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Mainstreaming Disaster Risk Reduction into Agriculture

A case study from Bicol Region, Philippines

ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT SERIES

ENVIRONMENT [CLIMATE CHANGE] ENERGY MONITORING AND ASSESSMENT

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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 and widespread flooding, resulting in the destruction of and damage to homes, public infrastructures and the agriculture sector.

Within the Philippines, Bicol Region is one of the most disaster-prone areas, due to its geophysical location. The natural hazards in Bicol Region, 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 sector that is most vulnerable to natural hazards. In 2006 alone, the loss of investment caused by Typhoon Reming was estimated at PHP 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's request to the Food and Agriculture Organization of the United Nations (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, Geophysical and Astronomical Services Administration (PAGASA) and 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 fisherfolk who are highly vulnerable to the frequent occurrence of extreme climatic events. The project was implemented from September 2009 to December 2011 in three provinces in Bicol Region (Albay, Camarines Sur and Sorsogon), covering the municipalities of Guinobatan, Buhi and Gubat in each province, respectively, and three barangays per municipality. The DA was the main implementing agency, with technical assistance provided by Bicol University, Central Bicol State University of Agriculture (CBSUA) and PAGASA.

The project was designed in accordance with FAO's Disaster Risk Reduction for Food and Nutrition Security (DRR for FNS) Framework Programme, that builds on and supports the implementation of the Hyogo Framework for Action 2005–2015, to reduce risks in the agriculture sector. The DRR for FNS Framework consists of four thematic pillars: (i) enable the environment; (ii) watch to safeguard; (iii) apply prevention and mitigation measures; and (iv) prepare to respond.

The project delivered six interrelated and mutually supportive outputs by working closely together with concerned local government units (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 of PAGASA for the provision of site-specific short- and long-term climate and weather outlooks/forecasts;
(c) strengthened capacity of the DA Regional Field Unit V (DA-RFU V) and LGUs in the area of post-disaster damage assessment for the agriculture and fishery sectors;
(d) community-based disaster risk management (CBDRM) plans were developed in selected municipalities;
(e) agricultural practices for improved disaster risk reduction and management (DRR/M) were identified, pilot tested and disseminated through the DA and LGU extension services; and
(f) policy recommendations were developed and shared with major stakeholders.

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

The first six months were devoted mainly to capacity building activities, detailed work planning, an in-depth situation and risk assessment in the project area and the pre-identification of potential good practice options (GPOs) for DRR and climate change adaptation (CCA). In total, nine institutional and technical capacity building activities were implemented involving close to 500 participants. In addition, technical briefings with LGUs 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 the DA to jointly prepare enhanced climate information and early warning services tailored to the needs of agriculture. Before the start of the project, PAGASA had provided six types of forecasts catered to the agriculture sector, including tropical cyclone warning, flood warning, gale warning, El Niño/La Niña advisory, monthly weather forecasts/outlooks and ten-day weather forecast. 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 season. The DA translated these climate forecasts into concrete agricultural advice and information bulletins.

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

Further, the project promoted community participation as a critical element of sustainable disaster risk management (DRM). In line with the new government act Republic Act 10121 (concerning local DRR planning) and with locally perceived needs to implement the act, the project assisted in the development of integrated barangay DRR/M action plans, which specifically focus on DRR/M in agriculture. This was done through facilitation support provided by CBSUA and with LGUs in 9 barangays and 3 municipalities. The CBDRM plans promote a bottom up approach in the planning and implementation of DRM activities. The process provided communities with an opportunity to evaluate and analyse their own hazardous conditions, vulnerabilities and capacities. CBSUA also provided training sessions for technical staff in the DA, LGUs and DRR/M councils to support the horizontal scaling up of the development of local DRR/M plans across the region.

In addition, the project assisted the DA-RFU V 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, post-disaster needs assessment (PDNA) methodology. A database was built up with the three pilot LGUs. 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 analysed. Two types of information are required for damage, loss and needs assessments: pre-disaster baseline information and post-disaster information on damages and losses.

Action research-based pilot testing of selected GPOs for DRR was undertaken during three cropping seasons. The pilot-tested GPOs were identified from various sources, including research and extension centres, the DA, 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, economic and social 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 before endorsing them to the project steering committee for approval. Only those which passed the evaluation process were implemented by selected farmer-cooperators.

During the three 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 by 70 farmer-cooperators in the fisheries/ aquaculture sector for one cropping season. The project demonstrated the potential of the selected GPOs to enhance livelihood resilience under variable climatic conditions, as manifested by their performance and the results of field evaluation. For the performance of validated technologies, better understanding of climate/weather forecasts and the 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 to inadequate weather advisories. Seasonal weather forecasts provided by PAGASA and the farm weather bulletin prepared by the DA-RFU V enabled farmers to take strategic decisions on proper crop choice, cropping schedule and cultural management practices, and to adopt and use 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 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.

ACRONYMS

AT	Agricultural Technician
BDRRMC	Barangay Disaster Risk Reduction and Management Council
BFAR	Bureau of Fisheries and Aquatic Resources
BU	Bicol University
BUCAF	Bicol University College of Agriculture and Forestry
CBDRM	Community-Based Disaster Risk Management
CBSUA	Central Bicol State University of Agriculture
CCA	Climate Change Adaptation
DA	Department of Agriculture
DA-RFU V	Department of Agriculture Regional Field Unit V
DCC	Disaster Coordinating Council
DRR for FNS	Disaster Risk Reduction for Food and Nutrition Security
DRR/M	Disaster Risk Reduction and Management
EFP	Existing Farmers’ Practice
EFV	Existing Farmers’ Variety
EMRV	Early Maturing Rice Variety
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FNS	Food and Nutrition Security
GPO	Good Practice Option
HVCC	High Value Cash Crops
LD	Long Duration
LGU	Local Government Unit
LOA	Letter of Agreement
M&E	Monitoring and Evaluation
MBCR	Marginal Benefit–Cost Ratio
MD	Medium Duration
NGO	Non-Governmental Organization
NPC	National Project Coordinator

OCD	Office of Civil Defense
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAO	Provincial Agriculture Office
PAR	Philippine Area of Responsibility
PDNA	Post-Disaster Needs Assessment
POA	Plan of Action
PSC	Project Steering Committee
SD	Short Duration
TWG	Technical Working Group

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CHAPTER 1

PROJECT BACKGROUND

1.1 PROJECT RATIONALE

The Philippines has a total land area of 298 170 km², of which 9.5 million ha are agricultural land. Its agriculture sector accounts for about 12 percent of the national gross domestic product and provides 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 and widespread flooding, resulting in the destruction of and damage to homes, public infrastructures and the agriculture sector.

FIGURE 1

Aftermath of Typhoon Reming in 2006

Within the Philippines, Bicol Region is one of the most disaster-prone areas. It consists of six provinces: 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 km^2, which is about 6 percent 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 and covering around 312 000 ha. It has a total population of more than 5.6 million (as of 2010), with a population growth rate of 1.2 percent and a population density of 5.24 people per ha. More than 42 percent of the region's total workforce derive their living from agriculture.

Natural hazards in Bicol Region, mainly storms and floods, put the lives of vulnerable households at risk. Those who are highly dependent on agriculture are those who usually suffer the most, since agriculture is one of the sectors that is most vulnerable to natural hazards in Bicol Region. The turning point was 2006 when the country was hit by three extremely destructive typhoons in a span of ten weeks from September to December. Typhoon Reming, which entered the Philippine Area of Responsibility (PAR) between 26 November and 1 December 2006, was the most destructive, severely affecting all the six provinces of 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 with rice, corn and high value cash crops (HVCCs) at varying stages of growth, as well as livestock and fisheries. The investment losses in terms of input costs such as seeds, fertilizers and labour was valued at PHP 817.42 million. Furthermore, Typhoon Reming claimed the lives of more than 1 000 individuals who were living in vulnerable areas.

With the devastation wreaked by Typhoon Reming, the DA presented a request to the Food and Agriculture Organization of the United Nations (FAO) in February 2007 for technical and financial support to undertake an overall needs assessment and design a rehabilitation plan. FAO's assessment revealed that the provinces of Albay, Camarines Sur and Sorsogon were the most highly affected areas. The assessment paved the way for the Technical Cooperation Programme project "Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region)", which focused on disaster risk reduction (DRR) 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 Bicol Region. More specifically, the immediate project objectives were to:

(i) enhance the institutional and technical capacities within the Department of Agriculture (DA), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and 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 fisherfolk who are highly vulnerable to the frequent occurrence of extreme climatic events.

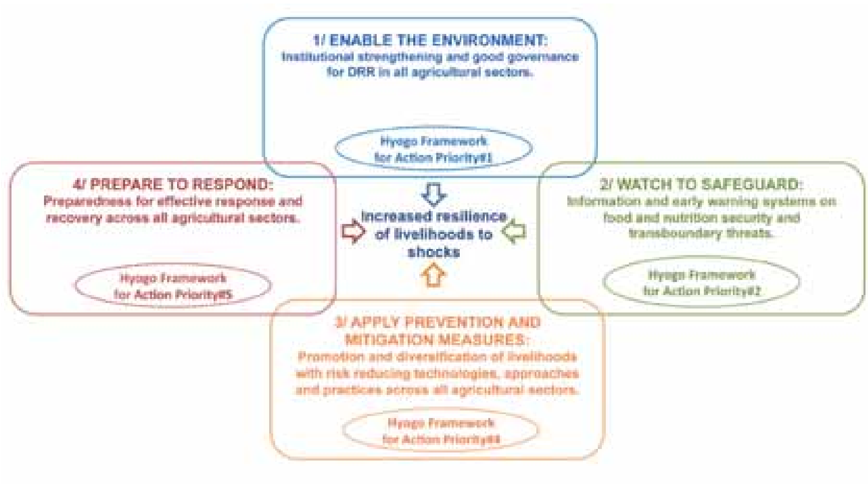
The project was designed in accordance with the Hyogo Framework of Action 2005–2015 and in line with FAO's Disaster Risk Reduction for Food and Nutrition Security (DRR for FNS) Framework Programme. The DRR for FNS Framework consists of four thematic pillars, with each pillar having a specific objective and making a direct contribution to one of the priorities for action of the Hyogo Framework for Action 2005–2015.

The objective of Pillar 1 (enable the environment) is to support the enabling of the environment of member countries with appropriate legislation, policies, strategies and institutional frameworks for DRR in the agriculture sector, 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 Regional Field Unit V (DA-RFU V), PAGASA and local government units (LGUs) were enhanced to promote local disaster preparedness. Further, the project facilitated the development of community-based disaster risk management (CBDRM) plans in each of the pilot communities, which were approved by their respective LGUs. Initial efforts were also undertaken to formulate the regional Plan of Action (POA) for DRR in agriculture.

Pillar 2 (watch to safeguard) aims to strengthen and harmonize food and nutrition security (FNS) information and early warning systems (EWS) to better monitor the multiple threats and inform decision making in preparedness, response, policy, advocacy and programming. This is premised

FIGURE 2

Project conceptual framework: promoting interlinked thematic pillars



Source: FAO, 2011

on the assumption that the quality of key data is essential for analysis, early warning and forecasting. The project promoted better seasonal weather and climate forecasting tailored to the needs of agricultural producers, as well as improved outreach to farmers, are 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 these lines, 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.

Pillar 3 (apply prevention and mitigation measures) the promotion and diversification of livelihoods with risk reducing technologies, approaches and practices across agriculture 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, fisherfolk and foresters. Transfer and scaling up of DRR proven technologies to benefit similarly situated farmers, herders, fisherfolk and foresters is part of the strategies of Pillar 3. The project adopted Pillar 3 strategies by identifying and pilot testing technologies that have the potential to enhance livelihood resilience against climate change hazards.

