Rice Variety |
| EWS | - | Early Warning System |
| FAO | - | Food and Agriculture Organization |
| FGD | - | Focus Group Discussion |
| FNS | - | Food and Nutrition Security |
| GFDRR/WB | - | Global Facility for Disaster Risk Reduction of the World Bank |
| GHG | - | Greenhouse Gas |
| GPO | - | Good Practice Option |
| HVCC | - | High Value Cash Crops |
| LD | - | Long-Duration |
| LGU | - | Local Government Unit |
| LOA | - | Letter of Agreement |
| RTS | - | Risk Transfer Strategy |
| MBCR | - | Marginal Benefit and Cost Ratio |
| MD | - | Medium-Duration |
| OPA | - | Office of the Provincial Agriculturist |
| NEDA | - | National Economic and Development Authority |
| NDRRMC | - | National Disaster Risk Reduction and Management Council |
| NPC | - | National Project Coordinator |
| OCD-DND | - | Office of Civil Defense-Department of National Defense |
| PAGASA | - | Philippine Atmospheric Geographical and Astronomical Services |
| | - | Administration |
| PAR | - | Philippine Area of Responsibility |
| PDNA | - | Post-Disaster and Needs Assessment |
| PHIVOLCS | - | Philippine Institute of Volcanology and Seismology |
| PRA | - | Participatory Rural Appraisal |
| PSC | - | Project Steering Committee |
| RDCC | - | Regional Disaster Coordinating Council |
| SD | - | Short-Duration |
| SEAFDEC | - | Southeast Asian Fisheries Development Center |
| TCP | - | Technical Cooperation Programme |
| TWG | - | Technical Working Group |
| UN | - | United Nations |

# EXECUTIVE SUMMARY

The Philippines is one of the most disaster-prone countries in the world due to its geographic location and physical environment. It experiences an average of 20 typhoons annually which trigger landslides, flash floods, mudslides, widespread flooding resulting to destruction and damage to homes, public infrastructures, and to the agriculture sector.

Within the Philippines, the Bicol Region is one of the most disaster-prone areas due to its geo-physical location. The natural hazards in Bicol, mainly storms and floods, put the lives of vulnerable households at risk. Those who rely predominantly on agriculture are the ones who usually suffer the most because it is the most vulnerable sector to natural hazards. In 2006 alone, the damage to investment losses of Typhoon *Reming* was estimated at ₱ 817.42 million not including the lives of more than one thousand individuals. The devastation caused by Typhoon *Reming* was the trigger for the Government request to FAO for the project ***"Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region)"***.

The long-term objectives of the project were to: (a) enhance the institutional and technical capacities within the Department of Agriculture (DA), the Philippine Atmospheric Geographical and Astronomical Services Administration (PAGASA), and of local institutions to better manage climate-related risks and promote local preparedness against recurrent natural hazards such as typhoons, floods, and drought; and (b) improve the livelihood resilience and food security of the farmers and fisher folks who are highly vulnerable to the frequent occurrence of extreme climatic events. The project was implemented from September 2009 to December 2011 in three (3) provinces in Bicol Region, namely, Albay, Camarines Sur, and Sorsogon covering the municipalities of Guinobatan, Buhi, and Gubat in each province, respectively, and three (3) barangays per municipality. The DA was the main implementing agency, with technical assistance provided by the Bicol University (BU), Central Bicol State University of Agriculture (CBSUA), and PAGASA.

The project was designed in accord with FAO's Disaster Risk Reduction (DRR) for Food and Nutrition Security (FNS) Framework Programme that builds on and supports the implementation of the Hyogo Framework for Action to reduce risks in the agriculture sector. The DRR for FNS Framework consists of four (4) thematic pillars: (i) enable the environment; (ii) watch to safeguard; (iii) prepare to respond; and (iv) build resilience.

The project delivered six (6) interrelated and mutually supportive outputs by working closely together with concerned LGUs and other project partners:

(a) improved local capacity in the use and interpretation of early warning messages and weather forecasts for enhanced disaster preparedness in the agriculture sector;
(b) strengthened capacity in PAGASA for the provision of site-specific short- and long-term climate and weather outlooks/forecasts;
(c) strengthened capacity of the Regional Field Unit (RFU) V of the DA and local government units (LGUs) in the area of post-disaster damage assessment for the agriculture sector and fishery;

(d) community-based disaster risk management plans were developed in selected municipalities;
(e) Agricultural practices for improved disaster risk reduction and management were identified, pilot tested, and disseminated through the DA and LGU extension services;
(f) Policy recommendations were developed and shared with major stakeholders.

Strategic partnerships with national institutions, institutional and technical capacity development, as well as knowledge management, communication, and gender equity were addressed as crosscutting priorities throughout all project activities.

The first six (6) months were devoted mainly to capacity building activities, detailed work planning, an in-depth situation and risk assessment in the project area, as well as to the pre-identification of potential Good Practice Options (GPOs) for DRR and climate change adaptation (CCA). In total nine (9) institutional and technical capacity building activities were implemented involving close to 500 participants; in addition technical briefings with Local Government Units and Municipality Agricultural Officers were conducted by the national consultants and partner-agencies before the start of the cropping season.

The project promoted PAGASA and DA to jointly prepare enhanced climate information and early warning services tailored to the needs of agriculture. Before project start PAGASA had provided six (6) types of forecasts catered to the agriculture sector, including, tropical cyclone warning, flood warning, gale warning, El Niño/La Niña advisory, monthly weather forest/outlook, and 10-day weather forecast. An innovation triggered by the project was the provision three monthly forecasts delivered at the beginning of each cropping cycle to facilitate strategic crop choices of farmers before each cropping seasons. DA translated these climate forecasts into concrete agricultural advice and information bulletins.

Results from a EWS outreach study revealed that the information generated through the EWS issued by PAGASA usually takes substantive time before reaching the barangays. As a result, the barangays and the intended end-users (i.e., farmers and fishermen) are unable to receive advance warnings which can be used for DRR. The weakness of the existing EWS flow is compounded by the lack of communication system. A model was proposed to address the existing weakness by enabling barangay officials and intended end-users to access information directly from PAGASA Regional Center.

Further, the project promoted community participation as a critical element of sustainable disaster risk management. In line with the new government act RA 10121 related to local DRR planning, and locally perceived needs to implement the act, the project, through facilitation support provided by CBSUA assisted together with LGUs 9 barangays and 3 municipalities in the development of integrated barangay DRRM action plans, which specifically focus on DRR/M in agriculture, The community-based DRRM plans promote a bottom-up approach in the planning and implementation of DRM activities. The process provided opportunity to the communities to evaluate and analyze their hazardous conditions, their vulnerabilities and capacities as perceived by themselves. CBSUA provided also training sessions for technical staff in DA/LGUs/DRMCs to support the horizontal up-scaling of the development of local DRRM Plans across the region.

Further, the project assisted DA RFU 5 in reviewing the existing damage and needs assessment methodology used in the Philippines from an agriculture sector perspective. This yielded an improved version of the methodology in the form of detailed guidance notes including baseline, manual and web-based application software to further facilitate the implementation of the agriculture specific PDNA methodology. A database was build-up with the 3 pilot local government units. The improved PDNA will allow a more comprehensive assessment of the impacts of natural disasters on agriculture and can also be used to predict the potential production losses. The barangays will be the basic political units from which the data will be gathered and analyzed. Two types of information are required for damage, loss, and needs assessment, namely, pre-disaster baseline information and post-disaster information on damages and losses.

Action research based pilot testing of selected Good practice Options (GPOs) for DRR was undertaken during three (3) cropping seasons. The pilot tested GPOs were identified from various sources including research and extension centers, the DA and academe, and local knowledge from the pilot communities and the internet. Before pilot field testing the GPOs were pre-evaluated according to their agro-ecological suitability, economically and socially feasibility, resilience against impacts of climate hazards, and estimated carbon balance. Technologies which passed the pre-evaluation were introduced to the pilot communities for field validation. Final technical evaluation of the technologies was done by the Technical Working Group (TWG) before endorsing them to the Project Steering Committee (PSC) for approval. Only those which passed the evaluation process were implemented by selected farmer-cooperators.

During the three (3) cropping seasons, five different GPOs were tested in the lowland irrigated rice area with 198 farmer-cooperators; three preselected GPOs were tested by 278 farmers in the upland/rainfed agro-ecological zone and four GPOs were field tested in the fisheries/aquaculture sector for one cropping season, with 70 farmer-cooperators. The project demonstrated the potential of the selected GPOs to enhance livelihood resilience under variable climatic conditions as manifested by their performance and results of field evaluation. But also for the performance of validated technologies better understanding of climate/weather forecast and timely delivery of advisories to LGUs and farmers are essential to enhance local disaster preparedness. During the first cropping season GPOs established in the upland/rainfed areas were mostly destroyed by extreme weather events due inadequate weather advisories. Seasonal weather forecasts provided by PAGASA and farm weather bulletin prepared by DA-RFU V enabled farmers to take strategic decisions on proper crop choice, cropping schedule, cultural management practices to adopt, and use of mitigating measures. Damage to the field demonstrations established during the second and third cropping seasons was averted because of the farm weather bulletin provided by the DA-RFU V to the LGUs and farmers.

This technical project summary report provides a consolidated overview about the specific project activities, the implementation processes, main findings and the establishment of institutional mechanisms that were established to promote ongoing collaboration between farmers, agriculture extension workers, researchers and local government officials.

# 1. Project Background

## 1.1. Project Rational

**Figure 1 Aftermath of Typhoon Reming in 2006**

The Philippines has a total land area of 298,170 square kilometers, of which 9.5 million hectares are agricultural land. Its agriculture sector accounts for about 12% of the national gross domestic product and providing employment to one-third of its workforce. Located in the Pacific Rim, the country is among the world's most disaster prone areas due to its geographic location and physical environment. It experiences an average of 20 typhoons annually which trigger landslides, flash floods, mudslides, widespread flooding resulting to destruction and damage to homes, public infrastructures, and to the agriculture sector.

Within the Philippines, the Bicol Region is one of the most disaster-prone areas. It consists of six (6) provinces, namely, Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, and Sorsogon. The region has one chartered city, six component cities, 107 municipalities, and 3,471 barangays occupying a land area of approximately 17,632.5 square kilometers which is about 6% of the country's total land area. The landscape is generally mountainous and hilly with a number of plains stretching from Camarines Sur to Albay making up the so-called Bicol River Basin covering around 312,000 hectares. It has a total population of more than 5.6 million as of 2010, with a population growth rate of 1.2% and a population density of 5.24 people per hectare. More than 42% of the region's total workforce derive their living from agriculture.

Natural hazards in Bicol, mainly storms and floods, put the lives of vulnerable households at risk. Those who highly depend on agriculture are the ones who usually suffer the most since agriculture is one of the most vulnerable sectors to natural hazards in Bicol. The turning point was 2006 when the country was hit by three extremely destructive typhoons in a span of 10 weeks from September to December. Typhoon *Reming*, which entered the Philippine Area of Responsibility (PAR) on November 26 to December 1 2006, was the most destructive, severely affecting all the six provinces of the Bicol Region. It brought 466 mm of rainfall in less than 24 hours, the highest measurement in 40 years, and wind speed of 320 km/hour. Typhoon *Reming* damaged thousands of hectares of land planted to rice, corn, and high value commercial crops (HVCCs) at varying stages of growth and livestock and fisheries. The damage to investment losses in terms of input costs such as seeds, fertilizers, and labor was valued at ₱ 817.42 million. Furthermore, Typhoon *Reming* claimed the lives of more than one thousand individuals who were living in vulnerable areas.

With the devastation wreaked by Typhoon *Reming*, the Department of Agriculture presented a request to the Food and Agriculture Organization (FAO) of the United Nations (UN) in February 2007 for technical and financial support to undertake an overall needs assessment and design a rehabilitation plan. The FAO assessment revealed that the provinces of Albay, Camarines Sur, and Sorsogon were the most highly affected areas. The assessment paved the way for the packaging of the Technical Cooperation Programme ***"Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region)"*** that focused on disaster risk reduction and risk reduction options in agriculture and livelihood activities related to fisheries and forestry.

### 1.2. Project Objective and Conceptual Framework

The overarching project objective was capacity development for proactive DRR in the agricultural sector in the Bicol Region. More specifically, the immediate project objectives were to:

(i) enhance the institutional and technical capacities within the DA, PAGASA, and of local institutions to better manage climate related risks and promote local level preparedness against recurrent natural hazards such as typhoons, floods and drought; and

(ii) improve the livelihood resilience and food security of farmers and fisher folks who are highly vulnerable to the frequent occurrence of extreme climatic events.

The project was designed in accord with the Hyogo Framework of Action and in line with the FAO framework programme on disaster risk reduction (DRR) for food and nutrition security (FNS). The DRR for FNS Framework consists of four (4) thematic pillars, with each pillar having a specific objective and making a direct contribution to one of the Priorities for Action of the Hyogo Framework for Action.

The objective of Pillar 1 (Enable the Environment) is to support the enabling environment of member countries with appropriate legislation, policies, strategies, and institutional frameworks for DRR in agricultural sectors, and to strengthen the institutional capacities to implement these initiatives. Institutional strengthening and good governance on DRR for FNS in agriculture, fisheries/aquaculture, livestock, and forestry is an important area of work within FAO. In support of this pillar, institutional and technical capacities of the DA-RFU V, PAGASA, and of LGUs were enhanced to promote local disaster preparedness. The project was also instrumental in the formulation of local DRR/M plans in nine (9) pilot communities which was approved by their respective LGUs.

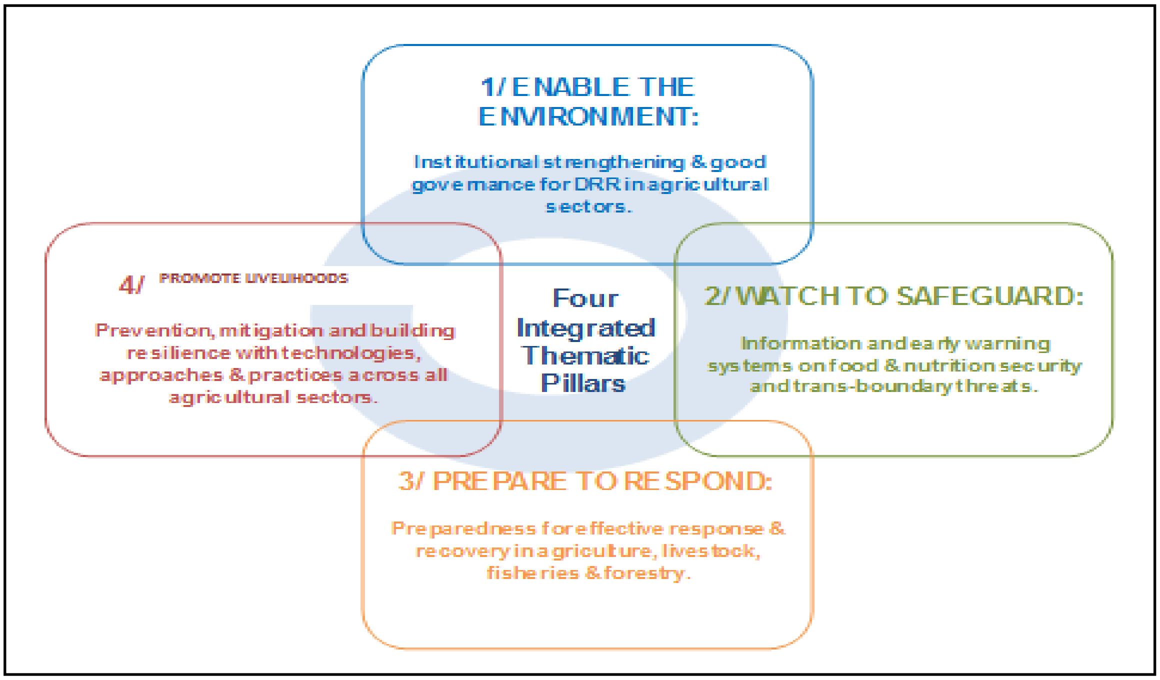



**Figure 2 Project conceptual framework: promoting interlinked thematic pillars (Source: FAO, 2011)**

Pillar 2 (Watch to Safeguard) aims to strengthen and harmonize FNS information and EWS to better monitor the multiple threats and inform decision-making in preparedness and response, policy, advocacy, and programming. This is premised on the assumption that the quality of key data is essential for analysis, early warning, and forecasting. As such, better seasonal weather and climate forecasting tailored to the needs of agricultural producers, and improved outreach to farmers is needed to enhance planning capacities for risk reduction in agriculture. Capacity development is needed to enable timely information of potential threats to support decision-making and ensure a timely response. Along this area, the project conducted training activities to enhance the use of EWS and proposed a model to improve the communication flow of EWS from the source to the intended users. Rain gauges were also installed in the pilot communities to improve the reliability of data for EWS. A post-disaster needs assessment (PDNA) software was also developed to expedite a more accurate estimation of post-disaster damages and losses as well as predict the potential production losses of a disaster on certain commodities.

Pillar 3 (Prepare to Respond) is about preparedness for effective response and recovery in agriculture, livestock, fisheries, and forestry. The objective of Pillar 3 is to strengthen capacities at all levels - in preparedness - to improve response to, and recovery from, future threats to food and nutrition security, and to reduce their potential negative impact on livelihoods. This could be operationalized in terms of any of the following actions or their combination: (a) support local and national preparedness/contingency plans for agriculture, fisheries/aquaculture, forestry and livestock; (b) integrate agriculture into local and national preparedness/contingency plans; and (c) inclusion of the agriculture sector in inter-agency preparedness/contingency plans. Pillar 3 was actualized by the project thru the development of a community-based disaster risk management plan in each of the pilot communities and activation of local DRR/M councils. Initial efforts were also undertaken to formulate the regional Plan of Action (PoA) for DRR in Agriculture.

Pillar 4 (Build Resilience) focuses on prevention, mitigation, and building resilience with technologies, approaches and practices across agricultural sectors. Its objective is to reduce the underlying risks to FNS and to build the resilience of livelihoods through the application of good practices, processes, and technologies in farming, fisheries, forestry, and natural resources management. It is argued that in order to adequately protect agricultural livelihoods and FNS it is critical to reduce the underlying drivers of risk and to build the resilience of farmers, herders, fishers, and foresters. Transfer and scaling up of DRR proven technologies to benefit similarly situated farmers, herders, fishers, and foresters is part of the strategies of Pillar 4. The project adopted Pillar 4 strategies by identifying and pilot testing technologies that have potential of enhancing livelihood resilience against climate change hazards.

The four pillars combined address DRR for FNS as a whole, and are interdependent and mutually reinforcing. The integrated implementation of the four pillars promotes a programmatic and holistic approach, striving to maximize the synergies and complementarities between the pillars and the critical links between good governance, early warning, preparedness, mitigation and prevention. It also supports the Philippine government’s strategy shift from response and recovery to a more pro-active and holistic approach of prevention, mitigation, and community preparedness within the context of risk management.

Corresponding to the 4 above integrated pillars of The DRR FNF Framework Programme this Technical Cooperation Programme (TCP) project delivered six interrelated and mutually supportive outputs:

(a) Improved capacity of provincial authorities in Albay, Camarines Sur, and Sorsogon in the use of climate information, early warning systems (EWS) and PAGASA forecasts for disaster preparedness in the agriculture sector.

(b) Strengthened capacity of PAGASA for the provision of site-specific short- and long-term forecasts/outlooks.

(c) Capacity of DA-RFU and other concerned LGUs strengthened to undertake timely and accurate post-disaster damage assessment in the agriculture and fishery sector.

(d) Community-based disaster risk management plans developed and implemented in selected municipalities.

(e) Climate risk management/preparedness practices for vulnerable livelihood groups identified, pilot tested and disseminated through DA and LGU extension services.

(f) Policy recommendations developed and shared with major stakeholders for follow-up activities in the selected pilot sites and to ensure replication of successful practices in other disaster prone areas in the country.

## 2. Implementation arrangements and preparation of field interventions

### 2.1. Project Partners and Responsibilities

The project was formally launched in September 2009 and implemented until December 2011 with funds and technical backstopping from FAO. It covered one (1) municipality and three (3) barangays in each of the provinces of Albay, Camarines Sur, and Sorsogon. A Field Operation Team composed of Agricultural Technicians (ATs) was organized in each municipality to assist in field implementation. Aside from the DA-RFU V which provided overall coordination mechanism, other local agencies were also involved in project implementation including PAGASA, Bicol University (BU), and Central Bicol State University of Agriculture (CBSUA) thru their respective Letters of Agreement (LOA) with FAO. A National Project Coordinator (NPC) was designated by the DA after project inception who was responsible for the overall execution of the project. National consultants were hired by FAO to provide the needed technical assistance in the project implementation. A Technical Working Group (TWG) composed of line agencies of the DA and partner-agencies was organized and chaired by the NPC. The TWG served as a clearinghouse of the project and was actively involved in the selection of the project sites and technical evaluation of proposals. The highest policymaking body of the project was the Project Steering Committee (PSC) chaired by the DA’s Undersecretary for Operations and composed of representatives from key agencies involved in DRR/M at national level and project partners at regional level.

