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

GOOD PRACTICES FOR DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION FOR RAINFED AND UPLAND AGRO-ECOLOGICAL ZONES, PHILIPPINES

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Final report

BICOL UNIVERSITY

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LIST OF ACRONYMS/ABBREVIATIONS

ATI	Agricultural Training Institute
BFAR	Bureau of Fisheries and Aquatic Resources
BU	Bicol University
CBSUA	Central Bicol State University of Agriculture
CCA	Climate Change Adaptation
DA	Department of Agriculture
DA RFU 5	Department of Agriculture Regional Field Unit 5
DA RAPID	Department of Agriculture Regional Agriculture and Fisheries Information Division
DRR	Disaster Risk Reduction
ENSO	El Niño Southern Oscillation
FAO UN	Food and Agricultural Organization of the United Nations
FGD	Focus Group Discussion
GHG	Greenhouse Gas
GP	Good Practice
GRDP	Gross Regional Domestic Product
ITCZ	Inter Tropical Convergence Zone
LACC	Livelihood Adaptation for Climate Change
LGU	Local Government Unit
MAO	Municipal Agriculture Officer
MGB	Mines and Geo-science Bureau
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAS	Provincial Agricultural Services
OMA	Office of the Municipal Agriculturist
OPAg	Office of the Provincial Agriculturist
SPCMAD	Special Projects Coordination and Management Assistance Division
TWG	Technical Working Group

EXECUTIVE SUMMARY

The vulnerability of Bicol Region to meteorological hazards such as typhoons, floods, drought, high magnitude rainfall and related hazards such landslides is underscored. The recurrent impacts of these events have wreaked havoc on environment, economy and society throughout the region.

The agriculture sector, particularly the rain fed and upland agro-ecological zones which is largely dependent on climatic conditions, is one of the most affected, putting food security at risk. The many resource-poor farmers in the Bicol Region are made even more vulnerable this time to the dangerous impacts of climate change to their livelihood. This necessitates putting in place adaptation strategies to reduce their vulnerability and enhance their adaptive capacities.

The project aimed to develop and implement climate risk management measures (good practice options) that will contribute to improve the livelihoods and food security of resource-poor farmers in the rain fed and upland agro-ecological zones. In the implementation of location specific good practice options (GPOs), the following activities were conducted: a) site visitation and focus group discussion to collect primary data on the profile of the barangay, past experiences on the damages caused by natural hazards, and local perception on the risk from natural hazards, b) secondary data on potential good practice technologies for enhanced DRR taking into consideration the relevance of lessons learned and researches in agriculture related to disaster prevention and preparedness were taken from published literatures and internet., and c) the selected good practices for the specific pilot area were assessed using Livelihood Adaptation to Climate Change (LACC) framework designed to increase climate resilience of farming and livelihood systems while contributing to socially, economically and ecologically sustainable rural development.

The implementation process was undertaken in collaboration with the Local Government Units and involved the provision of technical training as well as material inputs to cooperating farmers while at the same time ensuring that the project outputs are sustainable. The GP options recommended by the TWG were presented and discussed with barangay stakeholders for them to decide which GP options they will adopt. In the seven pilot sites, only two main GP options, namely coconut leaf pruning and strip intercropping were selected. The use of other GP options like use of improved varieties, composting, mulching, and combining crops of different growth durations were incorporated by some farmers in the implementation of the two main GP options.

A total of 228 farmer-cooperators and nine agricultural extension workers were trained in the implementation of the GPOs. *Ex post* analysis of the GP options implemented was done using the same criteria. The benefits derived of using the GP options over the farmer's practice over the three cropping seasons was analyzed using the marginal benefit cost ratio (MBCR). A number of important lessons were learned from the good practice implementation process.

In the consultation meetings and focus group discussions on the impact of climate change, local communities and farmers revealed that climate change have wider impacts over the agriculture and other livelihood activities of people residing in the rain fed and upland areas.

Farmers observed that typhoons are becoming stronger and brings more rains. Heavy rain results to soil erosion and decrease in soil fertility. Early onset of rainy season results to early cultivation of upland and there is relatively high agricultural production during such time resulting to higher income from farming. Farmers experience low farm production when rain comes late and farm produce becomes insufficient to meet family needs.

Farmers observed that flooding and excessive soil erosion occur during La Niña and soils in the upland lose its fertility and crops are damaged as consequence. Farmers mentioned that growth of the plants was inhibited during El Niño episodes due to unavailability of moisture which results to low or non-productivity of the crops and loss of farmer income.

Results of soil analysis revealed that only one pilot barangay appears to have adequate levels of the NPK. Other pilot areas were either deficient one, two, or three of these important nutrients.

All the three cropping seasons experienced high rainfall leading to wet conditions during crop growing periods. In comparison to the long-term average, the amount of rainfall during growing seasons were not only high but also erratic. In Gubat, Sorsogon, a 32.3, 144.6, and 38.3% increase over the total normal rainfall were observed during 2010 wet season, 2011 dry season, and 2011 wet season, respectively. Similarly, an increase of 48.4, 137.7, and 97.3% over the total normal rainfall were observed during 2010 wet season, 2011 dry season, and 2011 wet season, respectively in Guinobatan, Albay. Total rainfall observed in Buhi, Camarines Sur exceeded the total normal rainfall by 60.0, 169.0, and 59.7% during the 2010 wet season, 2011 dry season, and 2011 wet season, respectively.

A total of 76 women were implementors of the GP options for the three cropping periods and this represents one-third of the total farmer cooperators. Increasing trend in women participation in the implementation of GP options was observed from 2010 Wet Season to 2011 Wet Season. Greater participation of women was also observed in strip intercropping than in coconut leaf pruning.

In coconut leaf pruning, *Los Baños Lagkitan,* an early maturing composite corn variety which can be harvested within 70 to 75 days after planting had the highest mean MBCR of 2.90 across season followed *by Golden yellow* cassava variety with mean MBCR value of 2.39. The two sweet potato varieties, namely SP 30 and SP 23 gave MBCR values of 2.19 and 2.07, respectively.

In strip intercropping, crops planted were grouped based on their growth duration namely long duration (LD), medium duration (MD), and short duration (SD). Across sites and across locations, strip cropping combination of LD+SD crops gave had higher MBCR value of 3.16 than LD+MD (3.04), MD+SD (2.85), and SD+SD (2.04). Lowest MBCR value of 1.37 was obtained from LD+LD combination.

In conduct of the project, the following were the lessons learned:

1. It is widely accepted that climate variability has direct and indirect impacts on agriculture and resource-poor farmers are very vulnerable to current and future climate risks.

2. The appropriateness of technologies to small and resource-poor farmers can be improved by employing participatory approach, which involves the farmers to engage experiments in their own fields so that they can learn, adopt new technologies and spread them to other farmers.

3. The choice of the cooperating farmer is very important in implementing the good practice options. Cooperating farmers must be one regarded by other farmers as approachable, easy to work with and actively involved in the farming community.

4. There is a wide array of good practice options available. In this project (short-duration) where immediate results are required, only two GP options were implemented and these were *“built on what is already existing*”. For long-tern evaluation, GP options that require the need to change established practices can be implemented.

5. For successful implementation of the good practice options, there should be proper coordination among government agencies like Department of Agriculture as the lead agency for food security, PAGASA for the climate and climate-related information, local government units for the dissemination of the technologies to the farmers, and research institutions and state universities and colleges for technology generation.

6. With critical production decisions founded on climate-related concerns, the provision of proper information and advisories by PAGASA has the potential of improving over-all farm productivity.

7. Close monitoring of the farming activities and exercising peer pressure have also helped in achieving the targeted outputs in terms of production.

8. Timely procurement of project inputs results in successful implementation of the project.

The following conclusions are put forward in the implementation of climate change adaptation options in the upland and rain fed areas:

1. The project demonstrated that good practice options have a potentially significant role in maintaining or increasing farmer’s income under variable and changing climatic conditions. However, relatively unique adaptation options are required to deal with relatively unique sets of physical and socio-economic conditions.

2. Climate and climate-related information were undoubtedly among the major factors to be considered by farmers in their crop production activities. With critical production decisions founded on climate-related concerns, the provision of proper information and advisories by relevant institutions like the Department of Agriculture and PAGASA has the potential of improving over-all farm productivity.

3. Farmer's involvement in participatory research is a very useful tool in developing adaptation options that will be adopted by a local community because these methods recognize that knowledge often lies with the farmers in the field, and that local considerations should be integrated into long-term planning

4. In the implementation of good practice options, technologies that are already known, inexpensive and accessible, require few resources, are easy to maintain and have a minimum negative impact on the environment should be utilized to initiate the process of adaptation. More demanding practices should be addressed and phased in once farmers have experienced the value added of investing into adaptation practices.

5. The results of the soil sampling undertaken as part of the GP option implementation highlighted the need for more systematic soil analyses, advice and support to farmers in order to reduce fertilization imbalances and ensure optimum crop growth conditions. This is a basic precondition for successful adaptation. The result of the soil analysis further showed that it is not an issue of lack of capital as identified by the farmers but an issue of more effective allocation of limited capital (fertilizer) resources. It is recommended for DA RFU 5 will address this issue up more systematically.

6. The issuance of three-month seasonal forecast for 2010 and 2011 by PAGASA, the formulation of the Farm Weather Bulletin by the Department of Agriculture RFU V, and the action of the Agricultural Technicians of the LGUs in communicating the information to the farmers are key elements that determines the success of the implementation of GP options. In the context of improving food security under changing climatic conditions, strong collaboration of these three agencies is recommended.

7. Sweet potato and cassava can be grown as an intercrop in coconut plantation and sweet potato varieties (SP 23 and SP 30) and the Golden yellow variety of cassava are highly suitable and can be recommended for cultivation.

8. Growing of crops of different growth durations on the same plot or on different plots reduce the risk of complete crop failure since different crops are affected differently by climate events.

1.0 OVERVIEW OF THE PROJECT

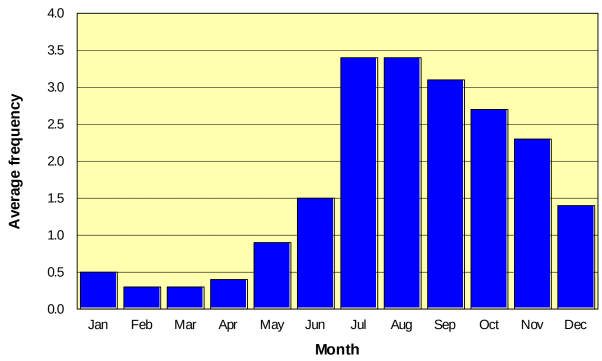
1.1 Introduction

Bicol Region, as Region V is more popularly known, is located on the southeastern extremity of Luzon, within 122 and 125 East longitude and 12 and 14 North latitude. The peninsular mainland looks like a huge flying bird and has a total landmass of about 17,632 km^2. Catanduanes and Masbate are the two insular provinces on the east and south while the four peninsular provinces are Camarines Norte, Camarines Sur, Albay and Sorsogon. The Pacific Ocean bounds the region on the east while Ragay Gulf separates it from the eastern Cordillera and Bondoc Peninsula.

Bicol Region exhibits one of the lowest levels of productivity mainly because of its frequent exposure to typhoons and floods and also because it is often affected by such weather phenomena as the El Niño and La Niña (Lobrigo et.al.). Bicol's geographic location predisposes it to strong typhoons which usually occur during the months of July to November. The six provinces differ with respect to their exposure to typhoons (Box 1).

Box 1

Monthly average frequency of occurrence of tropical cyclones in Bicol Region, Philippines



The Bicol Region lies within the so-called typhoon belt and seriously affected, on the average, by 20 typhoons per year. The typhoon months mostly affecting the region are July to November.

In 2006 in a span of ten weeks from 25 September to 1 December, the country was hit by three extremely destructive typhoons. Typhoon *Reming,* which hit on 30 November 2006 was the most destructive, severely affecting all the six provinces of the Bicol Region. Typhoon *Reming* brought 466 mm of rainfall, the highest in 40 years. It damaged 18,786 hectares planted to rice at varying stages of growth and the damage to investment losses in terms of input costs such as seeds, fertilizers and labor was valued at PhP 153.8 million.

Even when there is no major weather disturbance, Bicol Region tends to have a lot of rain not only due to typhoons but also due to Northeast monsoon (*Amihan*) from October to March and Southwest monsoon (*Habagat*) from July to September (Figure 1). Recent studies conducted by the Philippine Atmospheric and Geophysical Sciences Administration (PAGASA) showed that majority of the average rainfall in the country is due to the occurrence of tropical cyclones in the vicinity. The southwest and northeast monsoons each contribute seven (7) per cent while the remaining 39% is attributed to the combined effects of the Inter Tropical Convergence Zone (ITCZ),

Hazards	Months											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
NE moonsoon (*Amihan*)												
SW monsoon (*Habagat*)												
Transition												
Typhoon (*Bagyo*)	1	1	1	1	1	3-4	3-4	2-3	2-3	2-3	2-3	1-2
ITCZ (*Malawakang kaulapan*)												
Cold Front												
Thunderstorm (*Kulog at kidlat*)												

Figure 1. Weather disturbances in the Bicol Region (*Source: PAGASA*)

shearlines, easterly waves and other rainfall-causing weather patterns. The average annual rainfall in the region ranges from 1,900 to 3,500 mm.

The region's economy is basically agricultural with close to 50% of its workforce dependent on the industry. Agriculture and agriculture-related economic activities represent the major sources of income of families in the Bicol Region. In 2008, agriculture and fishery sector contributed a total of 30.97% to the Gross Regional Domestic Product (GRDP) of the region with more than 50% of the region's land being devoted to agriculture *(www.nscb.gov.ph/Ru5/secstats/accounts.html)*.

In February 2007, the DA presented a request to the FAO UN for technical and financial support to undertake an overall needs assessment and design a rehabilitation plan. The assessment revealed that the provinces of Albay, Camarines Sur and Sorsogon, were the most highly affected and the following municipalities namely; Buhi in Camarines Sur, Guinobatan in Albay, and Gubat in Sorsogon were identified as the project areas (Figure 2).

