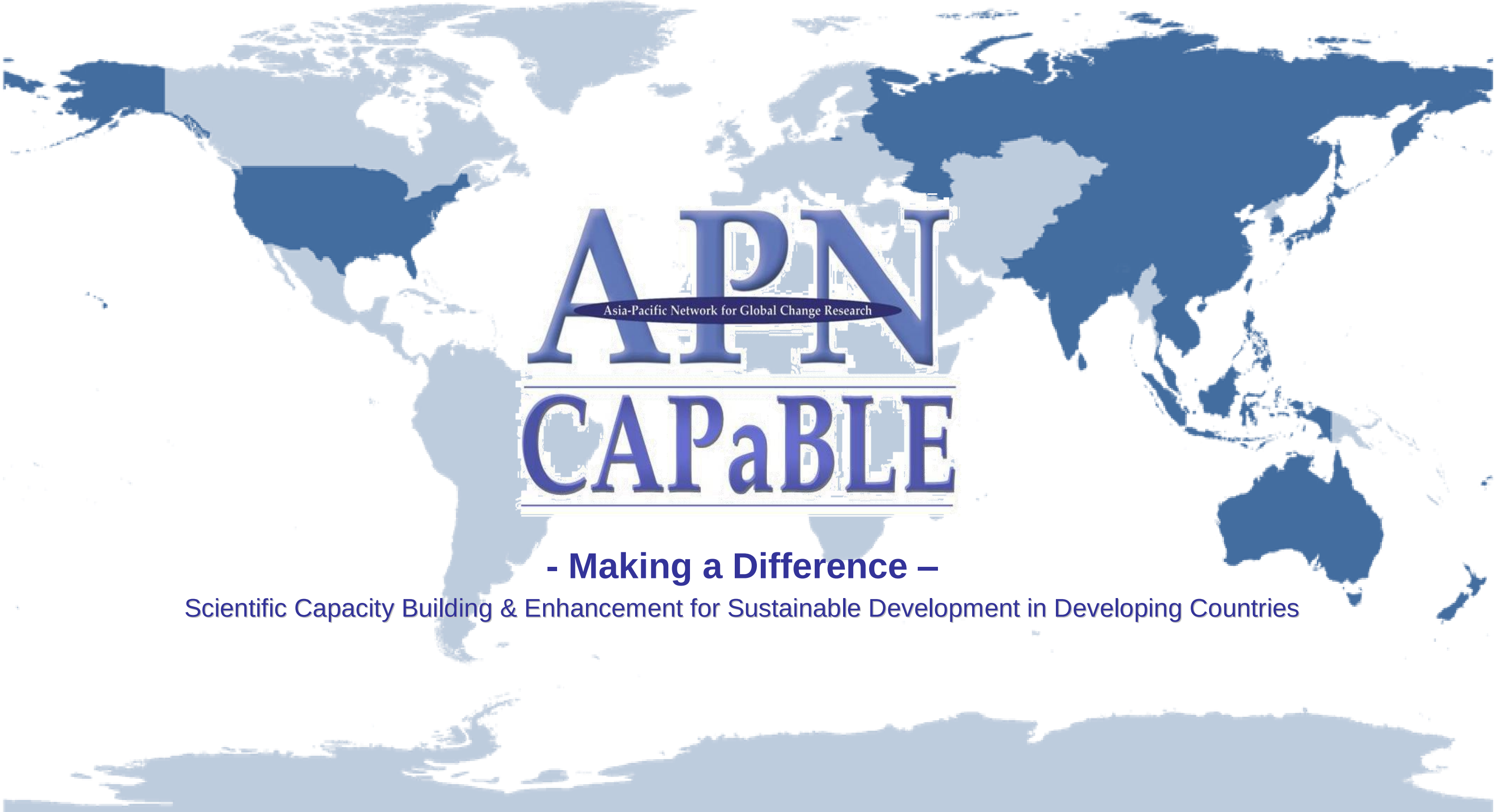
FINAL REPORT for APN PROJECT

Project Reference Number: CBA2011-15NSY-Wagan

Capability Enhancement of the Local Experts from State Universities and Colleges in Assessing Climate Change Vulnerability and Adaptive Capacity of Different Crop-based Farming Systems



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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

This is a capability enhancement project where agricltulture experts from various state universities and colleges (SCUs) in the Philippines were provided with knowledge on climate change and effects on Philippine agricultural systems and were equipped with skills on community-level vulnerability assessment which are requisites for a more relevant role in planning /implementing site specific adaptation measures for agriculture and the farming communities facing climate change adversities. The project enabled participating SCUs to identify site-specific adaptation measures for agriculture and disseminate information to local policy makers, local leaders, farming community and other stakeholders about the vulnerability of production systems in their regions. The community-based vulnerability assessment methodology for agriculture (developed by the proponents form the ASC-UPLB) called the VAST-Agro, was refined through this project. The VAST-Agro is a methodology that enables one to capture local experiences on climate hazards and effects on local food production, gauge local technological and institutional capability of coping with climate adversities and provides a vulnerability index for local policy-makers to use in prioritizing interventions for climate change adaptation. Through this project, vulnerability assessment of crop production areas in the country including vegetable highlands of Benguet province, mango production areas in Pangasinan and Iloilo provinces, banana production areas in Mindoro and Bukidnon provinces and coconut-based farming area of Quezon were done by the proponents and the participating agricultural SCUs.

Amount received and number years supported

The Grant awarded to this project was: US$ 37,000 for Year 1 and 6 months (extension)

Activity undertaken

The project involved series of activities where both the proponents and the participating agricultural state agricultural state universities and colleges from different regions in the country, learned from each others' experiences on climate change research and agricultural development. Through the activities conducted, the proponents also had the opportunity to interact with national and international experts who have advanced in the field of climate change research.

The methodology called the VAST-Agro or the Vulnerability and Adaptive Capacity Assessment for Different Agro-ecosystem was used in different crop-based farming systems by the proponents and the six participating agricultural state universities and colleges from different regions in the country. Before this was done though, the twelve participants, i.e. two agriculture specialists each from the six state universities and colleges were first provided with the following: A. sensitization course on adaptation strategies for enhancing resilience of different agroecosystem to climate change which is a series of lecture-discussion on climate change, climate trends in the Philippines, likely impacts on the Philippine agricultural systems and available farming systems technologies that may used to address climate change impacts in different agroecosystems; B. Training-workshop on VAST-Agro: Basic components, characteristics, data gathering techniques, field implementation and computation of the vulnerability index; This involved both classroom exercises (role play) and field exercises on the preparation and use of the VAST-Agro tools for data collection. The field exercise was conducted in three farming villages of Lucban Quezon. Results of the vulnerability assessment were presented to the respective communities. After this field exercise, a planning-workshop was conducted to further prepare the participants on vulnerability assessment using the VAST-Agro. This involved further discussion on the VAST agro tools and methods of data gathering, consolidation of the information gathered, formal presentation of the results, and planning for actual field work like identification of materials needed, anticipated expenses and timeline of activities; C. Vulnerability Assessment of different production areas in the country using the VAST-Agro by the proponents together with the participating agricultural state universities. The areas assessed included highland vegetable/strawberry production areas; banana and mango growing areas and coconut-based farming area. D. Report writing, E. Consultation-workshop, finalization and F. presentation of the results in a forum with wider group of crop experts and representatives form national agencies. G. Information Dissemination through publications, paper presentations in seminars and conferences.

Results

This project was able to impart to a core group of agriculture experts (12) from various agricultural state universities and colleges (SCUs), located in the Luzon, Visayas and Mindanao regions of the country, updated information on climate change in the Philippines and its anticipated impacts on the Philippine production systems, national action/R&D Plans for climate change adaptation as well as available farming systems technologies that may be used for enhancing resilience of agriculture production to climate change adversities.