Pillar 4 (prepare to respond) concerns preparedness for effective response and recovery in agriculture, livestock, fisheries and forestry. The objective of Pillar 4 is to strengthen capacities in preparedness at all levels to improve responses to, and recovery from, future threats to FNS and to reduce their potential negative impact on livelihoods. Pillar 4 was actualized by the improvement of the post-disaster needs assessment (PDNA) software 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.

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 shift in strategy from response and recovery to a more proactive and holistic approach of prevention, mitigation and community preparedness within the context of risk management.

Corresponding to the four integrated pillars of the DRR for FNS Framework Programme, this Technical Cooperation Programme 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, 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 the DA-RFU V and other concerned LGUs strengthened to undertake timely and accurate post-disaster damage assessments in the agriculture and fishery sectors;

(d) CBDRM plans developed and implemented in selected municipalities;

(e) climate risk management/preparedness practices for vulnerable livelihood groups identified, pilot tested and disseminated through the DA and LGU extension services; and
(f) developed and shared policy recommendations 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.

CHAPTER 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 municipality and three 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 an 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) through 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 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 the national level and project partners at the regional level.

CBSUA was contracted through an LOA with FAO to conduct the CBDRM planning. The main responsibilities of CBSUA relative to the CBDRM component were: (a) conduct in-depth situation assessment, including the DRM system in Bicol Region, with a specific focus on the agriculture sector in the selected project sites; (b) train provincial- and municipal-level DA technicians and disaster coordinating councils (DCCs) 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 concerns 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 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 the DA-RFU V was executed.

Pilot testing of the GPOs was spearheaded by the DA, with the 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 with respect to the GPO project component was: site selection; GPO validation and implementation guidelines; 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 supported by the agricultural extension personnel of the three 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 26 August 2009 with the newly-hired consultants and key personnel of the DA-RFU V to orient the latter about the project, its implementation arrangements and the mechanics for the conduct of the inception planning workshop. It was agreed during this meeting to have the project inception meeting on 10 September 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, BU, CBSUA, the National Economic and Development Authority and the Mines and Geoscience Bureau of the Department of Environment and Natural Resources.

2.3 INCEPTION PLANNING WORKSHOP

An inception planning workshop was held on 10 September 2009 in Legazpi City to brief the project participants about the project implementation approach, proposed work plan and timetable of activities, and to initially identify the

FIGURE 3

Project inception meeting held in Legazpi City on 10 September 2009

pilot communities or barangays where the project was to be implemented. The inception planning workshop was attended by representatives from various agencies which would be involved in the implementation of the project.

The one-day workshop was able to accomplish three important tasks: validation of the selection criteria for the barangays; shortlisting of at least five barangays per municipality as possible project sites; and identification of prospective members of the TWG which would 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 pilot barangays.

2.4 SELECTION OF PILOT COMMUNITIES

The project was implemented in three provinces of Bicol Region which were most affected by the three destructive typhoons that hit the region in 2006, namely Albay, Camarines Sur and Sorsogon. In each of these provinces, one municipality was selected as a project site based on the list of municipalities which the FAO mission identified as those most affected, and as a 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 municipalities were as follows: (a) areas with high level of dependence on the agriculture sector; (b) existence of well-established, a functioning farmers' organization such as a 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 programmes; (e) residents and livelihood groups were displaced after the recent typhoons but remain vulnerable to future risks; and (f) sites are accessible to various means of transport and possibly with access to a power source.

The final selection of the three priority barangays per municipality was done after the site validation conducted by a team composed of national consultants and technical staff of the DA-RFU V. The team visited each of the barangays which were initially identified by the LGU of the municipality to determine if these barangays met the selection criteria. Some initial

FIGURE 4

FAO and DA officials joined the team during site validation in Guinobatan, Albay

secondary data, such as land area and demographics, were also collected during the site visit. Barangay officials were interviewed to ascertain their interest in the project.

Results of the site validation process were presented to the TWG, which took the final decision on the selection of the three 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 (varying agro-ecological zones and vulnerability of residents and livelihood groups to future risks) were given 30 percent each while the remaining four criteria (level of dependence on agriculture, existence of well-established and a functioning farmers' organization, willingness of farmers and accessibility) were given 10 percent each.

2.5 PARTICIPATORY SITUATION ASSESSMENT

Crucial for the identification of location-specific 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; 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 risks/impacts and future climate risks;
(c) analyse current farming systems/practices in selected municipalities;
(d) determine existing vulnerability context, applying livelihood profiling methodology and existing coping mechanisms to climate change; and
(e) assessment of the institutional DRM system.

The assessment process adopted by the CBSUA team used the following procedures/methodology: (a) review of related literature and information about the project sites; (b) conducting 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, fisherfolk, women and youth, non-governmental organizations [NGOs], people's organizations, the DA-RFU V, academe and LGUs). It was undertaken to assess and evaluate the livelihood situation, climate change-related hazards, risk and vulnerability conditions and institutional capacity of the local and regional governments and private organizations working in the pilot areas. Different tools were used in the field assessment, such as: participatory rural appraisal; focus group discussions (FGD) for preparing a livelihood seasonal calendar; risk and hazard mapping; key informant interviews for institutional assessment and livelihood group profiling; and identification of vulnerable sectors and groups.

2.6 CAPACITY BUILDING AND TRAINING

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

The first training was conducted on 12–13 November 2009 and was attended by 58 participants coming from the three project sites/municipalities, the DA-RFU V, the Bureau of Fisheries and Aquatic Resources (BFAR), 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, type of hazard and number of people affected.

The second training was conducted by FAO on 12–13 February 2010 on CBDRM, and focused on the operational aspects of DRR in agriculture and fisheries. The training was attended by 61 participants from the three

FIGURE 5

PAGASA official providing input during the training on EWS

project sites/municipalities; the Provincial Agriculture Offices (PAOs) of Albay, Camarines Sur and Sorsogon; the Provincial Disaster Management Office of Camarines Sur; DA-RFU V; BFAR; BU; CBSUA; PAGASA agro-meteorological station; and an NGO from Sorsogon. The outputs of the training workshop were as follows: (a) vision of a disaster resilient community; (b) DRR plan in agriculture and fisheries; (c) CBDRM approach and process; and (d) assessment of hazard, risk, vulnerability and capacity.

Thereafter, the project continued to place a strong emphasis on capacity building at various levels with support for enhanced small-scale technology options at the local level in order to strengthen institutional capacities and community resilience against the impacts of natural hazards. The capacity building activities of the project consisted of 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 in these series of trainings were provincial and local authorities of the 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 the 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 DRR/M and CCA were capped by a three-day training provided by FAO on "Analysis of Disaster Risk Management Systems in Agriculture and Fisheries" on 7–9 December 2011. The training was attended by 45 participants coming from the three project sites/municipalities, PAOs, the DA-RFU V and state universities and colleges. The three-day training aimed, in general, to capacitate the members of the provincial, municipal and barangay DRR/M councils 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 three-day training workshop were: (a) sharing of inputs on proactive DRR in agriculture and fisheries; (b) identification/formulation of roles and responsibilities of the DRR/M councils at the provincial, municipal

FIGURE 6

Training workshop on "Planning for community-based adaptation to climate change" using FAO E-learning tool

and barangay levels in DRR; and (c) validation of DRR/M plans of partner municipalities/provinces.

2.7 INTEGRATION OF GENDER PERSPECTIVE IN DRR/M

Training on gender perspective integration in CCA and DDR/M was conducted to familiarize the project stakeholders with gender concepts and perspectives and on how to mainstream gender concerns in DRR/M. POAs for gender perspective integration in DRR were also prepared at the LGU level 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 the 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 responsible for attending to the farm when the husband is doing off-farm and non-farm labour. This was observed in some sites, particularly in Guinobatan, where women would take care of the farm to enable the men to take on non-farm labour (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 at the time 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 pulled out.

CHAPTER 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 barangays covered by the project. These climate-related hazards and risks were used as bases in the identification and design of GPOs for 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 Region

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

Figure 7 below shows the cumulative number of weather disturbances that had either landed in or crossed the country within the past five 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 in or crossed the country. Typhoons would usually hit Bicol Region during the later part of the year, starting in September. This time of the year also coincides with the rice harvest season.

FIGURE 7

Cumulative number of tropical cyclones or weather disturbances that had either landed in or crossed the Philippines between 2005 and 2009

The most intense typhoon ever recorded that affected Bicol Region was super Typhoon Reming (Durian) in 2006, with wind speeds of up to 320 km/hour. Heavy and/or continuous rainfall from monsoons and typhoons pose a serious risk to farmers and residents in the nine project sites. 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.

Between October and December is the period when Camarines Sur receives the highest amount of rainfall. Based on the 16-year 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,

TABLE 2

Number of rainy days in the three pilot provinces of the project

PROVINCE	NUMBER 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

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 provinces experience high rainfall averages (September to December) is also the period of the year when typhoons directly affect the region.

Heavy rainfall during the months of September to December usually leads to flashfloods/floods, landslides and soil erosion in some parts of the three pilot provinces, resulting in damage to 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 the 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 a benchmark in developing the DRR/M plans of the nine barangays. The result was also used in the identification of GPOs based on climate-related hazards occurring in the area.

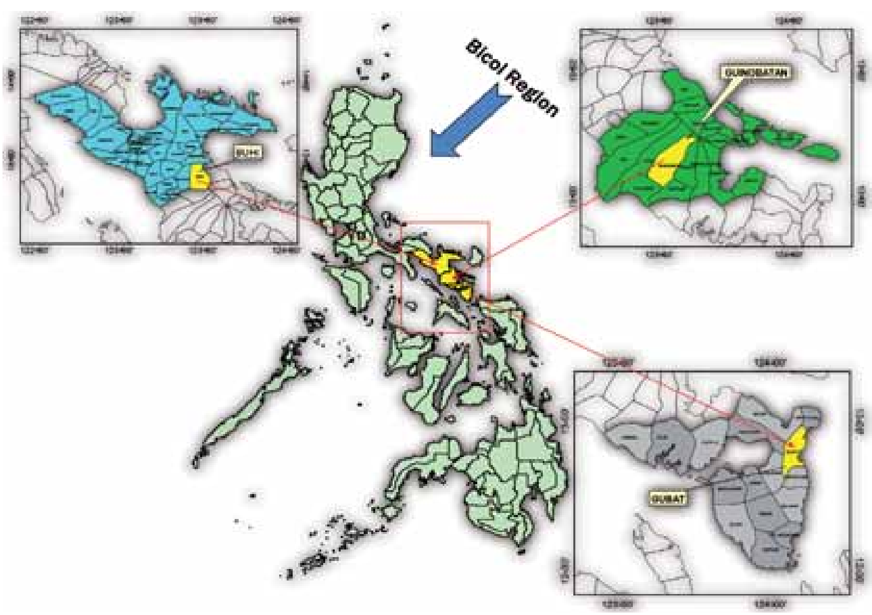
3.2 SUMMARY DESCRIPTION OF PILOT MUNICIPALITIES AND BARANGAYS

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 at 13°19' 30.4" north latitude and 123°59'45.1" east latitude and is bordered in the south by the mountain ranges of Pioduran, in the west by Ligao City and in the east by the municipalities of Camalig and Jovellar.

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 agro-ecological zones based on the FAO classification. It has a total population of 62 242, according to the 2000 census. The municipality is a predominantly agricultural area with almost 80 percent of its land area or 16 033.18 ha devoted to agriculture. Major crops cultivated are coconut, corn, rice, vegetables, root crops and fruit trees.