1.2 Objectives

The general objective of this project is to develop and implement climate risk management measures that will contribute to improve the livelihoods and food security of small-scale farmers in disaster prone areas. The outputs and deliverables of the project are:

1. identification and documentation good practice (GP) options for enhanced DRR and increased resilience of farmers against hazard impacts during wet and dry seasons in selected rain fed and upland farming systems of Bicol,

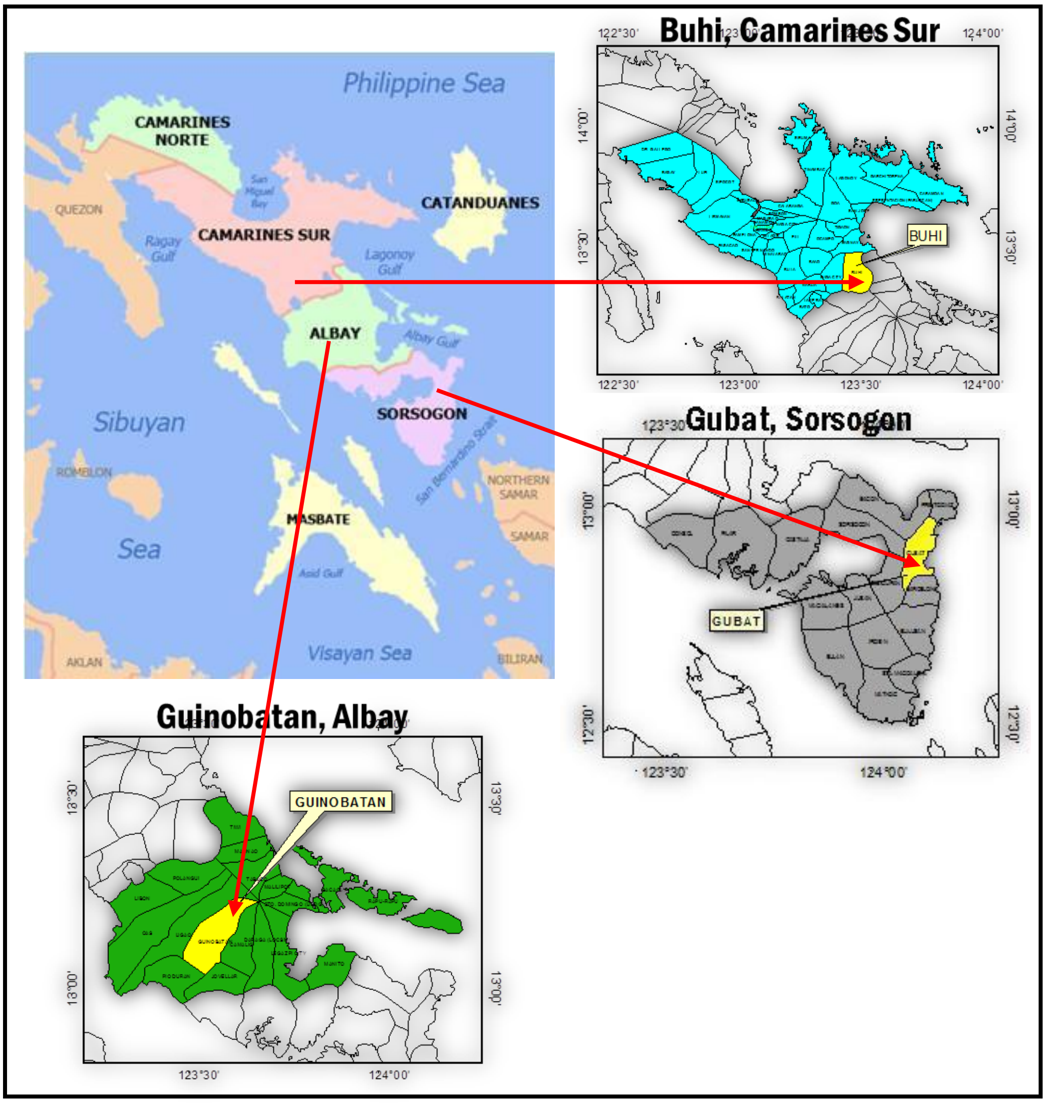


Figure 2. Pilot municipalities of the project

2. validation of potential GP options against technical criteria and for location specific suitability,

3. capacitating DA and LGU counterparts and farmer representatives on the implementation requirements of selected options,

4. guiding and technically advising the implementation and monitoring process of field testing of selected GP options and

5. analyzing and drawing lessons from testing in view of designing a strategy for dissemination of the good practices identified.

2.0 PROJECT SITES

From the five shortlisted barangays per municipality, selection of the pilot sites were conducted by National Consultants together with the technical staff of the Department of Agriculture Regional Field Unit 5 using the following criteria (Box 2).

Box 2

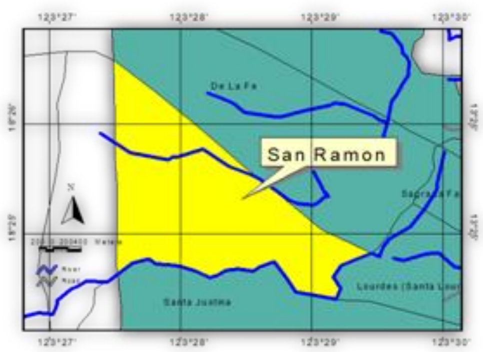
Selection Criteria for Barangay

Criteria	**Per cent**
1. Residents and livelihood groups remain vulnerable for future risks	30
2. Varying agro-ecological conditions (e.g. rain fed (upland), irrigated (lowland), riverine, etc.	30
3. High level of dependence on agriculture sector	10
4. Willingness of farmers to use their fields for demo purposes and attend training	10
5. Existence of a well-established functioning farmers' organization	10
6. Accessibility to transport and electricity	10

Based on the criteria, three barangays were chosen from the shortlisted barangays of the three municipalities from the three highly affected provinces by Typhoon *Reming*

Field visitations of the pilot areas were conducted to collect primary and secondary data on the profile of the barangay, past experiences on the damages caused by natural hazards, and local perception on the risk from natural hazards.

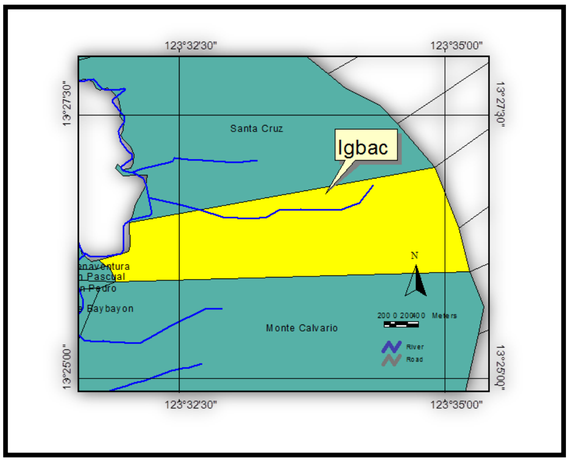
2.1 Buhi, Camarines Sur



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

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

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



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

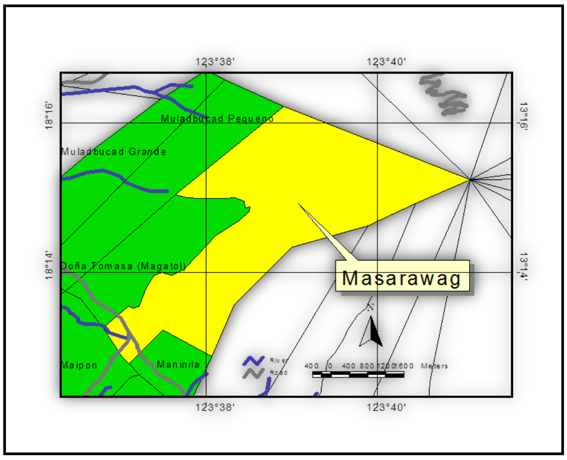
The barangay has mountain spring that supplies potable water to about 90% of its residents and a river as source of irrigation for lowland rice production.

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

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

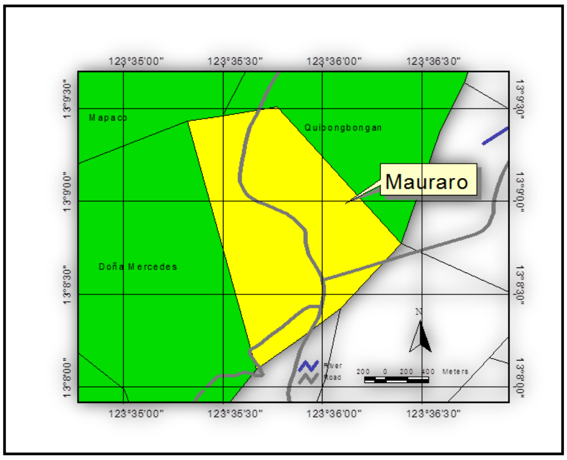
2.2 Guinobatan, Albay

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



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

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



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

The barangay has a total of 919 households composed of 2800 males and 3079 females with a mean family size of 6 individuals.

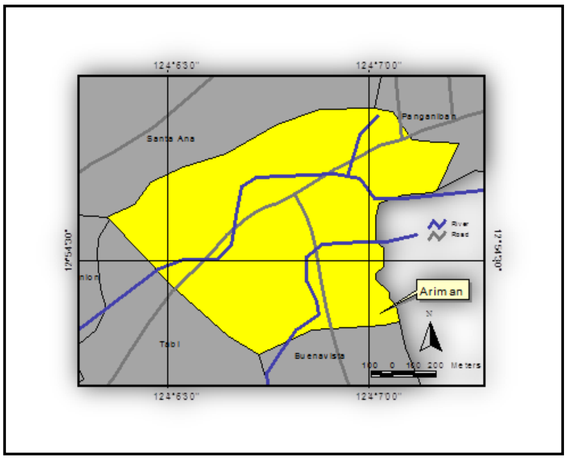
Agriculture contributes significantly to the socio-economic development of the barangay. Home-based women, after transplanting the rice crop, are engaged in the production of abaca handicraft, which is bought and assembled in the barangay.

The steep to moderately steep sloping lands and the type of agriculture production system increases the vulnerability of the site to natural hazards specifically typhoons and, in some occasions, flood due during heavy rainfall. Farmers also experienced drought during the dry season.

Cadang-cadang for coconut, bunchy top for abaca, and vegetable pest are threats to the existing crops in the barangay.

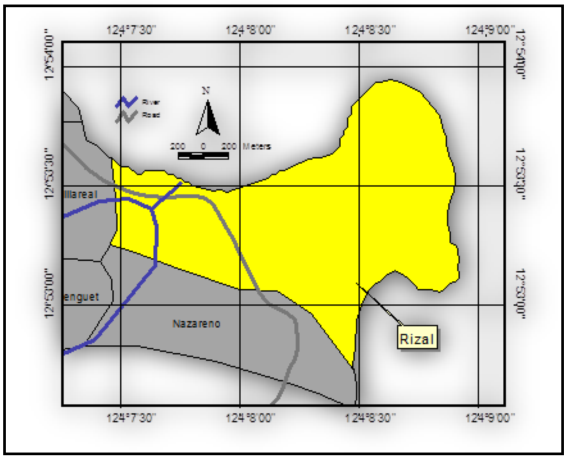
2.3 Gubat, Sorsogon

Ariman. Barangay Ariman is a coastal barangay located at the northern part of Gubat and is seven (7) kilometers away from the town proper. Sandy clay loam is the common soil type and its terrain is characterized as flat. It has a total land area of 238.72 hectares devoted to agricultural production with 133.38 hectares upland agro-ecological zone planted to 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/farming as major sources of livelihood yielding an average annual income per household is PhP 2,262.00 (Census, 2005). Farmers, after transplanting rice, are also engaged in fishing on a daily basis thereby putting to much pressure on the coastal resource. For the coconut farmers, they harvest their nuts every 45 days. The women of Ariman are into planting root crops like cassava, camote, gabi, and other vegetable crops. They also raise backyard animals like pig, carabao, goat and chicken for additional income and domestic consumption.

Typhoon, flooding (May, August to January) and saline intrusion to the rice areas are the major natural hazards experienced in Barangay Ariman. Soil erosion and landslide are great threat to steep to moderately steep sloping areas during heavy rainfall.



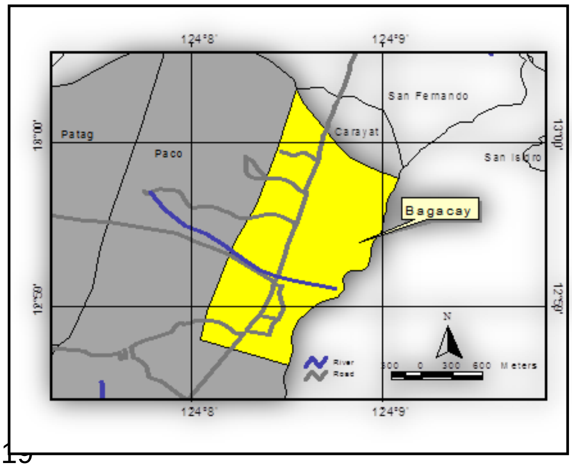
Rizal. Known for its white sand beach resorts, Barangay Rizal has a total land area of 584.06 hectares which represents the irrigated lowland (53.84 has), rain fed (35.51 has), and upland agro-ecological zones (236.00 has).

Upland agro-ecological zone is predominantly planted with coconut with pili (*Canarium ovatum*), banana, vegetables and, rootcrops as intercrops. Corn and vegetables are planted in the rain fed lowland agro-ecological zones after rice cropping.

Home-based women, after establishing the transplanted rice (TPR), are engaged in collection of *langao-langao*, making shell craft, planting root crops and vegetables and raise backyard animals like pig and chicken for domestic consumption and to augment their income.

Typhoon, saline intrusion in lowland rice areas near coast, drought (March to May), and flooding (October to December) are threats to agricultural production. Soil erosion and landslide are additional threats to steep to moderately steep sloping areas during heavy rainfall.

Bagacay. Bagacay is a coastal barangay in Gubat, Sorsogon with a total land area of 582.54 hectares. Irrigated lowland agro-ecological zone occupies about 127.12 hectares and about 324.00 hectares is considered as upland agro-ecological zone.



Upland agro-ecological zones are characterized by coco-based farming system where banana, root crops and vegetables are planted as intercrops. Pili (*Canarium ovatum*), an indigenous nut-producing tree is predominantly found in the upland agro-ecological zones of the barangay. Soil type is sandy clay

The barangay has 691 households with a total of 3,309 inhabitants Aside from farming, shellcraft and raising of animals (cattle, carabao, goat, and swine), and a fish processing (*kuyog, law-law, and turos*) are the existing alternative livelihood options among home-based women.

Typhoon, flood, and saline intrusion which occur in mostly in August are the major hazards experienced in Barangay Bagacay. Lean months (food is scarce) occur on Oct-Feb, especially for fishing households. They are the most vulnerable sector in the community owing to the fact that fishing is a seasonal source of living. They usually contend with the 15 days with fish catch and 15 days without earnings.

2.4 Cropping cycle

The prevailing type of climate in the pilot sites is the second type in the modified Corona classification. It is characterized by no dry season with a very pronounced maximum rain period from December to February, no single dry month, and minimum monthly rainfall occurs during the period from March to May (Concepcion, 2004).