The project also provided opportunity to involve agriculture experts from various agricultural state universities and colleges in the refinement and use/application of a community- based vulnerability assessment methodology called the VAST-Agro in different areas in the Luzon, Visayas and Mindanao regions of the country covering mango, banana, highland vegetable-growing areas and coconut-based farming systems area.

The results of the vulnerability assessment in different production areas can be used by the SCUs for further designing or implementing research and development activities on adaptation measures for agriculture in their locality. The knowledge and skills on the use of the methodology obtained through the training-workshop conducted by this project can also be used by the SCUs in identification of research and development interventions for climate change adaptation of agriculture in other production areas in their locality and can also be used for educating students and other researchers in their respective universities on community-level vulnerability assessment.

Results of the vulnerability assessment in different areas in the country provided a venue to inform local planners, development workers and farming communities on the vulnerability of their farming systems to changing climate and the need for site specific/local adaptation measures for agriculture.

A user manual on the VAST-Agro methodology was written, revised and reproduced. The VAST-Agro Methodology has 3 components: assessment of exposure to climate hazards, assessment of biophysical and socioeconomic sensitivity and assessment of technological and socio-economic capability. This user manual explains every step in the methodology including the tools needed for collecting data/information from the community respondents as well as techniques for data collection; it shows how to calculate indices for exposure, sensitivity, adaptive capacity to come up with the vulnerability index for each area assessed. The user manual is in printed form with a CD containing the VAST-Agro templates for calculating the vulnerability index. Copies will be provided to the participating SCUs and other government agencies /potential and target users of the methodology.

The project provided opportunity for the proponents to interact and learn from fellow researchers from SEA-START and Rice Department, Thailand; Research Center for Geotechnology-LIPI, Bandung and CCROM-SEAP –Bogor, Indonesia their works and experience on vulnerability assessment and the relevance of their works to climate change adaptation. Commenst and suggestions on the methodology VAST-Agro were also obtained.

Further information dissemination about the use of community level vulnerability assessment in agriculture and its relevance to identification/implementation of interventions for climate change adaptation was also accomplished through the seminars, forum, international conferences and contribution to newsletters.

Relevance to the APN Goals, Science Agenda and to Policy Processes

The project supports the APN scientific capacity development agenda where the ASC-University of the Philippines in Los Baños- College of Agriculture (UPLB-CA), through this project led and form a core group of crop experts representing different agricultural state universities and colleges and equipped them with a better understanding of the climate trend in the Philippines and anticipated changes based on scientific data and an enhanced knowledge about climate change, climate trends in the Philippines and impacts of Philippine agricultural production systems. This information is important in their R and Efforts to contribute to climate change adaptation especially for the production areas in their regions. A vulnerability and adaptive capacity assessment tool called the VAST-Agro that was refined through this project and the results of its implementation in various crop-based farming systems are important material for both the UPLB-CA and other state universities and colleges in educating the students, the farming community and the local decision-makers on the extent of vulnerability and required adaptive measures in different production areas in the country as well as for formulating local policies for a more resilient farming systems with inputs coming form both science and the farming community.

Self evaluation

This project is able to achieve its goals and objectives and was able to carry out all of the planned activities.

The course contents were fulfilling making the participants abreast of new findings and development about agriculture and climate change, a topic most often sought by agriculture specialist involved in R and D wanting to make their works relevant to current need of the time.

The project enabled the proponents to refine a locally-developed methodology, making it easy to use and understand , relevant and useful for identifying site interventions for climate adaptation as well providing an instrument for local policy making on climate change adaptation for agriculture;

The project methodology was most suitable, consisting of theoretical and practical phases equipping the participating state universities with both knowledge ,skills and tool useful for enhancing their roles in climate change adaptation in their regions;

Output on vulnerability assessment in several production sites in the country is useful for future research and development for climate change adaptation.

Potential for further work

After this project it was realized that the VAST-Agro Methodology can be further used for research and development on local management of agrobiodiversity for climate change adaptation;

Future training courses may be conducted for other agricultural state universities and colleges in the Philippines;

Publications (please write the complete citation)

Garcia, JNM; AM Wagan and SM Medina. 2011. Vulnerability and Adaptive Capacity Assessment in Different agroecosystem (VAST-Agro). Agricultural Systems Cluster, University of the Philippines Los Banos.

Wagan, AM., JNM Garcia and SM Medina. 2012. Course Manual and Proceedings: Sensitization Course on Adaptation strategies for Enhancing Resilience of Different Agroecosystems to Climate Change. University of the Philippines Los Baños.

Wagan,AM (Chair), Proceedings. Vulnerability Assessment in different Crop-based Farming Systems using VAST-Agro. Forum conducted by the Agricultural Systems Cluster (ASC) Project, funded by the Asia Pacific Network for Global Change Research (APN), held on May 24, 2012, Agricultural Systems Cluster Lecture Hall, University of the Philippines Los Banos.

Wagan, AW; JNM Garcia and SM Medina. Strengthening Capability of State Universities on Vulnerability Assessment to Enhance their Role in Climate Change Adaptation. Paper presented in the International Conference on Climate Change Impacts for Food and Environmental Security, November 21-22, 2012, SEARCA Los Banos Philippines.

Wagan, AW; JNM Garcia and SM Medina. Strengthening the SCU Role in Climate Change Adaptation for Agriculture through the Use of the VAST-Agro Methodology. Paper presented in 2012 ISSAAS International symposium and Congress, November 13-16, 2012, Legazpi City Albay.

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TECHNICAL REPORT

Preface

This project, in its attempt to support the role of agricultural state universities and colleges on climate change adaptation for agriculture, updated information about climate trends and impacts on food production in the country was imparted and a tool to assess vulnerability of agriculture at the local level (VAST-Agro) was provided. Contained in report are the project methodology, activities done to achieve the objectives, highlights of discussions on adaptation strategies for enhancing resilience of different agroecosystems to climate change; core components and basic steps of the VAST-agro methodology; and summary output of the vulnerability assessment using the VAST-Agro in the highland vegetable area, mango and banana production areas and coconut-based farming systems area.

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1.0 Introduction

There are a number of agricultural state universities and colleges (SCUs) in the Philippines and these are strategically located, i.e. near production areas of important agricultural cops in the country. The Philippine SCUs are also involved not only in instruction but in agricultural research and development. These factors gave them a critical role in climate change adaptation for agriculture. In our attempt to respond to the global change phenomena and to further define our role as agricultural systems experts and institution in addressing climate change, this was project was initiated. We believe that farming systems technologies can be used to help our farming communities and their production systems cope with the anticipated adversities due to climate change. Inspired by the farming systems development approach, where before making recommendations or implementing interventions in agricultural areas we always start with an understanding of the circumstances in a given area and of the farming community hence this methodology called VAST-Agro or Climate Change Vulnerability and Adaptive Capacity Assessment for Different Agroecosystems.

The VAST-Agro as a community-based assessment methodology may serve as a staring point for planning adaptation measures at the community level. VAST-Agro provides information on the specific hazards production systems and agricultural communities are exposed to, their sensitivity to climate–related hazards and the resources/ ability of production systems and farming communities to cope. With the involvement of the SUCs, the VAST-Agro was done in different production areas in the Philippines. VAST Agro was developed by the agricultural systems cluster-UPLB and further refined through this APN funded project.