FIGURE 8

Project location map showing the three pilot municipalities



Source: CBSUA, 2011

The municipality of Buhi is located in the southwestern tip of the province of Camarines Sur and is bordered in the east by Mount Malinao (in Albay), in the west by Mount Asog (in Iriga City), in the north by the Sagñay-Buhi mountain ranges and in the south by the low-lying ranges of Polangui (in Albay). It lies 13°25'32.4" north latitude and 123°30'49.1" east longitude and is located 75 km and 53 km away from Legazpi City and Naga City, respectively. The municipality has a generally mountainous and hilly surface. The total land area of 18 378 ha is within the watershed declared as a 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* (*Mistichthys luzonensis*) according to the Guinness Book of World Records. The municipality has a total population of 67 757, according to the 2000 census.

Lying along the Pacific Ocean, the municipality of Gubat is bordered in the north by the municipality of Prieto Diaz, in the south by the municipality of Barcelona and in the west by Sorsogon City. It is located 12°54'30.4" north latitude and 124°11'45.1" east longitude. The municipality has a total land area of 11 077 ha, of which 8 699.06 ha are classified as agricultural land. Gubat belongs to the type 2 climate based on the Corona system of classification. The municipality is 63 km southeast of Legazpi City and 29 km east of Sorsogon City. It has a total population of 52 556, with a total of 10 876 households, and an average family size of five.

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

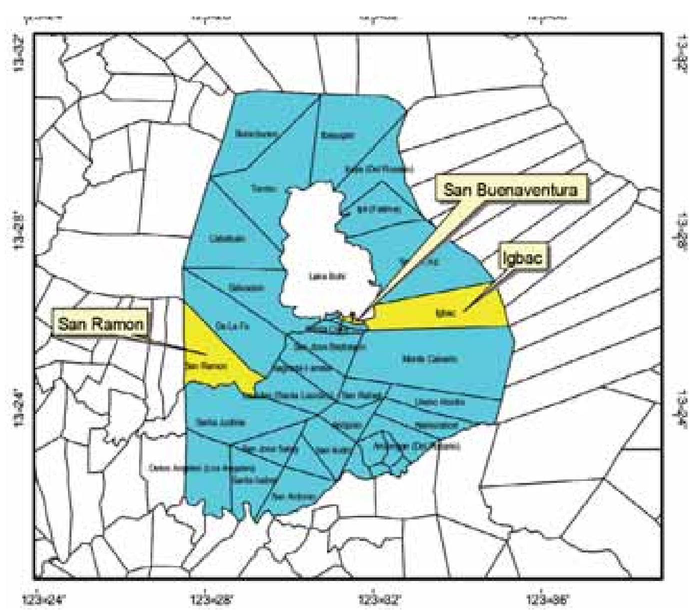
Buhi, Camarines Sur

- *San Ramon*: Barangay San Ramon is located 8 km 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 an average family size of 4.88. It has a population density of three individuals per hectare and 75 percent belongs to a group of indigenous people, or Katutubo (Itom). The barangay has three lakelets: Manapao, Katugday and Kimat.

  The barangay has a total land area of 468 ha 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 percent) of this area is planted with coconut trees, with a combination of understorey crops like anahaw, banana, upland rice, sweet potato and cassava. Typhoons, floods, and landslides are threats to agricultural production. The types of agricultural production system being practiced in the upland agro-ecological zone, which is characterized by 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 7 km 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 ha, with 225.2 ha classified as agricultural areas.

  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). The upland agro-ecosystem is characterized by coconut-based farming systems such as: coconut + banana + fruit trees, coconut + sweet potato and coconut + vegetable.

  Typhoons, landslides and flashfloods 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 the 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 ha, of which 42 percent is devoted to agriculture. The agricultural area, which is located along the Siminlong River, is mostly devoted to rice, corn and root crops. Fish culture is the major source of livelihood of San Buena residents and is carried out through a 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 two persons per hectare of land. Majority of San Buena's population are engaged in some major livelihood activities, with the wage labourers as the biggest group. Expectedly, there are more fisherfolk than farmers in the barangay. Lake fishing is, however, being threatened because of proliferation of water hyacinth which now covers 90 percent 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 6 km from the town proper of Guinobatan. As of the 2009 census, barangay Masarawag has a total of 919 households with a population of 3 984 individuals, including 2 034 males and 1 950 females.

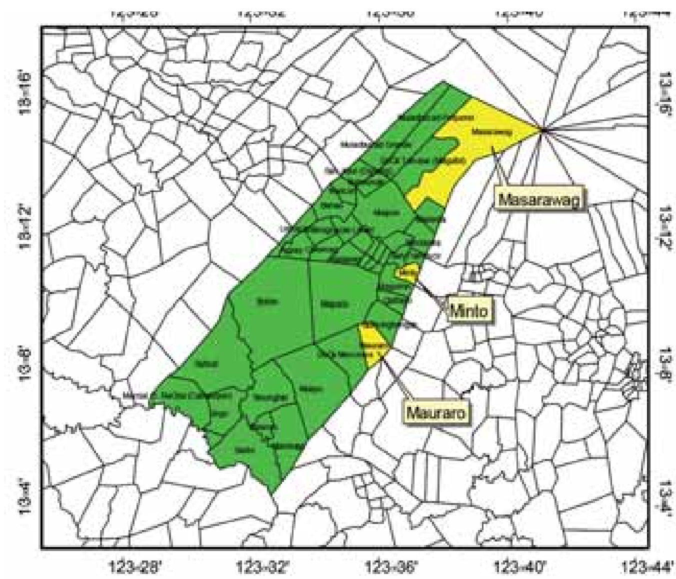
  Of the 859 ha total land area of Masarawag, 795.96 ha or 92 percent is devoted to agriculture. Coconut, fruit trees and banana are the predominant crops in the upland. Vegetables like tomato, ampalaya, pepper, pechay and cabbage are planted in areas not reached by the irrigation.

  Typhoons, flash floods, volcanic eruptions 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 period from October to March. The steep to moderately steep sloping lands and the type of agricultural production system increases the vulnerability of the site to flash floods during heavy rainfall.
- *Mauraro*: Barangay Mauraro lies on the southern portion of Guinobatan and is roughly 5 km away from the town proper. It has a total land area of 655 ha of which 562 ha are devoted to agriculture. Soil type is sandy loam, which is stable and moderately well drained. Upland areas are predominantly planted with 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 an average family size of six individuals. Population density is barely nine persons per hectare of land. 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 10percent of the total livelihood group.

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

FIGURE 10

Map of Guinobatan, Albay showing the three pilot communities



Source: CBSUA, 2011

- *Minto*: Barangay Minto lies in the eastern portion of Guinobatan and is about 3 km from the town proper. Its terrain is generally rolling, with few flat to moderately flat areas. It has a total land area of approximately 869 ha, 70 percent of which is devoted to agriculture. Half of the agricultural area is utilized for the production of coconut in combination with other crops like banana, root crops and vegetables, while the other half in sitio Binti is planted with lowland rice and vegetables. The remaining 30 percent of the barangay land area consists of rolling to upland terrain comprising rock formations.

  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 five. Its population density is barely two individuals per hectare of land. Of the total population, 36.3 percent belong to the major livelihood groupings. Half of the working population are wage labourers, working mainly as construction workers, followed by the farmer groups who are producing coconut, root crops, rice and vegetables.

Typhoons, volcanic eruptions and the associated secondary hazards like flash flooding, slow-onset flooding, mudflow and landslides 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.

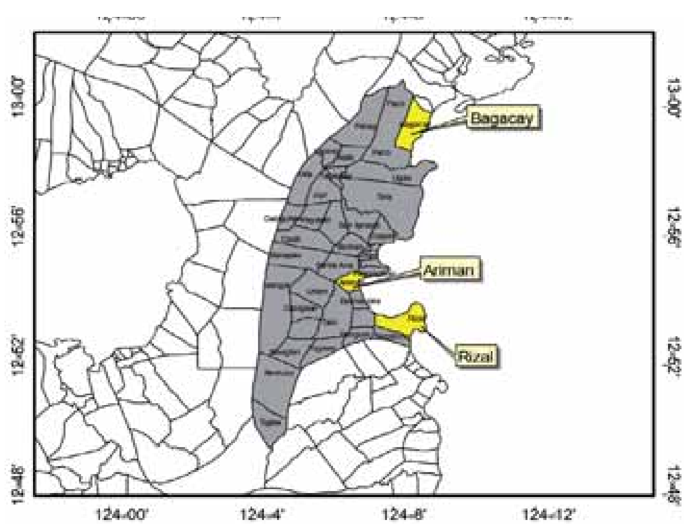
Gubat, Sorsogon

- *Bagacay*: Bagacay is a coastal barangay located in the northern part of Gubat, which is about 7 km from the town proper. It has a total land area of 582.54 ha, of which 450.3 ha or 77.32 percent is devoted to agriculture. About 308.5 ha are planted with coconut in combination with other crops like corn, vegetables and root crops, while 127.45 ha 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 six persons per hectare of land.

  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 and candy making) and fish processing and vending. Farmers constitute the biggest livelihood group, followed by

FIGURE 11

Map of Gubat, Sorsogon showing the three pilot communities



Source: CBSUA, 2011

fisherfolk. The peak season for fishing is between the months of August and November, which are incidentally the typhoon months. Fisherfolk are also engaged in farming as labourers during the 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 floods, soil erosion and earthquakes.

- *Ariman*: Barangay Ariman is a coastal barangay located at the northern part of Gubat and is 7 km 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 ha (or 94.56 percent) are devoted to agriculture. About 98 ha are devoted to lowland rice and 133.38 ha are planted with coconut, banana, root crops 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 and farming as the major sources of livelihood, yielding an average annual income per household of PHP 2 262 (according to the 2005 census). After transplanting rice, farmers are also engaged in fishing on a daily basis, thereby putting too much pressure on the coastal resources. For the coconut farmers, they harvest their nuts every 45 days. The women of Ariman plant root crops such as cassava, camote, gabi and other vegetable crops. They also raise backyard animals such as pig, carabao, goat and chicken for additional income and domestic consumption. Typhoons, flooding (May and August to January) and saline intrusion to the rice areas are the major natural hazards experienced in barangay Ariman. Soil erosion and landslides are a great threat to steep and 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 ha. The majority of the land area (or about 381 ha) is devoted to agriculture, with 236 ha planted with coconut in combination with other crops, and 89 ha planted with lowland rice. Other crops planted include corn, vegetables and root crops. 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 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 and fish processing and vending. Farmers represent the biggest livelihood group, followed by wage labourers. Fisherfolk are also involved in farming as an alternative livelihood source and as labourers during the lean season. Typhoons, saline intrusion in lowland rice areas near the coast, drought (March to May) and flooding (October to December) are threats to agricultural production. Soil erosion and landslides are additional threats in steep to moderately steep sloping areas during heavy rainfall.

CHAPTER 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 EWS, such as a weather forecast, cannot be overemphasized in DRM. Huge losses in life, property and agricultural production can be avoided through 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 warnings, 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 of the country.

4.1.1 Improved capacity for weather monitoring

At present, PAGASA weather forecasts 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 at the PAGASA weather station at the Bicol University College of Agriculture and Forestry (BUCAF) in August 2010 to obtain real-time weather data such as temperature, relative humidity, rainfall and wind direction, so that early warnings and alerts 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 on 16–24 February 2011. A briefing/orientation of the barangay council and the persons who will take charge of the data collection, 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 in August 2010

Rainfall data collected from the rain gauges were transmitted daily to the PAGASA regional centre, through text messaging on a cellular phone from the barangay. Rainfall data from rain gauges can also be retrieved from a data logger in case the barangay failed to record or send the data to the PAGASA regional centre. All of the weather data were shared with the 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, of which six cater to the agriculture sector, especially the farmers and fisherfolk. These products include tropical cyclone warnings, flood warnings, gale warnings (each issued twice a day), El Niño/La Niña advisories (updated monthly), monthly weather forecasts/outlooks and 10-day weather forecasts. Each of these early warning products, with the exception of the last two, was assessed by PAGASA in terms of their accessibility to intended users.