The Central Bicol State University of Agriculture (CBSUA) was contracted thru a Letter of Agreement (LOA) with the FAO to conduct the CBDRRM planning. The main responsibilities of CBSUA relative to the CBDRM component were: (a) conduct in-depth situation assessment including DRM system in the Bicol Region with specific focus on agriculture sector in the selected project sites; (b) train provincial- and municipal-level DA technicians and disaster coordinating councils on DRR concepts and approaches, risk prevention, impact mitigation and preparedness measures in the agriculture sector; (c) guide the preparation of DRR plans in the project sites; and (d) facilitate the mainstreaming of gender concern in the overall process of project implementation. The final product of this component is the development and implementation of CBDRM plans in selected municipalities.

In recognition of their mandate and expertise, PAGASA was involved in this project to help improve the capacity of provincial and other local authorities in the three pilot provinces in the use of the EWS and forecasts of PAGASA for disaster preparedness and mitigation in the agriculture sector. PAGASA’s main responsibilities in this component were as follows: (a) review the existing EWS in the Bicol Region particularly in the three pilot provinces and how it is communicated to their stakeholders; (b) evaluate the strengths and weaknesses of the current system and introduce possible improvements if necessary; and (c) conduct training-workshops for the setting up and maintenance of an improved EWS. The project included also the maintenance and operation of weather monitoring stations (rain gauges) in the nine barangays, for which a formal agreement between the barangay councils of the project sites, PAGASA, and DA-RFU V was executed.

Pilot testing of the GPOs was spearheaded by the Department of Agriculture and with support of the national consultant for lowland/irrigated farming systems, the BU

Team for upland/rainfed farming systems and the national consultant on Fisheries/Aquaculture for the Fishery and Aquaculture GPOs. Their main responsibility respectively to the GPO project component was: site selection, GPO validation and implementation guideline, social mobilization and the monitoring and analysis of results. The introduction of the GPOs to the communities, their validation, monitoring and evaluation took place in close collaboration with and support from the agricultural extension personnel of the three (3) municipal LGUs.

As a process-based and demand-responsive project undertaking, the following preparatory steps for field implementation were initiated.

### 2.2. Pre-Inception Meetings

As part of the project mobilization process, the FAOP conducted a pre-inception meeting on August 26, 2009 with the newly-hired consultants and key personnel of DA-RFU V to orient the latter about the project, its implementation arrangements, and the mechanics for the conduct of inception planning-workshop. It was agreed during this meeting to have the project inception meeting on September 10, 2009 in Legazpi City to be attended by the Municipal Mayors and Municipal Agriculturists of the target municipalities, selected DA-RFU V staff, PAGASA, the Philippine Institute of Volcanology and Seismology (PHIVOLCS), BU, CBSUA, National Economic and Development Authority (NEDA), and the Mines and Geoscience Bureau (BMG) of the Department of Environment and Natural Resources (DENR).

### 2.3. Inception Planning Workshop

An inception planning-workshop was held on September 10, 2009 in Legazpi City to brief the participants who will be involved in the project about the project implementation approach, proposed work plan and timetable of activities, and to initially identify the pilot communities or barangays where the project will be implemented. The inception planning workshop was attended by representatives from various agencies which will be involved in the implementation of the project.


**Figure 3 Project inception meeting held in Legazpi City on September 10, 2009**

The one-day workshop was able to accomplish three important tasks, namely, validation of the selection criteria for the barangays, shortlisting of at least five (5) barangays per municipality as possible project sites, and identification of prospective members of the Technical Working Group (TWG) which will provide technical backstopping to the project. It was agreed during the inception planning workshop that a site validation be made by a group composed of the National Consultants and key DA-RFU V staff, based on the agreed criteria to aid the selection of nine (9) pilot barangays.

### 2.4. Selection of Pilot Communities

The project was implemented in three (3) Bicol provinces which were most affected by the three (3) destructive typhoons that hit the region in 2006, namely, Albay, Camarines Sur, and Sorsogon. In each of these provinces, one municipality was selected as project site based on the list of municipalities which the FAO mission identified as the most affected ones and result of the field validation conducted by the national consultants and technical experts of the DA-RFU V. The municipalities selected as project sites were: Guinobatan (Albay), Buhi (Camarines Sur), and Gubat (Sorsogon). The criteria used in the final selection of the three (3) municipalities were as follows: (a) areas with high level of dependence on agriculture sector; (b) existence of well-established functioning farmers' organization such as cooperative, people's organization, or federation; (c) selected sites should have varying agro-ecological conditions such as rainfed (upland), irrigated (lowland), existing fishponds (riverine); (d) farmers are willing to use their field for demonstration purposes and participate in the training programs; (e) residents and livelihood groups were displaced after the recent typhoons but remain vulnerable to future risks; (f) sites are accessible to various means of transport and possibly with access to power source.

The final selection of the three (3) priority barangays per municipality was done after the site validation conducted by a team composed of national consultants and technical staff of DA-RFU V. The team visited each of the barangays which were initially identified by the LGU of the municipality to validate if these barangays met the selection criteria. Some initial secondary data like land area and demographics were also collected during the site visit. Barangay officials were interviewed to ascertain their interest in the project.

**Figure 4 FAO and DA officials joined the Team during site validation in Guinobatan, Albay.**

Results of the site validation process were presented to the TWG which took the final decision on the selection of the three (3) pilot communities/barangays per municipality. The TWG agreed to put corresponding weight per criterion to reflect the relative importance of each criterion in the site selection process. Two criteria, namely, varying agro-ecological zones and vulnerability of residents and livelihood groups to future risks, were given 30% each while the remaining four criteria (i.e. level of dependence on agriculture, existence of well-established and functioning farmers' organization, willingness of farmers, and accessibility) were given 10% each.

### 2.5. Participatory Situation Assessment

Crucial for the identification of location specific disaster risk reduction (DRR) interventions in the project sites was the assessment of climate-related hazards and the degree of vulnerability of selected communities. The situation/hazard assessment was spearheaded by the CBSUA Team in collaboration with the National Consultants, DA-RFU V technical staff, and LGU staff. The objectives of the situational assessment were to:

(a) Determine the physical/environmental situation and parameters influencing or influenced by the local hazard context; socio economic framework conditions; and current farming systems/practices in the selected municipalities; and if available existing land use plans in view of DRR;

(b) Assess local perceptions of climate hazard, past and present climate risk/impact and perception about future climate risks;

(c) Analyze current farming systems / practices in selected municipalities;

(d) Determine existing vulnerability context applying livelihood profiling methodology and existing coping mechanism to climate change; and

(e) Assessment of the institutional DRM system.

The assessment process adopted by CBSUA Team used the following procedures/ methodology: (a) review of related literature/information about the project areas/sites; (b) conduct of reconnaissance survey and work plan development; (c) field assessment; and (d) consolidation and analysis of findings.

The situation assessment also included a field assessment with representatives from various sectors (e.g. farmers, fisher folks, women/youth, non-government organizations, people's organization, DA-RFU V, academe, and LGUs). It was undertaken to assess and evaluate livelihood situation, climate change related hazard, risk and vulnerability conditions and institutional capacity of the local and regional government and private organizations working in the pilot areas. Different tools were used in the field assessment such as Participatory Rural Appraisal (PRA), Focus Group Discussion (FGD) for preparing livelihood seasonal calendar, Risk and Hazard Mapping, Key Informant Interview for institutional assessment and livelihood groups profiling, and identification of vulnerable sectors and groups.

### 2.6. Capacity Building and Training

The first six (6) months of project implementation was mostly devoted to capacity building activities side by side with risk assessment and identification of good practice options (GPOs) for DRR/CCA. This was done to prepare the project stakeholders on the various aspects of project implementation.

The first training was conducted on November 12-13, 2009 which was attended by 58 participants coming from the three project sites/municipalities, DA-RFU V, Bureau of Fisheries and Aquatic Resources (BFAR), Bicol University (BU), CBSUA, and FAO. The training covered concepts and operational aspects of natural hazards (*e.g.* typhoons, flood, landslides, and drought), risk prevention, impact mitigation and preparedness measures in the agriculture sector. Integration of gender perspective in DRR was also discussed. The outputs of this training-workshop were as follows: (a) hazard assessment in the project sites by type of hazard, severity and frequency of occurrence; (b) analysis of disaster preparedness of pilot communities based on strategic indicators, status of operation, and gaps that need to be addressed; and (c) risk assessment matrix by project site, by type of hazard and number of people affected.

**Figure 5 PAGASA official providing input during the training on EWS**

The second training was conducted by FAO on February 12-13, 2010 on Community-Based Disaster Risk Management and focused on the operational aspects of DRR in Agriculture and Fisheries. The training was attended by 61 participants from the three project sites/municipalities; Provincial Agricultural Office (PAO) of Albay, Camarines Sur, and Sorsogon; Provincial Disaster Management Office (PDMO) of Camarines Sur; DA-RFU V; BFAR; BU; CBSUA; PAGASA Agro-meteorological Station; and nongovernment organization from Sorsogon. The outputs of the training-workshop were as follows: (a) vision of a disaster resilient community, (b) disaster risk reduction plan in agriculture and fisheries, (c) community-based disaster risk management approach and process, and (d) assessment of hazard, risk, vulnerability, and capacity.

Thereafter the project continued strong emphasis on capacity building at various levels with support for enhanced small-scale technology options at local level in order to strengthen institutional capacities and community resilience against natural hazard impacts. The capacity building activities of the project consisted in short-term trainings and workshops on DRR and CCA. These were conducted both at CBSUA and on-site with teams from CBSUA and PAGASA and national consultants providing the technical inputs. Participants to these series of trainings were provincial and local authorities of DA-RFU V, provincial/municipal/barangay DRR/M councils, barangay officials of the project sites, and other project stakeholders.

Technical briefings of farmer-cooperators were conducted by the national consultants and BU team before the start of the cropping season to guide the former in the establishment of on-farm demonstration projects. Follow-up briefings of farmer-cooperators and ATs on data collection were also done by the project towards the middle of the cropping season.

Capacity building activities on DRRM and climate change adaptation was capped by a 3-day training provided by FAO on "Analysis of Disaster Risk Management Systems in Agriculture and Fisheries" on December 7-9, 2011. The training was attended by 45 participants coming from the three project sites/municipalities, Provincial Agricultural Office (PAO), DA-RFU V, and state universities and colleges (SUCs). The 3-day training aimed, in general, to capacitate the members of the provincial, municipal and barangay Disaster Risk Reduction and Management Council (DRRMC) in the project sites and in other provinces of the region in conducting DRM analysis to be able to institutionalize DRM in local governance. The outputs of the 3-day training-workshop were: (a) sharing of inputs on pro-active DRR in agri-fisheries; (b) identification/formulation of roles/responsibilities of the DRRMCs at the provincial, municipal, and barangay levels in DRR; and (c) validation of DRRM plans of partner municipalities/provinces.


**Figure 6 Dr. Stephan Baas (FAO) lectures on the use of e-planning tools for community-based adaptation to climate change**

### 2.7. Integration of Gender Perspective in DRR/M

Training on gender perspective integration in CCA and DDRM was conducted to familiarize the project stakeholders on gender concepts and perspective and on how to mainstream gender concerns in DRRM. Plans of action for gender perspective integration in DRR were also prepared at the LGU levels for implementation by their respective offices.

In the planning and implementation of GPOs, gender was an important consideration because women and children are actually involved in some farm activities and marketing of produce. Strenuous activities like land preparation, hilling-up, off-barring, and hauling of harvest are exclusively done by men, whereas, women and children are involved in the preparation of planting materials, planting, fertilizer application, harvesting, and marketing. They are also the ones who attend to the farm when the husband is doing some off-farm and non-farm labor. This was observed in some sites, particularly in Guinobatan where the housewives would take care of the farm to enable the husband to take on non-farm labor (*e.g*., offering transportation services, carpentry work, *etc*.) in order to earn some extra income for the family.

It was observed in the project sites that the number of female farmer-cooperators in the lowland and upland agro-ecological zones had increased over time. Almost one-third of the farmer-cooperators in the lowland and upland areas were females as of the third cropping season. This was not, however, the norm in the case of the fisheries/ aquaculture sector in which only one female appeared to have participated in one of the GPOs but who later on pulled out.

## 3. Description of Project Area and Pilot Sites

### 3.1. Project Area: Hazard and Climate Risk Exposure

One important output of the situational assessment conducted by CBSUA was the analysis of location specific climate-related hazards and risks in the nine (9) barangays covered by the project. These climate-related hazards and risks were used as bases in the identification and design of Good Practice Options (GPOs) for disaster risk management/ climate change adaptation (DRM/CCA). The following were the climate-related hazards identified in each of the project sites:

**Table 1 Natural Hazards and risks in project sites, Bicol**

| Municipality/Province | Barangay | Climate-Related Natural Hazards and Risks |
|---|---|---|
| Buhi, Camarines Sur | Igbac | ▪Typhoons, strong wind, heavy rainfall, river swelling, flash flood, and drought |
| | San Buenaventura | ▪Typhoon, heavy rainfall, flash flood, and flood |
| | San Ramon | ▪Typhoon, strong wind, flash flood, flood, landslide, and heavy erosion |
| Guinobatan, Albay | Masarawag | ▪Typhoon, flood, soil erosion, volcanic eruption, and lahar flow during heavy rainfall |
| | Minto | ▪Typhoon, flash flood, ashfall, and lahar flow during heavy rainfall |
| | Mauraro | ▪Typhoon, drought, and ashfall during volcanic eruption |
| Gubat, Sorsogon | Bagacay | ▪Typhoon, high tide, coastal flooding, saline water intrusion, drought, flash flood, and soil erosion |
| | Ariman | ▪Typhoon, high tide, coastal flooding, saline water intrusion, storm surge, and drought |
| | Rizal | ▪Typhoon, continuous rain, storm surge, sea water intrusion, flood, and soil erosion |

The graph (*Figure 7*) below shows the cumulative number of weather disturbances that had either landed or crossed the country within the past 5 years covering the period 2005-2009. Being in the “typhoon belt” area, mainland Bicol and the island-province of Catanduanes usually experience the effects of these typhoons whether or not they landed or crossed the country. Typhoons would usually hit the Bicol Region during the later part of the year starting September. This time of the year also coincides with the rice harvest season.

The most intense typhoon ever recorded that affected the Bicol Region was super typhoon *Reming* (Durian) in the year 2006 with wind speed of up to 320 km/hour. Heavy and/or continuous rainfall from monsoon and typhoons pose a serious risk among farmers and residents in the nine project sites. The Bicol Region has no pronounced dry or wet season. The highest and lowest number of rainy days recorded in a month was 15 and 10 in the province of Camarines Sur, 26 and 14 in Albay, and 22 and 12 in Sorsogon, respectively.

The month of October and December is the period when Camarines Sur receives the highest amount of rainfall. Based on the 16 years average monthly rainfall, November recorded the highest rainfall of 305.95 mm, followed by October with 294 mm. The months of November and December were the “rainiest” months for Albay and Sorsogon over a 35-year period. An average monthly rainfall of 515.60 mm and 539.20 mm were recorded in Albay and Sorsogon, respectively, for the month of December. The month of November recorded an average rainfall of 478.70 mm for Albay and 511.30 mm for Sorsogon. It is worth mentioning that the months in which the three (3) provinces experience high rainfall averages (September-December) is also the period of the year when typhoons directly affect the region.

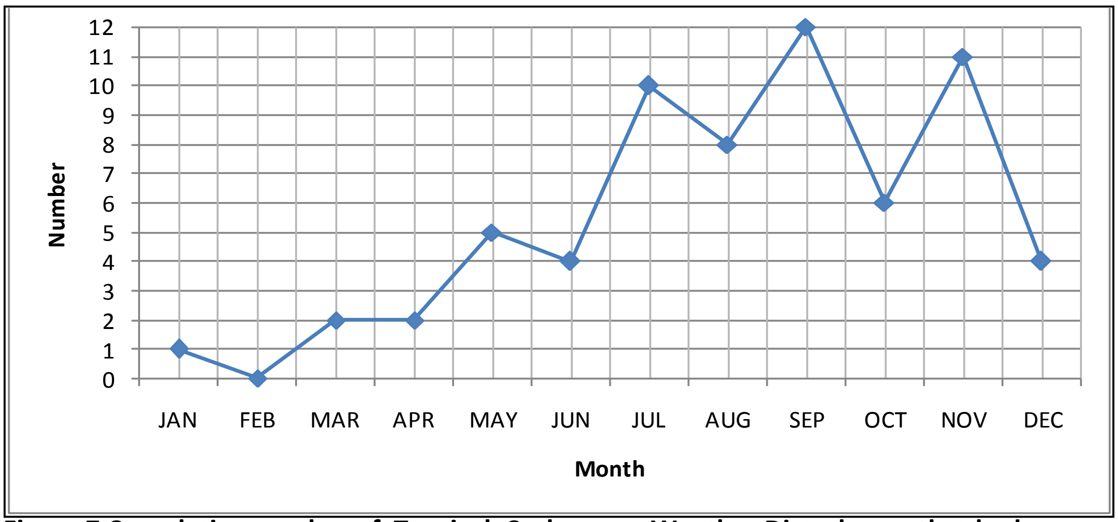



**Figure 7 Cumulative number of Tropical Cyclones or Weather Disturbance that had either landed or crossed the Philippines for the past five years (2005-2009).**

**Table 2 Number of rainy days in the three pilot provinces of the project.**

| Province | No. of Years Recorded | Average Number of Rainy Days per Month | | | | | |
|---|---|---|---|---|---|---|---|
| | | Monthly Average | | Dry Season | | Wet Season | |
| | | High | Low | High | Low | High | Low |
| Camarines Sur | 16 | 15 | 10 | 15 | 10 | 13 | 12 |
| Albay | 35 | 26 | 14 | 26 | 15 | 24 | 16 |
| Sorsogon | 35 | 22 | 12 | 22 | 13 | 18 | 13 |

Source: PAGASA

Heavy rainfall during the months of September to December usually leads to flashflood/ flood, landslide, and soil erosion in some parts of the three (3) pilot provinces resulting to damage in agriculture. In the coastal areas of Sorsogon province, particularly Gubat, typhoons and heavy rainfall results in coastal flooding and saline water intrusion which affect rice areas nearby.

In Albay, the project sites are also vulnerable to secondary hazards posed by volcanic eruption such as ashfall and lahar flow. Lahar deposits along the slopes of Mayon Volcano are carried downstream during heavy rainfall causing flooding and destruction of agricultural areas and other properties.

The assessment tried to determine from the barangay stakeholders climate-related risks in the area, risk classification and ranking, risk impact on various sectors, seasonality of risks, future or emerging risks, livelihood groupings and classification, and vulnerability of the different livelihood groups, among others. Result of the assessment served as benchmark in developing the DRRM plans of the nine barangays. The result was also used in the identification of GPOs based on climate-related hazards obtaining in the area.

### 3.2. Summary Description of Pilot Municipalities and Barangays

Each of the municipalities selected as a project site has a distinct characteristic. A land-locked municipality, Guinobatan is located at the foot of the famous Mayon Volcano. It lies $13^0$ 19’ 30.4” north latitude and $123^0$ 59’ 45.1” east latitude and is bounded on the south by the mountain ranges of Pioduran, on the west by Ligao City, and on the east by the municipalities of Camalig and Jovellar.

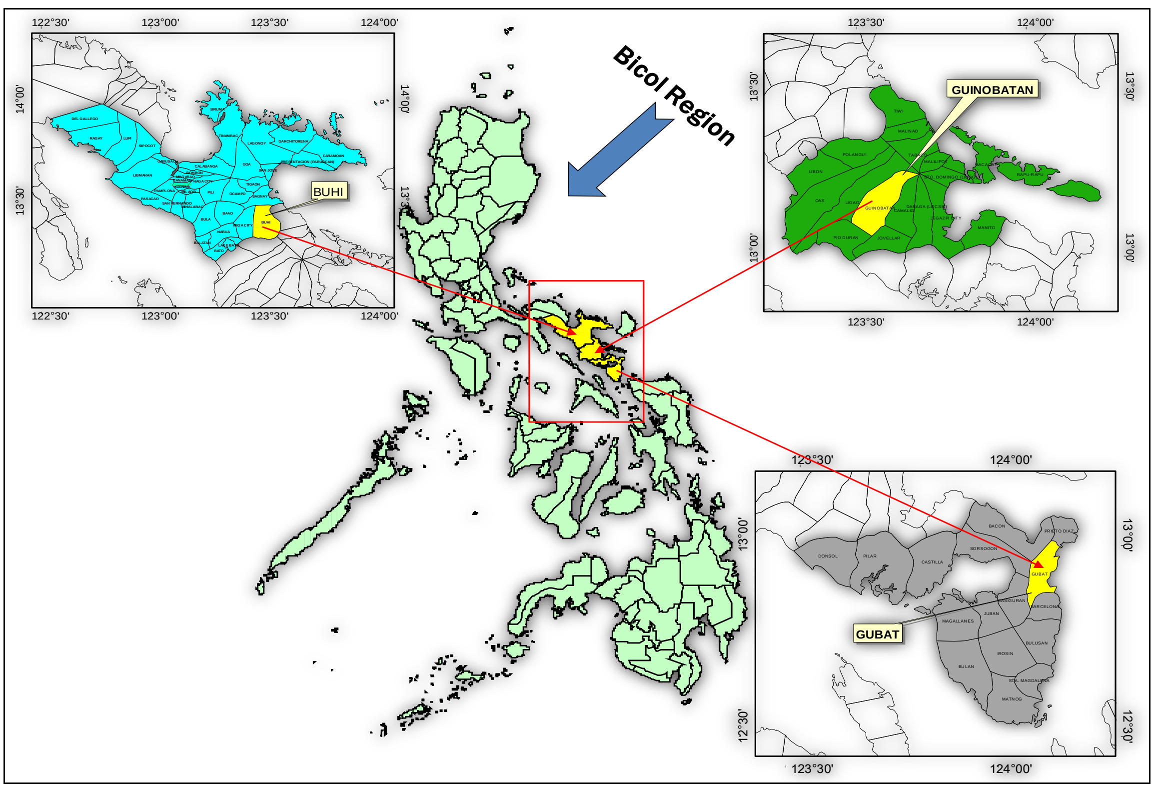



**Figure 8 Project location map showing the three pilot municipalities (Source: CBSUA, 2011)**

The municipality is 16 km and 65 km from Legazpi City and Naga City, respectively. Guinobatan has two climatic types, Types 2 and 4, and is characterized by two (2) agro-ecological zones based on FAO classification. It has a total population of 62,242 based on the 2000 census. The municipality is a predominantly agricultural area with almost 80% of its land area or 16,033.18 hectares devoted to agriculture. Major crops cultivated are coconut, corn, rice, vegetables, root crops, and fruit trees.