The general aim of this project is to provide a venue where agriculture experts from state universities and colleges, national and international climate change experts, farming community, local planners/policy makers may interact to come up with a community-based vulnerability and adaptive assessment tool whose result can serve as basis for developing and prioritizing site-specific and appropriate adaptation measures. The specific objectives of this project are: a. To enhance knowledge of local crop experts from state universities and colleges on climate change , climate trends in the Philippines and the likely impact on crops and farming systems of their concern; b. To develop a community-level vulnerability and adaptive capacity assessment tool for crop-based farming systems; c. To enhance capability of local experts from state universities and colleges in vulnerability and adaptive capacity assessment of crop-based farming systems; d. To equip local experts from the state universities the knowledge useful for drafting proposed adaptation measures in their areas of concern; e. To disseminate information to local policy makers, planners and community members on the extent of vulnerability and need for adaptation measures for the farming systems of their areas of concern.

2.0 Methodology

2.1 Development of the Vulnerability Assessment Methodology

This project started out with the refinement of the vulnerability assessment methodology initiated and developed by the proponents at the Agricultural Systems Cluster University of the Philippines Los Banos. Refinement of the methodology involved series of project team discussions on the variables to be included for assessing community exposure to climate risks, sensitivity of local production areas and communities to climate hazards and local capability for climate change adaptation as well as the method for computing the vulnerability index. This part of the project also involved interaction with researchers who has advanced in the field of climate change research in the Philippines, Thailand and Indonesia to gain insights and expert opinion about vulnerability assessment and in climate change adaptation.

The methodology was done (as internal project of the ASC-UPLB while waiting for project approval from the APN) by the project proponents in Magdalena Laguna, one of the agricultural municipalities of province of Laguna where the project is based. The methodology was also presented in a public seminar, conducted at the ASC-UP Los Banos to solicit further comments and suggestions from agriculture specialists from the academe. This methodology is now called the VAST-Agro or the Vulnerability and Adaptive Capacity Assessment for Different Agroecosystems. The first version of the VAST-Agro user manual was also prepared.

As in the case of any methodology development, refinement of the VAST-Agro continued as the project progresses into the next stages with inputs from the participating State Universities and Colleges and other researchers. A second version of the VAST-Agro user manual was also completed.

2.2. Capability Enhancement for Agricultural State Universities

A series of project team discussions were held for the preparation of the capability enhancement course module (objectives, content, duration, topical outline and identified resource persons); identification of state universities and colleges to be invited including criteria for selection of participants.

As proposed, this project intends to assess vulnerability of major production sites of other crops in the Philippines (other than rice and corn production) like vegetables, banana, mango and coconut based farming systems hence the invitation were sent to six agricultural state universities and colleges namely: Benguet Sate University (BSU) for highland agriculture; Pangasinan State University (PSU) and West Visaya State University (WVSU) for mango production areas in Luzon and Visayas regions, Mindoro State College of Agriculture and Technology (MINSCAT) and Central Mindanao University (CMU) for banana production areas in Luzon and Mindanao and last but not least the Southern Luzon State University (SLSU) for coconut based farming systems in Quezon province. Invitations were sent through the office of the Vice Chancellor for Research and Extension of the University of the Philippines Los Banos (OVCRE-UPLB) to the Office of the Presidents of the abovementioned Agricultural State Universities and Colleges.

2.2.1 Sensitization Course on Adaptation Strategies for Enhancing Resilience of Different Agroecosystems to Climate Change

This course is a two-day course designed to provide an overview of important concerns on climate and implications on food production in the Philippines. At the end of this activity the participants are expected to be able to: a) able to understand the climate trend in the Philippines and its implication on agricultural production in the country; b) aware of current efforts, R and D requirements for reducing the impacts of climate change on agricultural production in the country; and c) aware of available technologies and practices useful for planning adaptation measures for agriculture in vulnerable areas in the country.

Selected topics are on climate change process, climate trends and vulnerable areas in the Philippines, national plans and R&D thrusts on climate change. Emphasis is also given on farming systems technologies and practices useful for addressing climate change. Participants to the sensitization course are from selected SUCs and representatives from the OMAs in selected municipalities of Laguna.

To take advantage of this learning opportunity, invitation for participation in this 2-day course was extended to the municipal agriculture offices in the province of Laguna with whom the ASC-UPLB often collaborate with for agricultural research and development activities, including Nagcarlan,Liliw, Rizal, Magdalena and Lucban in Quezon province. This course was conducted in collaboration with the Office of the Dean of the College of Agriculture in UP Los Banos and the Southeast Asian Regional Center for Agriculture Research and Graduate

2.2.2. Training-workshop on the VAST-Agro Methodology

This is the core course for the project intended for the representatives of the participating (SCUs). The course is designed as a learning opportunity on how to conduct vulnerability assessment in agricultural production areas using the VAST-Agro Methodology. At the end of the training workshop, the participants are expected to be able to: 1.explain vulnerability and adaptive capacity to climate change; 2.understand the VAST-agro, its purpose, basic components, and data collection techniques. 3. Understand VAST-Agro tools for calculation of exposure, sensitivity, adaptive capacity and vulnerability indices; 3. Conduct VAST-Agro in an agricultural production area.

This 7-day training workshop involved the following activities:

Part 1. Classroom lecture discussions and exercises: Lecture-discussion on the VAST Agro Methodology; Review of different participatory data collection techniques often used in rapid community appraisal; Role Play/Classroom exercise on the use of VAST Agro tools for data collection; Classroom exercises on calculating vulnerability Index using the VAST-Agro tools;

Part 2. Field exercise on the use of VAST-Agro: This field exercise was conducted in three pre-selected villages of Lucban Quezon with diversified crop production systems (rice, vegetables, passion fruit, and other crops). The 12 participants were divided into 3 groups (with four members each) and with one project team member in each group, vulnerability assessment was conducted in each of the preselected farming village. Activities include review of secondary data about the pre-selected farming villages, preparation of the VAST-agro templates, site reconnaissance, group farmer interviews and photo-documentation, and presentation/validation of information gathered to the farming community. Prior to the conduit of this field exercise, site selection, communication and arrangement with municipal head, community heads and requests for field guides from the municipal agriculturists were done by the proponents.

Part 3. Analysis of Results and Presentation in class: Results of the VAST-Agro in Lucban Quezon were collated, interpreted and presented in class. This activity provided interaction among the participants and further discussion on the use of the VAST-Agro and techniques for data collection.

Part 4. Planning for the actual vulnerability assessment in different production areas: To completely prepare the participants in conducting vulnerability assessment in different production systems using the VAST-Agro, a timetable of activities was prepared and presented, including logistics and budget requirement.

2.3. Vulnerability Assessment in Different Crop Production Areas

After having prepared the SCU representatives on vulnerability assessment using the VAST-Agro, they were given the opportunity to select the study sites, formally communicate with the community heads about the activity, conduct initial visits to the site and preliminary study through secondary data about the sites. The project proponents joined the SCUs in the actual conduct of vulnerability assessment in the selected sites.

Preparation for a Focused Group Discussion: Close coordination with LGU was established thru the office of the Municipal Mayor- Mayor and the Office of the Agricultural Officer. Secondary data of the selected site was secured from the Barangay Captain .Site reconnaissance was conducted to observe the resources in the area, biophysical and socio-economic resources as indicated in the secondary data. Various components of the agricultural systems and the resources that are critical for food production was closely observed by conducting a transect walk and photo documentation.