Results of the assessment revealed that farmers and other client groups from the three pilot provinces become aware of incoming typhoons when

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
Cell phone	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
Regional DCC	2	2	0	1	4	2	1	0	0	0	0	0
Provincial DCC	2	2	0	1	5	2	1	1	0	0	0	0
Municipal DCC	4	1	3	1	7	3	4	1	0	0	0	0
Barangay DCC	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
Municipal Agriculture Office	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

the weather conditions start 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 two to three days before it enters the PAR.

The assessment further revealed that television, radio and PAGASA are the three major sources of information for 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 DCCs 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 systems (e.g. telephone, fax and Internet) in the municipalities and barangays had prevented the EWS from PAGASA and the regional DCC to be relayed from the provincial level 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 is relatively broad (regional in scope) and is not specific to their localities. Barangay stakeholders further observed that EWS issued by PAGASA take some time before they reached their locality because of the different channels this information had to pass through before reaching the barangay. This oftentimes led to a delayed DRR/M response, resulting in 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 no longer reaches the barangay level or the end users (farmers and fisherfolk). The problem was traced to inadequate communication systems between the municipal and barangay levels. As a result, the barangays and the end users are unable to receive advanced 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 DA-RFU V, to ensure more effective DRR/M in agriculture.

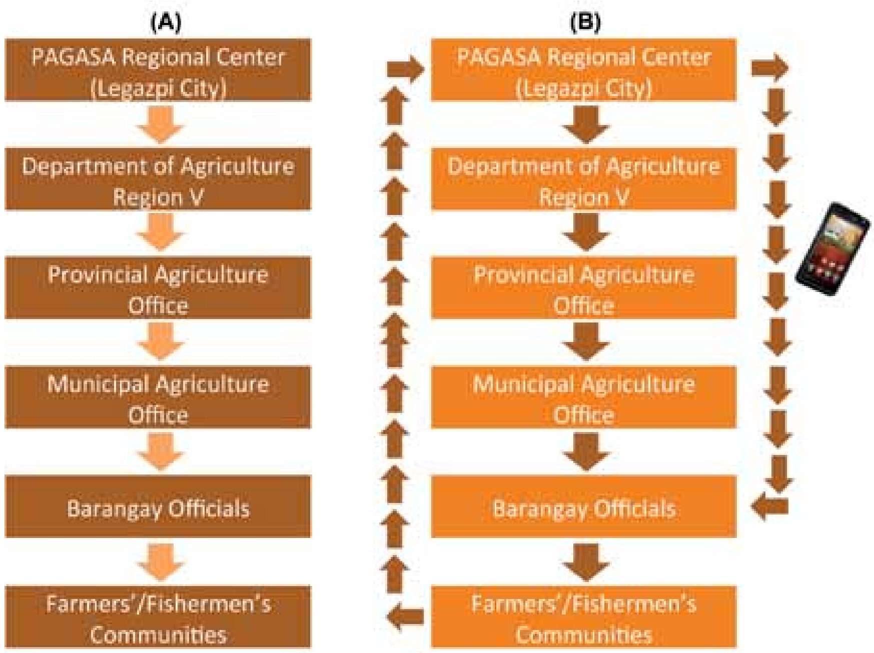
A workshop on EWS and CBDRM was conducted on 9–13 February 2010 and was attended by participants from the DA-RFU V and DCCs from the provincial level down to the barangay level. The first half of the training was devoted to the discussion of basic concepts about DRM and EWS. The second half was devoted to the conducting of a workshop to identify strategies to improve local-level EWS and communication systems, including how to overcome challenges of the inadequate knowledge of end users and delays in communication.

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 season. The DA translated these climate forecasts into concrete agricultural advice and information bulletins.

FIGURE 13

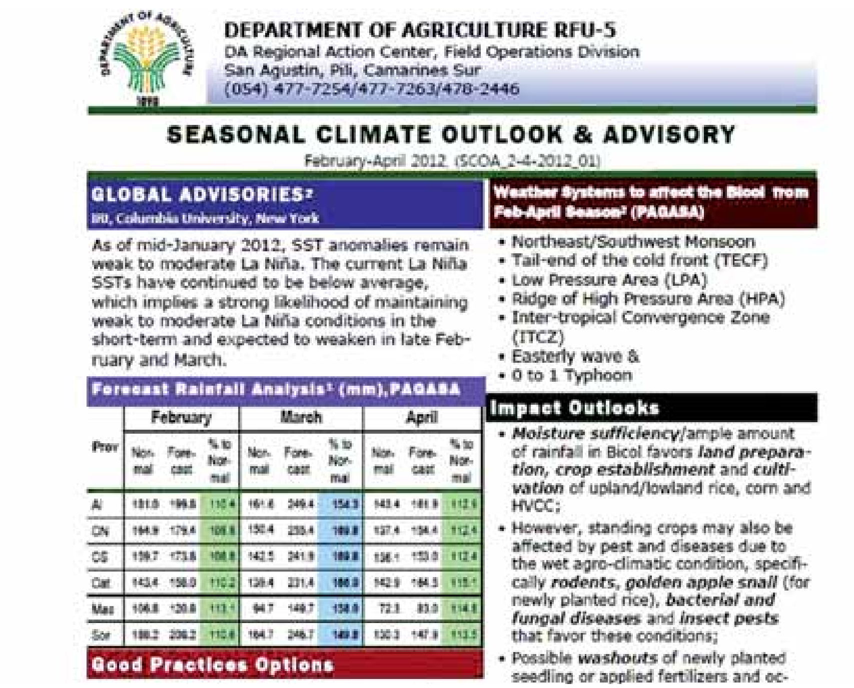
Existing flow of PAGASA's EWS (A) vs proposed EWS flow (B)



An agreement was brought forward between PAGASA and the DA-RFU V to jointly issue the seasonal farm weather bulletins, complemented by monthly updates, to thereby improve the location-specific applicability of PAGASA's EWS for farmers. A project office within the DA-RFU V was established under this project, and led the technical preparation (based on climate data provided by PAGASA) and regular dissemination to local levels of farm weather bulletins for farmers (see Figure 26). These bulletins were sent at least once every month to the three municipalities covered by the project. The farm weather bulletin provides localized and site-specific weather forecasts 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 the 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.

FIGURE 14

Sample farm weather bulletin, November 2011 – January 2012


DEPARTMENT OF AGRICULTURE RFU-5
DA Regional Action Center, Field Operations Division
San Agustin, Pili, Camarines Sur
(054) 477-7254/477-7263/478-2446

SEASONAL CLIMATE OUTLOOK & ADVISORY
February-April 2012 (SCOA_2-4-2012_01)

GLOBAL ADVISORIES[2]
IRI, Columbia University, New York

As of mid-January 2012, SST anomalies remain weak to moderate La Niña. The current La Niña SSTs have continued to be below average, which implies a strong likelihood of maintaining weak to moderate La Niña conditions in the short-term and expected to weaken in late February and March.

Forecast Rainfall Analysis[1] (mm),PAGASA

Prov	February			March			April		
	Normal	Forecast	% to Normal	Normal	Forecast	% to Normal	Normal	Forecast	% to Normal
Al	181.0	199.8	110.4	161.6	249.4	154.3	143.4	161.9	112.9
CN	164.9	179.4	108.8	150.4	255.4	169.8	137.4	154.4	112.4
CS	159.7	173.8	108.8	142.5	241.9	169.8	136.1	153.0	112.4
Cat	143.4	158.0	110.2	120.4	231.4	186.8	142.9	164.5	115.1
Mas	106.8	120.8	113.1	94.7	149.7	158.0	72.1	83.0	114.8
Sor	186.2	206.2	110.6	164.7	246.7	149.8	130.3	147.9	113.5

Good Practices Options

Weather Systems to affect the Bicol from Feb-April Season[3] (PAGASA)

- Northeast/Southwest Monsoon
- Tail-end of the cold front (TECF)
- Low Pressure Area (LPA)
- Ridge of High Pressure Area (HPA)
- Inter-tropical Convergence Zone (ITCZ)
- Easterly wave &
- 0 to 1 Typhoon

Impact Outlooks

- ***Moisture sufficiency***/ample amount of rainfall in Bicol favors ***land preparation, crop establishment*** and ***cultivation*** of upland/lowland rice, corn and HVCC;
- However, standing crops may also be affected by pest and diseases due to the wet agro-climatic condition, specifically ***rodents, golden apple snail*** (for newly planted rice), ***bacterial and fungal diseases*** and ***insect pests*** that favor these conditions;
- Possible ***washouts*** of newly planted seedling or applied fertilizers and oc-

The project was able to document the impact of the timely early warning services and greater access for end users (farmers and fisherfolk) 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. In the third cropping season (June to November 2011), the GPOs performed well and damages were reduced due to the preparation of farm weather bulletins and their recognition in the planning and implementation process of GPOs.

4.2 STRENGTHENING LOCAL CAPACITY IN PDNA

An important component of DRR/M is the conduct of a PDNA after a natural calamity such as typhoons, floods 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 (OCD) of the Department of National Defense (the secretariat and executive arm of the national DRR/M council) has prepared standard forms or matrices which the various line agencies of the Government use in reporting the damages from disasters. All local 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 of these inputs are submitted to the regional DCC for consolidation and submission to the national DRR/M council. The national DRR/M council will further process these reports for the information and action by the council's cabinet level and the President of the Republic of the Philippines.

The DA 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 disasters 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 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

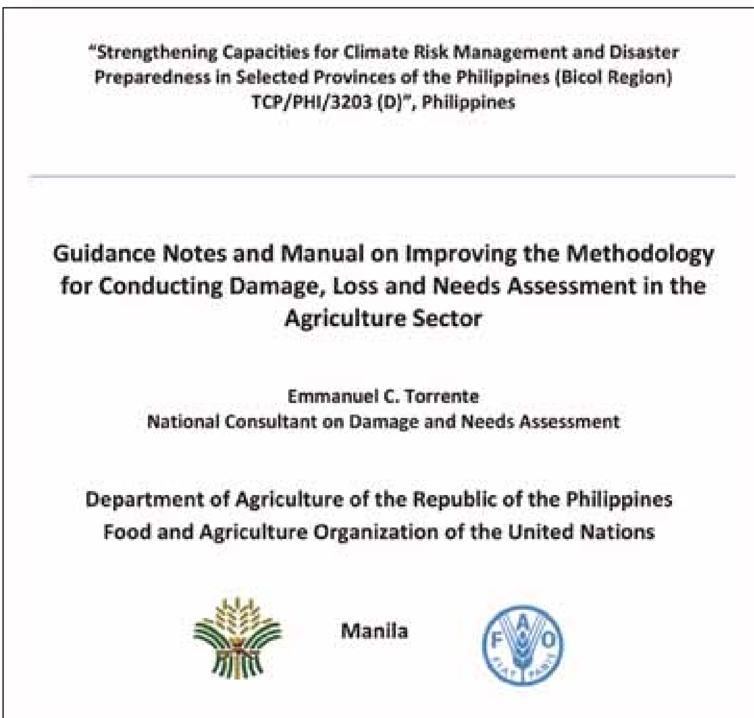
The guidance notes developed by the project intend to improve the existing assessment methodology of the DA and guide them, along with the LGUs and the community, in gathering additional information/data at the barangay level to comprehensively assess the impacts of natural disasters in agriculture.