The municipality of Buhi is located in the southwestern tip of the province of Camarines Sur and is bounded on the east by Mt. Malinao (in Albay), on the west by Mt. Asog (in Iriga City), on the north by Sagñay-Buhi mountain ranges, and on the south by the low-lying ranges of Polangui (in Albay). It lies 130 25' 32.4" north latitude and 1230 30' 49.1" east longitude and located 75 km and 53 km away from Legazpi City and Naga City, respectively. The municipality has generally mountainous and hilly surface. The total land area of 18,378 hectares is within the watershed declared as protected area by virtue of Presidential Proclamation No. 573 and Executive Order No. 224. Agriculture and inland fishing from Lake Buhi are the major sources of livelihood. Lake Buhi is home to the world's smallest edible fish locally known as "sinarapan" (Mystychtis Luzonensis) according to the Guinness Book of World Records. The municipality has a total population of 67,757 as of 2000 census.

Lying along the Pacific Ocean, the municipality of Gubat is bounded on the north by the municipality of Prieto Diaz, on the south by the municipality of Barcelona, and on the west by the Sorsogon City. It is located 120 54' 30.4" north latitude and 1240 11' 45.1" east longitude. The municipality has a total land area of 11,077 hectares, of which 8,699.06 hectares are classified as agricultural land. Gubat belongs to Type 2 climate based on the Corona system of classification. The municipality is 63 km and 29 km southeast of Legazpi City and east of Sorsogon City, respectively. It has a total population of 52,556, with a total of 10,876 households, and an average family size of 5.

From the three (3) municipalities identified as project area, three (3) barangays were identified and selected as project sites per municipality. Identification of project sites was done by a team composed of the national consultants, DA-RFU V technical staff, and representatives from the local government unit (LGU). At least five (5) barangays per municipality were identified by the team. Final selection of the three (3) project sites per municipality was done by the Technical Working Group (TWG) using the same criteria applied in the selection of the three (3) municipalities. It was decided, however, by the TWG that each criterion be given a corresponding weight: dependence on agriculture (10%), presence of well-established and functioning farmers' organization (10%), varying agro-ecological zones (30%), willingness of farmers to use their field for demonstration purposes (10%), vulnerability to future risks (30%), and accessibility to transport and other facilities (10%). Following is a brief description of each barangay.

***Buhi, Camarines Sur***

***San Ramon*.** Barangay San Ramon is located eight (8) kilometers from the town proper of Buhi. As of 2009, it has a total population of 1,363 with 714 males and 649 females. There are 279 households with a mean family size of 4.88. It has a population density of 3 individuals per hectare and 75% belongs to a group of indigenous people or the *Katutubo (Itom*). The barangay has three (3) lakelets, namely: Manapao, Katugday and Kimat.

The barangay has a total land area of 468 hectares and its terrain is generally mountainous and prone to erosion. Vegetative cover is good with sparsely scattered trees and fruits trees. A large portion (90%) of this area is planted to coconut trees, with a combination of under storey crops like anahaw, banana, upland rice, sweet potato and cassava.

Typhoon, flood, and landslide are threat to agricultural production. The types of agriculture production system being practiced in the upland agro-ecological zone which characterized as steep to moderately steep sloping lands make it vulnerable to landslide and soil erosion during heavy rainfall.

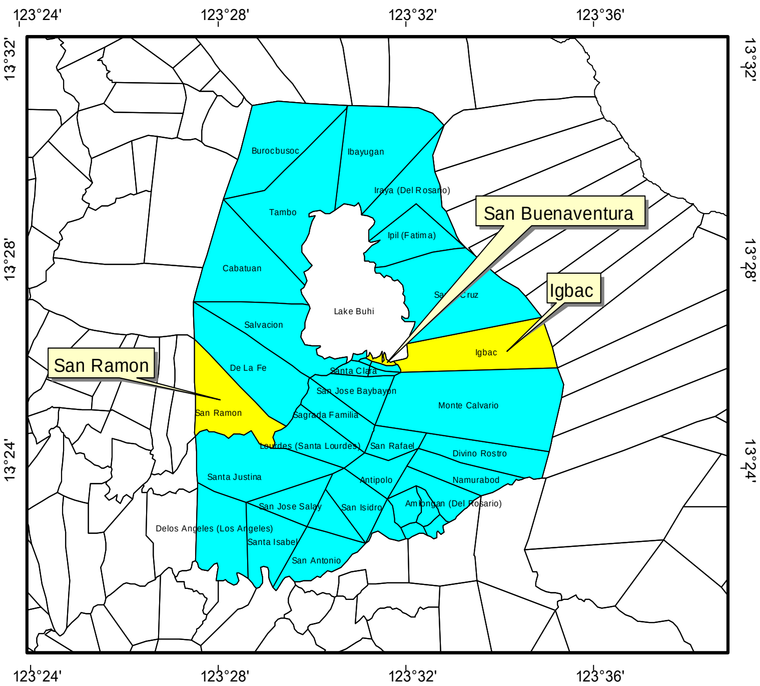



**Figure 9 Map of Buhi, Camarines Sur showing the three pilot communities (Source: CBSUA, 2011)**

***Igbac.*** Barangay Igbac is seven (7) kilometers from the town proper of Buhi. It has 263 households with a total population of 1,547 inhabitants composed of 803 males and 744 females as of 2009. The barangay has a total land area of 824.5 hectares and 225.2 hectares is classified as agricultural area.

The main source of livelihood in the barangay is farming. The major agricultural crops in the upland agro-ecological zone are corn, root crops (sweet potato, cassava and taro), commercial crops (coconut, abaca, banana, coffee and cacao), and fruit trees (Indian mango, pili, caimito and santol). Upland agro-ecosystem is characterized by coconut-based farming system like: coconut + banana + fruit trees, coconut + sweet potato, and coconut + vegetable.

Typhoons, landslide, and flashflood due to heavy rain were identified as natural hazards. Typhoons Sisang in 1970 and Reming in 2006 destroyed the coconut plantations and caused the overflow of Semenlong River that destroyed the rice fields in low lying areas of the barangay.

***San Buenaventura*****.** Barangay San Buenaventura, which is known as San Buena, is a lakeside barangay located in the town proper of Buhi. It has a total area of 32.98 hectares, of which 42% is devoted to agriculture. The agriculture area, which is located along the Siminlong River, is mostly devoted to rice, corn, and rootcrops. Fish culture is the major source of livelihood of San Buena residents and is carried out through fish cage operation in the lake.

As of 2009, San Buena has an estimated population of 2,532 inhabitants, with 1,250 males and 1,282 females. It has 450 households and a population density of barely 2 persons per hectare of land. Majority of San Buena's population are engaged in some major livelihood activities with the wage laborers as the biggest group. Expectedly, there are more fisher folks than farmers in the barangay. Lake fishing is, however, under threat because of proliferation of water hyacinth which now covers 90% of the lake.

Flooding is the main hazard in barangay San Buena which is caused by heavy rainfall brought about by monsoon rains and typhoons. The situation is further aggravated by local policies that control the normal flow of flood water. One such local policy is regulating or controlling flood water in order not to cause secondary flooding in the downstream low-lying municipalities in the Rinconada area. Flooding not only affects rice farmers but also other livelihood groups as it disrupts the normal economic activities along the lakeshore.

***Guinobatan, Albay***

***Masarawag*****.** Located at the foot of Mt. Mayon, barangay Masarawag is six (6) kilometers from the town proper of Guinobatan. As per 2009 census, barangay Masarawag has a total of 919 households with a population of 3,984 individuals, with 2034 males and 1,950 females.

Of the 859 hectares total land area of Masarawag, 795.96 hectares or 92% is devoted to agriculture. Coconut, fruit trees, and banana are the predominant crops in the upland. Vegetables like tomato, ampalaya, pepper, pechay and cabbage are planted areas not reached by the irrigation.

Typhoon, flashflood, volcanic eruption, and lahar flow, are the most experienced natural hazards in the locality. Strong winds of the southwest monsoon (Habagat) occur from July to September; while the northeast monsoon (Amihan) prevails during the months of October to March. The steep to moderately steep sloping lands and the type of agriculture production system increases the vulnerability of the site to flash flood during heavy rainfall.

***Mauraro*****.** Barangay Mauraro lies on the southern portion of Guinobatan and is roughly five (5) kilometers away from the town proper. It has a total land area of 655 hectares in which 562 hectares is devoted to agriculture. Soil type is sandy loam which is stable and moderately well drained. Upland areas are predominantly planted to coconut, abaca, fruit trees, banana, corn, and vegetables.

Mauraro's total population as of 2009 is estimated at 5,879, with 2,800 males and 3,079 females. The barangay has 919 households with a mean family size of 6 individuals. Population density is barely nine (9) persons per hectare of land.

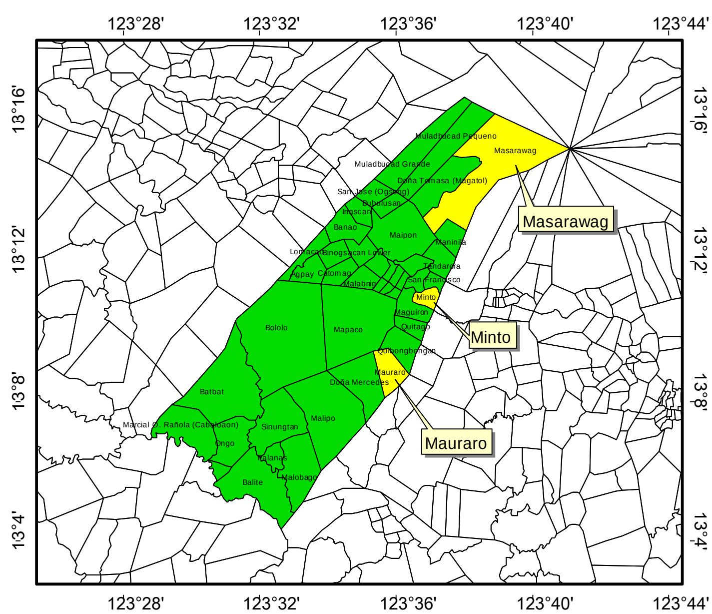



**Figure 10 Map of Guinobatan, Albay showing the three pilot communities (Source: CBSUA, 2011)**

Agriculture contributes significantly to the socio-economic development of the barangay. Home-based women, after transplanting the rice crop, are engaged in the production of abaca handicraft, which is bought and assembled in the barangay. Those engaged in abaca handicraft are the biggest livelihood group. Farmers constitute a little over 10% of the total livelihood group.

The steep to moderately steep sloping lands and the type of agriculture production system increases the vulnerability of the site to natural hazards specifically typhoons and, in some occasions, flood due during heavy rainfall. Farmers also experienced drought during the dry season. Plant diseases like cadang-cadang for coconut, bunchy top for abaca, and vegetable pest are threats to the existing crops in the barangay.

***Minto*****.** Barangay Minto lies at the eastern portion of Guinobatan and is about three (3) kilometers from the town proper. Its terrain is generally rolling with few moderately flat to flat areas. It has a total land area of approximately 869 hectares, 70% of which are devoted to agriculture. Half of the agricultural area is utilized for the production of coconut in combination with other crops like banana, rootcrops, and vegetables while the other half in sitio Binti is planted to lowland rice and vegetables. The remaining 30% of the barangay land area consist of rolling to upland terrain comprising of rock formation.

Minto's total population as of 2009 is estimated at 1,783 inhabitants with 862 males and 921 females. It has 394 households with an average household size of 5. Its population density is barely 2 individuals per hectare of land. Of the total population, 36.3% belong to the major livelihood groupings. Half of the working population are wage laborers, working mainly as construction workers, followed by the farmer groups who are producing coconut, rootcrops, rice, and vegetables.

Typhoon, volcanic eruption and the associated secondary hazards like flash flooding, slow-onset flooding, mudflow, and landslide are the common hazards in the area affecting mostly residents and farmers residing along the river. Farmers also mentioned plant pests and diseases as other major hazards.

***Gubat, Sorsogon***

***Bagacay*****.** Bagacay is a coastal barangay located in the northern part of Gubat which is about 7 kilometers from the town proper. It has a total land area of 582.54 ha, of which 450.3 hectares or 77.32% is devoted to agriculture. About 308.5 hectares are planted to coconut in combination with other crops like corn, vegetables, and rootcrops and 127.45 hectares are devoted to rice.

As of 2009, the barangay has a population of 3,397 with 1,723 males and 1,674 females. It has a population density of about 6 persons per hectare of land.

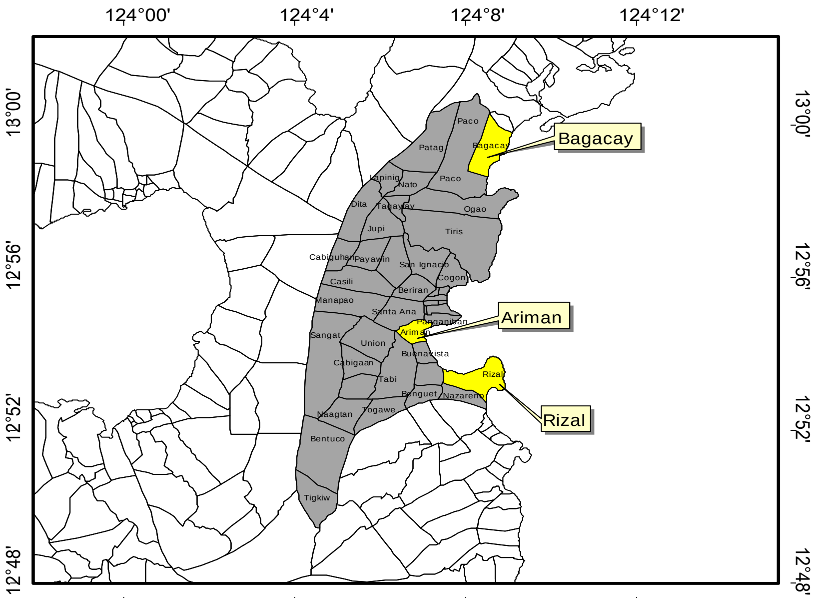



**Figure 11 Map of Gubat, Sorsogon showing the three pilot communities (Source: CBSUA, 2011)**

Coconut and rice farming are the main sources of livelihood. Secondary sources include backyard swine and chicken raising, fishing, home-based handicraft-making (e.g., shell craft, candy-making), fish processing, and vending. Farmers constitute the biggest livelihood group followed by fisher folks. The peak season for fishing is between the months of August and November, which are incidentally the typhoon months. Fisher folks are also engaged in farming as laborers during lean months which fall during the first quarter of the year.

Hazards associated with typhoons are the main risks faced by residents of Bagacay. High tide accompanied by coastal flooding cause saline water intrusion that destroys agricultural areas, leaving them unproductive for a long period. Other threats to agriculture are pests and diseases, drought, flash flood, soil erosion, and earthquake.

***Ariman*.** Barangay Ariman is a coastal barangay located at the northern part of Gubat and is seven (7) kilometers away from the town proper. The barangay has a flat terrain with sandy clay loam. It has a total land area of 239 ha, of which 226 hectares or 94.56% are devoted to agriculture. About 98 hectares are devoted to lowland rice and 133.38 hectares are planted to coconut, banana, rootcrops, and vegetables.

As of 2009, Barangay Ariman has a total of 317 households with a total population of 1,568 (828 males and 740 females). They rely on fishing/farming as major sources of livelihood yielding an average annual income per household is PhP 2,262.00 (Census, 2005). Farmers, after transplanting rice, are also engaged in fishing on a daily basis thereby putting too much pressure on the coastal resource. For the coconut farmers, they harvest their nuts every 45 days. The women of Ariman are into planting root crops like cassava, camote, gabi, and other vegetable crops. They also raise backyard animals like pig, carabao, goat and chicken for additional income and domestic consumption. Typhoon, flooding (May, August to January) and saline intrusion to the rice areas are the major natural hazards experienced in Barangay Ariman. Soil erosion and landslide are great threat to steep to moderately steep sloping areas during heavy rainfall.

***Rizal*.** Barangay Rizal, which is known for its white beach resorts, has a total land area of 584.06 hectares. Majority of the land area or about 381 hectares are devoted to agriculture, with 236 hectares planted to coconut combined with other crops and 89 hectares planted to lowland rice. Other crops planted include corn, vegetables, and rootcrops. The total population of the barangay as of 2009 is estimated at 2,775 with 1,433 males and 1,342 females. It has a population density of four (4) persons per hectare of land.

Coconut and rice farming are the main sources of livelihood. Similar to the two barangays, households have secondary livelihood sources such as backyard swine and poultry raising, fishing, home-based handicraft activities, fish processing, and vending. Farmers represent the biggest livelihood group followed by wage laborers. Fisher folks are also involved in farming as an alternative livelihood source as laborers during lean season. Typhoon, saline intrusion in lowland rice areas near coast, drought (March to May), and flooding (October to December) are threats to agricultural production. Soil erosion and landslide are additional threats to steep to moderately steep sloping areas during heavy rainfall.

## 4. Results and Outcomes

### 4.1. Improved Capacity to Use Climate Information and Early Warning Forecasts for Disaster Preparedness in Agriculture

The importance of accurate and timely Early Warning System (EWS) such as a weather forecast cannot be overemphasized in DRM. Huge losses in life, property, and agricultural production can be avoided thru EWS based on real time data. PAGASA is the agency of the government whose mandate is to provide EWS in the form of tropical cyclone and flood warning, public weather forecasts, extreme weather advisories, and other specialized services primarily for the protection of life and property and in support of the economic productivity and sustainable development in the country.

#### 4.1.1. Improved Capacity for Weather Monitoring

At present, weather forecasts of PAGASA come from data collected from the synoptic and agro-meteorological stations established in some parts of the region. To improve the quality of weather data more weather monitoring stations are needed across the area. The project installed one automatic weather station (AWS) at the PAGASA Weather Station in BUCAF last August 2010 to obtain real-time weather data such as temperature, relative humidity, rainfall, and wind direction so that early warning and alert could be disseminated to facilitate the timely evacuation of the local populace during emergencies. Moreover, additional weather monitoring stations were established by installing rain gauges in the nine project sites in February 16-24, 2011. A briefing/orientation of the barangay council and the persons who will take charge of the data collection and maintenance and upkeep of the rain gauges was also conducted by PAGASA in the barangay right after the installation.


Figure 12 Automatic weather station being installed at PAGASA Weather Station in BUCAF, Guinobatan, Albay on August 2010

Rainfall data collected from the rain gauges were transmitted daily to PAGASA Regional Center by the barangay using cellular phone thru text messaging. Rain fall data from rain gauges can also be retrieved from data logger in case the barangay failed to record or send the data to PAGASA Regional Center. All these weather data were shared with PAGASA Central Office in Manila for processing.

#### 4.1.2. Climate Information and Early Warning Services for Agriculture

PAGASA regularly issues different early warning products, from which six (6) cater to the agriculture sector especially the farmers and fishermen, namely, tropical cyclone warning, flood warning, gale warning- (each issued twice a day) El Niño/La Niña advisory (monthly updated), monthly weather forecast/outlook, and 10-day weather forecast. Each of these EW products, except for the last two, was assessed by PAGASA in terms of their accessibility to intended users.

Table 3 Source of information of barangay stakeholders in times of weather disturbance

| Information Source | Buhi, Camarines Sur | | | | Guinobatan, Albay | | | | Gubat, Sorsogon | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TC | Flood | Surge | EN/LA | TC | Flood | Surge | EN/LA | TC | Flood | Surge | EN/LA |
| Television | 14 | 8 | 4 | 5 | 14 | 6 | 9 | 11 | 15 | 10 | 10 | 3 |
| Radio | 13 | 7 | 3 | 4 | 11 | 7 | 7 | 8 | 12 | 7 | 7 | 3 |
| Cellphone | 3 | 2 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 0 |
| PAGASA | 12 | 5 | 3 | 5 | 13 | 9 | 9 | 8 | 6 | 2 | 3 | 0 |
| RDCC | 2 | 2 | 0 | 1 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| PDCC | 2 | 2 | 0 | 1 | 5 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| MDCC | 4 | 1 | 3 | 1 | 7 | 3 | 4 | 1 | 0 | 0 | 0 | 0 |
| BDCC | 3 | 5 | 5 | 1 | 7 | 4 | 4 | 1 | 2 | 0 | 1 | 0 |
| PAO | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| MAO | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| AT | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Total | 54 | 32 | 20 | 21 | 66 | 39 | 36 | 33 | 37 | 21 | 22 | 7 |

Results of the assessment revealed that farmers and other client groups from the three pilot provinces become aware of incoming typhoons when the weather condition starts to deteriorate (e.g. intermittent rain, gusty wind, etc.). That is the time that they start asking for information if there is a weather disturbance. They usually know of an impending typhoon 2 to 3 days ahead before it enters the Philippine Area of Responsibility (PAR).