Cropping calendar of vegetables in the rain fed and upland areas showed that squash, okra, eggplant, sweet potato, cassava, pole sitao, bitter gourd, and mung bean can be planted throughout the year (Figure 3). Dry season planting of tomato, pepper, peanut, snap bean and corn can be do ne in starting November while wet season planting can be carried out starting May. This information on the cropping calendar served as basis on what vegetables are suitable to grow during the dry and wet seasons.

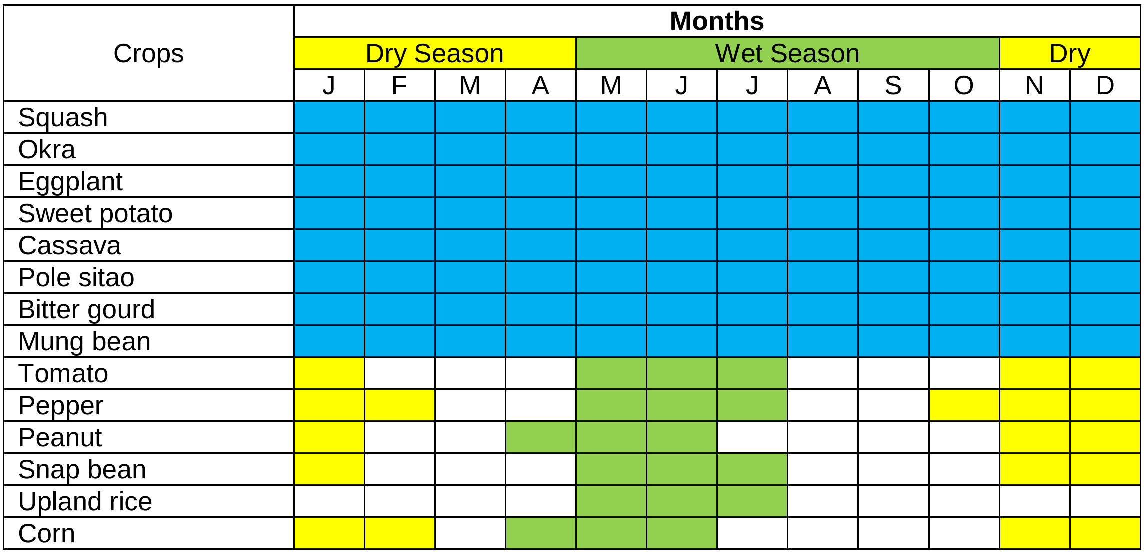


Figure 3. Cropping calendar in the Bicol Region (*Source: Gabay sa Pagtatanim – Department of Agriculture Information Division)*

3.0 METHODOLOGY

3.1 Preliminary field visit

Field visitations of the pilot areas and focus group discussions (FGD) were conducted to collect primary and secondary data on the profile of the barangay, past experiences on the damages caused by natural hazards, and local perception on the risk from natural hazards.

1. Buhi, Camarines Sur



2. Guinobatan. Albay



3. Gubat, Sorsogon


3.2. Documentation of good practice options for DRR in agriculture

The project initiated the documentation of a wide range of good practice options to reduce the risk of hydro-meteorological hazards in the rain fed and upland agro-ecological zones. The GP options were pre-evaluated using the Livelihood Adaptation to Climate Change (LACC) framework with some modification in the percentages of the criteria in consultation with the national consultants (Table 1).

Pre-evaluation of the agro-ecological suitability for the selected GP option includes suitability under existing and near future climatic status, edaphic and

Table 1. Criteria used in the evaluation of good practice options

Criteria for the selected GP option	Per cent
A. Agro-ecological suitability for the selected GP option 1. Suitable under existing and near future climatic status 2. Edaphic and topographic conditions and/or same agro-ecological zones 3. Farmers' perception 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 GHG emissions 1. +/- chemical fertilizer use (2. +/- energy use	5

topographic conditions and/or same agro-ecological zones, farmers' perception, and agro-ecological zone location.

Economic and social feasibility of the GP option means that it produces net benefits for farmers, does not enhance overall work load, and can be applied also by those with limited assets and contributes to their livelihood improvement. Indicators along this criterion includes cost of inputs, yield potential, net benefits, capacity building requirements, employment opportunities for the landless, and market potential.

Ease/cost of rehabilitation, recovery potential, and water use of the GP option during dry season/dry spells were the indicators used for increase resilience against impacts of climate hazards.

Contribution of the GP option to GHG emissions was evaluated based on proxy indicators including use of chemical fertilizer and energy requirements as compared to control plot.

The documented GP options were presented to the Technical Working Group (TWG) to validate and extract from the list, the most suitable GP options for the wet and dry season planting. The TWG is composed of the following:

a. Department of Agriculture Regional Field Unit 5
b. DA technical experts representing the crops and livestock and poultry sector
c. Bureau of Fisheries and Aquatic Resources
d. Agricultural Training Institute
e. SPCMAD
f. Office of the Provincial Agriculturist/Provincial Agricultural Services
g. Office of the Municipal Agriculturist/Municipal Agricultural Services
h. Bicol University
i. Central Bicol State University of Agriculture
j. Philippine Institute of Volcanology and Seismology
k. Philippine Atmospheric Geophysical and Astronomical Services Administration
l. DA-RAFID

The GP options recommended by the TWG (Table 2) were presented and discussed with barangay stakeholders for them to decide which GP options they will adopt. Listing of prospective farmers was done in each barangay. Appendix A provides the detailed description of the potentially suitable GPOs identified for the pilot areas.

Table 2. Recommended GPOs for wet and dry season planting by TWG

Wet Season	Dry Season
1. Coconut leaf pruning 2. Diversified cropping (Strip intercropping) 3. Waterlogged resistant varieties 4. Alley cropping 5. Vetiver grass technology 6. Sloping Agricultural Land Technology (SALT-1)	1. Coconut leaf pruning 2. Diversified cropping (Strip intercropping 3. Small farm reservoir 4. Mulching 5. Tillage practices 6. Drought tolerant crops 7. Wide row spacing for rainfall multiplication 8. Composting 9. Artificial insemination 10. “Supak” method of feeding for cattle during long dry periods

Exposure to a high degree of climate risk is a characteristic feature of rained and upland agriculture in the in the Bicol Region. Weather is certainly the most important factor determining the success or the failure of agricultural enterprises. Occurrences of erratic weather are beyond human control. However, it is possible to adapt to or mitigate the effects of adverse weather if a forecast of the expected weather can be had in time.

During the presentation of the GP options to the farmer-cooperators, the three-month seasonal weather forecast issued by PAGASA (Figure 4) was presented. This served as the basis in determining the crops or crop combinations to be planted in the GP options

Issued at: 12 April 2011
Valid Beginning: April-May-June 2011

Weather Outlook

- Weak *La Nina* occurrence in the Bicol Region starting April to neutral condition in June 2011.

Weather Forecast

April 2011
- Buhi, Guinobatan will experience above normal rainfall
- Gubat will experience near normal rainfall conditions

May 2011
- Buhi, Guinobatan and Gubat will experience near normal rainfall conditions.

June 2011
- Buhi, Guinobatan and Gubat will experience near normal rainfall conditions.

Figure 4. Three-month seasonal weather forecast

3.3 Selection of farmer-cooperators

Site validation of prospective farmer-cooperator was conducted to ascertain the suitability of the GP options they have selected. Aside from the *must criterion* which is “access to land of at least 1000 m^2 for the adaptation of option/technology to be tested”, the following criteria were adopted in the selection of farmer co-operators (Table 3).

Table 3. Criteria used in the selection of farmer-cooperators

Criteria	Per cent
1. Suitability of the available area to the option	25
2. Have interest and can devote time in the project activities	20
3. Active member of a farmers' organization	15
4. Has a potential to become a farmer-leader and/or trainer	15
5. Willing to provide counterpart such as labor for land preparation, day-to-day maintenance of the techno-demo farm	15
6. Have not received any or have received minimal livelihood assistance	5
7. A farmer cultivating one (1) hectare or less	5

3.4 Training on the implementation of GP options for CCA/DRR in the rainfed and upland agro-ecological zones

The training is part of the project's design to strengthen the capability of the farmer cooperators in implementing the good practice options to reduce the risk of hydro-meteorological hazards in rain fed and upland agro-ecological zones of three pilot municipalities.

At the start of every cropping season, a training was conducted for the farmer-cooperators to understand a) the objectives of the project, b) their roles and responsibilities as project stakeholders, and c) to strictly adhere to implementation guidelines of their selected GP option. Since the choice of the GP option is given to farmer-cooperators and guided by the principle that *"build on what already exists"* only two (2) main GP options namely, coconut leaf pruning strip intercropping and were implemented in the pilot sites the three cropping periods. Other GP options like use of improved varieties, composting, mulching, and combining crops of different growth durations were incorporated by some farmers in the implementation of the two main GP options. Other GP options such as small farm reservoir, alley cropping, sloping land agriculture technology (SALT-1), and *Vetiver* grass technology where their impact will take some time to be felt, were not chosen because of the short duration of the project. Table 4 shows the number of farmers trained and their corresponding GP options.

Table 4. Number of farmers-cooperators who implemented the GP options

Cropping Season	**Municipality**	**GP Options**	**No. of Farmers**
A. Wet Season 2010	Guinobatan	Strip intercropping	8
		Coconut leaf pruning	12
	Buhi	Strip intercropping	15
		Coconut leaf pruning	5
	Gubat	Strip intercropping	15
		Coconut leaf pruning	15
B. Dry Season 2011	Guinobatan	Strip intercropping	23
		Coconut leaf pruning	7
	Buhi	Strip intercropping	11
		Coconut leaf pruning	7
	Gubat	Strip intercropping	22
		Coconut leaf pruning	8
C. Wet Season 2011	Guinobatan	Strip intercropping	22
		Coconut leaf pruning	8
	Buhi	Strip intercropping	13
		Coconut leaf pruning	7
	Gubat	Strip intercropping	30
		Coconut leaf pruning	0
		Total	**228**

3.5 Implementation of GP options

For each option, the existing farmers' practice was used as control plot and the good practice option introduced as the manipulated variable. In the demonstration plots for the GPOs, seeds and fertilizer were provided to the farmer-co-operators. Both plots, measuring 1000 m^2 were monitored, and data and information were collected accordingly. A Farm Activity Record specifying the cultural practices to be undertaken for each GPO was designed and discussed with the farmer-cooperators to facilitate the implementation and recording of the farm activities conducted (Appendix A).

3.6 Data gathered

Before the implementation of the GP options, soil samples were obtained from the seven pilot barangays. These sample composites were made up of ten soil core subsamples that were collected from 0-20 cm soil depth using a core sampler in sampled farmer's field. The soil samples were immediately air-dried, pulverized using a wooden mallet and brought to the Regional Soils Laboratory of the Department of Agriculture Regional Field Unit 5 for chemical analysis. Results of the soil analysis, which are presented in Appendix B, were used as the basis of the fertilizer recommendation.

The three-month seasonal weather forecast, total monthly rainfall before and during the implementation of the GP options were taken from Southern Luzon PAGASA Regional Services Division, Airport Site, Legazpi City.

The crop cut method was used in the collection of yield data from the farmer's practice and the GP option plots yield was expressed in tons per hectare. The farm inputs used and activities done by the farmer-cooperators were taken from Farm Activity Record and were given corresponding cost.

3.7 Evaluation of GP options

The agro-ecological suitability of the GP options was evaluated in terms its ability to produce economic yield produced under existing agro-climatic, edaphic, and topographic conditions compared to the farmer's practice

The economic feasibility associated with the implementation of the GP options were determined. The values used depended on the market prices at the cropping season. The benefits of technology included the value of the yields. Labor requirements for land preparation, fertilizer application, planting, weeding, harvesting and postharvest operations were obtained from the farm activity record.

Partial budget analysis using 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 good practice option (GPO) compares to farmer's practice (FP). The net benefit values were calculated on per hectare basis and evaluation was done for the three cropping seasons. The following formula was used:

$$MBCR = \frac{Additional\ Benefit}{Additional\ Cost} = \frac{Sales_{GPO} - Sales_{FP}}{Production\ Cost_{GPO} - Production\ Cost_{FP}}$$

4.0 RESULTS

4.1 Agro-ecological suitability of good practice options

4.1.1 Suitability of the GP options in the context of perceived climate change

During the conduct of the study, consultation meetings, and focus group discussions were held with local communities and farmers on the impact of climate change. From their perspective, climate change has wider impacts over the agriculture and other livelihood activities of people residing in the upland and rain fed areas (Table 5).

Table 5. Farmers' perspectives on the impacts of current climate extremes and variability in the pilot sites

Agro-meteorological hazards	Impacts of climate variability
1. Rainy season	• Increase agricultural production because of favorable to the growth of crops due to abundant supply of water • However, too much moisture available during this season results to high incidence of fungal infestation. • In San Ramon, Camarines Sur, heavy rains causes the overflow of the Barit Rivers which results to destruction of crops • Occurrence of soil erosion and decrease in soil fertility due to heavy rains were observed by farmers in Masarawag Guinobatan, Albay and Igbac, Buhi, Camarines Sur. • The degree of vulnerability of upland farms in other sites to rainy season is not very profound. .
a. Early onset of rainy season	• Most of the farmers stated that early onset of rainy season results to early cultivation of upland and there is relatively high agricultural production during such time resulting to higher income from farming
b. Late onset of rainy season	• Since farming activity is dependent on rainfall, farmers have to resort to other sources of livelihood to feed their families due to late onset of rainy season. • Farmers experience low farm production when rain comes late and farm produce becomes insufficient to meet family needs.
2. La Niña	• Farmers observed that flooding and excessive soil erosion occur during La Niña. • Soils in the upland lose its fertility and crops are

	damaged as consequence.
3. El Niño	• Farmers mentioned that growth of the plants was inhibited during El Niño episodes due to unavailability of moisture. This condition results to low or non-productivity of the crops and loss of farmer income. • Farmers also noted that extreme dryness increases the possibility of the occurrence of fire in the area resulting to burning and/or damaging of the upland farms.
4. Dry season	• Farmers noted that high temperature during dry or summer season causes damage to crops.
5. Typhoons	• Typhoons are becoming stronger and brings more rains.

The results of field testing and farmers perceptions thereafter confirmed that the GP options selected for field testing were suitable to enhance resilience within the context of increasing climate variability and uncertainty.

4.1.2 Suitability of the GP options in the context soil analysis

In determining the critical levels of nutrients for vegetables based on the results of soil analysis, the criteria presented in Table 6 was used for soil pH and important soil nutrients such as N, P and K (AVRDC, 1990).