The guidance notes basically clarify that the definitions of damages and losses due to disasters are consistent with the international concepts developed by international agencies like the Economic Commission for Latin America and the Caribbean (as modified by the Global Facility for Disaster Risk Reduction of the World Bank and FAO, among others, aimed at standardizing post-disaster damage and loss reports which are the basis of needs assessment). The guidance notes cover the following subsectors of agriculture, some of which are not yet included in the existing damage assessment methodology of the DA:

(a) seasonal crops - rice, corn and HVCCs;
(b) permanent crops - those that require a certain period of time to mature before produce can be harvested regularly, such as 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; and
(f) infrastructure – the physical assets that are related to agriculture, such as irrigation facilities, rice warehouses, rice and corn mills, animal sheds, etc.

FIGURE 15

PDNA user manual


"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

Emmanuel C. Torrente
National Consultant on Damage and Needs Assessment

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Food and Agriculture Organization of the United Nations

Manila

The guidance notes and PDNA manual recommends the generation of two types of information for damage, loss and needs assessment, namely: pre-disaster baseline information and post-disaster information on damages and losses. It also recommends six important steps in the conduct of post-disaster damage and loss assessments, 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 analyse first the impacts of the disaster to identify priorities within the agriculture sector (which subsector to prioritize). The manual recommends two steps for identifying post-disaster needs: (a) analysing the disaster impacts based on the damages and losses; and (b) identifying the post-disaster needs in the agriculture sector.

In analysing the impacts of disasters, the following must be determined: (a) number of people affected and the socio-economic 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 at the personal or household level. These recovery activities could take the form of any of the following: cash- and food-for-work schemes, 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 a 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 entailed a participatory process whereby project stakeholders were involved in the revision and finalization. The first draft was presented during the workshop in Pili, Camarines Sur in 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 ATs during a workshop held in January 2011 before it was pre-tested in the three projects sites in Gubat, Sorsogon in 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

Based on the concepts in the PDNA guidance notes, a computer programme 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 the DA-RFU V, target LGUs, the Albay Public Safety and Emergency Management Office and the Office of the Provincial Agriculturist of Albay to agree on the parameters needed in developing the system. Three LGUs (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 ATs for the seasonal crops (rice, corn and three main HVCCs) and livestock were modified to fit the requirements of the computer programme. 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 a detailed database that includes the name of the farmer, basic household information and a description of the farm, such as land ownership and its level of vulnerability to floods and other natural disasters.

FIGURE 16

Project team meeting discussing on PDNA software development

The system was dynamically designed to make it open and to cover wider data requirements of the DA and LGUs. To address data security and data integrity, only registered ATs can log in, input data and view draft reports. By using the previously encoded baseline data; utilizing the assumptions on the percentage of disaster impact to crops as defined by the DA in its manual of disaster assessments and reporting systems; and 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; and
(e) post-disaster report after disaster (tenth day after the disaster).

FIGURE 17

Proposed damage and needs assessment tool web application

Once fine-tuned, the software will be uploaded on 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 reports required by the LGU and the 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.

A homepage was developed for the PDNA software (see Figure 16) for uploading, once it is finalized, and can be accessed through the following link (www.pdna1.cbsua.edu.ph).

4.3 DEVELOPMENT AND IMPLEMENTATION OF CBDRM PLANS

DRR is considered the first line of defence in the overall effort of addressing the effects of climate change. It is, therefore, necessary to expand and upgrade the capacity of LGUs to address and anticipate natural disasters such as typhoons, floods and landslides. This will entail using science-based EWS and capacity building for LGUs and organizations for disaster preparedness and risk management.

The project recognizes the fact that many of the disaster management programmes 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 CBDRM component. The CBDRM approach promotes a bottom up methodology in the planning and implementation of DRM activities. It provides an opportunity to the community to evaluate and analyse their own hazardous conditions, vulnerabilities and capacities. 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 DRR/M plans and to institutionalize the same in local governance, the following processes were adopted.

4.3.1 Rapport building and understanding the community

Preparation of DRR/M plan requires a good understanding of the community. To be able to understand the community, a project team must undergo community integration and establish a 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, which were attended by local officials and selected constituents. This provided the opportunity for barangay stakeholders to clarify some issues, gather 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 were organized to accompany the CBDRM 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

TABLE 4

Capacity building activities conducted by CBSUA

Title of training/workshop	Date	Venue	Number of participants
Training on DRR	12–13 Nov. 2009	CBSUA	58
Training on CBDRM	12–13 Feb. 2010	CBSUA	62
Training on gender integration and harmonization in DRM	10–11 March 2010	CBSUA	48
Barangay and municipal strategic planning workshop on integrating DRM in agriculture and fisheries	13 Oct. 2011 14 Oct. 2011 19 Oct. 2011	Guinobatan Gubat Buhi	28 29 36
Orientation seminar on RA 10121 (DRR/M Act of 2010)	5 April 2011	CBSUA	13
Orientation seminar on RA 10121 (DRR/M Act of 2010) and DRR plan validation	13 April 2011 14 April 2011 19 April 2011	Gubat Buhi Guinobatan	25 26 20
Organization of barangay disaster risk reduction and management council (BDRRMC) and barangay disaster quick response team	10 June 2011 29 August 2011 30 August 2011 31 August 2011	San Buena, Buhi Ariman, Gubat Bagacay, Gubat Rizal	17 14 27 20

from CBSUA and PAGASA and national consultants who provided the technical inputs. Participants in these series of trainings were provincial and local authorities of the DA-RFU V, provincial/municipal/barangay DRR/M councils, barangay officials of the project sites and other project stakeholders.

4.3.3 Participatory climate risk management planning

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

(a) Minto, Masarawag and Mauraro in the municipality of Guinobatan;
(b) San Buena, Igbac and San Ramon in the municipality of Buhi; and
(c) Bagacay, Ariman and Rizal in the municipality of Gubat.

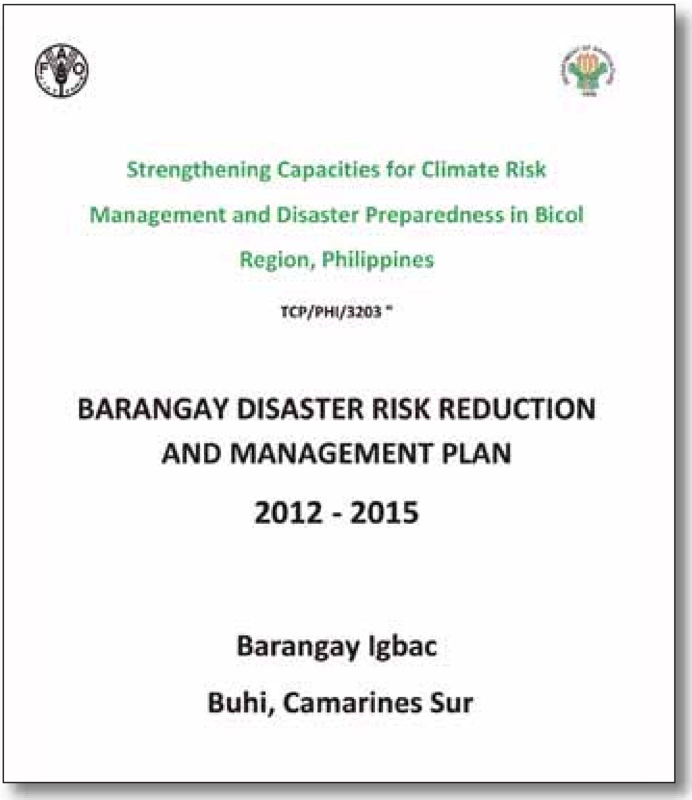
FIGURE 18

Barangay planning workshop to prepare the DRR/M plan

The preparation of the DRR/M plans in the nine barangays was participatory in nature, and various local stakeholders were involved in the planning and validation activities. Initial planning activities were undertaken during the two DRR/M trainings wherein participants were asked to: (a) identify the natural hazards that occur in their respective barangays; (b) assess their level of disaster preparedness; (c) assess the risk from the identified hazards and the number of people affected; (d) prepare a DRR plan in agriculture and fisheries; and (e) formulate a CBDRM approach and process. Three more planning sessions were conducted after the two trainings at the barangay and municipal levels: the first before the election of local officials, the second three months after the local election and the third after the passage of Republic Act 10121, or the DRR/M 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 DRR/M plan from local stakeholders.

FIGURE 19

Example of a community DRR/M action plan


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

Preparation of the DRR/M plan was facilitated by the organization of the BDRRMC in each of the nine barangays. The project team worked very closely with the BDRRMC in each barangay during the series of planning workshops and community validation.

A vulnerability assessment undertaken by CBSUA included the location and its accessibility, prevalent land and agricultural practices, the socio-economic situation and the identification of the main hazards and threats. The assessment was the basis for the development of location-specific DRR/M strategic plans and the identification of suitable GPOs for the respective barangays. Each plan defines specific actions for seven key themes:

1. **Establish a local structure on DRR/CCA for agriculture and fisheries** which includes capacity building of the members of the BDRRMC, the preparation of hazard maps, partnership with other entities on DRR and designation of structures as evacuation centres.
2. **Appropriate a specific budget for DRR/M in agriculture and fisheries** 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 institutions.
3. **Establish a local risk transfer strategy:** assess local resources and identify and adapt the most applicable and effective risk transfer strategy.
4. **Establish an effective EWS for agriculture and fisheries** which could be realized through appropriate EWS devices, effective EWS communication protocols and the improvement and utilization of some parts of the barangay hall for the BDRRMC and early warning equipments.
5. **Adopt locally tested GPOs on agriculture and fisheries** by adopting the GPOs 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 rehabilitation strategy for agriculture and fisheries** by updating the local agriculture and fisheries database, adopting an effective PDNA on agriculture and fisheries and by training constituents on data collection.
7. **Heighten awareness of farmers and fisherfolk on the impact of CCA on agriculture and fisheries** through the preparation and dissemination of information materials, regular assemblies for farmers and fisherfolk to discuss the impact of CCA on agriculture and fisheries and information bulletin boards in strategic areas showing hazard maps and vulnerability indicators with an emphasis on agriculture and fisheries.

A regional strategic planning workshop for integrating DRM in agriculture and fisheries was sponsored by the project on 19–20 October 2010 to provide the venue for the presentation and possible integration of the DRR/M plans of the nine barangays in the DRM plan of the DA-RFU V and PAOs of Albay, Camarines Norte and Sorsogon. All DRR/M plans of the nine barangays were subsequently endorsed by the Sangguniang Bayan (legislative council) of the three municipalities covered by the project for adoption and funding support.

4.4 GPOS 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 CBDRM planning and will be recommended for wider dissemination beyond the selected communities/municipalities. Farmers and fisherfolk 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 barangays.

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 fisherfolk against hazard impacts at least two to three 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 centres of the DA and academe, Internet searches 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 evaluated by the project team and experts from the DA-RFU V before being field validated.

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 percent), socio-economic acceptability (35 percent), resilience to natural hazards (20 percent) and not contributing to greenhouse gas (5 percent). Each of these criteria was further broken down to a number of subcriteria to properly guide the evaluation of the GPOs by the project team and the DA-RFU V experts. Five 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

FIGURE 20

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

production, technical and climate-related criteria and for location-specific suitability. An FGD attended by farmer-leaders and barangay officials was 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 included, among others, the suitability of the GPOs to the agrophysical setting of the community, labour and other input requirements and the market. The FGD also provided the venue for the national consultants, the DA-RFU V and LGU extension workers to clarify some issues pertaining to the GPOs. Another avenue to validate the technologies was through a 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 labour requirements, increased resilience against hazard impacts, value added to the existing system, environmental soundness, potential for wider replication,

TABLE 5

GPO selection criteria

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

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 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 fisherfolk who were identified to pilot test the selected GPOs for enhanced DRR/CCA. Prospective project cooperators were endorsed by farmer-leaders and barangay officials through 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 hectare or less; (b) farmers and sustenance fisherfolk living below the poverty threshold; (c) should be an active member of a farmers' organization; (d) farmers and sustenance fisherfolk 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 labour for land preparation, day-to-day maintenance of the techno-demo farm.