The assessment further revealed that TV, radio, and PAGASA are the three major sources of information of the project stakeholders from the nine barangays about tropical cyclones, floods, and other weather disturbances. Only a number of barangay stakeholders claimed to have received information about weather disturbances from disaster coordinating councils and from the provincial and municipal agricultural offices in the project sites. This means that the broadcast media have a very important role in the dissemination of information for DRR/M purposes. The lack of communication system (e.g. telephone, fax, and internet) in the municipalities and barangays had prevented the EWS from PAGASA and Regional Disaster Coordinating Council (RDCC) to be relayed from the provincial down to the municipal level.

It is encouraging to note that most of the barangay stakeholders understood the early warnings issued by PAGASA and they appear to be useful in their farming and/or fishing activities. There were, however, some stakeholders who claimed that the content of the EWS issued by PAGASA are relatively broad (regional in scope) and are not specific to their localities. Barangay stakeholders further observed that EWS issued by PAGASA takes some time before they reached their locality because of the different channels these information/advisories had to pass through before reaching the barangay. This oftentimes led to delayed DRR/M response resulting to huge damage and losses on the part of the end-users.

An assessment of the process flow of the EWS revealed that information from PAGASA tends to stop at the municipal level so that weather information do not anymore reach the barangay level and the end-users (farmers and fishermen). The problem was traced to inadequate communication system between the municipal and barangay levels. As a result, the barangays and the end-users are unable to receive advance warnings and other PAGASA products which can be used for disaster preparedness and mitigation to minimize losses and damages.

The project addressed the identified weaknesses through trainings and the establishment of a stronger collaboration between PAGASA and the DARFU V to ensure a more effective DRR/M in agriculture.

A workshop of EWS and Community-Based Disaster Management was conducted on February 9-13, 2010 which was attended by participants from DA-RFU V and disaster coordinating councils from the provincial down to the barangay level. The first half of the training was devoted to the discussion of basic concepts about DRM and EWS. The second half was devoted to the conduct of workshop to identify strategies to improve local level EWS and communication system including how to overcome challenges of the inadequate knowledge of end-users and delays in communication.

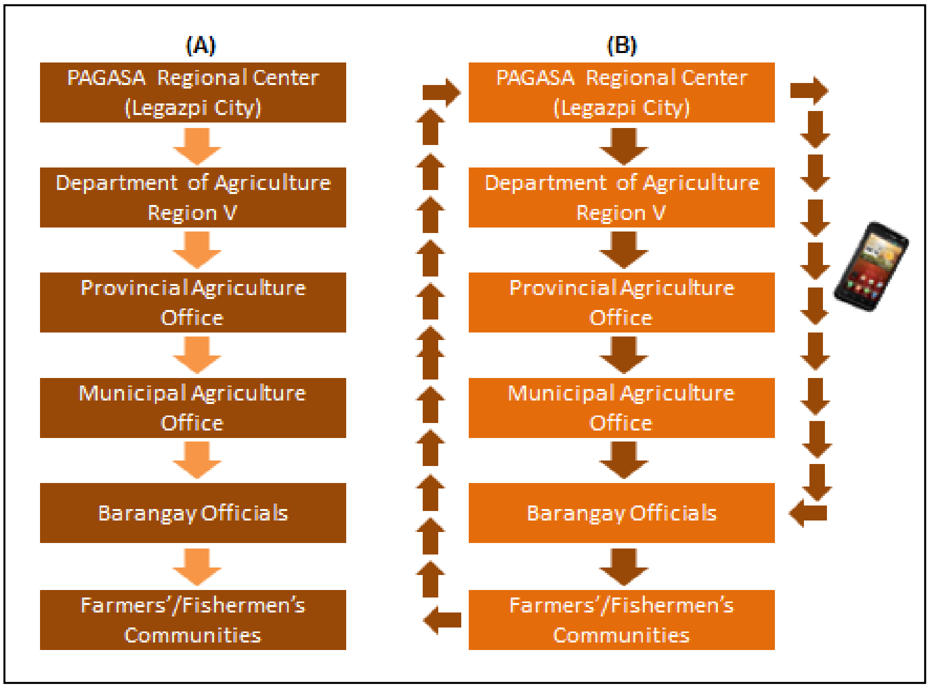


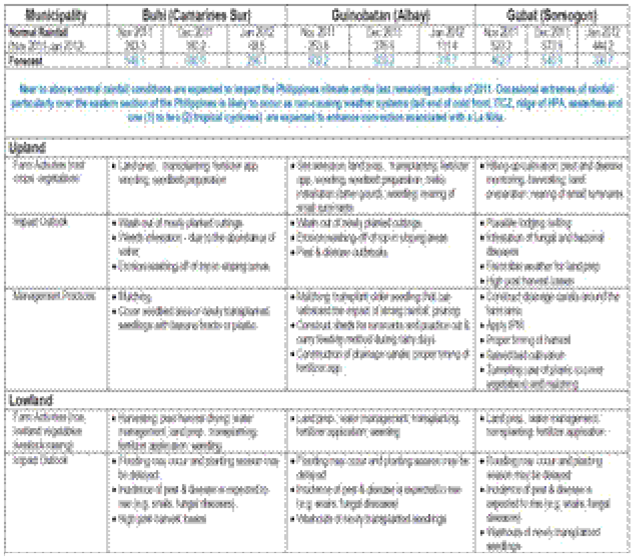

**Figure 13 Existing flow of PAGASA's EWS (A) vs. proposed EWS flow (B)**

### 4.1.3. Capacity Enhancement for Climate Services in Agriculture

An innovation triggered by the project was the provision of three monthly forecasts delivered at the beginning of each cropping cycle to facilitate strategic crop choices of farmers before each cropping seasons. DA translated these climate forecasts into concrete agricultural advice and information bulletins.

An agreement was brought forward between PAGASA and DA-RFU V to issue jointly the seasonal farm weather bulletins complemented by monthly updates and therewith improve the location specific applicability of PAGASA's early warning system for framers. A project office within DA RFU V was established under this project, lead the technical preparation (based climate data provided by PAGASA) and regular dissemination to local levels of farm weather bulletins for farmers (see Figures 14). These bulletins were sent at least once a month to the three municipalities covered by the project. The farm weather bulletin provides localized and site-specific weather forecast and their expected impact on agricultural crops and cropping cycles. The bulletins provide concrete agricultural advice to farmers with vital information on weather patterns for strategic planning decisions regarding type, length and timing of crop cultivation. They can provide extended warning on likelihood of expected hazards during reporting periods such as on drought spells, storms or floods and give advice, as may be needed, for risk reduction measures.

The project was able to document the impact of the timely early warning services and greater access for end-users (farmers and fishermen) to farm weather bulletins on the success of the GPOs. During the first two cropping cycles some crops were damaged by heavy rain and pest infestation, establishment of on-farm demonstration was delayed, or farmers failed to establish the demonstration farms. Whereas the GPOs in the third cropping (June-November 2011) season performed well and damages were reduced due to the preparation of farm weather bulletin and their recognition in the planning and implementation process of GPOs.



| Municipality | Buhi (Camarines Sur) | Guinobatan (Albay) | Gubat (Sorsogon) |
|---|---|---|---|
| Normal Rainfall | [illegible] | [illegible] | [illegible] |
| Forecast | [illegible] | [illegible] | [illegible] |
| Upland | | | |
| [illegible] | [illegible] | [illegible] | [illegible] |
| Lowland | | | |
| [illegible] | [illegible] | [illegible] | [illegible] |

**Figure 14 Sample farm weather bulleting November 2011- January 2012**

### 4.2. Strengthening Local Capacity on Post-Disaster and Needs Assessment

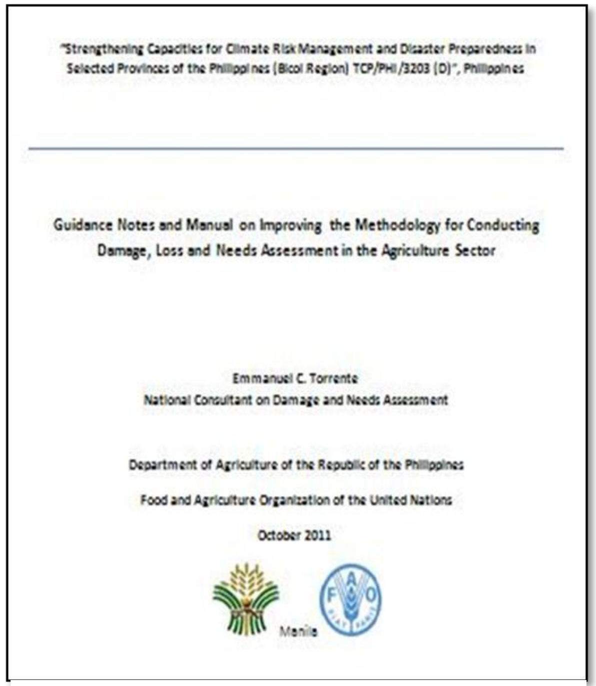
An important component of DRR/M is the conduct of a post disaster and needs assessment (PDNA) after a natural calamity such as typhoons, flood, and others in order to determine the extent of loss and damage and the nature of assistance/interventions required by affected communities. The Office of Civil Defense of the Department of National Defense (OCD-DND), which is the secretariat and executive arm of the National Disaster Risk Reduction and Management Council (NDRRMC), has prepared standard forms or matrices which the various line agencies of the government use in reporting the damages from disasters. All local disaster coordinating councils (DCCs) are required to submit their report using prescribed forms within a certain timeline to the next higher level, that is, from the barangay DCCs to municipal/city DCCs to the provincial DCCs. All these inputs are submitted to the regional DCC for consolidation and submission to the NDRRMC. The NDRRMC will further process these reports for the information and action by the NDRRMC Cabinet level and the President of the Republic of the Philippines.

The Department of Agriculture has developed its own methodologies to quickly assess the effects of disasters, particularly floods, typhoons, and drought, on the agriculture sector. These methodologies enable the DA to estimate post-disaster damages and losses and predict the potential production losses for rice and corn. The DA has also created standard reporting formats that will cover the effects of disaster on crops, livestock, and fisheries.

In order to achieve the objective of a timely and more accurate post-disaster damage assessment in the agriculture sector, the project had to examine existing post-disaster damage assessment (PDNA) methodologies. This project component yielded an improved version of a PDNA methodology in the form of guidance notes, from which the PDNA software was developed.

#### 4.2.1. Guidance Notes and Manual for PDNA in the Agriculture Sector

The guidance notes developed by the project intends to improve the existing assessment methodology of the DA and guide them, along with the LGUs and the community, in gathering additional information/data on barangay level to comprehensively assess the impacts of natural disasters in agriculture.


"Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) TCP/PHI/3203 (D)", Philippines

Guidance Notes and Manual on Improving the Methodology for Conducting Damage, Loss and Needs Assessment in the Agriculture Sector

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National Consultant on Damage and Needs Assessment

Department of Agriculture of the Republic of the Philippines

Food and Agriculture Organization of the United Nations

October 2011

Manila

**Figure 15 PDNA User's Manual**

The guidance notes basically clarifies the definitions of damages and losses due to disasters to be consistent with the international concepts developed by international agencies like the Economic Commission for Latin America and the Caribbean (ECLAC) as modified by the Global Facility for Disaster Risk Reduction of the World Bank (GFDRR/WB) and the Food and Agriculture of the United Nations (FAO), among others, aimed at standardizing post-disaster damage and loss reports which are the bases of needs assessment. The guidance notes covers the following sub-sectors of agriculture, some of which are not yet included in the existing damage assessment methodology of the DA:

(a) Seasonal crops (or crops) - rice, corn and high-value cash crops (HVCC).

(b) Permanent crops - those that require a certain period of time to mature before produce can be harvested regularly like coconut, fruit trees, coffee, abaca and others.

(c) Forestry - forest products like timber and rattan, among others.

(d) Livestock - those that are generally covered by the regular survey of the DA, like cattle, poultry, etc.

(e) Fisheries - includes both inland and marine fisheries.

(f) Infrastructure – the physical assets that are related to agriculture like irrigation facilities, rice warehouses, rice and corn mills, animal sheds, etc.

The Guidance Notes and PDNA Manual recommends the generation of two types of information for damage, loss, and needs assessment, namely: (a) pre-disaster baseline information and (b) post-disaster information on damages and losses. It also recommends six important steps in the conduct of post-disaster damage and loss assessment as follows: (a) creating a pre-disaster baseline information; (b) conducting a post-disaster damage assessment; (c) estimating losses in agriculture for the year that the disaster occurred; (d) summarizing the estimated damages and losses for the year that the disaster occurred; (e) estimating losses beyond the year the disaster occurred; and (f) summarizing the estimated losses beyond the year that the disaster occurred. The project has come up with formats and procedures to accomplish the formats and to estimate the damages and losses for a specific agricultural crop/commodity.

An important component of the PDNA Manual, which is an innovation of existing methodologies, is the identification of post-disaster recovery and reconstruction needs. Identification of post-disaster needs will require the DA to analyze first the impacts of the disaster to identify priorities within the agriculture sector (which sub-sector to prioritize). The manual recommends two steps for in identifying post-disaster needs: (a) analyzing the disaster impacts based on the damages and losses and (b) identifying the post-needs in the agriculture sector.

In analyzing the impacts of disasters, the following must be determined: (a) number of people affected and the socioeconomic impacts on families and women; (b) contribution of agriculture to other sectors; (c) contribution of agriculture to gross domestic product; (d) potential threats or hazards created by the disaster; (e) environmental effects; and (f) food security issues. The analysis of disaster impacts will give the basis for recovery and reconstruction activities in the agriculture sector. Recovery activities are generally short-term interventions designed to mitigate and shorten the adverse impacts of the disaster on the personal or household level. These recovery activities could take the form of any of the following: cash-and-food-for work scheme, direct subsidy to poor crop growers, provision of animals and the necessary veterinary and other related services, among others.

Reconstruction activities are those that usually take longer time period to implement and complete and are intended to sustain the recovery projects and/or mitigate future disasters. Possible reconstruction related activities in the agriculture sector could include the following: reconstruction and repair of agricultural structures, structural retro-fitting of undamaged or partially damaged agricultural facilities using better construction standards, relocation of vital facilities, soft term credit for reconstruction and repair of private agricultural businesses, among others.

Development of the Guidance Notes and PDNA Manual went through a participatory process wherein project stakeholders were involved in the revision and finalization. The first draft was presented during the workshop in Pili, Camarines Sur on February 2010. Several valuable inputs were generated from the participants of the workshop which included the DA-RFU V, project consultants, and local government officials at various levels. The revised draft was presented again to Agricultural Technicians (ATs) during a workshop held on January 2011 before it was pre-tested in the three projects sites in Gubat, Sorsogon on February 2011. Comments and suggestions obtained during the workshop with ATs and pre-testing were noted down in the final draft of the manual.

### 4.2.2. Development of a Web-based PDNA Software

**Figure 16 Project Team meeting with Dr. Aziz to discuss the concept of PDNA software development**

Based on the concepts in the PDNA guidance notes, a computer program was developed to automate the calculation of damages and losses due to disasters. The PDNA software is meant to expedite and reduce the error in the estimation of damages and losses based on the matrices developed by the DA. Development of the software required a series of consultations with DA-RFU V, target LGUs, Albay Public Safety and Emergency Management Office (APSEMO), and the Office of the Provincial Agriculturist (OPA) of Albay to agree on the parameters needed in developing the system. Three (3) LGUs, namely, Ligao City, Municipality of Oas, and Municipality of Guinobatan, were selected as pilot areas of the PDNA software development.

In developing the software, the templates used in the regular survey of the municipal Agricultural Technicians (ATs) for the seasonal crops (rice corn three main HVCCs) and livestock were modified to fit the requirements of the computer program. The data sets defined in the PDNA manual are clustered in the software as: (a) baseline information and (b) monthly planting updates. The software handles detailed database that includes the name of the farmer, basic household information and description of the farm and his house/farm-level information, such as land ownership and its level of vulnerability to flood and other natural disasters.

The system was dynamically-designed to make it open and cover wider data requirements of DA and LGUs. To address data security and data integrity, only registered ATs can log-in, input data, and view draft report. By using the previously encoded baseline data, utilizing the assumptions on the percentage of disaster impact to crops as defined by DA in their manual of disaster assessment and reporting system, plus a minimal additional updated data on the actual area of crops that were subjected to disaster, the following reports can be generated:

(a) Pre-disaster report [data sets before the disaster]
(b) 24-hour report after disaster
(c) 48-hour report after disaster
(d) 72-hour report after disaster
(e) Post-disaster report after disaster [10$^{th}$ day after the disaster]

Once fine-tuned, the software will be uploaded in the internet to provide real-time access to all ATs even if they are in the field visiting the flooded farms. They can update the farmers' database and generate updated report required by the LGU and DA as long as they are connected in the internet. The collected information can be viewed by the public in a pre-defined report format, saved in digital copy, and printed for easier data submission.

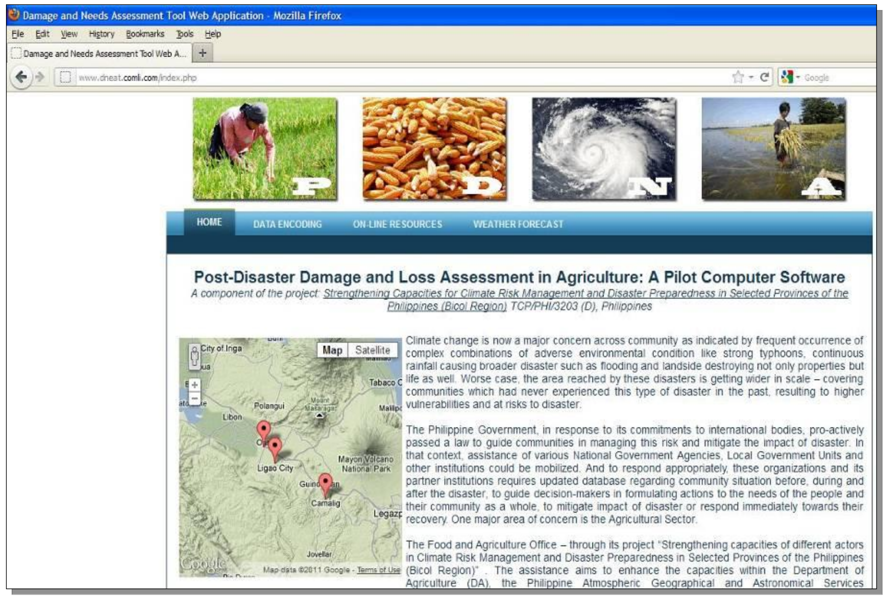



**Figure 17 Proposed damage and needs assessment tool web application**

A homepage was developed for the PDNA software (see Figure 17) for uploading once finalized and can be accessed through following link (www.pdna1.cbsua.edu.ph).

### 4.3. Development and Implementation of Community-based Disaster Risk Management (CBDRM) Plans

Disaster risk reduction (DRR) is considered as the first line of defense in the overall effort of addressing the effects of climate change. It is, therefore, necessary to expand and upgrade the capacity of local government units (LGUs) to address and anticipate natural disasters such as typhoons, flood, and landslides. This will entail using science-based early warning system and capacity building for LGUs and organizations for disaster preparedness and risk management.

The project recognizes the fact that many of the disaster management programs failed to be sustainable at the local level after completion of the project due to the lack of participation of target clientele. Community participation is a critical element of sustainable disaster management. The community and the people living therein should be given an opportunity to be involved in the planning and implementation of disaster management activities. This is the very essence of the project's Community-based Disaster Risk Management (CBDRM) component. The CBDRM approach promotes bottom-up approach in the planning and implementation of DRM activities. It provides opportunity to the community to evaluate and analyze their hazardous conditions, their vulnerabilities and capacities as they see themselves. Additionally, this participatory planning process enhances knowledge and raises the awareness of farmers on climate change and hazards. The approach further acknowledges the need to involve in the process as many stakeholders as needed, with the end goal of achieving capacities and transferring resources to the community that is expected to assume the biggest responsibility over disaster reduction. To come up with workable barangay and municipal Disaster Risk Reduction and Management (DRRM) plans and to institutionalize the same in local governance, the following processes was adopted.

#### 4.3.1. Rapport Building and Understanding the Community

Preparation of DRRM plan requires a good understanding of the community. To be able to understand well the community, it is a must for a project team to undergo community integration and establish good rapport with community members. The initial step taken by the CBSUA Project Team was to introduce the project in each of the nine barangays through consultation meetings that was attended by local officials and selected constituents. This provided the opportunity for barangay stakeholders to clarify some issues, gather some initial data, and for the Project Team to assess the level of awareness of the inhabitants.

#### 4.3.2. Capacity Building

A series of training events was organized to accompany the CBDRR/M planning process. The capacity building activities took place in the form of short-term trainings and workshops conducted both at CBSUA and on-site with teams from CBSUA and PAGASA and national consultants providing the technical inputs. Participants to these series of trainings were provincial and local authorities of DA-RFU V, provincial/municipal/barangay DRR/M councils, barangay officials of the project sites, and other project stakeholders.