Preparation of the VAST-Agro Templates for Data Collection: A base map was prepared to show the location of resources, land uses, crops and sensitive areas to climate related hazards. To facilitate the collection of necessary information the necessary eleven (11) template tools was prepared, to wit; (1)f frequency occurrence of identified hazards; (2) climate hazard timeline; (3) seasonal calendar; (4) sensitive areas/crops; (5)sensitivity of income sources to climate hazards and percent households engaging; (6)percentage of income from climate-sensitive sources; (7) socioeconomic sensitivity potential; (8) average sensitivity score; (9) adaptive capacity assessment; (10)technological adaptations; and (11) total adaptive capacity score.

Conduct Focused Group Discussion: A group farmer interview was conducted in each of the sites to be able to assess vulnerability of the production area and the farming community. A total of 11 VAST-agro templates were used. The assessment included identification of climate related hazards that were experienced by the community in the past the (10) years that affected their crop-based production; identification of significant climate events; cropping patterns and occurrence of climate hazards; Biophysical Sensitivity and Socioeconomic Sensitivity and Community's Adaptive Capacity

As planned the two representatives from each of the collaborating SCU conducted vulnerability assessment in at least two representative production sites in their regions as follows (Figure 1): Benguet State University- vegetable/strawberry production sites in the highland; Pangasinan Sate University - Mango production in the Northern part of the country; Mindoro State College of Agriculture and Technology – Banana production in central part of the Philippines; Southern Luzon State University – Coconut-based farming systems area in Southern Tagalog; West Visaya State University – Mango and Banana production in the Visayas Region; and Banana production in Mindanao;

2.4. Information Dissemination

Information about climate change vulnerability of the different crops and their production areas located in the country, as assessed using the VAST-Agro methodology, was done through a forum held in UP Los Banos where agriculture specialist and climate change enthusiasts from the academe were invited as well as representatives from national agencies with important roles in agriculture R and D and climate change adaptation of the agriculture sector were invited.

Prior to this though, similar information dissemination activities were also held in the assessment sites for the community members and officials.

Other information dissemination activities were done through written articles for newsletters, paper presentations in public seminars, in-house reviews and international conferences.

3.0 Results & Discussion

This part of the report discusses in detail the results of the activities conducted by the project including the details of the VAST-Agro methodology developed by the proponents and refined through this project with significant inputs gained from interacting with national and international researchers on agriculture and climate change as well as from the agriculturists from the State Universities and Colleges who participated in the vulnerability assessment in various production sites in the country. Also contained in this part of the report are gist of the course content conducted by the project and the result of the vulnerability assessment using the VAST-Agro in different production sites. Complete reports on the abovementioned are in the attached appendices.

3.1. Development of the Vulnerability Assessment Methodology
3.1.1 VAST-Agro Basic Components and Steps

The VAST-Agro was developed based on the following IPCC (2001) definition of Vulnerability to Climate Change as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes and a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. As such the VAST Agro has three basic components: Assessment of climate hazards, Sensitivity and Adaptive Capacity.

The VAST–Agro adheres to the definition of the following: climate hazard is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009); Sensitivity is the degree to which the community is affected by climatic stresses while adaptive capacity is the ability of the to cope and overcome the impacts of climate change.

The development of the VAST Agro involved: Review of existing vulnerability and adaptive capacity assessment tools; Development of a Framework for assessing vulnerability to climate change; Identification of climate and agriculture relevant variables; Development of qualitative measures for the variables identified; Formulation of vulnerability index and pretest of the tool (in Benguet,Mt Province and Magdalena, Laguna).

VAST-Agro is a method for assessing the vulnerability of agriculture to the hazards of climate change at the community level. Making use of participatory techniques for data collection, it is able to capture community experience on climate risks, gather information about the sensitivity of crops, crop production system and the farming community to climate hazards as well as the community capability to cope in terms institutional, socioeconomic factors and technological knowhow. A scoring system for the above information is provided in order to come up with the vulnerability Index which can be used for local planning for climate change adaptation.

The Variables included for assessing exposure to climate hazards are: climate hazards experienced in the community in the past 10 years and Frequency of occurrence in the past 10 years.

For assessing sensitivity, information on the following are gathered: Sensitive areas; Sensitive crops/animals; Income from climate sensitive sources
For Assessing Adaptive capacity information about the following is gathered: isolated groups; reliability and availability of Support services; Economic capability to overcome or cope with climate adversities and Knowledge of technology that can reduce negative impacts of climate change.

The basic step to the conduct of the VAST Agro can be summarized as follows: 1. Organize the Assessment Team; 2. Conduct Site Reconnaissance; 3. Study the Area through Secondary Information; 4. Plan and Prepare for the Field Work; 5. Assemble the Community Map; 6. Assess Exposure to Climate-related Hazards; 7. Assess Sensitivity to Climate-related Hazards; 8. Assess Adaptive Capacity; 9. Compute the Vulnerability Index ; 10 .Interpret Results

Vulnerability Index is calculated using the formula below:

$$Vulnerability\ Index\ (VI) = Adaptive\ Capacity\ Index\ (ACI) - Potential\ Impact\ Index\ (PII)$$

Where:

$$ACI = \frac{Total\ Adaptive\ Capacity\ (ACS)}{Maximum\ Adaptive\ Capacity\ Score\ (MACS)}$$

$$PII = \frac{Exposure\ Score\ (ES) + Sensitivity\ Score}{Maximum\ Exposure\ Score\ (MES) + Maximum\ Sensitivity\ Score\ (MSS)}$$

Shown below is one of the VAST-Agro tools, the summary table to show the result of the vulnerability assessment and the qualitative interpretation of the results obtained.

VAST-Agro Template for Presenting the Results of the Vulnerability Assessment

Variables	Typhoon	Heavier rain	Flood	Drought	Landslide	Frost	Others
Scores							
Exposure (ES)							
Sensitivity (SS)							
Adaptive Capacity (ACS)							
Maximum Scores							
Exposure (MES)							
Sensitivity (MSS)							
Adaptive Capacity (MACS)							
Indices							
Exposure (EI)							
Sensitivity (SI)							
Adaptive Capacity (ACI)							
Potential Impact Index (PII)							
Vulnerability Index							
Over-all Vulnerability Index							

** Average of all the vulnerability indices of climate hazards identified;* Qualitative Interpretation of Vulnerability Index: Extremely resilient=0.80 - 1.00; highly resilient=0.50 - 0.79; moderately resilient=0.20 - 0.49; Vulnerable= -0.19 - 0.19; moderately vulnerable= -0.49 - -0.20; highly vulnerable = -0.79 - -0.50; extremely vulnerable=-1.00 - -0.80

3.1.2. Meeting-Discussion with Fellow researchers from Thailand and Indonesia

Part of the activities of the project is to establish contact and possible collaboration with other researchers in other countries working on climate change. To this end, two of the agencies visited were the Rice Department of Thailand and the Southeast Asia START Regional Center in Chulalongkorn University, both in Bangkok and the Geotechnology Research Center, LIPI in Bandung and Climate Risk and Opportunity Management in SE Asia and Pacific in Bogor, Indonesia

In Thailand, the team met Ms. Kingkaw Kunket, a rice production technology specialist of the Rice Department of Thailand introduced to us by Mr Chanpithya Shimphalee (Deputy Director General). Her office assist farmers to adapt to climate change through the introduction of rice varieties that can withstand flooding. They also train farmers of other technologies to equip them to respond and adapt to the effects of climate change. At the SEA-START Regional Center, Dr. Suppakorn Chinvanno, a well-known climate change researcher, was at hand to meet the group. Much of the work that he has discussed with us deal on capacity building for farmers through training and transfer of knowledge so that they will be better equipped to respond to the adverse effects of climate change. Dr. Chinvanno thus encouraged us to make sure that our project results will eventually be of use in climate change adaptation especially for the most vulnerable sectors in the Philippines..