Five different GPOs were pilot tested in the lowland, three in the upland and four in the fishery/aquaculture agro-ecological zones of the nine pilot communities for three cropping cycles starting June 2010 until June 2011. A maximum of six 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 cooperators/partners.

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 plots, input requirements,

FIGURE 21

Distribution of rice seeds for the establishment of GPOs in lowland irrigated areas in Buhi, Camarines Sur

schedule of application of required inputs and care and maintenance, etc. 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 m^2 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 labour were the responsibility of the farmer-cooperator.

The GPO selection process was framed by *ex ante* and *ex post* evaluations for three cropping seasons using the same set of criteria discussed in the preceding section, namely agro-ecological suitability, socio-economic 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 (EFP).

FIGURE 22

Field visit to 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 EFP and give the corresponding cost. Crop cuts were obtained from both the GPOs and EFP in order to compare the yield performance. A statistical test was used to determine if the yield difference between the GPOs and EFP was significant. The marginal benefit–cost ratio (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 with EFP.

4.4.2 Results from the field testing of GPOs

4.4.2.1 GPOs for lowland agro-ecological zone

A total of five 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 (EMRV); (b) use of submergence rice variety; (c) use of salt-tolerant rice variety; (d) timing of planting plus rice ratooning; and (e) rice and duck farming system.

During the 2010 wet cropping season (June–October), there were 40 farmer-cooperators who participated in the pilot testing of five 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

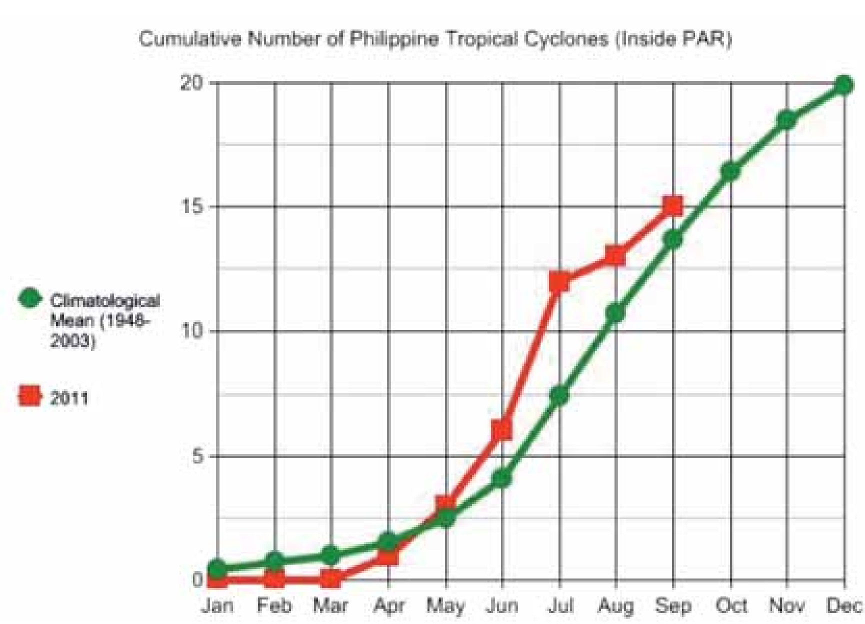
Name of GPO	No. of cooperators per cropping season			Total
	2010 wet season	2011 dry season	2011 wet season	
Use of EMRV	25	35	25	85
Use of submergence rice variety	3	25	35	63
Use of salt-tolerant rice variety	5	10	15	30
Timing of planting plus ratooning	10	10	15	35
Rice and duck farming system	-	3	50	53
Total	40	43	115	198

Use of EMRV

The use of EMRVs was introduced in the project sites to reduce the vulnerability of rice farmers to climatic events such as typhoons and drought/long dry spells 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 enter the PAR. Data from PAGASA from 1948 to 2003 revealed that an average of 20 tropical cyclones have entered the PAR. Tropical cyclones usually make their landfall in Bicol Region during the September–December period, at a time when the rice crop is about to be harvested. Heavy rainfall, flooding 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 the dry season in February–March affects the vegetative growth of the second rice

FIGURE 23

Tropical cyclones in the Philippines



Source: PAGASA

crop that ultimately results in a lower yield. Planting of an EMRV will enable farmers to harvest prior to the peak of the typhoon season and before the onset of the dry season.

The first cropping using an 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 percent 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 EMRVs. 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 EMRVs for three cropping cycles.

Use of submergence rice variety

During the rainy season, 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 Region 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 in 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, Sorsogon) agreed to plant this variety in their farm. The number of cooperators significantly increased during the second and third cropping seasons. Interestingly, six 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 problems. Rice farms along the mangrove area of Rizal and Bagacay had been reportedly 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 in early May upon receipt of the first rainfall, and transplant in late May or early June. Transplanting is delayed for a month when precipitation does not come on time.

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 with the use of NSIC Rc-108 was the duration of seedbed preparation, which takes three to four weeks before transplanting. Older seedlings (25–30 days) should be used due to their sensitivity to saline conditions during the early vegetative stage. This requires some adjustment in the timing/scheduling of crop establishment, as weather conditions are a crucial concern for farmers to be able to adapt to environment stress. The use of early maturing, salt-tolerant varieties (e.g. NSIC Rc-188 series) offers a better option for salt-affected rice areas for a quick turnaround and crop establishment.

FIGURE 24

A typical rice area in barangay Rizal which is affected by saline water intrusion

Timing of planting plus rice ratooning

Rice ratooning is a traditional practice among older rice farmers in Bicol Region. This is a technology wherein the rice field is fallowed during the turnaround period to allow the rice stalks to regrow and produce grains. This requires the planting of an EMRV 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 the 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 revegetate. Using an EMRV such as NSIC Rc-158 gives the rice stalks that remain on the ground a longer turnaround period to develop. The other rice variety which was introduced as a GPO was NSIC Rc-120.

Rice and duck farming system

Integration of duck raising in rice farming systems was formally introduced by the project in the pilot communities during the third cropping season to enhance food security and provide rice farmers with additional income. This GPO is appropriate for typhoon-prone, flood-prone and salt-affected areas. The project introduced the idea of a rice and duck farming system as a GPO during the community validation workshop in the first cropping season. The farmers were, however, undecided because of previous negative experiences with the technology. During the second cropping season, three women farmers from Ariman (Gubat), Masarawag (Guinobatan) and Igbac (Buhi) barangays took part in the exploratory pilot testing of this GPO. Participating farmers constructed a simple 10 m^2 shelter, surrounded by a used nylon fence, to shelter the ducks from rain and from other animals. Each cooperator was provided with 10 ready-to-lay ducks which were allowed to freely range on a 1 000 m^2 rice field, starting two weeks after transplanting until rice maturity. The project provided the planting material (NSIC Rc-194 in Igbac and Masarawag and NSIC Rc-158 in Ariman) while the three cooperators used their own laying ducks.

FIGURE 25

Selected rice farmers pilot tested duck raising as part of rice-based farming system

4.4.2.2 GPOs for upland agro-ecological zone

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

Strip intercropping

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 so 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 possibly 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 a long dry spell, heavy rainfall, typhoon, etc.) more than by 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 the strip intercropping GPO using a combination of long duration (LD), medium duration (MD) and short duration (SD) crops, as well as improved crop varieties. The following crops were used as intercrops: eggplant, upland rice, sweet potato, squash, tomato and pepper as LD crops; okra and peanut as MD crops; and green corn, pole sitao and snap bean as SD crops. 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 m^2 lot provided by the farmer-cooperator, using the planting materials and other farm inputs provided by the project. Since the implementation of the GPO involves several crop combinations, the crops planted were grouped based on their growth duration (i.e. LD, MD and SD). In addition to the different crop combinations, improved varieties were used.

Coconut leaf pruning

Coconut (*Cocos nucifera* L.) is a traditional plantation crop grown in 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 a short period of planting time, a smaller area (using vacant spaces between coconut trees) and less capital. 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, the majority of the coconut areas in the project sites remain monocultured. It is estimated that in coconut farms where palms are spaced at 8 m, nearly 75 percent of the land area is left unutilized and as much as 40–60 percent 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.

The project favourably endorsed the introduction of coconut leaf pruning GPOs in the pilot communities. The technology involves the removal or pruning of coconut leaves from leaf Rank 19, (i.e. supporting the tender

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

"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, the 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 evapotranspiration of intercrops.

Improved varieties of six crops – 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, the only difference being that improved varieties were used instead of the local varieties. Fertilizer was also applied based on the results 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 feed for livestock, abound in most of the pilot communities. It is for this reason that barangay stakeholders suggested goat raising during the planning workshop in the third cropping season. Goat raising will not only promote crop–livestock integration but would be an additional source of income for the upland farmers through the sale of milk and offspring. It will, therefore, further enhance the livelihood resilience of upland/rainfed farmers and cushion the possible impact of climate hazards.

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

FIGURE 27

Goat raising as an example for a gender-sensitive GPO

4.4.2.3 GPOs for fisheries/aquaculture

For the fisheries/aquaculture sector/zone, four GPOs were implemented: 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 were intended for coastal fishers who do not have a farm to cultivate.

A total of 70 farmer-cooperators participated in the implementation of the GPOs, as shown in Table 8. The majority, or 64 of the farmer-cooperators, were from Gubat (Sorsogon) and the remaining six 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 for household food security.

TABLE 8
List of GPOs implemented in the fishery/aquaculture zone

Name of GPO	Location	No. of cooperators per cropping season		Total
		First cropping	Second 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

Backyard tilapia farming

Tilapia farming was considered as a GPO because of its resilience against adverse weather conditions. 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 to avoid damage due to typhoons 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 in two different freshwater environments: in the coastal areas of Gubat (Sorsogon) and along the irrigated, lowland rice areas of Guinobatan (Albay). These two areas are geographically contrasting, with Guinobatan being a landlocked municipality at the foot of

FIGURE 28

A tilapia fishpond established just beside the rice farm

the Mayon Volcano, making it vulnerable to volcanic eruption, ash fall and flood; while Gubat faces the Pacific Ocean which makes it susceptible 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 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 m^2, built by digging or simply enclosing a depression to contain water and which were equipped with inlet and outlet pipes made of locally available materials. The pond was stocked with tilapia fingerlings at a density of 2 per m^2, and fed with natural fish food organisms through fertilization management and supplemented by rice bran (D1) given at 3–5 percent of the fish biomass. The stock were harvested upon reaching 80 to 100 g either through selective harvesting using a gill net of desired mesh size or total harvesting by totally draining the pond to harvest all the fish using a 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. The catch of fisherfolk in the project sites of Gubat has dwindled over the years. This is further exacerbated during adverse weather conditions like typhoons, heavy monsoon rains, 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 conditions. Seaweed farming is also an environmentally friendly resource product because it contributes to marine habitat rehabilitation and protection. Furthermore, it requires small start-up capital which is affordable to the farmers and produces higher yield in 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

FIGURE 29

Project partners of the seaweed farming project inspecting the field after a heavy rainfall

September to December 2011 with five cooperators who preferred an individual farm module. The first trial tested two methods, namely the raft method and the hanging long line method. The raft method consisted of nine raft modules measuring 6 m x 8 m per unit with a total of 405 cultivation lines, spaced at 30 cm between cultivation lines. The hanging long line had 12 hanging cultivation lines, measuring 100 m long per line and spaced at 7 m between cultivation lines. The modules were installed approximately 0.5 km from the shoreline, 3 m deep during high tide and 2.5 m deep during low tide.