**Table 4 Capacity building activities conducted by CBSUA**

| Title of Training/ Workshop | Date | Venue | Number of Participants |
|---|---|---|---|
| Training on Disaster Risk Reduction | Nov. 12-13, 2009 | CBSUA | 58 |
| Training on Community Based Disaster Risk Reduction and Management | Feb. 12-13, 2010 | CBSUA | 62 |
| Training on Gender Integration and Harmonization in DRM | March 10-11, 2010 | CBSUA | 48 |
| Barangay and Municipal Strategic Planning Workshop on Integrating DRM in Agriculture and Fisheries | Oct. 13, 2011<br>Oct. 14, 2011<br>Oct. 19, 2011 | Guinobatan<br>Gubat<br>Buhi | 28<br>29<br>36 |
| Orientation Seminar on RA 10121 (Disaster Risk Reduction and Management Act of 2010) | April 5, 2011 | CBSUA | 13 |
| Orientation Seminar on RA 10121 (Disaster Risk Reduction and management Act of 2010) and DRR Plan Validation | April 13, 2011<br>April 14, 2011<br>April 19, 2011 | Gubat<br>Buhi<br>Guinobatan | 25<br>26<br>20 |
| Organization of Barangay Disaster Risk Reduction and Management Committee (BDRRMC) and Barangay Disaster Quick Response Team (BDQRT) | June 10, 2011<br>August 29, 2011<br>August 30, 2011<br>August 31, 2011 | San Buena, Buhi<br>Ariman, Gubat<br>Bagacay, Gubat<br>Rizal | 17<br>14<br>27<br>20 |

### 4.3.3. Participatory Climate Risk Management Planning

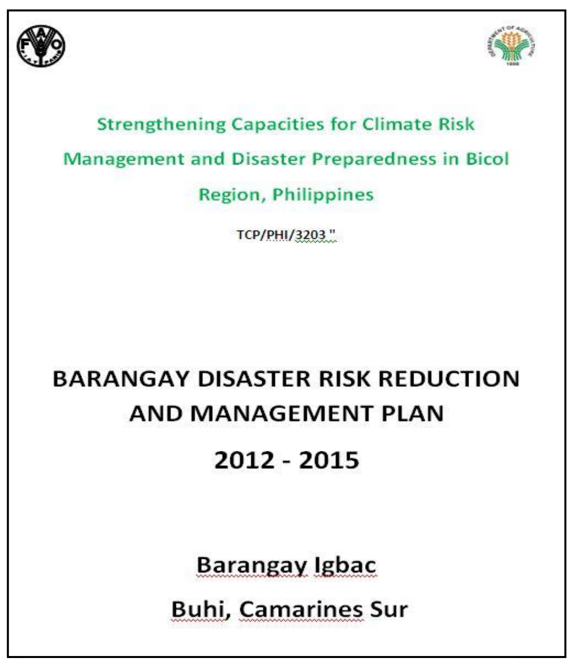
Under this project integrated barangay DRRM action plans, which specifically focus on DRR/M in agriculture, were developed by CBSUA and formally endorsed by the LGUs for 9 barangays namely:

1. Minto, Masarawag, and Mauraro in the municipality of Guinobatan
2. San Buena, Igbac, and San Ramon in the municipality of Buhi
3. Bagacay, Ariman, Rizal in the municipality of Gubat.

**Figure 18 A scene during the barangay planning workshop to prepare the DRRM plan**

The preparation of the DRRM plans in the nine barangays was participatory in nature in which various local stakeholders were involved in the planning and validation activities. Initial planning activities were undertaken during the two (2) DRRM trainings wherein participants were asked to: (a) identify the natural hazards obtaining in their respective barangays; (b) assess their level of disaster preparedness; (c) assess the risk from identified hazards and number of people affected; (d) prepare disaster risk reduction plan in agriculture and fisheries; and (e) formulate community-based disaster risk management approach and process. Three (3) more planning sessions were conducted after the two trainings at the barangay and municipal levels--before the election of local officials, three months after the local election, and after the passage of Republic Act 10121 or the DRRM Law. Validation of workshop outputs was done at the municipal and barangay levels in order to clarify some issues and concerns and to develop a sense of ownership of the DRRM plan from local stakeholders.

Preparation of the DRRM plan was facilitated by the organization of the Barangay Disaster Risk Reduction and Management Committee (BDRRMC) in each of the nine (9) barangays. The Project Team worked very closely with the BDRRMC in each barangay during the series of planning-workshops and community validation.



Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Bicol Region, Philippines

TCP/PHI/3203 "

BARANGAY DISASTER RISK REDUCTION AND MANAGEMENT PLAN

2012 - 2015

Barangay Igbac

Buhi, Camarines Sur

**Figure 19 Example of a Community DRR/M Action plan**

A vulnerability assessment undertaken by CBSUA included the location and its accessibility, prevalent land and agricultural practices and the socio-economic situation as well as the identification of the main hazards and threats. The assessment was the base for the development of location specific Disaster Risk Reduction and Management Strategic Plans and the identification of suitable GPOs for the respective barangay. Each plan defines specific actions for 7 key themes:

1. **Establish a local structure on DRR/CCA for Agriculture and Fisheries (A&F)** which includes the capacitating of the members of the BDRRMC, the preparation of hazard maps, partnership with other entities on DRR and designation of structures as evacuation centers.

2. **Appropriate a specific budget for DRRM in A&F** through the allocation of a portion of the local budget, identification of funding possibilities of the national government and enhancement of the accessibility to microfinance intuitions.

3. **Establish an Local Risk Transfer Strategy (RTS)**, which means to assess local resources and identify and adapt the most applicable and effective RTS.

4. **Establish an effective EWS for A&F** which could be realized through appropriate EWS devices, effective EWS communication protocols and the improvement and utilization of some parts of the Brgy. Hall for the BDRRMC and EW equipments

5. **Adopt locally tested Good Practice Options on A&F** by adopting the GP options and cropping calendar, establishing model farms of GPOs, disseminating information on GPOs and/or by conducting further trials on other appropriate GPOs

6. **Establish an effective A&F rehabilitation strategy for A&F** by updating the local A&F database, adopting an effective PDNA on A&F and by training constituents on data collection.

7. **Heighten awareness of farmers and fisher folks on impact of CCA on A&F** through the preparation and dissemination of information materials on the impact of CCA on A&F, regular assemblies for farmers and fisher folks to discuss impact of CCA on A&F and information bulletin boards in strategic areas showing hazard maps and vulnerability indicators with emphasis on A&F.

A regional Strategic Planning Workshop for Integrating DRM in Agriculture and Fisheries was sponsored by the project on October 19-20, 2010 to provide the venue for the presentation and possible integration of the DRRM plans of the nine barangays in the DRM plan of the DA-RFU V and PAOs of Albay, Camarines Norte and Sorsogon. All DRRM plans of the nine barangays were subsequently endorsed to the Sangguniang Bayan (legislative council) of the three municipalities covered by the project for adoption and funding support.

## 4.4. Good Practice Options for DRR/M

### 4.4.1. Selection and Validation Process

The GPOs were identified and tested to improve the livelihood resilience and food security of the various livelihood groups in the pilot communities who are highly vulnerable to extreme climatic events. As envisioned by the project, successfully tested GPOs will be included in the long-term community-based disaster management planning and will be recommended for wider dissemination beyond the selected communities/municipalities. Farmers and fisher folk who were involved in the pilot testing of the GPOs were supported by the project through provision of inputs and technical assistance. In total 12 GPOs were pilot tested in the lowland, upland, and fisheries agro-ecological zones of the nine (9) barangays.

**Figure 20 A member of the Bicol University Team answers questions during GPO validation at the community level**

The development of GPOs for DRR in agriculture and fisheries was premised on the assumption that there are already technologies developed earlier which can be pilot tested for DRR and CCA. With this, the national consultants (on farming systems and fisheries/aquaculture) and the BU Team had to identify and document GPOs with potential to increase resilience of farmers and fisher folks against hazard impacts at least 2 to 3 months before the start of the cropping season (wet and dry season cropping). Identification of GPOs was done from various sources such as local knowledge from pilot communities, research and extension centers of the DA and academe, internet search, and other sources at international levels. The national consultants and the BU Team were able to identify and catalogue about 20 GPOs from these sources which were later on evaluated by the Project Team and experts from DA-RFU V before being field validated.

**Table 5 GPO Selection Criteria**

| Criteria Used in the Selection of GPOs | Per cent |
|---|---|
| A. Agro-ecological suitability of the selected GP option | 40 |
| 1. Suitable under existing and near future climatic status | |
| 2. Edaphic and topographic conditions and/or same agro-ecological zones Farmers' perception | |
| 3. Agro-ecological zone location | |
| 4. | |
| B. Economically and socially feasible | 35 |
| 1. Cost of inputs | |
| 2. Yield potential | |
| 3. +/-Net benefits | |
| 4. Capacity building requirements | |
| 5. + / - Employment opportunities for the landless | |
| 6. Market potential | |
| C. Increases resilience against impacts of climate hazards | 20 |
| 1. Ease/cost of rehabilitation | |
| 2. Recovery potential | |
| 3. +/- water use | |
| D. Technology does not increase GHG emissions | 5 |
| 1. +/- chemical fertilizer use | |
| 2. +/- energy use | |

The criteria for the selection of the GPOs were adopted from a similar project implemented by FAO. These criteria and the corresponding weights were as follows: agro-ecological suitability (40%), socioeconomic acceptability (35%), resilience to natural hazards (20%), and not contributing to greenhouse gas (5%). Each of these criteria was further broken down to a number of sub-criteria to properly guide the evaluation of the GPOs by the Project Team and the DA-RFU V experts. Five (5) or more GPOs for each agro-ecological zone were selected for field validation based on their scores from the aforementioned criteria. This procedure was done at least two months before the start of the cropping season.

Technologies which passed the pre-evaluation were then brought to the pilot communities for field validation. The validation was done against production, technical, and climate-related criteria and for location-specific suitability. A focus group discussion (FGD) attended by farmers-leaders and barangay officials was usually organized by the Project Team in order to get the comments/suggestions and endorsement of the former. Concerns/issues which usually emerged during the FGD were on the suitability of the GPOs to the agro-physical setting of the community, labor and other input requirement, and market, among others. The FGD also provides the venue for the national consultants, DA-RFU V and LGU extension workers to clarify some issues pertaining to the GPOs. Another avenue to validate the technologies was through field visit. This was resorted to in order to ascertain the suitability of the GPOs relative to the following criteria such as impacts on land and water, costs, input and labor requirements, increased resilience against hazard impacts, value added to existing system, environmental soundness, potential for wider replication, social and cultural acceptability, etc. Technologies which passed the field validation process were presented to the TWG for further technical evaluation and fine-tuning before endorsing them to the Project Steering Committee (PSC) for approval. The PSC, which is chaired by the DA's Undersecretary for Operations, is the project's highest governing and policymaking body.

The project cooperators were farmers and fisher folk who were identified to pilot test the selected GPOs for enhanced DRR/CCA. Prospective project cooperators were endorsed by farmer-leaders and barangay officials thru a barangay meeting. Selection of project cooperators was based on the following criteria: (a) preferably a sustenance fisher or a small-scale farmer cultivating one (1) hectare or less; (b) farmers and sustenance fishers living below the poverty threshold; (c) should be an active member of a farmers' organization; (d) farmers and sustenance fishers which have not received any or have received minimal livelihood assistance; (e) legitimate residents of the barangay as certified either by the Barangay Chair or Barangay Secretary; (f) has a potential to become a farmer-leader and/or trainer; and (g) willing to provide counterpart such as labor for land preparation, day-to-day maintenance of the techno-demo farm.

Five different GPOs were pilot tested in the lowland, 3 in the upland, and 4 in the fishery/aquaculture agro-ecological zones of the nine (9) pilot communities for three (3) cropping cycles starting June 2010 until June 2011. A maximum of six (6) most suitable GPOs, regardless of the type of farming system/agro-ecological zone, were implemented in each project site/barangay. Each GPO was tested at least by five (5) cooperators/partners.

**Figure 21 Rice seeds being distributed by the Project Team for the establishment of GPOs in lowland irrigated areas in Buhi, Camarines Sur**

Prior to the establishment of the GPOs, a detailed implementation guideline was prepared by the national consultants and the BU Team for each GPO for the guidance of the LGU extension staff and farmer-cooperators. The guideline contains the step-by-step procedure in the establishment of the GPO including site preparation and size of plot/s, input requirement, schedule of application of required inputs, care and maintenance and others. A technical training was also conducted every cropping season prior to the establishment of the GPOs in each of the pilot sites to discuss the guidelines and implementation requirements of selected GPOs. The technical training was attended by the LGU extension staff and by identified farmer-cooperators.

Pilot testing of GPOs in the lowland and upland agro-ecological zones was done over a 1,000 sq. m. plot while the techno-demo area for fishery/aquaculture GPOs was dependent on the resource capacity of the cooperator. Farm inputs like planting materials, fertilizers, and pesticides were provided by the project while the pilot testing area and farm labor were the equity of the farmer-cooperator.

The GPO selection process was framed by ex-ante and ex-post evaluation for three (3) cropping seasons using the same set of criteria discussed in the preceding section, namely, agro-ecological suitability, socioeconomic acceptability, resilience to natural hazards, and estimated carbon balance. The ex-ante evaluation of GPOs was done to determine which technology will be field tested in the pilot communities. The ex-post evaluation was done for each GPO at the end of the cropping season by comparing it with existing farmers' practice.

**Figure 22 Mr. Tsurumi of FAO during his visit of on-farm demonstrations in Buhi, Camarines Sur.**

Farmer-cooperators were required to record the farm inputs used and activities done for both the GPOs and existing farmers' practice and given corresponding cost. Crop cuts were obtained from both the GPOs and existing farmers' practice in order to compare the yield performance. Statistical test was used to determine if the yield difference between the GPOs and existing farmers' practice was significant. The marginal benefit cost ration (MBCR) was used to determine whether the benefits of the adaptation measure outweigh the costs, whether net benefits are maximized, and how the GPOs compare to existing farmers' practice.

### 4.4.2. Results from the Field Testing of GPOs

#### 4.4.2.1. GPOs for Lowland Agro-ecological Zone

A total of five (5) GPOs were pilot tested in the lowland irrigated rice area in Buhi, Guinobatan, and Gubat for three cropping cycles starting June 2010 until October 2011 in order to address site-specific hazards. These GPOs were: (a) use of early maturing rice variety; (b) use of submergence rice variety; (c) use of salt-tolerant rice variety; (d) timing of planting + rice rationing; and (e) rice + duck faming system.

During the 2010 wet cropping season (June-October), there were 40 farmer-cooperators who participated in the pilot testing of 5 GPOs. The number of farmer-cooperators increased during the 2011 dry cropping season (December-April) and 2011 wet cropping season (June-October).

**Table 6 List of GPOs implemented in the irrigated lowland rice areas in the three project sites from June 2010 to October 2011.**

| Name of GPO | No. of Cooperators per Cropping Season | | | Total |
|---|---|---|---|---|
| | 2010 Wet Season | 2011 Dry Season | 2011 Wet Season | |
| Use of early-maturing rice variety | 25 | 35 | 25 | 85 |
| Use of submergence rice variety | 3 | 25 | 35 | 63 |
| Use of salt-tolerant rice variety | 5 | 10 | 15 | 30 |
| Timing of planting + ratooning | 10 | 10 | 15 | 35 |
| Rice + duck farming system | - | 3 | 50 | 53 |
| Total | 40 | 43 | 115 | 198 |

***Use of Early-Maturing Rice Variety***

The use of early-maturing rice varieties (EMRV) was introduced in the project sites to reduce the vulnerability of rice farmers to climatic events such as typhoons and drought/long dry spell and thereby enhance their level of food security. Rice farmers in the project sites usually grow two cropping seasons of rice, with the first crop planted in June-October and the second crop in December-April. The first cropping of rice (June-October) coincides with the typhoon season which is the period when tropical cyclones would enter the Philippine Area of Responsibility (PAR). Data from PAGASA from 1948 to 2003 revealed that an average of 20 tropical cyclones would enter PAR. Tropical cyclones would usually make their landfall in Bicol Region during September-December period at a time when the rice crop is about to be harvested. Heavy rainfall, flood, and strong wind brought by these typhoons cause heavy damage and losses to rice. While the second cropping of rice (December-April) is less vulnerable to typhoon, the onset of dry season in February-March affects the vegetative growth of the second rice crop that ultimately results to lower yield. Planting of early-maturing rice variety will enable farmers to harvest prior to the peak of the typhoon season and before the onset of the dry season.

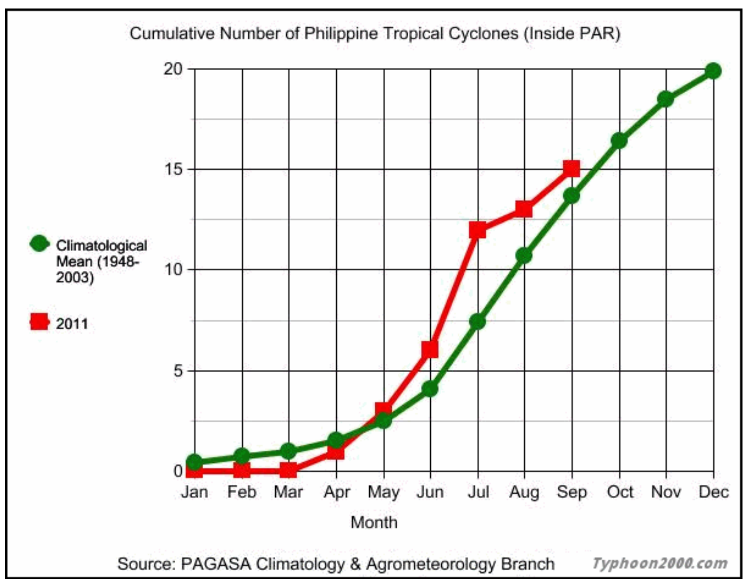



**Figure 23 Tropical cyclones in the Philippines**

The first cropping using EMRV (e.g. NSIC, Rc-120, IR-60) was established during the middle part of July 2010 in Bagacay, Gubat, Sorsogon and in mid-August 2010 in barangays San Ramon and Igbac in Buhi, Camarines Sur. At this time of the year, El Niño was already felt in the whole of Bicol Region. About 50% of the farmers were unable to plant rice in Sorsogon. In spite of this, farmer-cooperators in San Ramon, Ariman, and Bagacay took the risk of planting ERMVs. They were able to harvest a month earlier than those who planted the existing local variety, Binatang, which is a late-maturing variety. A total of 85 farmer-cooperators participated in the pilot testing of ERMVs for three cropping cycles.

***Use of Submergence Rice Variety***

During rainy season, the Bicol Region receives above normal rainfall causing the flooding of some low-lying areas for weeks. The three project sites are some of the areas in Bicol which experience flooding that leaves some rice areas submerged under water for a certain period. Prolonged submergence affects the growth of the rice crop resulting to poor yield. The project introduced NSIC Rc-194, a submergence rice variety, in the three project sites to determine its adaptability in the pilot communities of the project. For three cropping seasons, a total of 63 farmer-cooperators pilot tested NSIC Rc-194. During the first cropping season, only three farmers from Rizal, Gubat, Sorosogn agreed to plant said variety in their farm. The number of cooperators significantly increased during the second and third cropping seasons. Interestingly, six (6) farmers adopted the submergence rice variety and planted it in their lowland irrigated rice parcel without input assistance from the project.

***Use of Salt-Tolerant Rice Varieties***

Of the three project sites, the municipality of Gubat has a number of barangays which experience saline-intrusion problem. Rice farms along the mangrove area of Rizal and Bagacay had been reported as affected by salt water intrusion. Farmers cultivating rice farms along this area normally experience low rice yield because the existing rice variety being used by them is not suited under this type of stress environment, especially during the months of May and December. Seedbed preparation and seed propagation start early May upon receipt of first rainfall and transplant in late May or early June. Transplanting is delayed for a month when precipitation does not come on time.

**Figure 24 A typical rice area in barangay Rizal which is affected by saline water intrusion.**

A total of 30 farmers pilot tested NSIC Rc-108, a salt-tolerant rice variety, for three cropping seasons in barangays Bagacay and Rizal from August 2010 to June 2011. One major concern on the use of NSIC Rc-108 was the duration of seedbed preparation which takes 3 to 4 weeks before transplanting. Older seedlings (25-30 days) should be used due to their sensitivity to saline condition during early vegetative stage. This requires some adjustment in the timing/ scheduling of crop establishment as weather condition is a crucial concern for farmers to be able to adapt to environment stress. The use of early-maturing saline-tolerant variety (e.g., NSIC Rc-188 series) offers a better option for salt-affected rice areas for a quick turnaround and crop establishment.

***Timing of Planting + Rice Ratooning***

Rice ratooning is a traditional practice among older rice farmers in Bicol. This is a technology wherein the rice field is fallowed during the turnaround period to give the rice stalks to re-grow and produce grains. This requires the planting of an early maturing rice variety to allow early harvesting and using the turnaround period for the growing of ratoon crop.

The pilot communities identified this traditional technology during the planning session to be able to recoup crop production losses incurred during the typhoon season (September-December). There were 35 farmers who pilot tested the technology over three cropping seasons using NSIC Rc-158 rice variety. This rice variety is short - or early-maturing and has good ratoon ability. The technology uses the turnaround period for the rice crop to re-vegetate. Using short-maturing rice variety such as NSIC Rc-158 gives the rice stalks that remain on the ground longer turnaround period to develop. The other rice variety which was introduced as GPO was NSIC Rc-120.