Table 6. Critical levels of nutrients for vegetables

Soil Parameters	Low	Moderate	High
Soil pH	5.5-6.0	6.0 -7.5	>7.5
Organic carbon (%) Organic matter (%)	<2.0 <3.45	2.1-4.9 3.62 – 8.45	>5.0 >8.62
Bray No. 2 P (ppm)	<10	10-20	21-30
Exchangeable K (ppm) (meq/100 g soil)	 40-80 0.102 - 0.205	 81-120 0.207 - 0.307	 121-160 0.310 - 0.410

Table 7 presents the average values of nutrients determined in the sample farms for each site. These values were used as basis in the fertilizer recommendation for the crops planted. Except for Bagacay in Gubat, Sorsogon which have a moderate soil pH, all pilot sites had a low pH. For percent organic matter, only three sites namely, San Ramon in Buhi, Camarines Sur, Mauraro and Masarawag in Guinobatan Albay indicated moderate values, while the four sites have low values. For available P measured using Bray P No. 2, only Mauraro in Guinobatan, Albay has moderate value and the rest of the sites have moderate values. Only Masarawag in Guinobatan, Albay and Bagacay in Gubat, Sorsogon have low values for exchangeable K while the five sites have high values.

Table 7. Results of soil analysis from the different pilot sites

Municipality	Barangay	Parameters	pH	N (%OM)	P (ppm)	K	Ca	Mg	Na
						meq/100 g soil			
Buhi, Camarines Sur	Igbac	No. of samples	3	3	3	3	3	3	3
		Range	5.24 - 5.53	2.59 – 3.90	2.14 – 8.06	0.26 – 0.86	4.74 – 7.51	1.48 – 1.96	0.16 – 0.19
		Mean	5.34	3.42	4.25	0.64	6.26	1.76	0.17
		Description	Low	Low	Low	High			
	San Ramon	No. of samples	6	6	6	6	6	6	6
		Range	5.49 - 5.51	4.48 – 6.76	2.00 – 4.30	0.25 – 0.79	7.09 – 13.31	1.34 – 2.35	0.14 – 0.19
		Mean	5.73	5.58	2.93	0.51	11.04	1.98	0.16
		Description	Low	Moderate	Low	High			
Guinobatan, Albay	Masarawag	No. of samples	4	4	4	4	4	4	4
		Range	5.57 – 6.23	3.52 – 4.24	0.56 – 13.44	0.05 – 0.36	2.14 – 3.10	0.23 – 0.62	0.05 – 0.19
		Mean	5.89	3.91	4.36	0.18	2.60	0.40	0.12
		Description	Low	Moderate	Low	Low			
	Mauraro	No. of samples	7	7	7	7	7	7	7
		Range	5.19 – 5.80	2.70 – 5.08	6.72 – 38.56	0.26 – 1.29	6.74 – 20.66	1.72 – 3.49	0.15 – 0.28
		Mean	5.54	3.60	17.32	0.62	1.24	2.61	0.22
		Description	Low	Moderate	Moderate	High			
Gubat, Sorsogon	Ariman	No. of samples	4	4	4	4	4	4	4
		Range	4.95 – 6.10	1.54 – 5.17	0.66 – 32.84	0.03 – 1.14	2.61 – 17.95	0.42 – 3.21	0.13 – 0.32
		Mean	5.38	3.03	9.65	0.44	7.54	1.88	0.22
		Description	Low	Low	Low	High			
	Bagacay	No. of samples	4	4	4	4	4	4	4
		Range	5.35 – 6.57	1.02 – 4.83	1.60 – 14.12	0.08 – 0.21	5.15 – 26.56	1.18 – 7.42	0.11 – 0.18
		Mean	6.01	2.80	8.03	0.16	13.82	4.56	0.14
		Description	Moderate	Low	Low	Low			
	Rizal	No. of samples	7	7	7	7	7	7	7
		Range	4.40 – 5.57	1.79 – 4.13	0.80 – 10.08	0.04 – 0.75	1.28 – 5.16	0.35 – 2.58	0.09 – 0.27
		Mean	5.03	3.00	3.53	0.32	3.48	1.32	0.16
		Description	Low	Low	Low	High			

The results of soil analysis revealed that only Mauraro in Guinobatan, Albay appears to have adequate levels of the NPK while Bagacay in Gubat, Sorsogon is deficient in these important nutrients. San Ramon, in Buhi, Camarines Sur is deficient in phosphorus and the other four sites were deficient in nitrogen and phosphorus.

The data suggest that farmer-cooperators are undersupplying some nutrients and oversupplying others leading to nutrient imbalances in the soils which results to low yield. During the focus group discussion conducted in each pilot site, farmers identified lack of capital and high fertilizer prices as a key constraint to production and the low fertility status of the soil.

The results of the soil sampling undertaken as part of the GP option implementation confirmed the suitability of selected GP options under existing soil characteristics. However it also highlighted the generic need for more systematic soil analyses, advice and support to farmers in order to reduce fertilization imbalances and ensure optimum crop growth conditions. This is a basic precondition for successful adaptation.

The result of the soil analysis further showed that it is not an issue of lack of capital as identified by the farmers but an issue of more effective allocation of limited capital (fertilizer) resources. It is recommended for DA RFU 5 will address this issue up more systematically.

The three-month seasonal forecast of PAGASA was used in the formulation of the Farm Weather Bulletin by the Department of Agriculture RFU V in designing the fertilizer management strategy to improve fertilizer efficiency. During the excessive rainfall the fertilizer applied has a high possibility of being diluted in water and become unavailable to sustain the nutrients required for crop growth. Under this condition and based on the recommended fertilizer rate for their GP options, farmers were advised either performed early fertilizer application, split fertilizer application, and deeper fertilizer placement to anticipate nutrient losses.

4.1.3 GP Options' suitability in the context of 2010/11 features of monthly rainfall

The onset of rainy season in the three municipalities based on the 21-year records of PAGASA usually falls between May and June which is normal for the kind of climate in Bicol Region. While lower amount of rainfall was observed in Gubat, Sorsogon from July to September compared to the other two municipalities, increasing amount was observed from October to December (Figure 5).

Rainfall is one of the most important climatic variables in the rain fed and upland agro-ecological zones because of its two sided effects - as a deficient resource, such as droughts and as a catastrophic agent, such as heavy rains that can caused floods. It affects different crops differently. Therefore, changes in outputs and economic returns from different crops differ significantly which in turn also affects the corresponding crop growers differently. Farmers will be expecting losses, primarily, due to reductions in agricultural productivity, crop yields and loss of farm productivity.

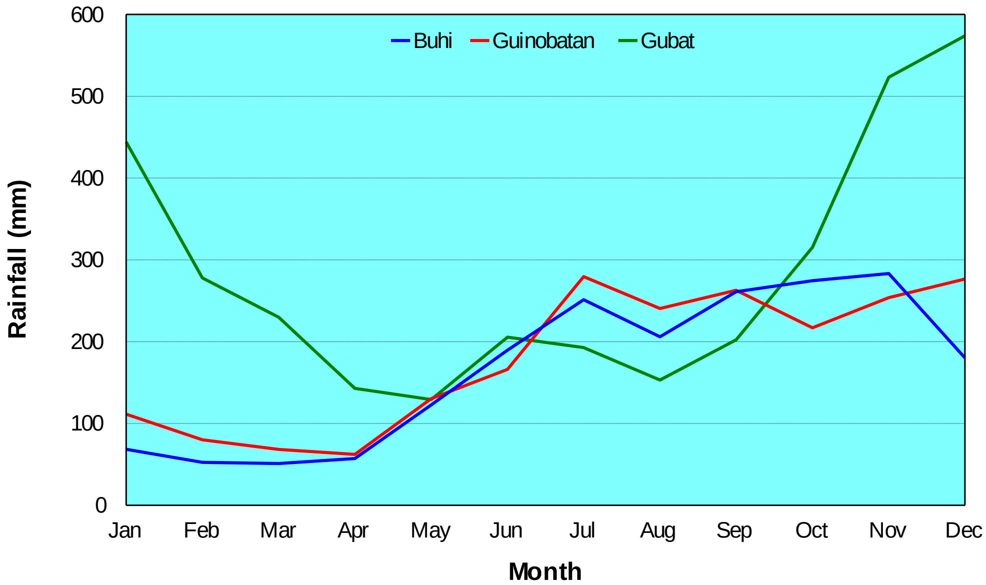


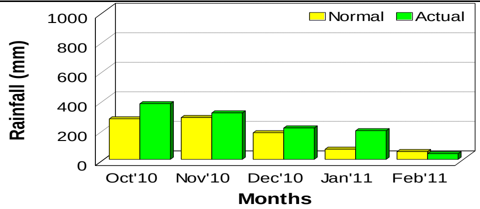
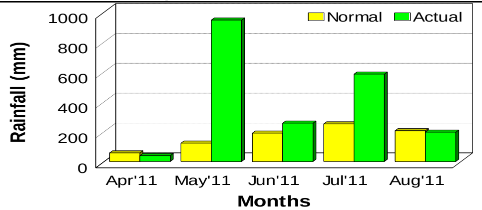
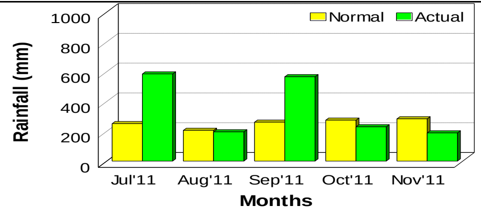
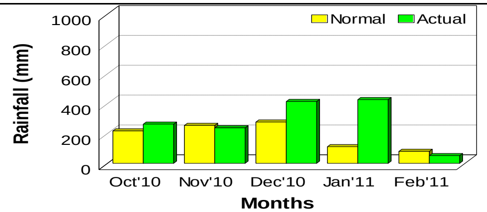
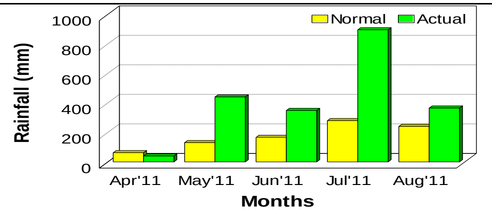
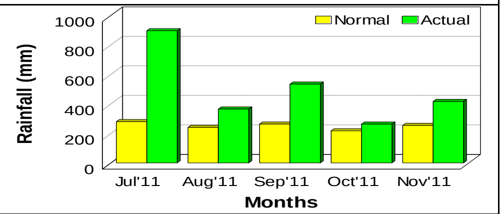
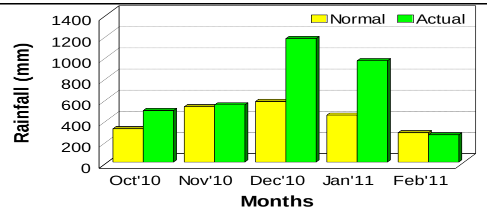
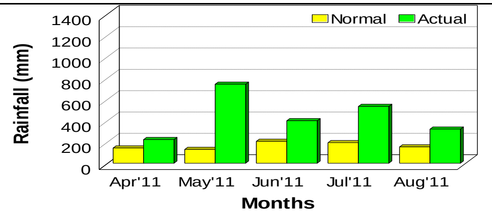
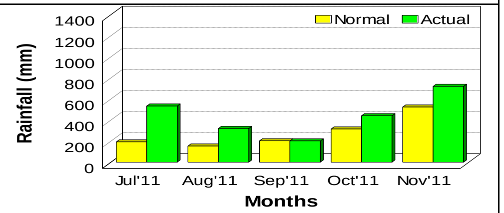
Figure 5. Twenty-one year average of monthly rainfall

The total normal and actual rainfall in the three project sites for the three cropping seasons is presented in Table 8. All the three cropping seasons experienced high rainfall leading to wet conditions during crop growing periods. In comparison to the long-term average, the amount of rainfall during growing seasons was not only high, but also erratic.

In Gubat, Sorsogon, a 32.3, 144.6, and 38.3% increase over the total normal rainfall were observed during 2010 wet season, 2011 dry season, and 2011 wet season, respectively. Similarly, an increase of 48.4, 137.7, and 97.3% over the total normal rainfall were observed during 2010 wet season, 2011 dry season, and 2011 wet season, respectively in Guinobatan, Albay. Total rainfall observed in Buhi, Camarines Sur exceeded the total normal rainfall by 60.0, 169.0, and 59.7% during the 2010 wet season, 2011 dry season, and 2011 wet season, respectively.

Except for the 2010 wet season cropping season in which implementation of the GP option was done in mid-October instead of July due to the delay in the procurement of inputs, the 2011 dry season and 2011 wet season were implemented on time in the three municipalities. The 2010 wet season cropping period (October 2010 to February 2011) saw the eastern seaboard saturated by rainfall starting December, with floods and landslides reported in the Bicol Region which damaged majority of demonstration plots in the three pilot municipalities. Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), the weather bureau, explained that the rain experienced in Bicol Region is not caused by a storm but rather due to the weather disturbances emerging from a cold front. This is likewise, an effect of the La Niña phenomenon, which was initially reported to strike in the months of December until January.

Table 8. Total normal and actual rainfall (mm) in the three project sites for three cropping seasons (Source: PAGASA)

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

The issuance of three-month seasonal forecast for 2010 and 2011 by PAGASA, the formulation of the Farm Weather Bulletin by the Department of Agriculture RFU V, and the action of the Agricultural Technicians of the LGUs in communicating the information to the farmers are key elements that determines the success of the implementation of GP options. In the context of improving food security under changing climatic conditions, strong collaboration of these three agencies is recommended.

4.2 Economic and social feasibility of selected GP options

4.2.1 Economic performance of GP options

4.2.1.1 Coconut leaf pruning

Coconut (*Cocos nucifera* L.) is a traditional plantation crop grown in the Bicol Region. Coconut being a widely spaced crop, its unique rooting pattern and canopy coverage offers scope for integrating various crops in the interspaces. In a coconut holding with palms spaced at 8.0 m, nearly 75% of the land area is left unutilized and as much as 40-60% of the sun light is transmitted through the canopy during the peak hours especially in palms aged around 25 years.

In the Bicol Region, vegetable intercropping under coconut palms is one of the popular intercropping practices in rural areas for many good reasons. This intercropping practice requires short period of planting time, smaller area (vacant spaces between coconut trees), provides additional income to coconut farmers and nutritious food for the farm communities. Vegetable intercropping such as tomato, eggplant, sweet pepper, squash, okra, ginger etc. is highly recommended under coconuts aged one to six years old or 26-60 years old. Rootcrops like sweet potato and cassava can also be successfully grown as an intercrop.

Coconut being grown predominantly in small and marginal holdings in the pilot sites, the GP option implemented was coconut leaf pruning. This technology involves the removal or pruning of coconut leaves from leaf Rank 19, (i.e. supporting the tender "buko" nuts down to the oldest leaf at harvest time using a harvesting pole and scythe to allow adequate sunlight for the normal development and high yield of perennial and annual crops.

Improved varieties of six crops namely; sweet potato (*SP 23 and SP 30*), cassava (*Golden yellow*), squash (*Rizalina*), corn (*Los Baños Lagkitan*), peanut (*Biyaya*), and eggplant (*Dumaguete long purple*) were tested under coconut leaf pruning technology. These were based on the crops being planted by the farmer-cooperators except that improved varieties were used instead of their local varieties so as not to complicate the implementation of the GP option. In addition to the improved varieties, fertilizer was also supplied based on soil analysis.