Taking advantage of the time the project team was in Thailand, the team participated (for free) the Refresher Course on Climate Change Adaptation and the Asia-Pacific Climate Change Adaptation Forum 2011.The Refresher Course was held last October 26, 2011 at the Siam Hotel, Bangkok, Thailand. The main activities at the workshop were the introduction, review and clarifications of key terms, concepts and arguments related to climate change and adaptation. Only a small number of delegates were able to attend the refresher course because of limited number of available seats. For the Asia-Pacific Climate Change Adaptation Forum 2011which was supposed to be on October 28-29, 2011, the organizers decided to cancel it indefinitely during that time because of the threat of flooding in Bangkok. This could have been a very good venue for the project team to meet more climate change researchers. But in general, the trip provided the group more insights about climate change and an actual encounter of an effect of climate change which was the flood that affected a large part of Thailand during that time.

In Indonesia,a more interactive discussion on vulnerability assessment was achieved during the discussion with Professor Boer and Dr.Santoso. Professor Boer who has an extensive experience on vulnerability assessment and climate change adaptation gave a thorough discussion about his project where he has developed a climate forecast model useful in addressing drought problems confronting rice production in certain parts of Indonesia. The model which can be accessed from the CCROM-SEAP website (in Indoneain Language) was used for training agricultural extension workers who then are in charge of informing the farmers of anticipated/projected drought occurrence. This model now serve as a tool for the ministry of agriculture in determining appropriate technology for rice production especially for the second cropping season of rice which is most affected by drought. The model was also used for policy recommendations and actions to overcome the anticipated effects on drought on rice production. An important insight gained from professor Boer is that the project is carried out by way of strong network with a number of government and agricultural agencies in the country and his idea is not volunteer to lead rather to offer a tool that can be used for policy-making and implementation of activities to address anticipated drought that will definitely affect rice production in Indonesia. Professor Boer also gave a few comments on the VAST-Agro methodology: that the VAST-Agro refers to reactive adaptation not proactive adaptation and that VAST-Agro is limited to current climate risks.

Dr. Heru Santoso who also had developed a model that can project scenarios on land use change and water resources as affected by climate change, gave a briefing of the some projects and activities (of their research center) that is related to climate change through the on-going exhibit held at the time of the visit, including earthquake-proof infrastructure technologies and environmental concerns in coastal areas. Some of his comments on the VAST-Agro methodology include: the Methodology is easy to use and to understand and might be a useful for one particular research in their office, on vulnerability assessment in small islands where during the time of the visit, the researchers are still planning to prepare and questionnaire that will assess vulnerability of communities in coastal areas. His other suggestions include the need to update definition of Exposure according to the new IPCC definition; the methodology is limited to current climate hazards thus may capture climate variability than climate change. On the exposure assessment, the Current IPCC definition of exposure has recently changed to include a number of indicators and /or variable and he suggested to refer to this new publication and might be worth integrating into the methodology for its further improvement in the future. The spatial scale for vulnerability assessment is also very important. He suggests good follow-up activity to the project and a potential area for future collaboration would be a gathering of those with experiences in adaptation to climate risks where others with similar condition may learn form the experiences of the others.

Discussion with Dr. Rahmi Danita of University of Jambi, who is currentky involved in mitigation potential of forage in a crop-livestock system, focused more on possible research collaboration in future on the use of the VAST-Agro for assessing local management of agrobiodiversity where gender issues may be integrated.

3.2 Capability Enhancement for the State Collegs and Universities

3.2.1. Sensitization Course on Adaptation Strategies for Enhancing Resilience of Different Agroecosystem to Climate Change

During this course, twelve paper presentations (as shown in the attached program) were delivered by experts from the academe, national agencies and from a local government unit covering a wide range of topics from climate change impacts on agriculture, production technologies with their potential uses for climate change adaptation and national and local plans and actions to overcome climate change adversities. Below are the highlights of the discussion categorized into six broad topics.

Climate Change and Impacts on Food Production in the Country. The Philippines being an archipelagic country is among the most vulnerable countries to the adversities of climate change. PAGASA climate projections for 2020, 2050 and 2100 show a projected increase of 1-2^{o}C by 2020 and 2050 under a medium emission scenario and 0.7- to 1.7^{o}C increase under a high emission scenario. This is based on observed increase in mean temperature of 0.64^{o}C during the last 60 years (1951 to 2010); Dry seasons will become dryer while wet seasons will become wetter where projected change in seasonal rainfall would be -0.2 to -0.4 % in 2020 and -0.1 to -1.4% in 2050 during the dry season and from 30% to 54.3% in 2020 and from 25% to 72% in 2050. Further projections of PAGASA include frequency of extreme rainfall like heavy daily rainfall exceeding 300mm will continue to increase in number in the Luzon, Visaya and Eastern sections of the country while frequency of hot temperatures will continue to become more frequent (Basco, 2012).
Evidences of climate change in the Philippines include increase in temperature by 0.14^{o}C from 1971-2000; increased annual mean rainfall since 1980's and rainy days since 1990's; increased occurrence of floods in 1990 and 2004 and increased frequency of cyclones entering PAR during the period 1990-2003 by more than four times.

Studies on the impact of climate change in crop production in the Philippines, such as declines in rice yield as temperature increases revealed alarming results, i.e. a 1^{o}C increase in temperature in Nueva Ecija would result to 14.12% and 7.91% yield reduction during the dry and rainy season, respectively. In corn, relative change in yield in northern Philippines (Isabela) may range form 5-30%, and over 20-30% in the southern part of the country (Bukidnon) at 0.5-2^{o}C increase in temperature. In sugarcane production, with 0.5-2^{o}C increase in temperature, yield was reduced by more than 10% to more than 50% in Northern Philippines (Tarlac), 5% to nearly 10% in central Philippines (Negros Occidental) and 10% to over 30% yield reduction in Southern Philippines (Bukidnon) (Lansigan, 2012).

The likely impacts of climate change on agriculture and food security in the Philippines are alarming. Based on international studies, the Philippines ranked 6thin vulnerability rankings of countries in the world and ranks 3rd in the 2011 world risk index (estimated based on exposure, susceptibility, coping mechanism and adaptive capacity). Landslide, drought and flood occurrences during the past 8 years have caused severe damage. Considering the country's agricultural and fishery development zones (SAFDZ), these climate events affected 11.12M Ha (34% of the total country area). Also, 69 provinces in the country are shown to be prone to landslide, thus, are likely to be affected by the predicted occurrence of La Niña events that may occur during the months of January to March and from July to December (Godilano, 2012.)

In spite these grim facts about climate change and its likely impacts, there are a number of prospective courses of action for agriculture and food security in the country. While it was cited that a 1^{o}C increase in temperature would imply a million tons of rice imports, Godilano (2012), highlighted that the country may not have to live by rice alone if other sources of carbohydrates like corn, root crops and banana which the country can produce abundantly, can very well be harnessed. A paradigm shift in rice production can be developed, where instead of the usual two rice cropping within a year, gabi-duck-fish system or early maturing transplanted rice follows after the first rice cropping season. The latter can yield 5 tons more rice than the usual double rice cropping a year.