***Rice + Duck Farming System***

**Figure 25 Selected rice farmers pilot tested duck raising as part of rice-based farming system.**

Integration of duck raising in rice farming system was formally introduced by the project in the pilot communities during the third cropping season to enhance food security and provide additional income among rice farmers. This GPO is appropriate for typhoon-, flood-prone, and salt-affected areas.

The project introduced the idea of rice + duck farming system as a GPO during the first cropping season community validation workshop. The farmers were, however, undecided because of previous negative experience with the technology. During the second cropping season, three (3) women-farmers from barangays Ariman (Gubat), Masarawag (Guinobatan), and Igbac (Buhi) took part in the exploratory pilot testing of this GPO. Participating farmers constructed a simple 10 sq. m. shelter surrounded by a used nylon fence to shelter the ducks from rain and from other animals. Each cooperator was provided 10 ready-to-lay ducks which were allowed to freely range on a 1,000 sq. m. rice field two weeks after transplanting until rice maturity. The project provided the planting material (NSIC Rc-194 in Igbac and Masarawag; NSIC Rc-158 in Ariman) while the three (3) cooperators used their own laying ducks.

#### 4.4.2.2. GPOs for Upland Agro-ecological Zone

In the upland/rainfed agro-ecological zone, three (3) GPOs were implemented in the nine pilot communities which involved a total of 278 farmer-cooperators. These three (3) GPOs were strip intercropping, coconut leaf pruning, and goat raising with 153, 65, and 60 farmer-cooperators, respectively.

***<u>Strip Intercropping</u>***

Strip intercropping is the practice of producing two or more crops in narrow strips located throughout the length of the field. The strips are wide enough that each can be managed independently, yet narrow enough that each crop can influence the microclimate and yield potential of adjacent crops. Strip intercropping is an adaptation or risk management response to changes in climate. It involves on-farm alteration of crop mixes and perhaps, the introduction, addition or substitution of new crop varieties. A mix of crop types with different climate-related characteristics is expected to reduce the risk of income loss during inclement weather (such as long dry spell, heavy rainfall, typhoon, etc.) than planting a single crop over the same area of land.

**Table 7 List of GPOs implemented in the upland/rainfed areas in the three project sites from June 2010 to October 2011**

| Name of GPO/ Location | No. of Cooperators per Cropping Season | | | Total |
|---|---|---|---|---|
| | 2010 Wet Season | 2011 Dry Season | 2011 Wet Season | |
| Strip Intercropping | | | | |
| ▪ Guinobatan | 8 | 23 | 16 | 47 |
| ▪ Buhi | 15 | 11 | 13 | 39 |
| ▪ Gubat | 15 | 22 | 30 | 67 |
| Coconut Leaf Pruning | | | | |
| ▪ Guinobatan | 12 | 7 | 4 | 23 |
| ▪ Buhi | 5 | 7 | 7 | 19 |
| ▪ Gubat | 15 | 8 | - | 23 |
| Goat Raising | | | | |
| ▪ Guinobatan | - | - | 30 | 30 |
| ▪ Buhi | - | - | 20 | 20 |
| ▪ Gubat | - | - | 30 | 30 |

It is recognized that the growth duration of a crop in an intercropping system plays an important role in achieving high yield. Higher yield is expected when the maturity period of the intercrops are different and are planted in a correct time spacing. With these considerations, the project introduced strip intercropping GPO using a combination of long-duration (LD), medium-duration (MD), and short-duration (SD) crops and improved crop varieties. The following crops were used as intercrops: LD crops- eggplant, upland rice, sweet potato, squash, tomato, and pepper; MD crops- okra and peanut; and SD crops- green corn, pole sitao, and snap bean. Following are the different crop combinations introduced in the pilot communities for three cropping seasons:

(1) LD + MD + SD: *eggplant* + *okra* + *green corn* and *eggplant* + *okra* + *pole sitao*;
(2) LD + LD: *upland rice* + *sweet potato, squash* + *eggplant, squash* + *tomato, squash* + *pepper, tomato* + *pepper*, and *squash* + *eggplant*; #
(3) LD + MD: *eggplant* + *okra and squash* + *peanut*;
(4) LD + SD: *squash* + *snap bean, squash* + *pole sitao, eggplant* + *snap bean, eggplant* + *pole sitao, tomato* + *snap bean, eggplant* + *green corn, squash* + *sweet corn*, and *pepper* + *sweet corn*;
(5) MD + SD: *peanut* + *green corn*; and
(6) SD + SD: *sweet corn* + *snap bean, green corn* + *pole sitao*, and *green corn* + *snap bean*.

The aforementioned GPOs were established on a 1,000 square meter lot provided by the farmer-cooperator, using the planting materials and other farm inputs provided by the project. Since the implementation of the GP option involves several crop combination, crops planted were grouped based on their growth duration namely long duration (LD), medium duration (MD), and short duration (SD). Aside from the different crop combinations, improved varieties were used.

***<u>Coconut Leaf Pruning</u>***

**Figure 26 Coconut leaf pruning allows the planting of intercrops with high sunlight requirement**

Coconut (Cocos nucifera L.) is a traditional plantation crop grown in the Bicol Region, particularly in the nine pilot communities of the project. Being a widely spaced crop, coconut's unique rooting pattern and canopy coverage offers a good opportunity for integrating various crops in the interspaces. Vegetable intercropping under coconut is one of the popular intercropping practices in the region because of the additional income and improved food security it provides to the farming households. This intercropping practice requires short period of planting time, smaller area (using vacant spaces between coconut trees), and less capital requirement. Crops that are highly recommended as coconut intercrops include tomato, eggplant, sweet pepper, squash, okra, ginger, sweet potato, and cassava.

In spite of the good prospects of coconut intercropping using annual or semi-annual crops, majority or if not most of the coconut areas in the project sites remain monocultured. It is estimated that in coconut farms where palms are spaced at 8.0 meters, nearly 75% of the land area is left unutilized and as much as 40-60% of the sunlight is transmitted through the canopy during peak hours especially in palms aged around 25 years. The lack of sunlight underneath the palms and competition for soil nutrients are some of the reasons why farmers do not utilize the interspaces for the production of cash crops.

With the aforementioned, the project favorably endorsed the introduction of coconut leaf pruning (CLP) GPO in the pilot communities. The technology involves the removal or pruning of coconut leaves from leaf Rank 19, i.e. supporting the tender "buko" nuts down to the oldest leaf at harvest time using a harvesting pole and scythe to allow adequate sunlight for the normal development and high yield of perennial and annual crops. By pruning older leaves, growth of the intercrops is enhanced due to increased sunlight transmission below the tree canopy resulting in higher solar energy for and better yield of the intercrops. The pruned leaves can also be used as mulching materials to prevent evapo-transpiration of intercrops.

Improved varieties of six crops, namely, sweet potato (SP-23 and SP-30), cassava (Golden Yellow), squash (Rizalina), corn (Los Baños Lagkitan), peanut (Biyaya), and eggplant (Dumaguete Long Purple) were planted as intercrops under coconut leaf pruning technology. These crops were chosen as intercrops because these were being grown by the farmers in the pilot communities except that improved varieties were used instead of the local varieties. Fertilizer was also applied based on the result of the soil analysis as part of the value added of the GPO.

***Goat Raising***

As observed during the situational assessment, grasses and crop residues which can be used as feeds for livestock abound in most of the pilot communities. It is for this reason that barangay stakeholders suggested goat raising during the planning workshop for 3rd cropping season. Goat raising will not only promote crop-livestock integration but would be an additional source of income for the upland farmers thru the sale of milk and offsprings. It will, therefore, further enhance the livelihood resilience of upland/rainfed farmers and cushion the possible impact of climate hazards.

**Figure 27 Goat raising is a gender-responsive good practice option**

For these reasons, the project distributed a total of 80 does which were about to kid in a few months in seven (7) of the nine (9) pilot communities. The beneficiaries of the goat raising project were farmer-cooperators of either strip cropping or coconut pruning + intercropping GPOs as follows: Mauraro-18, Masarawag-12, Igbac- 10, San Ramon- 10, Bagacay-10, Ariman-10, and Rizal-10. The agreement was for the municipal LGU to provide the male goat for breeding purposes and for farmer-cooperators to return to the LGU one (1) female kid for dispersal to other interested farmers.

#### 4.4.2.3. GPOs for Fisheries/Aquaculture

For the fisheries/aquaculture sector/zone, four (4) GPOs were implemented, namely, backyard tilapia farming, small-scale seaweed farming, freshwater prawn farming, and squid pot. Backyard tilapia farming was designed for farmer-cooperators with access to land while seaweed farming and squid pot for coastal fishers who do not have a farm to cultivate.

**Table 8 List of GPOs implemented in the fishery/aquaculture zone.**

| Name of GPO | Location | No. of Cooperators per Cropping Season | | Total |
|---|---|---|---|---|
| | | 1st Cropping | 2nd Cropping | |
| Backyard Tilapia Farming | Rizal, Gubat | 6 | - | 6 |
| | Ariman, Gubat | 8 | - | 8 |
| | Masarawag, Guinobatan | - | 6 | 6 |
| Seaweed Farming | Bagacay, Gubat | 2 | 5 | 7 |
| Freshwater Prawn Farming | Ariman, Gubat | - | 10 | 10 |
| Squid Pot | Rizal, Gubat | - | 10 | 10 |
| | Ariman, Gubat | - | 16 | 16 |
| | Bagacay, Gubat | - | 7 | 7 |
| **Total** | | 16 | 54 | 70 |

A total of 70 farmer-cooperators participated in the implementation of the GPOs as shown in Table 8. majority or 64 of the farmer-cooperators were from Gubat, Sorsogon and the remaining six (6) from Guinobatan, Albay. Cooperators from Gubat were engaged in farming and fishing while those from Guinobatan, particularly in Masarawag, were mostly rice farmers who wanted to integrate fish farming in their farm lots for household food security.

***Backyard Tilapia Farming***

Tilapia farming was considered as a GPO because of its resilience against adverse weather condition. In calamity prone areas, tilapia is one of the best suited species because they are hardy fish that can tolerate adverse environmental conditions (i.e. high temperature, low dissolved oxygen, turbid waters, etc.). They are also fast growing and disease resistant, making it possible to shorten the cropping cycle

**Figure 28 A tilapia fishpond established just beside the rice farm**

to avoid damage due to typhoon and floods. The pond used for backyard tilapia farming can also be a source of water for irrigation and growing vegetables in drought-prone areas. Moreover, tilapia is widely accepted as food fish even in coastal areas, thereby enhancing their food security.

Backyard tilapia farming was implemented twice at two (2) different freshwater environments--in the coastal areas of Gubat, Sorsogon and along irrigated lowland rice areas of Guinobatan, Albay. These two (2) areas are geographically contrasting, with Guinobatan being a landlocked municipality at the foot of Mayon Volcano, making it vulnerable to volcanic eruption, ash fall, and flood; while Gubat faces the Pacific Ocean which makes it gullible to storm surge and flooding especially during typhoon season.

The first batch of pilot testing was done in Gubat in September 2010 while the second batch was in Guinobatan in mid July 2011. There were 14 cooperators who pilot tested the technology in Gubat and six (6) in Guinobatan. Aside from the on-site technical presentation of the option, a detailed technical training was conducted prior to project implementation in as much most farmers did not have any training on fish farming. All made use of a portion of existing ponds with an area of 40 to 2,500 square meters, built by digging or simply enclosing a depression to contain water, equipped with inlet and outlet pipes made of locally available materials. The pond was stocked with tilapia fingerlings at a density of two per square meter and fed with natural fish food organism through fertilization management and supplemented by rice bran (D1) given at 3-5% of the fish biomass. The stock were harvested upon reaching 80 to 100 grams either selective harvesting using gill net of desired mesh size or total harvesting by totally draining the pond to harvest all the fishes using seine net.

***Seaweed Farming***

The project considered the pilot testing of seaweed farming as a GPO as a way of enhancing the livelihood resilience of small fishermen. Fish catch of fishermen in the project sites of Gubat has dwindled over the years and this is further exacerbated during adverse weather condition like typhoon, heavy monsoon rain, etc. The choice for seaweed farming using Eucheuma was further influenced by the fact that the technology is relatively simple and farm structures can be made from locally-available materials that can be easily transferred to a safer place during adverse weather condition.  Seaweed farming is also an environment-friendly resource product because it contributes to marine habitat rehabilitation and protection. Furthermore, it

**Figure 29 Project partners of the seaweed farming project inspecting the field after a heavy rainfall.**

requires small start-up capital which is affordable to the farmers and produces higher yield at a relatively shorter culture period.

A total of seven cooperators participated in the pilot testing of seaweed farming in barangay Bagacay in Gubat, Sorsogon. Two sets of farm trials were established--the first was from November 2010 to March 2011 with two cooperators who opted for a joint-venture while the second was from September to December 2011 with five cooperators who preferred individual farm module. The first trial tested two methods, namely, the raft method and hanging long line method. The raft method consisted of nine (9) raft modules measuring 6 m x 8 m per unit with a total of 405 cultivation lines, spaced at 30 cm between cultivation lines while the hanging long line had 12 hanging cultivation lines measuring 100 m long per line spaced at 7 m between cultivation lines. The modules were installed approximately half kilometer from the shoreline, 3 meters deep during high tide, and 2 ½ meters deep during low tide.

A total of 500 kilograms of seaweed was planted. Seaweed cuttings were prepared on shore at 250 kilograms of seedlings per module type (raft and hanging long line) at a distance of 20 cm. A total of 8 days family labor (composed of 6 family members) was employed in the preparation for planting of the two methods. A wooden boat was used to transport the prepared modules to the target the site. Floats were installed on cultivation lines of hanging long line method spaced at 7 m. Cultivation lines were installed 2 feet below sea water surface. Day-to-day management included removal of debris, replacing of lost/dead plants, tightening loose lines/ties.

***Freshwater Prawn Farming***

Small-scale freshwater prawn (Macrobrachium rosenbergii) farming was introduced as a GPO in barangay Ariman in Gubat, Sorsogon to provide farmers with alternative source of livelihood. One comparative advantage of farming freshwater prawn is its omnivorous benthic feeding nature that allows it to survive on locally-available feedstuff from agricultural by-products. Freshwater prawn can also be grown in combination with fish such as carp and tilapia or integrated in rice farming. The farming technology is easy and the capital requirement is within the resource capacity of farmers and fishers. The project was implemented by 10 farmer-cooperators in barangay Ariman. Small concrete-lined and earthen ponds supplied with free-flowing and underground water source were used. The ponds were stocked with post larva 30 days (PL30) procured from Southeast Asian Fisheries Development Center (SEAFDEC) in Binangonan, Rizal on August 2011 when the actual rainfall was higher than normal. The project provided the farmer-cooperators with technical training and technical backstopping as this was the first time that they engaged in freshwater prawn farming. They were also given a Farm Guide for Freshwater Prawn Farming and Farming Schedule after the training for their reference.

***Squid Pot***

**Figure 30 This cooperator had just pulled up his fishing gear to fix the nets**

Squid pot, which is locally known as "bubo pangnokos" is an alternative fishing gear or trap used for catching squid or cuttlefish in coastal waters. It is an enticing device in the form of regular receptacle mainly to catch squid in coastal waters. The shape of the gear is semi-cylindrical and is generally made of polyethylene netting mounted on a bamboo frame. It is provided with a non-return valve which allows easy entrance but difficult exit. The device is baited with squid roe mounted on young coconut leaves, placed inside the pot. It is hung on a bamboo buoy and anchored on depths of 8-15 fathoms in such a way that it lies midway of the water depth. Hauling of squid pot was done once a day by simply be pulling the hanging line until the squid pot emerged and hauled on board with the aid of a hook attached to a bamboo pole or a hook tied with rope. The operation is done with the help of a diver. The catch is bailed out and the squid pot thoroughly washed to remove debris before dropping it back. The squid pot technology was introduced in the three pilot communities and tested by 27 cooperators in Gubat, Sorsogon to provide additional income to small fishers.

### 4.4.3. Performance of the GPOs

#### 4.4.3.1. Agro-ecological Suitability of the GPOs

Performance of the GPOs in terms of agro-ecological suitability was evaluated in terms of farmers' perception, suitability under existing and near future climatic status, and edaphic and topographic conditions and/or similar agro-ecological zone. It should be noted that the project did not significantly alter the existing farming system and/or fisheries/aquaculture system in the pilot communities but instead built on existing farmers' practices and knowledge as well as agro-physical conditions.

**Table 9 Degree of agro-ecological suitability of the GPOs**

| Name of GPO | Degree of Agro-ecological Suitability | | |
|---|---|---|---|
| | Low | Medium | High |
| Use of early rice maturing rice variety | | | x |
| Use of submergence rice variety | | | x |
| Use of salt-tolerant rice variety | | | x |
| Timing of planting + rice ratooning | | | x |
| Rice + duck farming system | | | x |
| Strip intercropping | | | x |
| Coconut leaf pruning + intercropping | | | x |
| Goat production | | | x |
| Backyard tilapia farming | | x | |
| Seaweed farming | | x | |
| Freshwater prawn farming | x | | |
| Squid pot | | x | |

As shown in Table 9, GPOs that were pilot tested in the lowland irrigated rice areas demonstrated high degree of agro-ecological suitability based on farmers' feedback/perception and results of the field testing. Both farmer-cooperators and non-cooperators shared a favorable perception about the use of rice varieties which could adapt to climate-related hazards (e.g. early maturing variety, submergence variety, saline-tolerant variety), timing of planting + ratooning, and integration of duck in rice farming system. This is evidenced by the number of farmer-cooperators and non-cooperators who opted to adopt these technologies after the trial period. It is noteworthy to mention that part of the seed requirement for the second and third cropping seasons was sourced from the farmer-adopters.

The agro-ecological suitability of the lowland GPOs was also demonstrated in terms of their adaptability to the soil and weather conditions obtaining in the pilot communities. It should be noted that the use of said varieties was the main value-adding intervention to improve the livelihood resilience of lowland irrigated rice farmers. No fertilizer was applied but yield performance was comparable, if not higher, with rice crops that were fertilized. This is a good indication of the suitability of the GPOs to the existing soil type/condition in the pilot communities.

Except for some crops, the GPOs in the uplands showed high degree of agro-ecological suitability. This is due to the fact that crops chosen as intercrops (e.g., sweet potato, cassava, squash, corn, peanut, and eggplant) under coconut were the same crops being grown by the farmers in the pilot communities except that improved varieties were used instead of the local varieties. Fertilizer was applied based on the result of the soil analysis. Overall, the soil analysis confirmed the suitability of selected GPOs for strip cropping and intercropping under coconut under existing soil characteristics.

Unlike the GPOs in the lowland irrigated and upland/rainfed areas, the GPOs for fisheries/aquaculture had medium to low degree of agro-ecological suitability. Implementation of tilapia backyard farming in the municipality of Gubat was a failure due to heavy rainfall brought by the cold front in December 2010-January 2011 which severely damaged all pilot farms in the municipality of Gubat. This was not the case, however, of the rice farmers in Guinobatan who established backyard tilapia farming adjacent to their rice field. This is because they were spared of flooding despite experiencing the same rainfall pattern.

While seaweed is being grown already in barangay Bagacay in the municipality of Gubat, the cooperators who ventured in this project were not successful due to the damage brought by typhoon and heavy rainfall. Aside from typhoon, the seaweeds pilot farms were also affected by “ice-ice” disease. The disease is believed to be caused by changes in salinity seawater temperature and light intensity brought about by heavy rain causing stress to seaweeds. It produces a "moist organic substance" that attracts bacteria in the water and induces the whitening characteristic and hardening of the seaweed's tissues.

Squid pot technology was found to have a medium degree of agro-ecological suitability. The presence of squid eggs in the area is the best practical indicator of suitability of the area for the gear. However, cooperators reported that there were days when they did not have any catch especially during adverse weather condition. It should be noted that the success in squid pot fishing depends largely on the fishing ground where the gears are installed as well as on the season of the year which influences water current patterns and wave action particularly in the months of September to February. The structure has to be removed when water current and waves are strong to prevent it from being damaged.

#### 4.4.3.2. Economic Feasibility of the GPOs

The economic feasibility of the GPOs was determined by comparing the costs and benefits against existing farmers’ practice. Results of the evaluation of the economic feasibility of each GPO is presented below:

***Use of Early-Maturing Rice Variety***

The field trial revealed that EMRVs (e.g., NSIC Rc-120 and IR-60) had a better yield performance compared to Binatang, the existing farmers’ variety (EFV), which is a late-maturing variety. Statistical analysis indicates a significant difference in the duration of planting to harvest between the GPO using EMRVs and the EFV. The EMRVs were harvested 3.08 months or 92.4 days after transplanting while the EFV was harvested 3.62 months or 108.6 days. It should be noted that the establishment of the GPO was delayed for a month but it was harvested five days ahead of the EFV and its yield was comparably higher than the latter.