A total of 500 kg of seaweed was planted. Seaweed cuttings were prepared on shore at 250 kg of seedlings per module type (raft and hanging long line) at a distance of 20 cm. A total of eight days of family labour (composed of six family members) were used in the preparation for planting of the two methods. A wooden boat was used to transport the prepared modules to the target site. Floats were installed on cultivation lines of hanging long line method spaced at 7 m. Cultivation lines were installed 2 ft below the sea water surface. Day-to-day management included removal of debris, replacing of lost/dead plants and 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 an alternative source of livelihood. One comparative advantage of farming freshwater prawns is their omnivorous benthic feeding nature which allows them to survive on locally available feedstuffs from agricultural by-products. Freshwater prawns 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 fisherfolk. The project was implemented by ten farmer-cooperators in barangay Ariman. Small concrete-lined and earthen ponds, supplied with a free-flowing and underground water source, were used. The ponds were stocked with postlarvae (30 days), procured from the Southeast Asian Fisheries Development Center 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

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 a regular receptacle mainly to catch squid in coastal waters. The shape of the gear is semicylindrical 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 makes exiting difficult. The device is baited with squid roe mounted on young coconut leaves and is placed inside the pot. It is hung on a bamboo buoy and anchored at depths of 8–15 fathoms, in such a way that it lies at half the depth of the water. The hauling of squid pot was done once a day by simply pulling the hanging line until the squid pot emerged. It was then hauled onboard with the aid of a hook attached to a bamboo pole or a hook tied with rope. The operation was done with the help of a diver. The catch was 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 fisherfolk.

FIGURE 30

Cooperators just pulled up the fishing gear to fix the nets

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' perceptions, 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 EFP and knowledge as well as agrophysical conditions.

As shown in Table 9, GPOs that were pilot tested in the lowland irrigated rice areas demonstrated a high degree of agro-ecological suitability based on farmers' feedback/perceptions and the results of the field testing. Both farmer-cooperators and non-cooperators shared a favourable perception about the use of rice varieties which could adapt to climate-related hazards (e.g. early maturing variety, submergence variety and salt-tolerant variety), timing of planting plus ratooning and integration of ducks in rice farming systems. This is evidenced by the number of farmer-cooperators and non-

TABLE 9

Degree of agro-ecological suitability of the GPOs

Location	Degree of agro-ecological suitability		
	Low	Medium	Medium
Use of EMRV			x
Use of submergence rice variety			x
Use of salt-tolerant rice variety			x
Timing of planting plus rice ratooning			x
Rice and duck farming system			x
Strip intercropping			x
Coconut leaf pruning plus intercropping			x
Goat production			x
Backyard tilapia farming		x	
Seaweed farming		x	
Freshwater prawn farming	x		
Squid pot		x	

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-cooperators who had adopted these methods.

The agro-ecological suitability of the lowland GPOs was also demonstrated in terms of their adaptability to the soil and weather conditions 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 a 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 results 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 a 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, for the rice farmers in Guinobatan, who established backyard tilapia farming adjacent to their rice field. This is because they were spared from 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 typhoons and heavy rainfall. Aside from typhoons, 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 seaweed. It produces a moist organic substance that attracts bacteria in the water and induces a whitening characteristic and the hardening of the seaweed 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 conditions. 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 time of the year, which influences water current patterns and wave action particularly in the months from 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 EFP. Results of the evaluation of the economic feasibility of each GPO is presented below.

Use of EMRVs

The field trial revealed that EMRVs (e.g. NSIC Rc-120 and IR-60) had a better yield performance compared with 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 after 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 (tonnes/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 an additional yield of 375 kg/ha. The increase in yield is equivalent to 4.5 cavans of milled rice as food for the households during the lean season and adverse weather conditions. The farmers may also sell this additional yield as fresh *palay*, which could provide the households with an additional income of PHP 4 500.

Use of submergence rice variety

The use of NSIC Rc-194, a submergence rice variety, had enabled farmer-cooperators to produce a better yield than the EFV under above normal rainfall conditions during the second and third cropping seasons in barangays Rizal (in Gubat), Binti and Masarawag (in Guinobatan) and Igbac (in Buhi). Results tend to indicate that the 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 vs EFV in tonnes/ha

Location	Second cropping season		Third 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 EFV in terms of yield in the project sites during the second and third cropping season. A statistical test indicates that the yield difference between the submergence rice variety (GPO) and EFV is significant, at 5 percent, with a t-value of 2.88. Records also showed that farmer-cooperators would spend around PHP 18 000/ha for this GPO. An additional 1 700 kg/ha can be realized per cropping season using the submergence rice variety. This means that a farmer could earn PHP 20 400/ha each cropping season, which is 38 percent 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 tonnes/ha, 2.93 tonnes/ha and 4.15 tonnes/ha in the three sites for the first, second and third cropping seasons, respectively, was higher than the EFV (see Table 12).

The yield difference between the GPO and the EFV was also found to be statistically significant.

TABLE 12

Comparative performance of salt-tolerant rice variety vs EFV in Gubat, Sorsogon

Location	First cropping season		Second cropping season		Third 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 Niño during the first cropping cycle, the GPO still produced a higher yield compared with Binatang (the EFV). The use of NSIC Rc-108 was more productive and cost-efficient than the EFV. On average, farmer-cooperators spent PHP 15 027 to establish a hectare of the GPO and get an additional yield of 1.14 tonnes/ha, which is roughly equivalent to PHP 13 738. Planting rice varieties which are not suited to saline-affected rice areas only increases the cost of production, which could range from PHP 18 000 to PHP 20 000/ha, and affects the food security of farming households due to low yield.

Timing of planting plus 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 (tonnes/ha) vs EFP for three cropping seasons

Location	First cropping season		Second cropping season		Third cropping season		Average yield	
	GPO	EFV	GPO	EFV	GPO	EFV	GPO	EFV
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 the three cropping seasons revealed that the EMRV produced a higher yield than the existing local variety being used by the farmers in the project sites. Moreover, the rice ratoon gave the farmer-cooperators additional rice yields of 550 kg/ha within 45 days (see Table 13). Yield difference was significant at 5 percent.

Rice and 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 molluscicides and insecticides spray application. Finally, protein-rich food (egg) has become one of the family's daily food items. Excess eggs were sold to stores in the locality and provided the households with an additional source of cash.

The project did an exploratory trial of the rice and duck farming system during the second 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 a higher yield, but the ducks raised also produced eggs which were either consumed or sold (see Table 14). During the second cropping season, the farmer-cooperators

TABLE 14

Comparative performance of rice and duck farming system vs EFP in three project sites during the second and third cropping seasons

Location	Second cropping season			Third cropping season		
	GPO		EFP (tonnes/ha)	GPO		EFP (tonnes/ha)
	Rice (tonnes/ha)	Egg (No.)		Rice (tonnes/ha)	Egg (No.)	EFV
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

from Buhi and Guinobatan reportedly produced 720 eggs each, while those from Gubat had 480 eggs. The number of eggs produced during the third cropping season was relatively lower because ducks that were distributed did not immediately produce eggs. Results of this pilot testing indicate that rice and 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 increase in rice yield can provide for the food requirements of the household during adverse weather conditions. 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 with crop combination of same growth durations (Table 11). Across sites and across locations, combination of LD and SD crops had a higher MBCR value (3.16) than LD + MD (3.04), MD + SD (2.85) and SD + SD (2.04). The 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 GPO. Despite the abnormal climatic conditions (above normal rainfall) that occurred during the three copping seasons, the GPOs have produced an 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 the three seasons in the three pilot municipalities revealed that planting improved crop varieties under coconut leaf pruning technology resulted in 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 a 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 seasons, followed by Golden Yellow cassava variety with a mean MBCR value of 2.39. The two sweet potato varieties (SP 30 and SP 23) gave MBCR values of 2.19 and 2.07, respectively (see Tables 15 and 16).

Glutinous Composite #2, or Lagkitan, is a white, glutinous and open-pollinated corn variety, grown primarily for table use, native delicacies and kornik. It has small to medium to large soft kernels with excellent eating quality. It has an average marketable ear yield of 40 tonnes/ha that can be harvested in 72 days. Data showed that this corn variety can be grown in any soil type during the 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 offspring. A mature doe is capable of producing two kids in three to five months and goat milk for at least two months. The animals, however, were yet to deliver their kids at the time of project termination.

TABLE 15

MBCR of using improved crop varieties planted under coconut leaf pruning technology from three cropping seasons in three municipalities

GPOs	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

MBCR of different strip intercropping combinations based on crop growth duration from three cropping seasons in three municipalities cropping seasons in three municipalities

GPOs	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**

(continuation…)

GPOs	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 a GPO was characterized by varying degrees of success and failure. In Gubat, continuous heavy rain last 28–29 December 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 in the escape of 20 to 60 percent of the stock and the 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 kg from the remaining stock, valued at PHP 1 200 to PHP 3 000 at a selling price of PHP 60 00/kg.

In Guinobatan, out of the ten farmers who attended the technical training, only six actually implemented the project. Two of the six 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 continued because they believed backyard tilapia farming will improve their food security as well as provide 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 17 to 22) fingerlings. The farmer-cooperators also stocked their fishpond with common carps (*Cyprinus carpio*) procured from a neighbour 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 do not feed in the same feeding niche. The fish stocks attained approximately 80–100 g in three months of 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 PHP 981 from the 330 tilapia fingerlings which yielded 21 kg (mean size of 100 g) at harvest time from a 100 m^2 pond area, valued at PHP 1 260. Another farmer-cooperator harvested 55 kg of tilapia from his 400 m^2 pond area, valued at PHP 3 300 that gave him a net income of PHP 1 888 from an aggregate investment of PHP 1 412 for farm inputs. There was also a farmer-cooperator who earned a net income of PHP 5 826 from his 600 m^2 fishpond with 1 980 tilapia fingerling stocks (that yielded 125 kg) and capital investment of

PHP 1 674. 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 kg from his 2 500 m^2 fishpond which he stocked with 5 000 fingerlings.

Seaweed farming

There were two 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 flooding resulting from heavy rain on 28–29 December 2010. An estimated 2 000 kg of seaweed were lost, leaving at least three cultivation lines (hanging long line module) with 200 kg of seaweed slightly damaged. The cooperators tried their best to recover from the loss by working on the remaining three cultivation lines that survived until the seaweed reached about 650 kg in three months (January to March 2011). But due to the tsunami warning for coastal areas along the Pacific Ocean on 11 March 2011, the cooperators decided to harvest and set aside 150 kg as planting materials for the next farming season or second trial.

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

TABLE 17

Status of second trial of seaweed farming in Bagacay, Gubat, Sorsogon

Name of cooperator	Harvest data			Capital investment (PHP)	Remarks
	Dried (PHP)	Fresh (PHP)	Total (PHP)		
Joseph Emano	1 520	1 365	2 885	12 171.50	Harvested 40 kg dried & 91 kg fresh
Domingo Espena	1 140	300	1 440	12 171.50	Damaged by typhoon and "ice-ice" but harvested 30 kg dried and 20 kg fresh
Isidro Estabaya	760	150	910	12 171.50	Damaged by typhoon and "ice-ice" but harvested 20 kg dried and 10 kg fresh
Teddy Emano	760	150	910	12 171.50	Damaged by typhoon and "ice-ice" but harvested 20 kg dried and 10 kg fresh
Benny Nivero	3 800	1 125	4 925	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

Freshwater prawn farming

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

It is assumed that high rainfall has 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 physico-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 2012). Prawns raised during the dry season, for instance in Thailand, had the highest survival rate (34.27 percent) and growth rate (0.19 g per day) compared with those raised in the rainy season with 24.25 percent and 0.15 g per day survival growth rate.