Table 9 shows the marginal benefit cost ratio (MBCR) of using improved crop varieties planted under coconut leaf pruning technology for three seasons in three pilot municipalities. The MBCR signifies the increased revenue to the farmer per additional peso to plant the improved varieties. Across seasons and across sites, shifting from the traditional/local varieties to improved varieties of sweet potato, cassava, and corn resulted in higher MBCR.

Table 9. Marginal benefit cost ratio (MBCR) of using improved crop varieties planted under coconut leaf pruning technology from three cropping seasons in three municipalities

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

Los Baños Lagkitan, an early maturing composite corn variety which can be harvested within 70 to 75 days after planting had the highest mean MBCR of 2.90 across season followed *by Golden yellow* cassava variety with mean MBCR value of 2.39. The two sweet potato varieties, namely SP 30 and SP 23 gave MBCR values of 2.19 and 2.07, respectively.

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

Sweet potato and cassava are commodities which are tolerant to adverse climatic impacts. Planting sweet potato and cassava has several advantages within the context of cropping systems, namely, (a) it gives reliable yields in sub-optimal growth conditions, (b) it requires lower labor inputs (appropriate for vulnerable households) than other staples, and (c) it serves as an alternative food source for urban populations, facing increasing prices of cereals.

Recently, the Philippine Root Crop Research and Training Center (PhilRootcrops) and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) is implementing a program called "Enhancing Research Utilization for Sweet potato Livelihood Development in Disaster-Prone Communities". This sweet potato production and livelihood program is being undertaken in Albay to enhance its potential as a cash crop in these calamity-prone provinces where many sweet potato farms are located.

Although some crops were tested for only one season, improved varieties also showed higher MBCR values over the traditional/local varieties. These MBCR values were even higher than the 2.0 considered by PCARRD as the minimum required before recommending a new technology

Coconut leaf pruning (CLP) which involves the removal or pruning of coconut leaves allows adequate sunlight for the normal development and high yield of perennial and annual crops. With the Type 2 climate prevailing in the pilot sites, planting of corn and root crops do not compete for soil resources like water and soil nutrients They are shallow rooted plants, requiring smaller area (vacant spaces between coconut trees) and short period of cropping time.

4.2.1.2 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 that each crop can influence the microclimate and yield potential of adjacent crops.

Since the implementation of the GP option involves several crop combination, crops planted were grouped based on their growth duration namely long duration (LD), medium duration (MD), and short duration (SD). Aside from the different crop combinations, improved varieties were used.

Data showed that strip intercropping of varying growth durations gave higher MBCR values compared to crop combination of same growth durations (Table 10). Across sites and across locations, combination of long duration (LD) and short duration (SD) crops gave had higher MBCR value of 3.16 than LD+MD (3.04), MD+SD (2.85), and SD+SD (2.04). Lowest MBCR value of 1.37 was obtained from LD+LD combination.

Although tested only once during the 2011 wet season cropping in Gubat, Sorsogon, combining strips of LD+MD+SD in the same plot produced the highest MBCR of 4.98.

Strip intercropping, is recognized as an adaptation or risk management response to changes in climate. It involves the on-farm alteration of crop mixes, and perhaps the introduction, addition or substitution of new crop varieties. A mix of crop types with different climate-related characteristics is expected to reduce the risk of income loss as a result of climate change better than a reliance on a single crop with particular characteristics and susceptibilities, especially when climate change risks include those associated with inter-annual variability and changes in the frequency and magnitude of droughts or heavy rains.

The growth duration of crops in an intercropping system plays a useful role in achieving yield advantage. Higher yield advantage can be expected when the maturity period of the component crops are different. With a diversified plot, the farmer increases his chances of dealing with the uncertainty and/or the changes created by climate change.

The agro-ecological suitability in terms of topography and climatic conditions of coconut leaf pruning and strip intercropping using improved varieties was demonstrated by the acceptable yield obtained despite the abnormal climatic conditions (above normal rainfall) that occurred during the three copping seasons. Furthermore, both GP options contributed to the reduction of the impact of climate-related risk on their source of livelihood, thus improving their resilience.

Growing of annual crops under coconut and intercropping has been long practiced by upland farmers more food and agricultural products. In the framework of *"build on what is already existing"*, the introduction of leaf pruning and improved varieties in coco-based farming system and combining improved varieties of vegetables of different growth duration brought the desired benefits to farmers. The high MBCR (more benefits from additional costs) obtained, proved their economic feasibility these two GP options. With minimal cost that will be incurred for leaf pruning and improved varieties, it is socially feasible for famers will limited assets to adopt these GP options to improve their family income.

Table 10. Marginal benefit cost ratio (MBCR) of different strip intercropping combinations based on crop growth duration from three cropping seasons in three municipalities

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

Legend:

LD Long duration
MD Medium duration
SD Short duration

Continuation Table 10

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**

4.2.2 Women's role in the implementation of GP Options

In the implementation of the GP options, gender is one of the important socio-economic variables in climate change adaptation. In the pilot sites, majority of the farming households cultivating in the rain fed and upland agro-ecological zones grow crops mainly for home consumption. Table 11 shows the number of men and women cooperators who implemented the GP options for three cropping seasons.

Table 11. Gender participation in the implementation of the GP options

Cropping Season	Municipality	GP Options	Number of Cooperators		
			Male	Female	Total
A. Wet Season 2010	Guinobatan	Strip intercropping	3	5	8
		Coconut leaf pruning	8	4	12
	Buhi	Strip intercropping	9	6	15
		Coconut leaf pruning	5	0	5
	Gubat	Strip intercropping	14	1	15
		Coconut leaf pruning	13	2	15
	Sub-total		**52**	**18**	**70**
B. Dry Season 2011	Guinobatan	Strip intercropping	14	9	23
		Coconut leaf pruning	5	2	7
	Buhi	Strip intercropping	5	6	11
		Coconut leaf pruning	5	2	7
	Gubat	Strip intercropping	14	8	22
		Coconut leaf pruning	7	1	8
	Sub-total		**50**	**28**	**78**
C. Wet Season 2011	Guinobatan	Strip intercropping	8	14	22
		Coconut leaf pruning	7	1	8
	Buhi	Strip intercropping	9	4	13
		Coconut leaf pruning	5	2	7
	Gubat	Strip intercropping	21	9	30
		Coconut leaf pruning	0	0	0
	Sub-total		**50**	**30**	**80**
		Total	**152**	**76**	**228**

Women represented one-third (76) of the farm co-operators during the three cropping periods. Furthermore, there was an increasing number of them participating in the implementation of the GP options: 18 during the 2010 Wet Season, 28 during the 2011 Dry Season, and 30 during the 2011 Wet Season. Greater participation of women were observed in strip intercropping than in coconut leaf pruning.

In general, arduous farm activities like land preparation, plowing, hilling-up, off-barring, hauling of harvest are exclusively done by men. However, the project observed that women contributed significantly in reducing the cost of production by helping prepare the planting materials, planting, fertilizer application, harvesting, and marketing

This shows that women nowadays are not just are seen as 'farmer's wives' but as true farmers and capable of doing farm activities. The situation shows that climate change has increased women participation in farm activities while men are pushed into non-farm activity. Feminization in agriculture was greatly observed in Guinobatan, Albay. Once the field has been planted, care of the plants is given to the wives while the husbands shifted to non-farm activities like *habal-habal* (door-to-door motorcycle transport), construction, and other paid labor to earn extra income for the family.

4.3 Impacts of GPOs on resilience against climate hazards and carbon footprint

In principle, the GP options implemented were suitable to enhance hazard-specific resilience of farming systems. Based on the *ex ante* analysis, coconut leaf pruning and strip intercropping can strengthen the livelihood resilience of farmers during period of drought and heavy rainfall.

Gomez and Prado (2007) reported that coconut roots usually grow to a depth of close to 0.80 m with 60-90% found in the top 0.5 m of the soil. In 10-year coconut grown under rainfed conditions, the effective root zone of absorption was at 1.4 m from the trunk. Generally, coconut and root crops do not compete for soil resources, except in dry season. In areas with distinct dry period of 3-6 months with a monthly rainfall of < 100 mm, leaf pruning or removal of the older leaves of coconut reduce the effective transpiration surface area resulting in conservation of soil moisture. This condition allows the planting of sweet potato and cassava which requires short period of cropping time.

Although Johnston et al. (1994) reported that the coconut canopy may be of less importance in determining wind damage than the trunk height and the bole diameter, removal of the older leaves could minimized the effect of typhoons on coconuts.

Strip intercropping is a technology that usually involves the planting of two or more crops that compete for available resources in a given land unit. During dry season, where there is limited supply of readily available soil moisture, the competitive success of any crop is governed by number of plants drawing on the available resources and by the relative rates at which they take up the nutrients.

In rainfed and upland agro-ecological zones where water availability is a primary factor controlling plant growth and productivity processes, the strategy lies in selecting crops constituting the intercrop combination with the ability to sustain soil moisture stress. In the implementation of the GP option, crop combination was based on their growth duration.

However the specific weather conditions during the three seasons testing period 2010/2011 with significantly above average rainfall did not allow to draw field based evidence against on this assessment criterion. There is a need to continue monitoring against this criterion after project termination by DA RFU 5, and/or in the envisaged follow-up project. A situation of high seasonal climate variability and uncertainty of weather conditions (as forecasted as being “likely” under CC conditions) led to non-typical seasonal weather conditions, particularly during dry season 2010/11. This experience suggests need for longer term research trials in order to obtain more reliable data.

The impact of the tested GP options against increase GHG emissions and carbon foot printing could not established as part of the action research approach at field level. Thus no measured parameters are available. It was confirmed however that the tested GP options did not increase the need for chemical fertilizer (the production of chemical fertilizer produces high GHG emission), or energy (no additional pumping of water or transportation needs were induced); other indicators like methane emission levels, or spoil carbon sequestration could not be measured under the simple available field research design on farmers fields. Further systematization of the research approach along this criterion is needed with longer term time horizons as well. It is recommended to consider this criterion as part of adaptive research conducted by the research institutions before releasing new varieties, including field testing against this criterion under research conditions. Results could then be communicated as part of release recommendations. Such an approach seems more suitable that trying to assess carbon footprint with a basic action research design an limited monitoring capacities on farmers field sites.

5.0 LESSONS LEARNED

The implementation of the good practice options, led to the following lessons learned:

1. It is widely accepted that climate variability has direct and indirect impacts on agriculture and resource-poor farmers are very vulnerable to current and future climate risks. Focusing on the resource-poor farmers and most vulnerable and marginalized communities is important because of their high dependency on climate-sensitive resources that would enable them to adapt to climate change.

2. Understanding the vulnerability of communities to existing agro-meteorological hazards, while integrating good practice options, help build a solid foundation to work ahead. The appropriateness of technologies to small and resource-poor farmers can be improved by employing participatory approach, which involves the farmers to engage experiments in their own fields so that they can learn, adopt new technologies and spread them to other farmers.

3. The choice of the cooperating farmer is very important in implementing the good practice options. Cooperating farmers must be one regarded by other farmers as approachable, easy to work with and actively involved in the farming community.

4. There is a wide array of good practice options available. In this project (short-duration) where immediate results are required, only two GP options were implemented and these were *"built on what is already existing".* For long-tern evaluation, GP options that require the need to change established practices can be implemented.

5. Climate change cannot be dealt with in isolation. For successful implementation of the good practice options, there should be proper coordination among government agencies like Department of Agriculture as the lead agency for food security, PAGASA for the climate and climate-related information, local government units for the dissemination of the technologies to the farmers, and research institutions and state universities and colleges for technology generation

6. Climate information proved to be a major factor in on-farm decision-making. Seasonal Weather Forecast (SCF) allows farmers to make informed decisions on the proper choice of crop, cropping schedule, levels of input and use of mitigating measures With critical production decisions founded on climate-related concerns, the provision of proper information and advisories by PAGASA has the potential of improving over-all farm productivity.

7. Close monitoring of the farming activities and exercising peer pressure have also helped in achieving the targeted outputs in terms of production.

8. Timely procurement of project inputs results to successful implementation of the project.

6.0 CONCLUSIONS

1. The project demonstrated that good practice options have a potentially significant role in maintaining or increasing farmer's income under variable and changing climatic conditions. However, relatively unique adaptation options are required to deal with relatively unique sets of physical and socio-economic conditions.

2. Climate and climate-related information were undoubtedly among the major factors to be considered by farmers in their crop production activities. With critical production decisions founded on climate-related concerns, the provision of proper information and advisories by relevant institutions like the Department of Agriculture and PAGASA has the potential of improving over-all farm productivity.

3. Farmer's involvement in participatory research is a very useful tool in developing adaptation options that will be adopted by a local community because these methods recognize that knowledge often lies with the farmers in the field, and that local considerations should be integrated into long-term planning

4. In the implementation of good practice options, technologies that are already known, inexpensive and accessible, require few resources, are easy to maintain and have a minimum negative impact on the environment should be utilized to initiate the process of adaptation. More demanding practices should be addressed and phased in once farmers have experienced the value added of investing into adaptation practices.

5. The results of the soil sampling undertaken as part of the GP option implementation highlighted the need for more systematic soil analyses, advice and support to farmers in order to reduce fertilization imbalances and ensure optimum crop growth conditions. This is a basic precondition for successful adaptation. The result of the soil analysis further showed that it is not an issue of lack of capital as identified by the farmers but an issue of more effective allocation of limited capital (fertilizer) resources. It is recommended for DA RFU 5 will address this issue up more systematically.

6. The issuance of three-month seasonal forecast for 2010 and 2011 by PAGASA, the formulation of the Farm Weather Bulletin by the Department of Agriculture RFU V, and the action of the Agricultural Technicians of the LGUs in communicating the information to the farmers are key elements that determines the success of the implementation of GP options. In the context of improving food security under changing climatic conditions, strong collaboration of these three agencies is recommended.

7. Sweet potato and cassava can be grown as an intercrop in coconut plantation and sweet potato varieties (SP 23 and SP 30) and the Golden yellow variety of cassava are highly suitable and can be recommended for cultivation.

8. Growing of crops of different growth durations on the same plot or on different plots reduce the risk of complete crop failure since different crops are affected differently by climate events.