**Table 10 Yield (tons/ha) performance of EMRV vs. EFV for three cropping seasons.**

| Location | 2010 Wet Season | | 2011 Dry Season | | 2011 Wet Season | | Average | |
|---|---|---|---|---|---|---|---|---|
| | GPO | EFV | GPO | EFV | GPO | EFV | GPO | EFV |
| Buhi, Camarines Sur | 4.20 | 3.90 | 3.16 | 1.76 | 3.35 | 3.70 | 3.57 | 3.12 |
| Guinobatan, Albay | 2.70 | 2.20 | 3.50 | 2.70 | 3.25 | 2.10 | 3.15 | 2.33 |
| Gubat, Sorsogon | 2.90 | 2.30 | 4.50 | 3.90 | 3.30 | 2.30 | 3.56 | 2.83 |
| Average | 3.30 | 2.80 | 3.72 | 2.78 | 3.30 | 2.70 | 3.43 | 2.76 |

Using EMRVs, farmers were able to get additional yield of 375 kg/ha. The increase in yield is equivalent to 4.5 cavans of milled rice as food for the household during lean season and adverse weather condition. The farmer may also sell this additional yield as fresh palay which could provide the household an additional income of P 4,500.

***Use of Submergence Rice Variety***

The use of NSIC Rc-194, a submergence rice variety, had enabled farmer-cooperators to produce better yield than the existing farmer's variety under above normal rainfall condition during the 2nd and 3rd cropping season in barangays Rizal (in Gubat), Binti and Masarawag (in Guinobatan), and Igbac (in Buhi). Results tend to indicate that NSIC Rc-194 rice variety was able to tolerate the above normal rainfall from December 2010 to March 2011 due to La Niña.

**Table 11 Yield performance of submergence rice variety per cropping season versus existing farmers' variety in tons per hectare**

| Location | 2nd Cropping Season | | 3rd Cropping Season | |
|---|---|---|---|---|
| | GPO | EFV | GPO | EFV |
| Buhi, Camarines Sur | 3.05 | 1.95 | 3.80 | 2.65 |
| Guinobatan, Albay | 2.94 | 2.32 | 3.75 | 2.50 |
| Gubat, Sorsogon | 3.03 | 1.95 | 3.10 | 2.20 |

Based on Table 11, the submergence rice variety outperformed the existing farmers' variety in terms of yield in the project sites during the second and third cropping season. Statistical test indicates that the yield difference between the submergence rice variety (GPO) and existing farmer's variety is significant at 5%, with a t-value of 2.88. Records also showed that farmer-cooperators would spend around P 18,000.00 per hectare for this GPO. An additional 1,700 kg per hectare can be realized per cropping season using the submergence rice variety. This means that a farmer could earn P 20,400.00 per hectare per cropping season which is 38% higher than what a farmer can earn using the existing rice variety.

***Use of Salt-Tolerant Rice Varieties***

NSIC Rc-108 was used in saline-affected rice areas in barangays Rizal, Bagacay, and Ariman in Gubat, Sorsogon for three cropping seasons. Results of the pilot testing revealed that the average yield of the GPO of 2.28 tons/ha, 2.93 tons/ha, and 4.15 tons/ha in the three sites for the 1st, 2nd, and 3rd cropping season, respectively, was higher than the existing farmers' variety (see Table 12). The yield difference between the GPO and the EFV was also found to be statistically significant.

**Table 12 Comparative performance of saline tolerant rice variety versus existing farmers' variety in Gubat, Sorsogon**

| Project Sites | 1st Cropping Season | | 2nd Cropping Season | | 3rd Cropping Season | |
|---|---|---|---|---|---|---|
| | GPO | EFV | GPO | EFV | GPO | EFV |
| Rizal, Gubat, Sorsogon | 2.25 | 1.30 | 3.10 | 2.12 | 4.10 | 2.70 |
| Bagacay, Gubat, Sorsogon | 2.30 | 1.25 | 2.76 | 1.38 | 4.20 | 2.95 |
| Ariman, Gubat, Sorsogon | 2.28 | 1.28 | 2.93 | 1.75 | 4.15 | 2.83 |

Despite the experienced El Nino during the 1st cropping cycle the GPO still produced higher yield compared to Binatang, which is the existing farmers' variety. The use of NSIC Rc-108 was productive and cost-efficient than the existing farmers' variety. On the average, farmer-cooperators spent P 15,027 to establish a hectare of the GPO and get an additional yield of 1.14 tons/ha which is roughly equivalent to P 13.738.00. Planting rice varieties which are not suited to saline-affected rice areas only increases the cost of production which could range from P 18,000.00 to P 20,000.00 per hectare and affects the food security of farming households due to low yield.

### ***Timing of Planting + Rice Ratooning***

Farmer-cooperators in Buhi and Guinobatan reported that NSIC Rc-120 did not perform well during the first cropping season due to above normal precipitation and rice black bug infestation. However, NSIC Rc-120 performed well during the second cropping cycle (December to April 2011) in Gubat when the province of Sorsogon experienced limited precipitation.

**Table 13 Yield performance of NSIC Rc-158 plus ratooning (tons/hectare) versus existing farmers' practice for three cropping seasons**

| Project Sites | 1st Cropping Season | | 2nd Cropping Season | | 3rd Cropping Season | | Average Yield | |
|---|---|---|---|---|---|---|---|---|
| | GPO | EFP | GPO | EFP | GPO | EFP | GPO | EFP |
| Buhi, Cams. Sur | - | - | 4.20+0.40 | 3.28 | 3.35+0.39 | 2.70 | 3.77+0.39 | 3.00 |
| Guinobatan, Albay | 2.60+0.42 | 2.50 | 3.25+0.39 | 3.00 | 3.20+0.42 | 2.75 | 3.02+0.41 | 2.75 |
| Gubat, Sorsogon | 2.75+0.09 | 2.25 | 4.50+0.89 | 2.95 | 3.45+0.80 | 2.97 | 3.57+0.86 | 2.72 |
| Average Yield | 2.93 | 2.37 | 4.54 | 3.07 | 3.87 | 2.81 | 3.45+0.55 | 2.82 |

The field trials for three cropping seasons revealed that the EMRV outyielded the existing local variety being used by the farmers in the project sites. Moreover, the rice ratoon gave the farmer-cooperators additional rice yield of 550 kg/hectare within 45 days (see Table 13). Yield difference was significant at 5%.

### ***Rice + Duck Farming System***

Farmers observed that by allowing 10 ducks to freely range in the rice field the population of golden apple snail was reduced within eight months. Moreover, farmer-cooperators did not have to use mollucides and insecticides spray application. Finally, protein-rich food (egg) has become a part of the family's daily food item. Excess eggs were sold to stores in the locality and provided the household additional source of cash.

**Table 14 Comparative performance of rice + duck farming system versus existing farmers' practice in three project sites during the 2nd and 3rd cropping seasons.**

| Project Sites | 2nd Cropping Season | | | 3rd Cropping Season | | |
|---|---|---|---|---|---|---|
| | GPO | | EFP (tons/ha) | GPO | | EFP (tons/ha) |
| | Rice (tons/ha) | Egg (No.) | | Rice (tons/ha) | Egg (No.) | |
| Buhi, Camarines Sur | 2.70 | 720 | 1.80 | 3.50 | 280 | 2.70 |
| Guinobatan, Albay | 2.70 | 720 | 1.80 | 3.72 | 309 | 1.36 |
| Gubat, Sorsogon | 4.50 | 480 | 4.00 | 4.20 | 275 | 3.50 |

The project did an exploratory trial of rice + duck farming system during the 2nd cropping season with one farmer-cooperator in each of the project sites to determine the feasibility of this GPO. Results of the trial revealed that farmer-cooperators did not only obtain higher yield but ducks raised also produced eggs which they either consumed or sold (see Table 14). During the 2nd cropping season, the farmer-cooperators from Buhi and Guinobatan reportedly produced 720 eggs each while the one from Gubat had 480 eggs. The number of eggs produced during the 3rd cropping season was relatively lower because ducks that were distributed did not immediately produce eggs. Results of this pilot testing indicate that rice + duck farming system will not only enhance the livelihood resilience of rice farming households but also improve their food security. The farming household can sell part of the egg produce to generate additional income while consuming the remainder, thereby, improving their nutritional status. The increment in rice yield can provide for the food requirement of the household during adverse weather condition. With these findings, the DA-RFU V was encouraged to replicate the GPO to 50 farmer-cooperators and procured 500 ready-to-lay ducks for distribution to identified farmers.

***Strip Intercropping***

Data showed that strip intercropping of varying growth durations gave higher MBCR values compared to crop combination of same growth durations (Table 11). Across sites and across locations, combination of long duration (LD) and short duration (SD) crops gave had higher MBCR value of 3.16 than LD+MD (3.04), MD+SD (2.85), and SD+SD (2.04). Lowest MBCR value of 1.37 was obtained from LD+LD combination. Although tested only once during the 2011 wet season cropping in Gubat, Sorsogon, combining strips of LD+MD+SD in the same plot produced the highest MBCR of 4.98 (see Table 15 and 16).

The high MBCR obtained from combining crops of different growth duration demonstrated the agro-ecological suitability and resilience of the GP option. Despite the abnormal climatic condition (above normal rainfall) that occurred during the three copping seasons, the GPOs have produced acceptable yield. Furthermore, strip intercropping of crops of different growth duration contributed to the management of risk impacts in terms of improving the resilience of the family.

***Coconut Leaf Pruning***

Results of the MBCR analysis for three (3) seasons in the three (3) pilot municipalities revealed that planting improved crop varieties under coconut leaf pruning technology resulted to an increase in revenue for the farmer-cooperators. Across seasons and across sites, shifting from the traditional/local varieties to improved varieties of sweet potato, cassava, and corn resulted in higher MBCR. Los Baños Lagkitan, an early maturing composite corn variety which can be harvested within 70 to 75 days after planting, had the highest mean MBCR of 2.90 across season followed by Golden yellow cassava variety with mean MBCR value of 2.39. The two sweet potato varieties, namely, SP 30 and SP 23 gave MBCR values of 2.19 and 2.07, respectively (see Table 15 and 16).

Glutinous Composite # 2 or 'Lagkitan' is a white glutinous open-pollinated corn variety, grown primarily for table use, native delicacies and 'kornik'. It has small to medium to big soft kernels with excellent eating quality. It has an average marketable ear yield of 40 tons/ha that can be harvested in 72 days. Data showed that this corn variety can be grown in any soil type during wet and dry seasons.

***Goat Raising***

The goat raising project was expected to provide additional income to the farmer-cooperators from the sale of goat milk and/or offsprings. A mature doe is capable of producing two (2) kids in 3 to 5 months and goat milk for at least two (2) months. The animals, however, were yet to deliver their kids at the time of project termination.

**Table 15 Marginal benefit cost ratio (MBCR) of using improved crop varieties planted under coconut leaf pruning technology from three cropping seasons in three municipalities.**

| GP Options | Wet Season 2010 | | Dry Season 2011 | | Wet Season 2011 | | Mean MBCR |
|---|---|---|---|---|---|---|---|
| | No. of Farmers | Average MBCR | No. of Farmers | Average MBCR | No. of Farmers | Average MBCR | |
| **A. Sweet potato** | | | | | | | |
| SP 23 (Buhi, Camarines Sur) | 1 | 2.07 | 3 | 2.18 | 2 | 2.09 | 2.13 |
| SP 23 (Gubat, Sorsogon) | 2 | 1.87 | 5 | 2.08 | | | 2.02 |
| **Mean** | **3** | **1.94** | **8** | **2.12** | **2** | **2.09** | **2.07** |
| SP 30 (Buhi, Camarines Sur) | | | 2 | 2.27 | 2 | 2.12 | 2.19 |
| SP 30 (Gubat, Sorsogon) | 1 | 2.02 | 5 | 2.23 | | | 2.19 |
| **Mean** | **1** | **2.02** | **7** | **2.24** | **2** | **2.12** | **2.19** |
| **B. Cassava (*Golden yellow*)** | | | | | | | |
| Buhi, Camarines Sur | 1 | 2.19 | 2 | 2.93 | 4 | 2.36 | 2.50 |
| Gubat, Sorsogon | 2 | 1.92 | 7 | 2.42 | | | 2.31 |
| **Mean** | **3** | **2.01** | **9** | **2.53** | **4** | **2.36** | **2.39** |
| **C. Squash (*Rizalina*)** | | | | | | | |
| Buhi, Camarines Sur | | | 2 | 2.78 | | | 2.78 |
| **Mean** | | | **2** | **2.78** | | | **2.78** |
| **D. Corn (*IPB Lagkitan*)** | | | | | | | |
| Guinobatan, Albay | 2 | 2.81 | 1 | 3.60 | | | 3.21 |
| Gubat, Sorsogon | | | 1 | 2.36 | | | 2.36 |
| **Mean** | **2** | **2.81** | **2** | **2.98** | | | **2.90** |
| **E. Peanut (*Biyaya*)** | | | | | | | |
| Gubat, Sorsogon | | | 2 | 2.14 | | | 2.14 |
| **Mean** | | | **2** | **2.14** | | | **2.14** |
| **F. Eggplant (*Dumaguete LP*)** | | | | | | | |
| Guinobatan, Albay | | | | | 2 | 2.48 | 2.48 |
| **Mean** | | | | | **2** | **2.48** | **2.48** |

**Table 16 Marginal benefit cost ratio (MBCR) of different strip intercropping combinations based on crop growth duration from three cropping seasons in three municipalities.**

| GP Options | Wet Season 2010 | | Dry Season 2011 | | Wet Season 2011 | | Mean MBCR |
|---|---|---|---|---|---|---|---|
| | No. of farmers | Average MBCR | No. of farmers | Average MBCR | No. of farmers | Average MBCR | |
| **A. LD + MD + SD** | | | | | | | |
| **1. Gubat, Sorsogon** | | | | | | | |
| Eggplant + okra + green corn | | | | | 18 | 4.91 | 4.91 |
| Eggplant + okra + pole sitao | | | | | 3 | 5.02 | 5.02 |
| **Mean** | | | | | **21** | **4.93** | **4.93** |
| **B. LD + LD** | | | | | | | |
| **1. Buhi, Camarines Sur** | | | | | | | |
| Upland rice + sweet potato | 4 | 1.36 | | | | | 1.36 |
| Squash + eggplant | | | | | 1 | 2.16 | 2.16 |
| **2. Guinobatan, Albay** | | | | | | | |
| Squash + tomato | | | 2 | 1.12 | 2 | 1.96 | 1.54 |
| Squash + pepper | | | | | 2 | 1.15 | 1.15 |
| Tomato + pepper | | | 2 | 1.03 | | | 1.03 |
| Squash + eggplant | | | 2 | 1.23 | | | 1.23 |
| **Mean** | **4** | **1.36** | **6** | **1.13** | **5** | **1.68** | **1.37** |
| **C. LD + MD** | | | | | | | |
| **1. Buhi, Camarines Sur** | | | | | | | |
| Eggplant + okra | | | 3 | 2.96 | | | 2.96 |
| **2. Guinobatan, Albay** | | | | | | | |
| Squash + peanut | | | | | 2 | 3.16 | 3.16 |
| **Mean** | | | **3** | **2.96** | **2** | **3.16** | **3.04** |

Legend:

LD - Long Duration
MD- Medium Duration
SD - Short Duration

Table 17 (continuation. . . .)

| GP Options | Wet Season 2010 | | Dry Season 2011 | | Wet Season 2011 | | Mean MBCR |
|---|---|---|---|---|---|---|---|
| | No. of farmers | Average MBCR | No. of farmers | Average MBCR | No. of farmers | Average MBCR | |
| **D. LD + SD** | | | | | | | |
| **1. Buhi, Camarines Sur** | | | | | | | |
| Squash + snap bean | | | 2 | 3.42 | | | 3.42 |
| Squash + pole sitao | | | 2 | 2.35 | 1 | 1.96 | 2.10 |
| Eggplant + snap bean | 1 | 4.80 | 2 | 4.95 | 1 | 2.86 | 4.39 |
| Eggplant + pole sitao | 1 | 2.97 | 2 | 2.50 | 2 | 2.01 | 2.39 |
| **2. Guinobatan, Albay** | | | | | | | |
| Squash + pole sitao | | | 7 | 3.04 | | | 3.04 |
| Eggplant + snap bean | | | 2 | 3.31 | 2 | 3.67 | 3.49 |
| Eggplant + pole sitao | | | | | 2 | 3.32 | 3.32 |
| Tomato + snap bean | | | 3 | 2.83 | | | 2.83 |
| Eggplant + green corn | | | 6 | 3.51 | | | 3.51 |
| Squash + sweet corn | | | | | 4 | 2.52 | 2.52 |
| Pepper + sweet corn | | | | | 4 | 1.86 | 1.86 |
| **3. Gubat, Sorsogon** | | | | | | | |
| Eggplant + snap bean | | | | | 3 | 4.12 | 4.12 |
| Eggplant + pole sitao | | | | | 6 | 3.78 | 3.78 |
| **Mean** | **2** | **3.89** | **26** | **3.23** | **25** | **3.02** | **3.16** |
| **E. MD + SD** | | | | | | | |
| **1. Gubat, Sorsogon** | | | | | | | |
| Peanut + green corn | | | 10 | 2.85 | | | 2.85 |
| **Mean** | | | 10 | 2.85 | | | **2.85** |
| **F. SD + SD** | | | | | | | |
| **1. Guinobatan, Albay** | | | | | | | |
| Sweet corn + snap bean | | | | | 4 | 2.85 | 2.85 |
| Green corn + pole sitao | | | 3 | 1.12 | | | 1.12 |
| Green corn + snap bean | | | 2 | 1.26 | | | 1.26 |
| **2. Gubat, Sorsogon** | | | | | | | |
| Green corn + pole sitao | 2 | 3.66 | 5 | 1.63 | | | 2.21 |
| **Mean** | **2** | **3.66** | **10** | **1.40** | **4** | **2.85** | **2.04** |

***Backyard Tilapia Farming***

Implementation of backyard tilapia farming as GPO was characterized by varying degree of success and failure. In Gubat, continuous heavy rain last December 28-29, 2011 triggered a flood that severely damaged all pilot farms in barangays Rizal and Ariman. The fishponds were either completely covered with mud and other debris or overflowed resulting to the escape of 20% to 60% of the stock and entry of predators (i.e., Ophicephalus straitus, Clarias batrachus, and C. macropcephalus). These unexpected experiences prompted most of the farmer-cooperators to discontinue the project but some still managed to harvest 20-50 kilograms from the remaining stock, valued at P 1,200 to P 3,000 at a selling price of P 60.00 per kilogram.

In Guinobatan, out of the 10 farmers who attended the technical training, only six (6) actually implemented the project. Two (2) of the six (6) farmers, however, did not continue for varied reasons (e.g., fishpond was destroyed by heavy rain and fish stock was lost due to poaching). The remaining four (4) continued because they believed backyard tilapia farming will improve their food security besides providing additional income. They did the stocking in mid-July 2011 and harvested the stock by the end of December 2011. The pilot farms which were located adjacent to their rice field, used a mixed size of tilapia hybrid (size 22 to 17) fingerlings. The farmer-cooperators also stocked their fishpond with common carps (Cyprinus carpio) procured from a neighbor because of the belief that both can be farmed together in order to increase productivity. Technically, the farmer-cooperators unknowingly used the concept of polyculture where two or more species are farmed together in the same area as long as these species does not feed in the same feeding niche. The fish stocks attained approximately 80-100 grams in three (3) months rearing.

Unlike in Gubat, farmer-cooperators in Guinobatan were spared from flooding and experienced some degree of success despite the almost similar rainfall pattern. One farmer-cooperator earned a net income of P 981.00 from the 330 tilapia fingerlings which yielded 21 kilograms (mean size of 100 grams) at harvest time from 100 m2 pond area, valued at P 1,260.00. Another farmer-cooperator harvested 55 kilograms of tilapia from his 400 m2 pond area, valued at P 3,300.00 that gave him a net income of P 1,888.00 from an aggregate investment of P 1,412.00 for farm inputs. There was also a farmer-cooperator who earned a net income of P 5,826.00 from his 600 m2 fishpond with 1,980 tilapia fingerling stocks (that yielded 125 kilograms) and capital investment of P 1,674.00. Only one farmer-cooperator had not yet harvested at the end of the project in December 2011 because he was reserving the harvest for family consumption. He expects, however, to harvest more than 278 kilograms from his 2,500 m2 fishpond which he stocked with 5,000 fingerlings.

***Seaweed Farming***

There were two (2) seaweed farming trials that were established one after the other in barangay Bagacay. The trial was a failure due to the unexpected occurrence of strong waves and flash flood due to heavy rain on December 28-29, 2010. An estimated 2,000 kg of seaweeds were lost leaving at least three (3) cultivation lines (hanging long line module) with 200 kilograms of seaweed slightly damaged. The cooperators tried their best to recover from the loss by working on the remaining three (3) cultivation lines that survived until the seaweed reaches to about 650 kilograms in three (3) months

(January to March 2011). But due to the tsunami warning for coastal areas fronting the Pacific Ocean in March 11, 2011, the cooperators decided to harvest and set aside 150 kilograms as planting materials for the next farming season or second trial.

The second trial which was established in May-October 2011, did not also yield good results for the cooperators due to Typhoon Bebeng (International Code: Aere) which affected the Bicol Region on May 7, 2011. Typhoon Bebeng brought heavy damage on seaweed stock, farm structures and other livelihood assets such that remaining seaweeds stocks could not even pay off the capital invested amounting to P 12,171.50 (see Table 18). Aside from typhoon, the seaweeds pilot farms were also affected by "ice-ice" disease.