Squid pot

Out of 27 squid pot cooperators, only six continued the project while the rest had hauled up their gear because of the rough sea brought by the northeast monsoon starting September 2011. Interviews revealed that fishers could only catch 3 to 5 kg of fish in an 8 to 15 hour fishing operation. There were, however, days when they did not have any catch, especially during adverse weather conditions. It was observed that the catch was greater during days after the first quarter phase before the 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 PHP 300 per day.

4.4.3.3 Increased resilience against impact of climate hazards

The GPOs implemented in the nine 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 a basis for the identification and design of the GPOs for DRR/M. It should be noted that all three cropping seasons experienced high rainfall, leading to wet conditions during the growing period of the crops. During the 2010 wet season cropping (October 2010 to February 2011), the eastern seaboard experienced too much rainfall – starting in December – resulting in the flooding of low-lying areas, landslides and the 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 to strike in the months of December and January (see Table 7). As recorded by PAGASA, there were increases of 32.3 percent, 144.6 percent and 38.3 percent 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 percent, 137.7 percent and 97.3 percent 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 percent, 169.0 percent and 59.7 percent during the 2010 wet season, 2011 dry season and 2011 wet season, respectively (see Table 19).

The heavy rainfall during the 2010 wet season cropping destroyed the majority of GPOs. The impact of adverse weather conditions 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 the DA-RFU V) in March 2011 to determine the appropriate mix of crops.

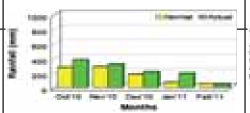
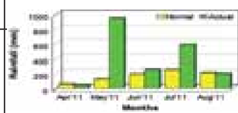
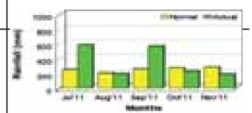
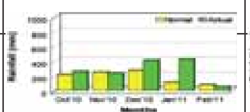
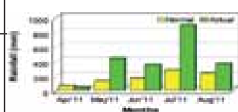
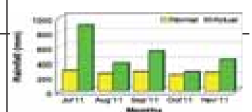
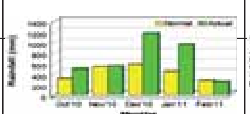
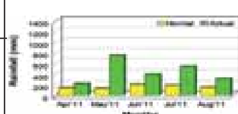
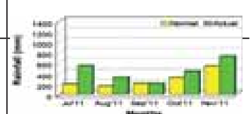
In the lowland irrigated rice areas, the GPOs were found to be adaptable to the climatic condition of these communities. Yield performance of the GPOs was not significantly affected by near drought conditions during the first cropping season and extreme rainfall during the second and third cropping seasons. EMRVs 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 EMRVs confirms that a shortened growth duration reduces the exposure to climate hazards, particularly in Bicol Region where typhoons hit the area during the months of September to November (the time when the rice grains are about to be harvested). During dry season cropping, EMRVs give rice farmers a longer turnaround 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 a buffer during adverse weather conditions.

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 Bicol Region from December 2010 until March 2011.

Salt-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 the salt-tolerant rice variety NSIC Rc-108 was able to address the effects of saline intrusion. Additionally, NSIC Rc-108 yielded better than the EFV (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.

TABLE 18

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

	Wet season 2010	Dry season 2011	Wet season 2011
A. Buhi, Camarines Sur			
Total normal rainfall (mm)	859.1	826.8	1 276.3
Total normal rainfall (mm)	1 136.5	2 022.8	1 765.4
Total normal rainfall (mm)	32.3	144.6	38.3
B. Guinobatan, Albay			
Total normal rainfall (mm)	938.9	878.7	1 253.6
Total normal rainfall (mm)	1 393.0	2 088.8	2 472.9
Total normal rainfall (mm)	48.4	137.7	97.3
Gubat, Sorsogon			
Total normal rainfall (mm)	2 134.5	823.6	1 387.0
Total normal rainfall (mm)	3 414.6	2 213.8	2 214.9
Total normal rainfall (mm)	60.0	169.0	59.7

Results of the pilot testing of the upland/rainfed areas revealed that crops used either for strip cropping or intercropping under coconut showed some degree of adaptability under extreme weather conditions, 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 of heavy 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 the dry months. Coconut leaf pruning is expected to enhance the growth of intercrops underneath. For strip intercropping, two 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. LD, MD and SD) because it is an indicator for utilization of soil nutrients, soil moisture and the capacity to withstand stress. Goat raising was introduced by the project as value added to the existing farming system and provided alternative sources of nutrition and income, thereby enhancing 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 an alternative income source to fisherfolk 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, such as the occurrence of strong waves and flash floods due to heavy rain on 28–29 December 2010 and Typhoon Bebeng (international code: Aere) which affected Bicol Region on 7 May 2011. It must be noted that the training of the farmer-cooperators is 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 results.

Although the project duration did not allow to scientifically validate the effectiveness of the GPOs in the face of climate hazards, the 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 CCA potential. In order to prove this potential in the long term, a longer evaluation period of the GPOs and further testing are required to obtain more reliable and conclusive data. The total or partial failure of some GPOs – such as 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 would not increase greenhouse gas emissions by being implemented on a small scale with a small amount of fertilizer and chemicals used, only applied if and when they were needed depending on the soil requirements. Therefore, this criterion was given the lowest weight in the evaluation, and no parameters like methane emission level were collected or observed.

CHAPTER 5

CONCLUSIONS AND LESSONS LEARNED

The project was implemented for more than two 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 season were integrated into the planning activities for the upcoming season, which allowed for effective improvement throughout the project duration. The lessons learned from this process and the results of the project could offer practical advice on how to mainstream CCA/DRR in agriculture.

Project coordination and local institutions:

(a) CCA and DRR 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 costs of CCA 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) CCA and DRR are continuous 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 CCA in order to prepare them for any unexpected/unforeseen events.

(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 in order 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:

(a) 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 the farm weather bulletin prepared by the DA-RFU V enabled farmers to take strategic decisions on proper crop choice, cropping schedule, cultural management practices and the use of mitigating measures. The impact of such information bulletins was demonstrated by the improvement of the performance of GPOs, when damages that occurred in the first cropping season due to above normal rainfall were averted during the second and third cropping seasons because of the farm weather bulletin provided by the DA-RFU V to the LGUs and farmers.

(b) Online tools, such as the improved PDNA methodology, enable the DA to estimate more reliable and faster post-disaster damages and losses, and to predict the potential production losses of rice and corn due to flood, strong winds and drought. For its further institutionalization and scaling up, 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 besides rice, and scale up the system to the regional level. It is further recommended to integrate GIS maps into the system to visualize the hazards and vulnerabilities of agricultural areas. Once the system is fine-tuned and finalized, the DA should host the PDNA online system for agriculture-related commodities. In the long term, the system should be harmonized and integrated with the disaster system, and be led by the 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 partial 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 combined with climate information for their continuous adjustment to unexpected climate variability.

(b) CCA 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 may not be suitable for another in a different microenvironmental setting. This was manifested especially in the GPOs that were pilot tested in the fishery/aquaculture sector. There will be no "one size fits all" solutions at the local level.

(c) An important lesson which the project learned from three 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 the technical and field evaluation and were found to have had a good impact on the environment and climate resilience (e.g. small water impounding project, riverbank stabilization using bamboo, etc.) were not implemented because no farmers were interested adopting them. CCA/DRR should, therefore, focus particularly 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 for the measurement of more complex outcomes on DRR in agriculture.

CHAPTER 6

POLICY RECOMMENDATIONS

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

(a) For the coordinated implementation of prevention, mitigation and preparedness measures in agriculture at the regional level, the DA should facilitate the development of a regional POA for DRR in agriculture. The POA should outline the objectives, 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 also be 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 the capacity development of local officials on DRR/M in agriculture should be vigorously pursued to ensure the bottom up implementation of the POA for DRR in agriculture and fisheries.

(c) CBDRM plans with a focus on agriculture should be horizontally scaled up and streamlined to promote the mainstreaming of locally identified planning priorities into sectoral planning for DRR/M at the municipality and provincial levels. Technical staff in the DA, LGUs and DRR/M councils 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 the local level. The DA should further build strategic partnerships 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 of the project output/benefits and lessons learned over a wider geographic scope.

(e) Information and EWS 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 and 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 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.

REFERENCES

Amano, L. O.; V. L. Amano; and A. P. Candelaria. 2012. Disaster Reduction/ Climate Change Adaptation Good Practice Options for Rainfed and Upland Agro-ecological Zones. Report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Bicol University, Legazpi City, Philippines.

Binoya, C. S. and P. P Muñez, Jr. 2011. Situation Assessment Report. Report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Central Bicol State University for Agriculture, San Jose, Pili, Camarines Sur, Philippines.

Dalida, L. U. 2011. PAGASA's Assessment of Existing Early Warning Systems (EWS) in Selected Provinces of Bicol Region. Report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, PAGASA Regional Center, Legazpi City, Philippines.

De la Torre, E. T. 2012. Lowland Irrigated Good Practice Options for Disaster Risk Reduction/Climate Change Adaptation. Consultant's report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Department of Agriculture Regional Field Unit No. V, San Agustin, Pili, Camarines Sur, Philippines.

FAO. 2011. Resilient Livelihoods: Disaster Risk Reduction for Food and Nutrition Security. Rome, Italy.

FAO. 2009. Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region), TCP/ PHI/3203 Project document. Department of Agriculture, Diliman, Quezon City, Philippines.

Foronda, V. 2011. User's Manual for PDNA Version 1.10 On-Line Post-Disaster Needs Assessment System for Rice and Corn. Consultant's report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Department of Agriculture Regional Field Unit No. V, San Agustin, Pili, Camarines Sur, Philippines.

Nieves, P. M. 2012. Performance and Lessons Learned from Pilot Testing of Adaptive Fisheries and Aquaculture Livelihood Options in Selected Provinces in Bicol. Consultant's report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Bicol University Tabaco Campus, Tabaco City, Philippines.

Torrente, E. C. 2011. Guidance Notes and Manual on Improving the Methodology for Conducting Damage, Loss, and Needs Assessment in the Agriculture Sector. Consultant's report on *Strengthening Capacities for Climate Risk Management and Disaster Preparedness in Selected Provinces of the Philippines (Bicol Region) (TCP/PHI/3203)*, Food and Agriculture Organization, Makati, Philippines.

United Nations International Strategy for Disaster Reduction. 2007. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (Extract from the final report of the World Conference on Disaster Reduction).

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The Philippines is one of the most disaster-prone countries worldwide. Bicol Region is regularly exposed to a variety of natural hazards including tropical storms, typhoons, droughts, drought spells, flash floods, floods, landslides and volcano eruptions, causing frequent destruction, damage and losses. Agriculture is among the most vulnerable sectors to extreme weather events and changing climate. People depending on agriculture are regularly facing the challenge to protect and maintain their livelihoods. This Disaster Risk Reduction project in Bicol Region aimed at (i) strengthening the institutional and technical capacities, risks related services' provision and coordination in agriculture to better prepare for and manage climate-related risks, and (ii) enhancing the risk reduction capacities and livelihood resilience of farmers and fisher folks, who are highly vulnerable to risks and extreme climatic events. The project was designed in accordance with FAO's Disaster Risk Reduction for Food and Nutrition Security Framework Programme which builds on and supports the implementation of the Hyogo Framework for Action 2005–2015 from the perspective of agriculture and food and nutrition security. This technical summary report presents results and lessons from the project.

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