Designing/Establishing Adaptation Measures for Agriculture and Farming Systems Technologies as adaptation to climate Change. Designing adaptation measures for agriculture would require understanding and knowledge of climatic, bio-physical, cultural and economic circumstances. A number of steps may be involved. First, awareness of the climate change scenario, i.e. changes in rainfall pattern, amount of rainfall, and length of rainy period or the usual crop growing period and range of temperature variation and pattern of extreme weather events is very necessary. Second, alternative crops that can be grown with consideration of consumption, market, other uses, and sensitivity to climate hazards like drought, heavy rains and typhoons must be described. Third, the climatic and biophysical requirements of the chosen or alternative crops in terms of their water, temperature and soil requirements must be understood. Fourth, the requirements of the crops in relation to the changed climate scenario such as soil, water availability, temperature and biophysical requirements must be matched to obtain the cropping calendar. Fifth, appropriate management practices and strategies, including the necessary changes or adjustments, like the use of stress-tolerant varieties or establishments of soil and water conservation measures must be determined. Sixth, the technical feasibility of the new cropping calendar should be assessed by matching available resources (land, labor and capital) with the resource requirements. Seventh, the profitability of the new cropping pattern and stability of production and earnings must be determined through a cost-benefit analysis. Lastly the performance of the new cropping pattern should be tested and monitored over a number of cropping seasons through on-farm trials (Garcia, 2012).

There is a number of farming systems technologies which merit further investigation as to their potential for climate change adaptation. These technologies already exist, some of which are already widely practiced, yet might have to be given a second look as to where they might be more practical and beneficial given their anticipated effects on climate change.

Crop diversification practices like multiple cropping, integration of crops resistant to climate stress, diversifying income sources by processing of underutilized crops into food and other useful products are just some of viable agricultural strategies

Use of Stress Tolerant Rice Varieties and Water Resource Management for Climate Change Adaptation. The total rice area in the Philippines is about 1.2M hectares, which are in one way or another, pre-disposed to certain conditions. About 40% is drought prone, 26% is submergence-prone, 22% zinc-deficient, 10% are mainly highland areas and 25% is saline.

For drought resistance, there are at least 10 rainfed and one upland rice varieties developed by the UPLB, PhilRice and IRRI. Further there are least available 9 varieties suitable for rainfed conditions.

Management practices for saline areas are continuously being developed while submergence rice varieties are in continuous development and testing in various conditions including submergence for more ten days to two weeks, stagnant partial flooding or long-term flooding up to 60cm of standing water for most of the growing season, deep water flooding or more than 100cm of more than 10days to 5 months and very deep water of up to 3-4 m (Labios, 2012).

Water resource management for agriculture to address climate change requires an understanding of the effects of climate change on water resource behavior and enhancing water supply and decreasing flood water. The basic principle to achieve the latter is to restore or improve infiltration and percolation rates of soil and increase infiltration time and area. Some of the practices or techniques are reforestation, soil erosion control measures like contour farming, planting of hedgerows and terracing. For artificial aquifer recharge methods, the principle is to store or impound surface runoff which can be achieved through the development of medium to large reservoirs, small water impoundment or small farm reservoir (Villano, 2012).

Alternative Livelihood Strategies and Technologies to Enhance Local Resilience and Adaptation to Climate Change. Enhancing livelihood source is a way of enhancing the adaptive capacity of farming communities to climate change. One livelihood strategy is the raising of native swine to a more profitable venture. A new approach to community participation in livestock raising was introduced through an initiative tagged by the locals as "dos por cinco". This approach has provided a mechanism for community partnership in animal dispersal that successfully sustained project cycle and benefitted more farmers economically and further strengthening community organization. (Bulatao, 2012)

Organic agriculture is another strategy for climate change adaptation. There are three ways through which organic agriculture may achieve this. First, the use of traditional knowledge in managing agriculture can be more appropriate in addressing the impacts of climate change on food production. Second, soil fertility build-up can be promoted through the adoption of organic agricultural practices. Soils that are "organically-managed" are better adapted to weather extremes. One research has shown that there is higher water capture in organic soils than ordinary soil during torrential rains. Third, organic farming practices can promote diversity at varying spatial scales of the agricultural systems that can result to resilience to climate stress. (Pangga, 2012)

For technologies, a scientifically developed methodology is the Site-Specific Nutrient Management (SSNM) technique where the amount of chemical nutrient applied to the soil is specific to the crop requirement, both in quantity and in kind. This method can also provide a target yield, given the biophysical and socioeconomic conditions. SSNM is a nutrient management strategy that aims for productivity, profitability and sustainability with lesser negative impact on the environment. In corn production, this technology has increased corn yield by an average of 2 tons per hectare compared with farmers' fertilizer practice. At present, there is a national management team for the nationwide implementation of SSNM for corn areas (Labios, 2012).

Community Experiences in Overcoming Impacts of Climate Change. Infanta, Quezon is one of the areas in the country usually hit by typhoon and landslide. Its worst experience was in 2004 with Typhoon Winnie. After this event, Infanta was able to mobilize the entire community in disaster preparedness through information and communication materials, capability building activities and community-based early warning system through the leadership of the municipal head. This endeavor was duly recognized during the 2007 Galing Pook Award (Crisostomo, 2012)

Another community-based experience involving overcoming impacts of climate change was the bell and bottle project in Bicol. It is an innovation that involves the community in disaster-preparedness. The bell and bottle provides a cheap, easy to install-easy to understand early warning devise for flood and landslide. Through community organizing and capacity enhancement, community access and use of hazard-risk information, installation of locally fabricated rain-gauge, community participation and learning for determining critical rainfall are improved (Manalo, 2012).

National Strategic Policy and Program Initiatives for Climate Change Adaptation and Mitigation. The Philippine S&T Agenda/Framework on Climate Change in the Agri-ANR sectors being spearheaded by PCARRD covers both vulnerability and impact assessment and the development of strategies for adaptation and mitigation. Among others, this framework was crafted to provide a national S&T direction to address the impacts of climate change in the AFNR sectors and to mainstream climate change considerations in national and local development efforts through policy and capacity enhancement. Vulnerability and impact assessment would entail mapping areas vulnerable to climate change, resource and ecosystem assessment and monitoring, evaluating and assessing indicators. Adapting to climate change would involve the implementation of efficient and effective disaster management, adoption of appropriate soil and water conservation technologies, improvement and utilization of indigenous genetic resources and upgrading production and post-production systems. On the other hand, response mechanisms to mitigate climate change calls for carbon sequestration, reduction of GHG emission and development of new biofuel sources (Faylon, 2012).

Additionally, the National Climate Change Commission is trying to focus on reducing climate change impacts on food production and security in the Philippines through a National Framework Strategy on Climate Change and a National Climate Change Action Plan for Food Security. The National Framework Strategy embodies the government policy and the country's roadmap towards climate change mitigation and adaptation with emphasis on disaster risk reduction (DRR). It has seven strategic priorities which include food security, water sufficiency, ecosystem resilience and environmental stability, human security, climate-smart industries and services, sustainable energy and knowledge and capacity development. For the National Climate Change Action Plan, it aims to build the adaptive capacity of men and women in their communities, increase resilience of vulnerable sectors and natural ecosystem to climate change and optimize mitigation opportunities towards a gender-responsive and rights-based sustainable development. The Action Plan will cover the period 2011-2028 (Dela Torre, 2012).

3.2.2 Vulnerability Assessment of Different Production Areas using the VAST-Agro

This part of the reports shows the location of the vulnerability assessment sites using the VAST-Agro (Figure1) conducted by the participating SUCs together with project proponents. Presented also in this part of the gist of the reports on the results of the vulnerability assessment conducted.

VAST-AGRO 1. Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST Agro in a Highland Area in Philippines[1]

Two case study sites in a highland area namely Puguis, La Trinidad and Poblacion, Tuba, Benguet in the Mountain Province were selected by the two training participants from the Benguet State University for the implementation f the VAST-Agro.