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Appendix A

Description of the GP Options

A. Dry Season Cropping

Coconut Leaf Pruning	
1. Description	Coconut (*Cocos nucifera*) leaf pruning (CLP) involves the removal of the older leaves of the crop and maintaining only the desired number of leaves to reduce the effective transpiration surface area. In bearing palms, any of the 13, 18, or 23 functional upper leaves of the tree crown may be retained.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Drought
4. Environmental suitability	CLP may be applied to other younger stages of the coconut plant (nursery seedlings, seedlings for field planting, young plantings and immature, or non bearing palms) subjected to long, dry season. Leaf pruning may also be done on mango, coffee, and guava to make trees more drought resistant by removing unnecessary tree load (more balanced crown or canopy, a desirable “dwarfing effect” increasing lodging resistance). CLP is applicable to all areas.
5. Dysfunctional Consequences	Excessive CLP (not following the proper pruning levels) may result in critical or inadequate photosynthetic source, thus severely damaging the growth and producing marginal yield levels. Improper timing of the initial and subsequent CLP may result in minimal beneficial effects within the context of drought avoidance and resistance as the transpiration surface has been greatly reduced and significant volume of water from the soil storage already lost via evapotranspiration.
6. Contribution to disaster risk reduction	Adaptation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • Normal, healthy, and productive palms with at least 28 living leaves in the tree crown • Tree should not be more than 30 years old, with height less than 15 m • Regular harvesting at 30-60-day cycle

b. Support System

- Technology skills training of farmer-users on proper CLP
- Farm extension advisory and farm visits to monitor CLP
- El Niño advisory, particularly on rainfall amounts and distribution in all regions to determine the timing of CLP application in different localities

c. Equipment/Information

- Only appropriate harvesting poles and sharpened knives are needed to remove the leaves to be pruned at initial CLP and succeeding harvests

9. Contribution to disaster reduction/ prevention

- Reduces water requirement of the crop because of reduction of the transpiration surface (less functional leaves) and volume of water loss
- Minimizes crop damage, particularly on flowering, fruit set and yield
- Increases sunlight transmission below the tree canopy resulting in higher solar energy for and better yields of the intercrops (e.g., corn yield under coconut with CLP = 3.71 t/ha vs. coconut without CLP = 2.16 t/ha)
- Pruned leaves (9-15) during initial CLP can be used as mulching materials

Strip Intercropping	
1. Description	Strip intercropping involves multiple crops growing in side-by-side, narrow strips. There is a potential “biological efficiency” built into narrow strips. It has to do with the borders between the strips. That is where neighboring crops can use resources like light, fertility, and soil moisture in complementary ways. Properly managed strip intercropping improves both overall crop yields and soil conservation.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Drought
4. Environmental suitability	Increased diversity of the physical structure of plants in an strip intercropping system produces many benefits. Increased leaf cover in intercropping systems helps to reduce weed populations once the crops are established (Beets 1990). Having a variety of root systems in the soil reduces water loss, increases water uptake and increases transpiration. The increased transpiration may make the microclimate cooler, which, along with increased leaf cover, helps to cool the soil and reduce evaporation (Innis 1997). This is important during times of water stress, as intercropped plants use a larger percentage of available water from the field than monocropped plants.
5. Dysfunctional Consequences	
6. Contribution to disaster risk reduction	Adaptation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	• Farmer selects crops with varying resource requirements and growth patterns. • Soil is prepared based on crop needs, and crops are cultivated simultaneously in strips • To ensure effective planning, the following must be considered: spatial arrangements of plants, planting rates, and maturity dates.
9. Contribution to disaster reduction/ prevention	• Strip intercropping presents a large level of risk reduction for the smallholder. If one crop is entirely lost to pest or drought damage, the farmer may still harvest the other crop in the field. • Given the unpredictable rainy season and the different water requirements of each crop, planting many varieties of the same crop in an intercropped field gives the

farmer a better chance that some crops will survive.

Small Farm Reservoir (SFR)	
1. Description	The small farm reservoir (SFR) is an earth dam structure used to trap, harvest, and store rainfall and water runoff. It has a typical pond area of 500-1,500 m2 with a maximum embankment height of 4 m. The technology allows storing of rainfall and runoff during the wet season that can be used during the dry season. The SFR system has three basic components, namely: the catchment area; the reservoir; and the service area. High points bound the catchment area from which runoff drains into the reservoir. The reservoir is the portion where water is stored by an earth embankment. The service area is the portion of the farm being irrigated using the stored water from the reservoir
2. Location where it can be applied	• Guinobatan (Minto, Mauraro) • Buhi (San Ramon, Igbac)
3. Suitability by hazard	Drought and flooding due to heavy rainfall
4. Environmental suitability	The SFR unit can be constructed in sloping areas as long as its technical requirements are met. Potential sites must, therefore, be evaluated on a case-to-case basis.
5. Dysfunctional Consequences	• Improper SFR design and construction may render the unit useless—the reservoir may not store water to its maximum capacity. It may also cause breakage in the embankment thereby, creating a host of damages to the service area
6. Contribution to disaster risk reduction	Prevention and mitigation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • Loam, sandy loam, clay loam and sandy clay loam are ideal soil types for embankment construction. • Sufficient catchment area to harvest runoff must be present. • Farm size must be 0.5 ha or larger and must have no tenurial problems. • Topography must be undulating. • Unimodal type of climate, with defined wet and dry seasons, will give the highest benefits. • The average cost must be P8,000-12,000 per 1,000 m^3 of reservoir capacity.. b. Support System • Technical support for proper site selection and construction specifications should be provided. • Farmer adoptor should be trained on SFR

		utilization for optimum benefits c. Equipment/Information • Bulldozers should be provided • Manpower for manual labor should be made available, if heavy equipment is not available.
9.	Contribution to disaster reduction/ prevention	• SFR addresses the water requirement of rain fed farms, particularly those situated in sloping and undulating areas. • It allows for other income-generating activities such as dry season cropping, fish culture, agroforestry, and livestock raising. • It reduces the velocity of water flow from higher areas, thereby minimizing soil erosion and nutrient losses. • It aids in groundwater recharge. • It has a cheaper investment cost per hectare of service area than deepwells, run-of-the river systems, or surface pumps. • In times of heavy rainfall, the SFR unit aids in soil and water conservation. It reduces the velocity of water flow from higher areas, which in turn minimizes soil erosion and nutrient loss

Mulching		
1.	Description	Mulching is the process of spreading organic mulches from plant residues (leaves, stalks, crowns, roots, straws, woodchips, and sawdust) and synthetic materials (plastic sheets, aluminum foil, kraft paper, and newspaper) over the ground between crop rows or around tree trunks to protect bare soil. Mulches can be classified as transported or in-site and organic or manufactured. Transported mulches are vegetative materials that have been grown and harvested elsewhere and spread over the ground, while in-site mulches are plants that have completed their life cycle or have withered because of herbicide prior to crop introduction.
2.	Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3.	Suitability by hazard	Drought
4.	Environmental suitability	Mulching are highly applicable in drought-affected areas. Mulches can be applied in vegetable beds, gardens, orchards and post-rice crops.
5.	Dysfunctional Consequences	Plastic mulches, when used for long periods, may lead to poor soil.
6.	Contribution to disaster risk reduction	Adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	High
8.	Requirements for adoption	a. Minimum • Availability of mulching materials • Availability of labor for spreading mulches • Spade fork or shovel • Carrier/cart for easy handling and transport of mulching materials
9.	Contribution to disaster reduction/ prevention	• Reduces soil erosion • Improves moisture retention • Allows buildup of organic materials • Suppresses growth of weed by blocking out sunlight • Serves as insulator that keeps soil cool under intense sunlight and warm during cold weather

Tillage Practices (Zero and Minimum Tillage)		
1.	Description	Tillage practices refer to zero and minimum tillage that are being done to reduce soil and water losses. Garrity (1998) defines zero tillage as the complete elimination of mechanical seedbed preparation and weed control. It also refers to the practice of sowing crops directly into the residue of the previous crop without cultivation. In contrast, minimum tillage refers to the reduction in the frequency of tillage operation and the degree of cultivation in the crop production systems. Usually, only a single light cultivation of a limited area of the soil surface is used to prepare an area for planting.
2.	Location where it can be applied	• Guinobatan (Minto. Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3.	Suitability by hazard	Drought
4.	Environmental suitability	• Zero and minimum tillage are applicable in both lowland and upland agriculture. • In lowland areas with irrigation problems, the practice allows for moisture conservation. • For sloping areas with high risk of soil erosion during intense rainfall, the system provides stability to the soil.
5.	Dysfunctional Consequences	• Continued practice of zero/minimum tillage over a long period of time may cause soil compaction.
6.	Contribution to disaster risk reduction	Adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	Medium
8.	Requirements for adoption	a. Support system • Use of herbicides to suppress weed growth. The farmer must seek the service of extension workers or experts on the use of right herbicides in terms of economic and safety usage. b. Equipment/Information • Hoes and digging sticks • Dibbler, coulters, and row cleaners • Draft animals and disc plow for primary tillage operations • Information on integrated pest management (IPM)
9.	Contribution to disaster reduction/ prevention	• Lessens the direct impact of raindrops on bare soil, thus minimizing soil erosion • Minimizes degradation of organic matter and minimizes damage of soil structure • Slows down the mineralization rate leading to more sustained use of nutrients from the

organic matter

- Lessens labor cost for tillage and weeding
- Can be practiced in marginal soils that might not otherwise be feasible to cultivate.
- The practice of minimum tillage maintains the integrity of the soil making it more resistant to soil erosion, rainfall, and run-off.

Wide Row Spacing for Rainfall Multiplication		
1.	Description	Rainfall multiplication during dry period is the process of maximizing the use of available water for crop production. This involves crop planting with rows spaced three times the conventional spacing, but at higher density within the row. This system enables the sharing of moisture in the adjacent crops and effectively multiplying the rainfall and conserved moisture through reduced evaporation. Reduced area of planting and planting at higher density enable the maximum utilization of moisture for better crop yield during dry season.
2.	Location where it can be applied	• Guinobatan (Minto, Mauraro) • Buhi (San Ramon, Igbac)
3.	Suitability by hazard	Drought
4.	Environmental suitability	• Wide row spacing can be done in areas with low rainfall. • It can also be applied in areas with distinct wet and relatively long dry season.
5.	Dysfunctional Consequences	• In highly sloping/rolling areas, the wide spaces between rows, if not properly managed, may cause soil erosion during heavy downpours. • Low crop productivity may be encountered within densely planted rows, if proper nutrient management is not observed.
6.	Contribution to disaster risk reduction	Adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	High
8.	Requirements for adoption	a. Minimum • Demonstration of the technology in selected farms especially in drought-prone areas is needed. b. Equipment/Information • Information on how to effectively layout the area for rainfall multiplication should be provided.
9.	Contribution to disaster reduction/ prevention	• It enables the farmers to grow and harvest a good crop in a smaller area even with low rainfall.

Composting	
1. Description	Compost fertilizers are plant and animal wastes which have been degraded through composting. It involves a biological process of rotting organic waste materials such as rice straws, cogon, grasses, weeds, rice hulls, corn stalks, bagasse, and animal manure to become part of the soil and used as soil amendment or biofertilizer. Compost fertilizers improve the soil's physical properties that help conserve soil moisture during drought periods.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac, San Buena) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Drought
4. Environmental suitability	The use of compost fertilizers is applicable to both upland and lowland agriculture.
5. Dysfunctional Consequences	Compost fertilizers often contains only small amounts of nutrients needed by crops. For best results, complement its use with inorganic fertilizers.
6. Contribution to disaster risk reduction	Adaptation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • availability of materials such as rice straw and other farm waste, compost pen, animal manure, Compost Fungus Activator (CFA), cover for the compost rice, metal fork and shovel. • Good aeration, enough water, high temperature, suitable carbon to nitrogen ratio b. Support Systems • Technical assistance on where to get CFA
9. Contribution to disaster reduction/ prevention	• Contains active microorganisms that help in the degradation of undecomposed materials in the soil thereby, converting nutrients into readily available forms for plant use. • Improves the physical condition of soils by promoting soil aggregation and preventing surface crusting, thus, improving water infiltration, plant root penetration and soil aeration. • Conserves the nutrients contained in animal manure, sewage sludge, and similar materials. • Supplies the plant growth hormones not found in inorganic fertilizers. • Increases the buffering capacity of soils

and minimizes the adverse effects of soil acidity and alkalinity.

- Reduces cost of farm inputs.

Drought Tolerant Crops		
1.	Description	Drought tolerance refers to the species-specific adaptable capacity of the protoplasm to survive dehydration. Hence, the plant can withstand long periods of dryness or extreme water deficit or drought. There are already drought-tolerant varieties of okra (Smooth Green), mungbean (Pag-asa 7 and Pag-asa 9) pole sitao (UPL PS-1, UPL PS-2, and PSB PS-3, and cassava (UPL Cv-10 and UPL Cv-6). Proper planting schedule should, however, be observed to ensure availability of moisture during crop growth.
2.	Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac, San Buena) • Gubat (Ariman, Rizal, Bagacay)
3.	Suitability by hazard	Drought
4.	Environmental suitability	The use of drought resistant crops is applicable to both upland and lowland agriculture.
5.	Dysfunctional Consequences	No dysfunctional consequences
6.	Contribution to disaster risk reduction	Adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	High
8.	Requirements for adoption	a. Minimum • availability of planting materials
9.	Contribution to disaster reduction/ prevention	• It enables the farmers to grow and harvest a good crop in a smaller area even with low rainfall.

Artificial Insemination		
1.	Description	Artificial insemination (AI) is a good alternative to natural breeding, especially during prolonged heat or El Niño episodes. This management practice lessens the adverse effects of hot weather to reproductive performance of animals.
2.	Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac, San Buena) • Gubat (Ariman, Rizal, Bagacay)
3.	Suitability by hazard	Drought
4.	Environmental suitability	Applicable even at the peak of heat of the day during El Niño
5.	Dysfunctional Consequences	No dysfunctional consequences
6.	Contribution to disaster risk reduction	Adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	High
8.	Requirements for adoption	a. Minimum • availability of AI service • availability of quality breeding animals b. Support System • AI training • information materials on AI • source of good boar and semen c. Equipment/Information • vacuum bottles, gloves, gauze, catheter, stain, slides, microscope, water bath, beaker, graduated cylinder
9.	Contribution to disaster reduction/ prevention	Ensures high conception rates and large litters due to less stress on the animals as against natural breeding

“Supak” Method of Feeding for Cattle during Long Dry Periods	
1. Description	Cattle farmers in some areas of the country particularly, in Batangas practice an indigenous technology known as “supak” system or forced feeding scheme. Typically, 15-25 kg of fresh ipil-ipil leaves are gathered, finely chopped, and pounded. The leaves are then mixed with one-half kerosene can of water, 1 kg rice bran, and a little salt or molasses. This mixture is then force fed to animals, which exhibit depressed appetite due to effects of heat and humidity, using a bamboo sliced diagonally (refer to picture). Moreover, this practice serves as a feed supplementation strategy when forages and grasses are limiting. This indigenous forced feeding technique for cattle ensures that the animal’s nutrient requirements are met and has been proven to result in quality beef.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac, San Buena) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Drought
4. Environmental suitability	Applicable even at the peak of heat of the day during El Niño
5. Dysfunctional Consequences	Improper application may lead to vomiting of the animals, or worse, respiratory problems may occur
6. Contribution to disaster risk reduction	Adaptation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • availability of feed ingridients • tamed or trained animals b. Support System • deworming and parasite control practices c. Information/equipment • information on proper forced feeding • materials needed in preparation of the “supak” mixture, i.e., bamboo and basin.
9. Contribution to disaster reduction/ prevention	The technology can boost cattle performance to meet the desired weight on schedule even during the onset of El Niño.