**Table 18 Status of 2nd trial of seaweed farming in Bagacay, Gubat, Sorsogon**

| Name of Cooperator | Harvest Data | | | Capital Investment (₱) | Remarks |
|---|---|---|---|---|---|
| | Dried (₱) | Fresh (₱) | Total (₱) | | |
| Joseph Emano | 1,520.00 | 1,365.00 | 2,885.00 | 12,171.50 | Harvested 40 kg dried & 91 kg fresh |
| Domingo Espena | 1,140.00 | 300.00 | 1,440.00 | 12,171.50 | Damaged by typhoon and "ice-ice" but harvested 30 kg dried and 20 kg fresh |
| Isidro Estabaya | 760.00 | 150.00 | 910.00 | 12,171.50 | Damaged by typhoon and "ice-ice" but harvested 20 kg dried and 10 kg fresh |
| Teddy Emano | 760.00 | 150.00 | 910.00 | 12,171.50 | Damaged by typhoon and "ice-ice" but harvested 20 kg dried and 10 kg fresh |
| Benny Nivero | 3,800.00 | 1,125.00 | 4,925.00 | 12,171.50 | Damaged by typhoon and "ice-ice" but harvested 100 kg dried and 75 kg fresh |

*Price: Dried @ Php 38/kg and Php 15/kg for fresh planting stocks.*

***<u>Freshwater Prawn Farming</u>***

As indicated in the preceding section, freshwater prawn had poor growth performance due to above normal rainfall Most of the freshwater prawn died before reaching maturity stage. Farmer-cooperators did not earn any incremental benefits.

It is assumed that the high rainfall have lowered the water temperature of the ponds to a level which affected the appetite and feed intake of the prawns during the growing period. Studies have shown that changes in weather conditions obviously influence the physic-chemical condition of pond waters, particularly temperature, which is an important modifier of energy flow that affects the specific growth rate of shrimps (Dong et al, 1994a and Zhang et al, 1998 as cited by Nieves, 2011). Prawns raised during dry season in for instance Thailand had the highest survival rate (34.27%) and growth rate (0.19 g/day) compared to those raised in the rainy season with 24.249% and 0.15 g/day survival growth rate, respectively.

***<u>Squid Pot</u>***

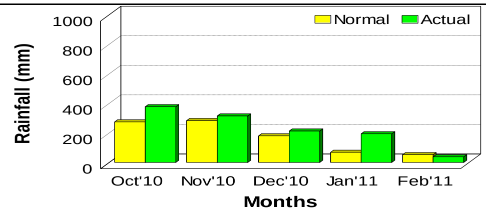
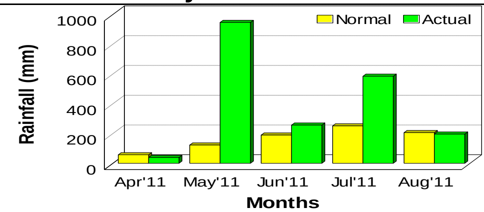
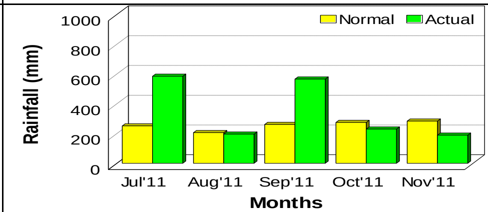
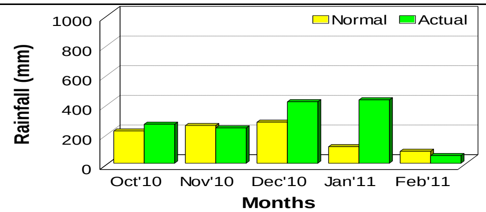
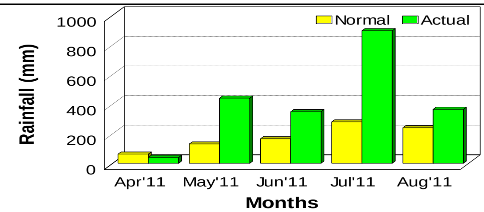
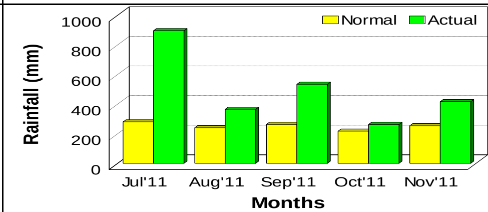
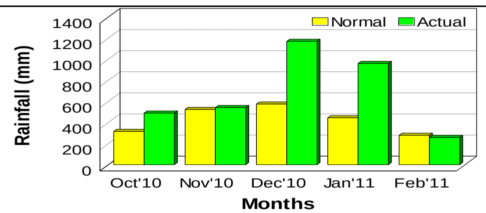
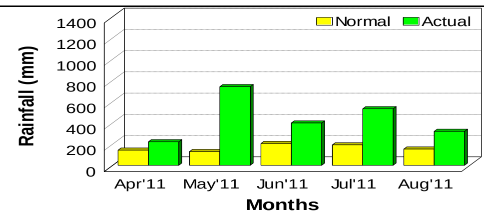
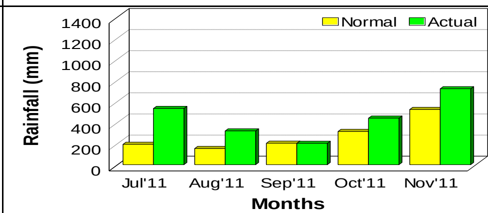
Out of 27 squid pot cooperators, only six (6) continued the project while the rest had hauled up their gears because of the rough sea brought by the northeast monsoon starting September 2011. Interviews revealed that fishers could only catch 3 to 5 kilograms of fish for an 8 to 15 hours of fishing operation. There were, however, days when they do not have any catch especially during adverse weather condition. It was observed that fish catch was greater during days after the first quarter phase before full moon. One cooperator from barangay Ariman reported a harvest of 45 kg before pulling out his gear due to northeast monsoon. Another cooperator from Ariman also reported a harvest of 26 kg during this period before pulling out the gear. Other cooperators reported an average of 2 kg per day. The intervention was able to provide an additional income of at least P 300.00 per day.

#### 4.4.3.3. Increased Resilience Against Impact of Climate Hazards

The GPOs implemented in the nine (9) pilot communities were the offshoot of the situational assessment that was conducted at the start of the project. The climate-related hazards and risks that were identified during the situational assessment were used as bases in the identification and design of the GPOs for DRR/M. It should be noted that all three (3) cropping seasons experienced high rainfall leading to a wet condition during the growing period of the crops. During 2010 wet season cropping (October 2010 to February 2011), the eastern seaboard (facing the Pacific Ocean) experienced too much rainfall starting December resulting to flooding of low-lying areas and landslides and destruction of the majority of demonstration plots in the three pilot communities. PAGASA reported that the heavy rainfall experienced in Bicol Region was due to a weather system emerging from a cold front and to La Niña phenomenon that was initially reported by PAGASA to strike in the months of December until January (see Table 19). As recorded by PAGASA, there was an increase of 32.3%, 144.6%, and 38.3% over the total normal rainfall during the 2010 wet season, 2011 dry season, and 2011 wet season, respectively, in Buhi, Camarines Sur. Similarly, an increase of 48.4%, 137.7%, and 97.3% over the total normal rainfall was observed in Guinobatan, Albay during the 2010 wet season, 2011 dry season, and 2011 wet season, respectively. The total rainfall observed in Gubat, Sorsogon also exceeded the projected normal rainfall by 60.0%, 169.0%, 59.7% during the 2010 wet season, 2011 dry season, and 2011 wet season, respectively (see table 19).

The heavy rainfall during 2010 wet season cropping destroyed the majority of GPOs. The adverse impact of adverse weather condition was, however, mitigated during the 2011 dry season and wet season cropping by using the seasonal and monthly weather forecast (by PAGASA) as well as the farm weather bulletins (by DARFU V) in March 2011 to determine the appropriate mix of crops.

**Table 19. Total normal and actual rainfall (mm) in the three project sites for three cropping seasons**

<table>
<tr><th>A. Buhi, Camarines Sur</th><th>Wet Season 2010</th><th>Dry Season 2011</th><th>Wet Season 2011</th></tr>
<tr><td></td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Total normal rainfall (mm)</td><td>859.1</td><td>826.8</td><td>1276.3</td></tr>
<tr><td>Total actual rainfall (mm)</td><td>1136.5</td><td>2022.8</td><td>1765.4</td></tr>
<tr><td>Increase over normal (%)</td><td>32.3</td><td>144.6</td><td>38.3</td></tr>
<tr><td>B. Guinobatan, Albay</td><td></td><td></td><td></td></tr>
<tr><td></td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Total normal rainfall (mm)</td><td>938.9</td><td>878.7</td><td>1253.6</td></tr>
<tr><td>Total actual rainfall (mm)</td><td>1393.0</td><td>2088.8</td><td>2472.9</td></tr>
<tr><td>Increase over normal (%)</td><td>48.4</td><td>137.7</td><td>97.3</td></tr>
<tr><td>Gubat, Sorsogon</td><td></td><td></td><td></td></tr>
<tr><td></td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Total normal rainfall (mm)</td><td>2134.5</td><td>823.6</td><td>1387.0</td></tr>
<tr><td>Total actual rainfall (mm)</td><td>3414.6</td><td>2213.8</td><td>2214.9</td></tr>
<tr><td>Increase over normal (%)</td><td>60.0</td><td>169.0</td><td>59.7</td></tr>
</table>

In the lowland irrigated rice areas, the GPOs were found to be adaptable to the climatic condition of these communities. Yield performance of the GPOs was not significantly affected by near drought condition during the first cropping season and extreme rainfall during the second and third cropping season. Early maturing rice varieties were introduced to reduce the exposure of the rice crop to climate-related hazards and risks thereby, enhancing the food security of the lowland rice farmers. The pilot testing of EMRV confirms that a shorten growth duration reduces the exposure to climate hazards particularly in the Bicol Region where typhoons hit the area during the months of September to November, at the time when the rice grains are about to be harvested. During dry season cropping early maturing rice varieties give rice farmers longer turn-around period to take advantage of available soil moisture for the growing of ratoon rice crop. Harvest from the ratoon rice crop would further enhance the food security of rice farmers and serves as buffer during adverse weather condition.

Submergence rice varieties were used during wet season cropping to mitigate the effects of flooding brought about by typhoons and heavy rainfall. The pilot testing of the variety NSIC Rc-194 demonstrated the adaptation potential since it tolerated the effects of La Niña (i.e., above normal precipitation) which hit the country and the Bicol Region from December 2010 until March 2011.

Saline-tolerant rice varieties were likewise tried in lowland rice areas where saline water intrusion was one of the major problems especially during wet season cropping. Results indicate that the use of saline-tolerant rice variety NSIC Rc-108 was able to address the effects of saline intrusion. Additionally NSIC Rc-108 yielded better than the existing farmers' variety (Binatang) under El Niño conditions experienced during the first cropping season. Finally, to provide additional income to lowland rice farmers, reduce costs of farm inputs like fertilizer or pesticides while at the same time conserving the environment , the project introduced duck raising as part of the rice-based farming system.

Results of the pilot testing of the upland/rainfed areas revealed that crops used either for strip cropping or intercropping under the coconut showed some degree of adaptability under extreme weather condition except for sweet corn/green corn, tomato, and peanut during the first cropping season. These crops did not perform well as they are not tolerant with too much rainfall. Removal of older leaves is expected to minimize the damages caused by typhoons particularly on flowering fruit set and yield. and reduces the water requirement and transpiration of coconut during dry months. Coconut leaf pruning is expected to enhance the growth of intercrops underneath. For strip intercropping, two (2) or more complimentary crops were planted on a given land unit to maximize productivity. One of the considerations in the choice of crop combination was the growth duration (i.e., long-duration, medium-duration, and short-duration) because it is an indicator for utilization of soil nutrient, soil moisture and capacity to withstand stress. Goat production was introduced by the project as value-added to the existing farming system and providing alternative sources of nutrition and income thus enhance the livelihood resilience of upland/rainfed farmers against impacts of climate-related hazards and risks.

The GPOs in the fisheries sector were implemented to enhance the livelihood resilience of fishers and farmers by providing an additional source of income. Expectedly, backyard tilapia farming and freshwater prawn farming would provide alternative income source to fishers during inclement weather and to rice farmers when their rice crop is damaged by natural disasters. Furthermore Seaweed farming and squid pot are GPOs practicable also for landless households. All aquaculture/fishery GPOs are relatively less resistant to extreme weather events as the occurrence of strong waves and flash flood due to heavy rain on December 28-29, 2010 and the Typhoon Bebeng (International Code: Aere) which affected the Bicol Region on May 7, 2011. It has to be noted, that the training of the farmer cooperators are an additional important factor to enhance the performance of the GPOs and react appropriately on unexpected weather influences. Further pilot testing therefore could yield better result.

Although the project duration did not allow to scientifically validate the effectiveness of the GPOs in face of climate hazards, results of the field testing showed promising effects especially those that were pilot tested in lowland irrigated rice areas and upland/rainfed agro-ecological zone. The good performance under and resistance to actual extreme weather events of some GPOs can shed light on their general climate change adaptation potential. In order to prove this potential on the long run a longer evaluation period of the GPOs and further testing is required to obtain more reliable and conclusive data. The total or partial failure of some GPOs like freshwater prawn farming, seaweed farming, and backyard tilapia farming, among others, can be attributed to natural factors which were beyond the control of the project. It must be pointed out, however, that these technologies were scientifically evaluated and were found to have performed well in other geophysical settings.

#### 4.4.3.4. Balance of Carbon Emissions

It was assumed at the outset that the GPOs will not increase GHG emission by being implemented on a small-scale with a small amount of fertilizer and chemicals use, only applied if and when needed depending on the soil requirement. Therefore this criterion was given the lowest weight in the evaluation and no parameters like methane emission level were collected or observed.

## 5. Conclusions and Lessons Learned

The project was implemented for more than two (2) years, starting in September 2009 until December 2011. The implementation of the project over three cropping seasons opened up the possibility of a continuous learning process. Findings from the first cropping were integrated in the planning activities for the upcoming season which allowed an effective improvement during the project duration. The lessons leant from this process and the results of the project could offer practical advice how to mainstream CCA/DRR in agriculture.

### Project coordination and local institutions:

(a) Climate change adaptation and disaster risk reduction are cross-cutting issues that need a broad and long-term programmatic implementation approach. Thus, cross-sectoral partnerships for DRR/M are needed to adequately tackle climate change and undertake adaptation measures. The cost of climate change adaptation are more manageable and effective when shared and carried out collaboratively with other agencies. The project was able to demonstrate that mutual cooperation and/or partnership among local government agencies and research institutions (*e.g.*, DA-RFU V, PAGASA, BU, CBSUA, and LGUs) with clearly defined roles/ obligations is necessary in implementing CCA/DRR in agriculture. This promoted greater synergy and complementation of the project activities and allowed each partner to concentrate on areas of CCA/DRR where it has comparative strength.

(b) Disaster risk reduction and climate change adaptation are continuing and evolving learning processes. It remains a challenge to anticipate exact climate impacts even at the local level due to greater weather variability and unpredictability in a climate change setting. Empowering and capacitating local stakeholders, communities and vulnerable groups, therefore, becomes a primary goal of climate change adaptation in order to prepare them for any unexpected/unforeseen eventuality.

(c) The establishment of a Project Office and clear division of the roles and arrangements among project partners and concerned stakeholders at the onset of a project are crucial to timely conduct planned activities, cooperation and support of partners, and to attain the project objectives. This applies especially to the LGUs (i.e., provincial, municipal/city, and barangay) which play a key role in mainstreaming DRR/CCA in agriculture due to their direct dialogue with the project beneficiaries and their familiarity with the challenges faced by vulnerable communities.

**Climate information availability:**

(d) Better understanding of climate/weather forecasts and timely delivery of advisories to LGUs and farmers enhances local disaster preparedness and reduces livelihood losses. Seasonal weather forecasts provided by PAGASA and farm weather bulletin prepared by DA-RFU V enabled farmers to take strategic decisions on proper crop choice, cropping schedule, cultural management practices and on the use of mitigating measures. The impact of such information bulletins was demonstrated in the improvement of the GPOs performance, when damages that occurred in the first cropping season due to above normal rainfall were averted during the 2$^{nd}$ and 3$^{rd}$ cropping seasons because of the farm weather bulletin provided by the DA-RFU V to the LGUs and farmers.

(e) Online tools like the improved PNDA methodology enables DA to estimate more reliable and faster post-disaster damages and losses and predict the potential production losses of rice and corn due to flood, strong winds and drought. For its further institutionalization and up scaling municipality agricultural officers need to be better guided and capacitated through on the job training. While the PDNA tool/software can expedite the estimation of post-disaster damages and losses, it can also predict the potential production losses of rice and corn due to flood, strong winds and drought. It is, therefore, recommended to expand the tool by including other key commodities beside rice and upscale the system on the regional level It is further recommended to integrated GIS maps into the system to visualize the hazards and vulnerabilities of agricultural areas. Once the systems is fine-tuned and finalized the Department of Agriculture should host the PDNA online system for agriculture-related commodities. On the long run the system should be harmonized and integrated to the disaster system being led by the Office of the Civil Defense (OCD) to ensure an extensive utilization.

**GPO pilot testing:**

(a) The project was able to demonstrate the potential of GPOs in enhancing livelihood resilience under variable climatic conditions. This was manifested in the evaluation of economic viability of the majority of the GPOs which were pilot tested in the communities. The partly failure of the fishery/aquaculture GPOs underscores the high demand for relevant technical experts to give reliable advice to farmers in their implementation, trainings for the extension unit, and the sources of back up specialist advice. The GPO pilot testing also emphasized the importance of a comprehensive approach of DRR/M, which requires not only advanced technologies, but also capacitated local institutions for wider dissemination and climate information for their continuous adjustment to unexpected climate variability.

(b) Climate change adaptation is a location-specific process and appropriate GPOs are needed to fit a particular setting. The project has demonstrated that a good adaptation practice for one farmer must not be suitable for another in a different micro-environmental setting. This was manifested especially in the GPOs that were pilot tested in fishery/aquaculture sector. There will be no “one fits all” solutions at local level.

(c) An important lesson which the project learned from three (3) cropping seasons of pilot testing GPOs is that farmers will not try these adaptation measures unless the benefits and the net return will accrue to them while applying them in their own farms. Several GPOs which passed technical and field evaluation and were found to have good impact on the environment and climate resilience (*e.g.*, small water impounding project, riverbank stabilization using bamboo, *etc.*) were not implemented because there were no interested “takers”. CCA/DRR should, therefore focus particular on farmer livelihoods.

(d) A proper Monitoring and Evaluation (M&E) system that captures the contribution of field demonstrations and capacity building activities to CCA and DRR is challenging but essential for systematic learning and an evaluation that goes beyond crop yields. The application of the M&E system has to be as simple as possible to be practicable for local institutions with limited capacities. At the same time it should include assessments that allow the measurement of more complex outcomes on DRR in agriculture.

## 6. Policy Recommendations

Based on the results of implementing the project and lessons learned, the following recommendations can guide future initiatives along CCA and DRR/M in agriculture:

(a) For the coordinated implementation of prevention, mitigation and preparedness measures in agriculture at regional level DA should facilitate the development of a Regional Plan of Action for DRR in agriculture. The PoA should outline the objectives and tasks and responsibilities of local stakeholders in agriculture within the overall context of the national DRR/M framework shifting from a response approach towards a proactive DRR/M system. The institutionalization of DRR/M should be also ensured within overall sectoral planning.

(b) Mainstreaming CCA/DRR in agriculture and fisheries requires active local participation especially by municipal and barangay officials. Formation of local DRR/M committees/councils and capacitating of local officials on DRR/M in agriculture should be vigorously pursued to ensure the bottom up implementation of the Plan of Action for DRR in agriculture and fisheries.

(c) Community based DRR/M plans with a focus on agriculture should be horizontally up scaled and up-streamed to promote mainstreaming of the locally identified planning priorities into sectoral planning for DRR/M at municipality and provincial levels. Technical staff in DA, LGUs, and DRR/MCs need to be trained on how to develop the DRR/M action plans for agriculture.

(d) Cross-sectoral partnerships for DRR/M are needed to enhance outreach and dissemination of good practices for DRR/M at local levels. The DA should further build strategic partnership with LGUs, academe, and other relevant agencies and stakeholders including private sector to collaboratively address climate change and its impacts. The strategic partnership and/or collaboration should build on the relative strengths of the partners in addressing climate change. This partnership can create synergies, provide the mechanism for the scaling up and/or replicating the project output/benefits and lessons learned over a wider geographic scope.

(e) Information and early warning systems such as seasonal weather forecasts, farm weather bulletin, and PDNA are effective tools to facilitate informed decision making for CCA/DRR in agriculture. The climate information services tested by the project should be further enhanced in quality tailored to the needs of agricultural producers, outreach and regular dissemination. following the proposed EWS flow.

(f) There is a high demand for wider dissemination of agro-ecosystem specific good practice technologies for DRR in agriculture into provinces, communities and municipalities not covered by the project but with similar agro-ecological and socio-economic characteristics. Dissemination should be done through the agricultural extension services in order to ensure technical quality standards and institutionalization of DRR. The replication will also provide the opportunity to further validate previous findings. Further pilot testing is recommended for GPOs which did not perform well during the field testing period.

(g) A proper Monitoring and Evaluation (M&E) system that captures the contribution of field demonstrations and capacity building activities to CCA and DRR is challenging but essential for systematic learning and an evaluation that goes beyond crop yields. The application of the M&E system has to be as simple as possible to be practicable for local institutions with limited capacities. At the same time it should include assessments that allow the measurement more complex outcomes on DRR in agriculture.

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