Benguet province is located in the southern tip of the Cordillera Mountain Range in the northern part of the Luzon Island. It is a plateau 5000 ft above sea level characterized by rugged sloping

[1] Based on the VAST-Agro report of Marissa R. Parao and Janet P. Pablo, Benguet State University

terrain and deep valleys. The primary agricultural activity is vegetable production with white potato, beans, peas, strawberries, cabbage, lettuce and carrots as the major crops. Benguet is tagged as the “Salad Bowl” and the “Strawberry country” in the Philippines. It is characterized by wet season from May to October and dry during the rest of the year. The average temperature ranges from 17.3 ºC to 20.7ºC with the coldest month on January and warmest on June. About 96% of total precipitation falls from June to October. The average total rainfall from year 1952 to 2002 is 3878mm with an average monthly rainfall of 323.17mm, relatively high as compared to other areas of the country.

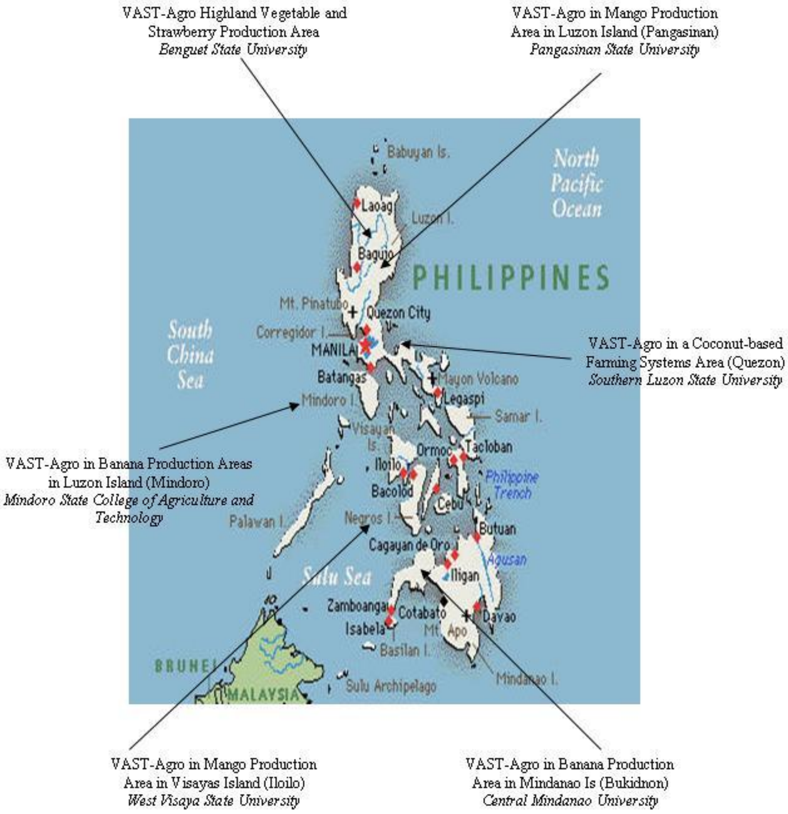

Figure 1. Location for the Vulnerability Assessment using the VAST-agro methodology (2012).

Site A. Cabugao, Poblacion,Tuba, Benguet

Assessment of Exposure to climate hazard. Typhoons and heavy rains usually occurs during the wet season; landslide caused by the heavy rains; frost that annually occurs in the month of January to February; ice rain or hail during the onset of rainy season (May and June) and; strong wind (no rain) in the month of September affect agriculture in the area.

Sensitivity of crops and production areas to climate hazards. Crop growth and yield of strawberry and highland vegetables are easily affected by climate. During typhoons, since majority of the farms are planted to highland vegetables farmers may experience 50 to 100% damage or loss due to rotting of fruits (strawberry) and roots (most vegetables including chayote) due to continuous rains. For broccoli, delayed flowering is also observed. In worst situation farmers observed 80% to 100% damage on vegetables thus require replanting. Hail storm and frost annually occur in January and

February and are as damaging as typhoons (60 – 100% damage). Among the effects in crops includes, occurrence of molds, death at vegetative stage of the crops and browning of broccoli curds.

Sensitivity of Income Sources to Climate Hazards. Income sources are farming, 22% (359 households); non-farm, 28% (437 households), employment in government and private enterprises, 20% (322 households) and the remaining 30% are unemployed. Retailing of vegetable crops and food processing are some of the agriculture -related income sources. Eighty-five percent of the total number of household in the area is dependent on climate-sensitive income sources (like agriculture, other on-farm sources) and only 5% have income sources that are classified as not climate-sensitive (regular employment and with family member working overseas).

Assessment of Adaptive Capacity. Based on socioeconomic characteristics, the case study site is rated with high adaptive capacity. Dependency ratio is about 38% which include the children below 15 and the elderly and those with disabilities. For technological adaptations**,** there are a number of farming practices, often implemented in the area to overcome the adversities of specific climate hazards examples are like tunneling, hilling up and tree planting.

Vulnerability Rating. Based on the exposure, sensitivity and adaptive capacity assessment Cabugao tuba Benguet is rated moderately resilient. For specific climate hazards, the area is rated moderately vulnerable typhoon, frost, strong wind and hailstorm.

Table 1. Vulnerability Assessment using the VAST-Agro in Cabugao, Tuba Benguet.

Variables	**Typhoon**	**Landslide**	**Frost**	**Strong wind**	**El Nino**	**Hail storm**	**Pest (leaf miner)**
Scores							
Exposure (ES)	5	5	5	5	1	5	1
Sensitivity (SS)	5	3	4	5	4	5	3
Adaptive Capacity (ACS)	40	40	36	35	35	35	35
Maximum Scores							
Exposure (MES)	5	5	5	5	5	5	5
Sensitivity (MSS)	5	5	5	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45	45	45	45
Indices							
Exposure (EI)	1.000	1.000	1.000	1.000	0.200	1.000	0.200
Sensitivity (SI)	1.000	0.600	0.800	1.000	0.700	1.000	0.500
Adaptive Capacity (ACI)	0.889	0.889	0.800	0.778	0.778	0.778	0.778
Potential Impact Index (PII)	1.000	0.800	0.900	1.000	0.450	1.000	0.428
Vulnerability Index	-0.111	0.089	-0.100	-0.222	0.328	-0.222	0.428
Qualitative Description	Moderate-ly Vulnerable	Moderate-ly Resilient	Moderate-ly Vulnerable	Moderate-ly Vulnerabl e	Moderate -ly Resilient	Moderate-ly Vulnerabl e	Moderatel y Resilient
Over all Vulnerability Index	0.027						
Over-all Qualitative Description	Moderately Resilient						

This rating is explained by frequent exposure to landslides, frost, strong wind and hail storm and sensitivity to typhoons, strong wind and hail storms. Highly contributory to this rating is dependence on livelihood sources affected by climate hazards and the high rating for socioeconomic adaptive capacity due to availability of resources, support institution, labor, communication and accessibility though there are few technological adaptations.

Potential Interventions for Climate Change Adaptation

- A water pump for production areas located in higher elevations which is often experience dry condition and water shortage;
- Massive tree planting and construction of wind breaks like bamboos, Alnus and Eucalyptus along slopes.
- Improve exiting water impoundments;
- Encourage organic farming "Mukosako" technology for strawberry and other highland vegetable as initiated by innovative farmers because of the high premium for agricultural produce.

Site B. Puguis, La Trinidad, Benguet

Assessment of Exposure to Climatic Hazards. The climatic hazards identified by the respondents were typhoon, landslide, intense rainfall, flooding, La Nina and El Nino. The very frequent hazards experienced were typhoon and flooding.