B. Wet Season Cropping

Coconut Leaf Pruning
Strip Intercropping

Multi-storey cropping system (Coconut-based)	
1. Description	A large portion of area under coconut, representing over 20% of the available arable land in most producing countries, can be use more productively with either a single intercrop or a multi-storey cropping system. Mixed cropping or multi-storey cropping system is a cropping system of growing of two or more crops on the same coconut field in a year. Mixed cropping model is a combination of crops of different heights and having different types of root systems within the coconut soil environment. Example are coconut + papaya + pineapple, coconut + papaya + pineapple + peanut, coconut + coffee + papaya + pineapple, coconut + cacao + black pepper + pineapple, and coconut + banana + blackpepper.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Soil erosion, landslide
4. Environmental suitability	Upland and rain fed
5. Dysfunctional Consequences	No known dysfunctional consequences
6. Contribution to disaster risk reduction	Adaptation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • Plants shall be selected based on their adaptation to the climatic region and soil properties and capabilities. • Canopy covers will be balanced/ managed to optimize health and growth of plants in each story or level as determined by client objectives for each story of vegetation. b. Support System • Institutional and research support are required to identify suitable plant species in different layers within the multi-storied cropping system. • Selection of component crops for a

		coconut multistory scheme should guided by the local marketability, agronomic suitability and profitability of the cropping model. • Technical capacity building is required with regard to selection of optimal plant species, spacing, fertilizer schedule and other intercultural operations. • Institutional support is required to supply planting materials during appropriate season
9.	Contribution to disaster reduction/ prevention	• Reduces water and wind induced soil erosion • Protect growing crops from wind-borne soil particles • Increases farm resilience

Alley Cropping		
1.	Description	Alley cropping is a system where hedgerows of fodder tree legumes (*Gliricidia sepium, Leucaena leucocephala, Desmodium rensonii, and Flemingia macrophylla)* or shrub legumes (*Desmanthus virgatus)* or grasses (*Pennisetum purpureum*) are established across the slopes and along the contours of an area. Agricultural crops such as corn, upland rice, peanut, mungbean, and other vegetable can be grown as intercropped or in rotation in the alleys. formed between the hedgerows. The hedgerows provide biophysical barrier that minimizes soil erosion by trapping sediments at their base and slowing down surface runoff. These also contribute green leaf manure for food crops grown in the alleys as these are pruned regularly and the herbage is returned to the soil (PCARRD, 1996).
2.	Location where it can be applied	• Guinobatan (Minto, Mauraro, Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3.	Suitability by hazard	Typhoon and soil erosion due to heavy rain
4.	Environmental suitability	Degraded hillylands/sloping upland farms. Celestino (1985) suggested the following guide based on the rule that the steeper the slope, the closer the hedgerow should be: Slope (%) — Interval (m) 10 – 15 — 25 – 30 16 – 25 — 20 – 24 41 – 60 — 10 – 14 > 61 — 4 - 9
5.	Dysfunctional Consequences	• When right contour lines are not properly determined using an A-frame, soil erosion will not be minimized. • When hedgerows are not trimmed, shading of alley crops will occur leading to a decrease in yield. • Uprooting of hedgerows will lead to continuous water flow in the wrong direction that will result in soil erosion.
6.	Contribution to disaster risk reduction	Prevention and adaptation
7.	a. Agro-ecological suitability	High
	b. Economic and social feasibility	High
	c. Increased resilience against hazard	High
	d. Does not contribute to GHG	High
8.	Requirements for adoption	a. Minimum • Knowledge of biophysical and socio-

	economic condition of the area. The biophysical assessment shall include among others the topography, vegetation, climatic condition and soil characteristics of the area. Socio-economic assessment will cover the predominant farming systems of the nearby communities, customs, means of livelihood, and the availability of social, economic, and market services in the area. These information will help farmers decide what particular crops/systems are to be planted in the area. • Availability of planting materials for the hedgerows • Labor requirement for the hedgerow establishment and planting of alley crops b. Support Systems • Technical assistance from experts. Farmers should link with competent extension workers in the area or experts from DA, DENR or other agencies to ensure proper and efficient application of the technology. c. Equipment/Information • A-frame. A simple device made up of three wooden or bamboo poles with a levelling machine attached is required. In the absence of an A-frame, use carpenters water level hose. • Leguminous seeds/fruit tree seedlings and seeds for alley crops
9. Contribution to disaster reduction/ prevention	• Reduces soil loss to a tolerable level of less than 10 t/ha per year • Increases crop yield and farm income • Less dependence on inorganic fertilizers

Vetiver Grass Technology	
1. Description	Vetiver is a fast-growing perennial grass which grows up to a meter or more and has massive root system that can provide the structural strength needed in a relatively short period of time. This extensive and thick root system which reaches about 2-3 m depth binds the soil, as well as makes it very difficult to dislodge. Vetiver is also greatly tolerant to drought and flood. New roots are developed from nodes when buried by trapped sediment. Vetiver continues to grow in the new ground level which eventually forms terraces, if trapped sediment is not removed.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro Masarawag) • Buhi (San Ramon, Igbac) • Gubat (Ariman, Rizal, Bagacay)
3. Suitability by hazard	Typhoon and soil erosion due to heavy rain
4. Environmental suitability	Suitable in open areas of flat land to hillylands, drought- and flood-prone areas, riverside and roadside
5. Dysfunctional Consequences	Inappropriate techniques may cause failure of vetiver planting. For example, immature or poor-quality planting materials will not adapt to poor and harsh conditions.
6. Contribution to disaster risk reduction	Prevention and mitigation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • availability of vetiver grass • Areas without shade b. Information • training, demonstration and technical assistance on how to grow vetiver grass and its application for slope stabilization, erosion, and flood control • Experiences of vetiver farms in the Philippines
9. Contribution to disaster reduction/ prevention	• The practice reduces soil erosion and conserves the rain water effectively. • The fertility status can be improved due to presence of organic materials. • Vetiver has a myriad of on-farm and other uses besides those mentioned above, including, for example • use as a living fence and boundary marker.

- The leaves and roots of vetiver can be used for an extensive range of handicrafts and are excellent for thatching.
- The young leaves are palatable to livestock and have about the same nutritive value as Napier grass (*Pennisetum purpureum*). It is used domestically in cooking and insect control and also has medicinal properties.

Sloping Agricultural Land Technology (SALT - 1)	
1. Description	SALT is a diversified farming system which can be considered agroforestry since rows of permanent shrubs like coffee, cacao, citrus and other fruit trees are dispersed throughout the farm plot. The strips not occupied by permanent crops, however, are planted alternately to cereals (corn, upland rice, sorghum, etc.) or other crops (sweet potato, melon, pineapple, castor bean, etc.) and legumes (soybean, mungbean, peanut, etc.). This cyclical cropping provides the farmer some harvest throughout the year. SALT also includes planting of trees for timber and firewood on surrounding boundaries. Examples of tree species for "boundary forestry" in SALT are mahoganies, casuarinas, sesbanias, cashew nuts, pili nuts, etc. The experience of the Mindanao Baptist Rural Life Center in Bansalan, Davao del Sur, shows that this technology can help reduce soil erosion four times, increase the yield of crop five times, and improve income six times.
2. Location where it can be applied	• Guinobatan (Minto, Mauraro) • Buhi (San Ramon and Igbac) • Gubat (Ariman, Rizal)
3. Suitability by hazard	Typhoon and soil erosion due to heavy rain
4. Environmental suitability	Uplands, hilly lands and agroforestry farms
5. Dysfunctional Consequences	No known dysfunctional consequences
6. Contribution to disaster risk reduction	Prevention and mitigation
7. a. Agro-ecological suitability	High
b. Economic and social feasibility	High
c. Increased resilience against hazard	High
d. Does not contribute to GHG	High
8. Requirements for adoption	a. Minimum • Locating and developing contour lines. After the contour lines have been located and marked, plow and harrow these for planting. Prepare 1-m wide contour lines. • Planting contour lines with leguminous shrubs and trees. On each contour line, make two furrows 1/2 m apart. Plant at least 2-3 seeds per hill at a distance of 1/4 inch between hills. Cover the seeds firmly with soil. • Cultivating and planting strips alternately. To prepare the soil for planting before the nitrogen-fixing trees (NFTs like *Gliricidia sepium* and *Leucaena leucocephala*) are fully grown, plant alternately on strips 2, 4, 6,

8, and so on. Alternate cultivation will prevent erosion because the unplowed strips will hold the soil in place.

- Planting long-term crops on every third strip and land borders. Permanent crops may be planted at the same time the seeds of NFTs are sown. Only the spots for planting are cleared and dug; later, only ring weeding is employed until the NFTs are large enough to hold the soil so full cultivation can begin.
- Planting short-term crops on every first and second strip. Plant short-and medium-term crops between strips of permanent crops as source of food and regular income, while waiting for the permanent crops to bear fruits. Plant short crops away from tall ones to avoid shading.
- Trimming the contour hedgerows regularly. Cut down continuously growing NFTs to 1 m when these begin to shade crops. Pile cut leaves at the base of the crops to serve as fertilizer. Gradually decrease the use of commercial fertilizer if the crops already look healthy and productive.
- Rotating food and cash crops. A good way of crop rotation is to plant grains, tubers, and other crops on strips where legumes were previously planted and vice versa. This practice will help maintain the fertility and good condition of the soil. Conduct weeding and control pest and insect regularly.
- Maintaining the SALT-1 farm. Aside from providing adequate food and sufficient income, SALT controls soil erosion by planting double thick rows of NFTs and forming natural terraces along the contour lines of the hill. As farming the sloping land progresses, keep gathering and piling up straws, stalks, twigs, branches, leaves, rocks and stones at the base of the rows of NFTs.

b. Support System

- Technical and marketing assistance

c. Recommendation

- Use NFTs such as *Flemingia congesta, Gliricidia sepium (madre de cacao or kakawate), Leucaena diversifolia* (acid-tolerant ipil-ipil), and *Desmodium rensonii.*

	• Prefer short- and medium-term crops such as grains (corn, upland rice, sorghum), tubers (camote, cassava, gabi), and other crops (pineapple, castor bean, peanut, mungbean, melon).
9. Contribution to disaster reduction/ prevention	• Simple, applicable, low-cost, and a timely method of farming the upland and hillylands • Designed for farmers with few tools, small capital, and little knowledge in agriculture • Traditional farming practices can be integrated in the SALT system • Controls soil erosion • NFTs will continue to grow and overshadow the crop area. By the time the land is reverted to cultivation, the soil has already been enriched by the large amount of leaves from NFTs and erosion is minimized. • Provides additional source of income from sale of firewood or charcoal

Appendix B

FARM ACTIVITY RECORD

GP Option: Coconut Leaf Pruning
Commodity: Sweet Potato
Season: Dry Season 2011
Barangay:
Name of Farmer:

For inquiries, please contact
DR. LUIS O. AMANO (0908-620-4449)

ACTIVITY	PROCEDURE	DATE	NO. DAYS/HOURS	WEATHER CONDITION	COMMENTS AND OBSERVATIONS
1. Leaf pruning	• Prune leaves of coconut trees from Leaf Rank 19 (i.e.supporting the tender "buko" nuts down to the oldest leaf at harvest time) using a harvesting pole and scythe. • Retain about 0.75 cm of leaf fronds (supporting the developing nut/bunches) to remain attached to the trunk.				
2. Land preparation	• Plow and harrow the soil twice or until soil is loose and friable. • Form ridges of about 30 centimeters high by using a carabao-drawn mold-board plow with a distance of about 100 centimeters between ridges.				
3. Planting	• Before planting, soak the vines in Ditane at the rate of 1 tbsp per 16 liters of water. • Plant vine at one cutting per hill diagonally on top of ridges during the rainy season to prevent the crop from being soaked under water, or in the furrows during dry season so that				

	moisture reserve in the soil can be utilized by the crop. • Expose 2-3 leaves at the tip at a distance of 25 cms between hills.				
4. Fertilizer application	• Apply 14-14-4 at the rate of 8 grams per hill at planting time at 8-10 centimeters from the base of the plant cover subsequently with soil.				
5. Weeding and cultivation	• If weeds are abundant, shallow cultivation is done 10-12 days after planting. • Hilling-up cultivation is done at 25-30 days after planting.				
6. Harvesting	• Most of the recommended varieties are ready for the harvest 110-130 days after planting (DAP). • Harvesting can be determined by root sampling and if desired size has been attained, harvesting can be done anytime. • Before harvesting, cut and roll the vines like a mat, fork, hoe or, pass a plow below the ridges, then hand pick the roots. Handle the roots carefully to minimize injury. • Sort out damaged or bruise roots from undamaged ones.				

FARM ACTIVITY RECORD

GP Option: Coconut Leaf Pruning
Commodity: Cassava
Season: Dry Season 2011
Barangay:
Name of Farmer:

For inquiries, please contact
DR. LUIS O. AMANO (0908-620-4449)

ACTIVITY	PROCEDURE	DATE	NO. DAYS/HOURS	WEATHER CONDITION	COMMENTS AND OBSERVATIONS
1. Leaf pruning	• Prune leaves of coconut trees from Leaf Rank 19 (i.e. supporting the tender "buko" nuts down to the oldest leaf at harvest time) using a harvesting pole and scythe. • Retain about 0.75 cm of leaf fronds (supporting the developing nut/bunches) to remain attached to the trunk.				
2. Land preparation	• Prepare field by plowing two to three times, followed by harrowing when there is enough soil moisture. Make ridges with 15-20 cm high and 75-100 cm distance between furrows.				
3. Planting	• Plant cuttings in furrows one meter apart, each cutting set at 0.75 to 1 meter apart between ridges and 0.50 to 0.75 cm between hills. • Plant in a slanting position at an angle of 45 when the soil is fairly dry, and in vertical position when planting is done during the wet season, at least 15 cm of the				

	cutting should be buried or covered with soil. • Replant missing hills 2 weeks after planting				
4. Fertilizer application	• Apply 14-14-14 at the rate of 175 grams one month after planting 10 centimeters depth and 20 centimeters away from the base of the plant and cover subsequently with soil. • The use of compost or organic fertilizer is highly recommended.				
5. Weeding and cultivation	• At least 80% of failed cropping of cassava is due to inadequate weeding. • Cultivate when weeds begin to grow. Weed the plant within two (2) months after planting. If possible, do off barring and spot weeding 3-4 weeks after planting to effectively control weeds. • Then weed the plant 4-5 weeks after planting. Hill-up ridges 7-8 weeks after planting followed by spot weeding.				
6. Harvesting	• Cassava is a highly perishable crop. It starts to deteriorate as early as one to three days after harvest see harvest cassava at the right time and in the proper way. To prolong its shell-life, store it properly.				

	• Harvest cassava at full maturity or 6-7 months after planting. Harvesting too early results in low yield and poor eating quality. • Do not harvest cassava right after a heavy rain or when the soil is too wet.				

FARM ACTIVITY RECORD

GP Option: Strip Intercropping
Commodity: Eggplant – Snap bean
Season: Dry Season 2011
Barangay:
Name of Farmer:

For inquiries, please contact
DR. LUIS O. AMANO (0908-620-4449)

ACTIVITY	PROCEDURE	DATE	NO. DAYS/HOURS	WEATHER CONDITION	COMMENTS AND OBSERVATIONS
1. Land preparation	• Prepare the land thoroughly by plowing twice, each plowing followed by one harrowing. Thorough land preparation minimizes growth of weeds, enhances water retention and ensures good germination of seeds and growth of seedlings.				
2. Seedling production	Eggplant • Prepare five seedbed measuring 1 x 1 m each. Incorporate 1 kg fully decomposed chicken manure and 300 g carbonized rice hull/m^2. • Wet the seedbed and make shallow line 5 in a part. Sow thinly 20-25 g of seeds and cover lightly with soil. • Mulch with rice hull or chopped rice straw. Provide partial shade during the dry season and rain shelter during the wet season. Water regularly. • Harden seedlings one week before transplanting by decreasing the frequency of watering and by				

	exposing fully to sunlight to minimize transplant shock. Transplant at four weeks after emergence.				
3. Planting/ Transplanting	Eggplant • Make furrows 1 m apart. Spread fully decomposed manure along rows at 1 kg/linear meter or 500g/hill. Apply complete fertilizer (14-14-14) at 10-15g/hill and cover lightly with soil. • Irrigate area before transplanting. Plant 1 seedling/hill at a distance of 0.5-1.0 m depending on variety. Snap bean • Make furrows 1 m apart. Spread fully decomposed manure along rows at 1 kg/linear meter or 500g/hill. Apply complete fertilizer (14-14-14) at 10-15g/hill and cover lightly with soil. • Irrigate area before transplanting. Plant 1 seedling/hill at a distance of 0.5-1.0 m depending on variety.				
4. Crop establishment	Eggplant • Provide 1 m- long stake to prevent lodging. Irrigate by furrow every 7-14 days depending on the season and the soil type.				

	Snap bean				

	• Construct A-type or fence type trellis using bamboo sticks or wire # 16 and plastic twine for vine development.				
5. Fertilizer application	Eggplant • Sidedress with 46-0-0 at 10 g/hill every two weeks during the vegetative stage. Use equal parts 46-0-0 and 0-0-60 at the start of fruiting. Snap bean • Before planting, apply uniformly 10 kgs of 14-14-14 and 2 sacks of organic • Sidedress 15 kgs of 14-14-14 30 days after planting				
6. Weeding and cultivation	• Pull out weeds regularly up to 3rd week • Hill-up after 3-4 weeks to cover the sidedress fertilizer and to suppress weed growth. • Spot weeding is recommended				
7. Harvesting	Snap bean • Snap bean can be harvested 60-70 days after planting and can be handpick 3-5 days interval up to 10 harvest. • Harvest early in the morning (6-8 am) before the heat of the sun becomes intense to avoid weight loss.				

	Eggplant • Harvest mature fruits which are				

	shiny and still soft. More frequent harvest can reduce damage from fruit borers. harvest all fruits including deformed and damaged one to prevent spreads of pest and diseases. Harves ting can last for 3-6 months.				

FARM ACTIVITY RECORD

GP Option: Strip Intercropping
Commodity: Glutinous corn – Pole Sitao
Season: Dry Season 2011
Barangay:
Name of Farmer:

For inquiries, please contact
DR. LUIS O. AMANO (0908-620-4449)

ACTIVITY	PROCEDURE	DATE	NO. DAYS/HOURS	WEATHER CONDITION	COMMENTS AND OBSERVATIONS
1. Land preparation	• Prepare the land thoroughly by plowing twice, each plowing followed by one harrowing. Thorough land preparation minimizes growth of weeds, enhances water retention and ensures good germination of seeds and growth of seedlings.				
2. Planting	Note: Four rows of glutinous corn and four rows of pole sitao Glutinous corn • After the last harrowing and when there is adequate moisture, lay-out furrows at 75 cm apart at a depth of approximately 8 cm. • Plant two (2) seed/hill at a distance of 25 cm between hills at about 3-5 cm deep when the soil moisture is just right for planting, then cover the seeds with soil. • Thin seedlings to one plant per hill about 7-10 days after emergence.				
	Pole sitao				

	• Space the furrows with 100 cm interval • Sow 2-3 seeds per hill 30-40cm apart (10-12 kg of seeds are needed per hectare). • Plant in furrows and over the seed with a thin layer of fine soil.				
3. Crop establishment	Pole sitao • Construct a side trellis as soon as the seed germinates. • Layout 2.5m long and 2-2.5cm wide ipil-ipil, bamboo, or kakawate poles 3-4 m apart within the rows. • Connect the poles horizontally by wire (#16 or #18) at the top, middle and bottom portions in every row. • Tie the top wire to the stakes at the end of the rows to make the poles stable. • Cut abaca twine or synthetic straw and tie them vertically from the top to bottom wires in every hill.				
4. Fertilizer application	Glutinous corn • Mix 2.5 kgs urea and 20 kgs 14-14-14 and broadcast uniformly before planting • Apply 5 kgs urea in narrow band 4-6 cm from the base of the plant at 30 days after planting				

	Pole sitao				

	• Before planting, apply uniformly 10 kgs of 14-14-14 and 2 sacks of organic				
5. Pest and disease control	Glutinous corn • At 45-53 DAP monitor and spray any recommended insecticide if necessary to control corn borer (2x if needed) 1st spraying at 10-20% flowering then follow-up at 80-100% flowering. • Detasseling 75% of the corn plants may be done to reduce incidence of corn borer. . Pole sitao • Use insecticide only when needed and do not use insecticide with red or yellow lines when the plants begin to bear pods. • For pod borer and aphids, spray with native hot pepper juice mixed with water (100g of pepper per 16 liters of water)				
6. Weeding and cultivation	• Pull out weeds regularly up to 3rd week • Hill-up after 3-4 weeks to cover the sidedress fertilizer and to suppress weed growth. • Spot weeding is recommended				
7. Harvesting	Glutinous corn				

	• Glutinous corn can be harvested 75-80 days after planting Pole sitao • Harvest the pods 7-10 days after the flowers have dried up. • Harvest every 2-4 days to prolong flowering at fruiting of the plants				

Appendix C

Result of Soil Analysis

Department of Agriculture
Regional Field Unit V
REGIONAL SOILS LABORATORY
Del Rosario Naga City
Tel No. (054) 4758204

Dr. LUIS AMANO
3UCAF, Guinobatan, Albay
escription/Location: Soil / Buhi, CS;Guinobatan, Albay

Date Submitted: 6/15/2010
Date Finished: 7/14/2010

RESULT OF ANALYSIS

FARMER	PROVINCE	MUNICIPALITY	BARANGAY	pH	N	P	K	Ca	Mg	Na	Zn	Cu	Fe	Mn
					(%OM)	(ppm)	(meq/100g soil)				(ppm)			
DOLORES PARCERO	CAM. SUR	BUHI	SAN RAMON	5.91	6.76	3.08	0.34	7.09	1.34	0.15	1.15	2.55	64.8	18.
LIM JOVEN	CAM. SUR	BUHI	SAN RAMON	5.78	6.64	2.42	0.55	12.44	1.75	0.14	1.51	1.83	53.6	14.6
NESTOR BALATONG	CAM. SUR	BUHI	SAN RAMON	5.8	4.82	4.3	0.58	13.81	2.21	0.16	2.3	2.71	118.6	22.1
JULIE HERMOSA	CAM. SUR	BUHI	SAN RAMON	5.48	5.79	2	0.79	9.2	1.92	0.16	2.12	2.5	89.8	16.4
SOCORRO CEDERIA	CAM. SUR	BUHI	SAN RAMON	5.56	4.48	3.22	0.25	11.41	2.3	0.17	3.64	3.01	128.2	28.
JESUS CEDERIA	CAM. SUR	BUHI	SAN RAMON	5.86	4.98	2.54	0.52	12.76	2.35	0.19	3.47	1.8	75.4	17.9
RAUL MORANTE	CAM. SUR	BUHI	IGBAC	5.53	2.59	8.06	0.26	4.74	1.48	0.16	3.04	3.51	67.8	82.7
ROMULO LLATER	CAM. SUR	BUHI	IGBAC	5.25	3.76	2.54	0.81	6.54	1.96	0.16	7.06	4.47	72.4	176.
SAN PEDRO	CAM. SUR	BUHI	IGBAC	5.24	3.9	2.14	0.86	7.51	1.85	0.19	6.86	3.77	64.6	117.6
DANILO ESQUILLO	ALBAY	GUINOBATAN	MASARAWAG	5.79	3.52	0.92	0.05	2.18	0.23	0.05	2.27	2.38	44.6	1.4
ROGELIO PALLEN	ALBAY	GUINOBATAN	MASARAWAG	5.98	4.24	2.54	0.23	2.99	0.53	0.1	2.77	1.86	21.9	2.
VICTORIA ORUBIA	ALBAY	GUINOBATAN	MASARAWAG	6.23	3.89	13.44	0.36	3.1	0.62	0.19	3.78	1.68	29.3	2.
RODITO MUJAR	ALBAY	GUINOBATAN	MASARAWAG	5.57	3.98	0	0.06	2.14	0.23	0.12	2.29	3.16	46.4	1.
ARNOLD OFRECIO	ALBAY	GUINOBATAN	MINTO	5.54	2.95	20.32	0.72	6.24	1.19	0.23	7.9	4.85	96.6	7.0
GIUILLERMO CONDES SR.	ALBAY	GUINOBATAN	MINTO	5.26	3.86	74.72	0.49	5.28	0.9	0.11	6	3.8	74.8	2.6
LUZ CARAANG	ALBAY	GUINOBATAN	MAURARO	5.67	3.55	6.72	0.26	10.19	2.76	0.23	6.22	5.61	71	76.0
SIGFREDO BABOL	ALBAY	GUINOBATAN	MAURARO	5.8	2.7	15.46	0.4	8.91	1.72	0.24	6.02	4.97	91.4	46.5
MANUEL MILLARES	ALBAY	GUINOBATAN	MAURARO	5.6	5.08	36.74	1.29	14.48	3.09	0.17	8.6	8.8	136.8	92.1
ARIAN NABO	ALBAY	GUINOBATAN	MAURARO	5.19	3.3	6.98	0.3	9.9	2.73	0.18	3.33	4.82	85.2	85.4
ARLENE NABO	ALBAY	GUINOBATAN	MAURARO	5.77	4.29	10.08	0.32	20.66	3.49	0.27	3.84	3.75	39.8	63.5
EDDIE PACIFICO	ALBAY	GUINOBATAN	MAURARO	5.21	2.78	18.56	0.87	6.74	2.11	0.15	3.11	4.09	77.8	46.
CARLITO NABO SR.	ALBAY	GUINOBATAN	MAURARO	5.51	3.5	6.72	0.9	7.8	2.36	0.28	4.2	4.43	73.6	36.5

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Del Rosario Naga City
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escription/Location: Soil / Gubat, Sorsogon

Date Submitted: 6/15/2010
Date Finished: 7/14/2010

RESULT OF ANALYSIS

FARMER	PROVINCE	MUNICIPALITY	BARANGAY	pH	N	P	K	Ca	Mg	Na	Zn	Cu	Fe	Mn
					(%OM)	(ppm)	(meq/100g soil)				(ppm)			
ANGEL ESPINEDA	SORSOGON	GUBAT	RIZAL	5	4.13	1.6	0.06	3.5	0.66	0.27	0.76	0.16	58.8	2.3
JOSE ESPINEDA	SORSOGON	GUBAT	RIZAL	5.36	3.49	2.42	0.24	5.16	1.54	0.14	1.08	0.11	26.48	2.9
CARLOS PURA	SORSOGON	GUBAT	RIZAL	5.57	2.23	1.88	0.31	2.26	0.7	0.09	0.51	0.07	15.1	2.7
EFREN GALAO	SORSOGON	GUBAT	RIZAL	5.42	2.12	10.08	0.75	3.51	1.61	0.11	44	0.16	32.48	5.5
DANILO ENCILA	SORSOGON	GUBAT	RIZAL	4.4	1.79	7.12	0.11	3.89	1.77	0.23	7.22	2.99	243.8	52.
IRENEO PEGASON	SORSOGON	GUBAT	RIZAL	4.62	4	0.8	0.7	4.74	2.58	0.16	3.73	1.53	23.7	250.4
MATEO FERERRAS	SORSOGON	GUBAT	RIZAL	4.84	3.26	0.8	0.04	1.28	0.35	0.09	1.11	0.31	36.54	5.6
JOEY DICHOSO	SORSOGON	GUBAT	BAGACAY	6.13	3.57	14.12	0.1	26.56	1.18	0.12	6.6	2.27	55.2	124.
PABLITO ESPINOLA	SORSOGON	GUBAT	BAGACAY	5.35	4.83	1.6	0.12	5.15	3.01	0.18	3.53	1.7	32.02	298.
WILLIAM ESCORTA	SORSOGON	GUBAT	BAGACAY	5.98	1.79	12.5	0.21	13.39	6.62	0.16	2.58	3.44	134	92.5
RUBIO ENGAY	SORSOGON	GUBAT	BAGACAY	6.57	1.02	3.9	0.08	10.18	7.42	0.11	1.8	1.76	50.2	27.2
PEDRO EREÑO	SORSOGON	GUBAT	ARIMAN	6.1	5.17	32.84	1.14	17.95	3.21	0.18	30.5	11.3	73.2	196.4
PEDRO EREÑO	SORSOGON	GUBAT	ARIMAN	4.95	2.89	0.8	0.45	5.12	2.31	0.32	6.48	1.23	48.2	206.6
JUAN ESPEÑO	SORSOGON	GUBAT	ARIMAN	5.2	1.54	0.66	0.13	4.49	1.6	0.26	2.09	1.16	79.4	40.9
LEA ANDRACA SANTOS	SORSOGON	GUBAT	ARIMAN	5.26	2.53	4.3	0.03	2.61	0.42	0.13	1.11	0.47	22.68	3.5

by:

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