Assessment of Sensitivity to Climate Hazards. During typhoons, heavy rains and La Niña, most of the crops grown are affected such as strawberry and highland vegetables like lettuce and broccoli, and cutflowers. A hundred percent loss or damage occurs if excessive rainfall is followed by long sunshine duration causing plants to wilt. Flooding affect wider area since most of the cropping area of Puguis is located at lower elevations while damaged trellises of chayote and crops observed in prodcution areas in the slopes due to erosion and landslides.

Sensitivity of Income Sources to Climate Hazards. Barangay Puguis is one of the commercial areas of La Trinidad. Based from Barangay Puguis Development Plan, about 48% of the population depends on agriculture. Respondents indicated that 10% of the household rely solely in agriculture; 70% are engaged in agriculture plus other livelihood while 20% are either locally or overseas. Further, based on the data gathered, only 40% of the household have income sources that are sensitive to climate change while 60% of the population are engage in non-sensitive sources of income. Thus the computed socio-economic sensitivity showed that the residents of Puguis are not sensitive to these climatic hazards.

Adaptive Capacity. On the physical capacity of the community, the respondents claimed that there is very high availability of family labor with about 4 people in a family. Based on record, the population is 5,801 with 1,075 households, wherein about 55% of the population can be considered as productive and only about 45% can be considered as dependents which consist of youth (<14 yrs old and handicaps). On literacy rate, most (>80%) of the respondents can read and write thus, able to understand information about climate change hazards from any medium or sources of information. The high literacy rate is attributed to the presence and accessibility of academic institutions and of public schools with low tuition rates. The respondents claimed that they have a moderate knowledge of the hazards. The community desire a more comprehensive campaign on climate change and adaptive measures.In terms of Community Support Services of the resources such as transportation, communication facilities and support systems exist in the community. On the economic capacity of the community to adapt to climate change, the rating is rather low.

Although the community claimed that with the presence of credit or lending agencies, they can afford to spend for adaptation costs.

Technological Adaptations. Since the most common problem in the community is typhoon and heavy rains, tunneling is practiced by most farmers as adaptation against strong rains. Mulching is also done in order to protect the soil and strawberries during rains. Drainage canals are constructed to lessen impact of flooding. Stone walling or rip rapping is done in eroded or landslide areas and damaged trellis is repaired. Tree planting, crop rotation, organic farming and change of variety are also considered as means to adapt to climate change.

Vulnerability Rating. Using the VAST-Agro tool the area rated moderately resilient. This is explained by its high exposure to typhoon, intense or heavy rainfall and flooding but rarely experience landslide, La Nina and El Nino. Most of the income sources are not sensitive to the climate hazards and only few are solely dependent on agriculture and other climate sensitive sources of income.

Table 2. Vulnerability Assessment using the VAST Agro in Puguis, La Trinidad, Benguet.

Variables	Typhoon	Landslide	Flooding	La Nina	El Nino	Intense rainfall
Scores						
Exposure (ES)	5	1	5	1	1	5
Sensitivity (SS)	3	2	3	3	2	2
Adaptive Capacity (ACS)	37	33	33	37	36	36
Maximum Scores						
Exposure (MES)	5	5	5	5	5	5
Sensitivity (MSS)	5	5	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45	45	45
Indices						
Exposure (EI)	1.000	0.200	1.000	0.200	0.200	1.000
Sensitivity (SI)	0.500	0.300	0.600	0.600	0.400	0.400
Adaptive Capacity (ACI)	0.822	0.733	0.733	0.000	0.800	0.800
Potential Impact Index (PII)	0.750	0.250	0.800	0.400	0.300	0.700
Vulnerability Index	0.072	0.483	-0.067	-0.400	0.500	0.100
Qualitative Description	**Moderately Resilient**	**Highly Resilient**	**Moderately Vulnerable**	**Highly Vulnerable**	**Highly Resilient**	**Moderately Resilient**
Over all Vulnerability Index	0.115					
Over-all Qualitative Description	Moderately Resilient					

The adaptive capacity is relatively high with the availability of support and communication systems, high physical, cognitive and resource ability, and high accessibility or low degree of isolation. There was a low economic capacity to spend for the cost of adaptation, though the income sources is not climate sensitive, it was claimed to be just enough for the basic and daily needs of the family. Further, only few technological interventions were adapted by the farmers.

Potetial Interventions for Climate Change Adaptation.

- Conduct of education campaign on climate change awareness and technological adaptation strategies specifically for the climate hazards identified.
- Improvement of the drainage system and sewage canal in the lower elevations of the barangay.
- Development of on-farm irrigation system in preparation for the El Nino event or development of water harvesting technologies.

Conclusion for Benguet

Findings show that both production areas that were assessed are moderately resilient to the effects of climate change as a result of their high adaptive capacity even if their exposure level is relatively high. Such findings are supported by collected fact that the farming communities in these areas are not completely dependent on agriculture for income. The diversity of income source increased their adaptive capacity rating.

While highland vegetables and strawberries are among the most vulnerable crops to climate hazards, the competitive price of highland vegetables and strawberries is an advantage. Farmers in Benguet continue to employ technological adaptations to overcome effects of climate stress in their agricultural products.

VAST Agro 2. Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Sta. Maria, Pangasinan, Philippines[2]

About the Study Sites

Mango is one of our important crops that are vulnerable to climate change. Pangasinan is the top producer of Mango especially the Carabao Mango for export in Region I. Sta. Maria, although, not the top producer of mango in the province, is a mango for export community. In fact, mango production areas in Sta. Maria are increasing. Mango farmers are not exporting their products although these farmers if clustered could be a potential mango exporting community. Sta. Maria, being located along the Agno River, is vulnerable to flooding as indicated in the geohazard map of the Mines and Geosciences Bureau.

The town of Santa Maria, Pangasinan has a population of 30,721 (2007 census) distributed in a total area of 6,953 ha in 23 barangays. Rice and corn are the most important crops but mango is an emerging income-generating crop with 83.52% of their land devoted to agriculture

Study Site 1, Paitan, 70% of their agricultural land is devoted to mango production, 28% is devoted to rice-corn production and 2% to vegetable production. Agno River on the north is the major source of water for irrigation but is also a threat to the barangay.

Study site 2, Caboluan, 20% of their agricultural land is devoted to mango production and 80% is devoted to rice-corn production areas. There are two streams and irrigation canals that traverse the community .

A. Exposure Assessment. The study site Paitan is most exposed to Typhoon and Heavy Rain both with exposure score of 5 or “very frequent”. The barangay has been hit by strong typhoons, most notable is Typhoon Pepeng which poured heavy rain equivalent to a month of rain during rainy season. This resulted to flooding and erosion along the Agno River which caused significant damages to crops and livestock animals. Heavy rains also occur during months of August and September however, unusual heavy downpours would occur during La Nina months. Drought, on other hand, rarely occurs. Long drought only occurs during El Nino while pest outbreak would occur six times in ten years. Rodents are the usual pest problems for corn and for rice farmers. Pest outbreaks in mango such as cecid fly and mango hopper infestations would occur but this can be managed with appropriate insecticides and timing of application. One problem that is hard to address is the

[2] Based on the report of Oliver C. Caasi and Edwin N. Alferez, Pangasinan State University

occurrence of thick fog resulting to dew during the cold months of December to January. This can cause damage on the emerging mango flowers or premature fall of fruits. It also increases pest infestations.

Seasonal Calendar. In Barangay Paitan, there are three main cropping patterns: mango, rice-corn-corn, and vegetables. Mango is an important crop in the community with approximately ha of mango plantations especially on the northern part. There are two flower induction period: the early and late spraying. The early flower induction of mango is from August to September which coincides with heavy rainfall while late spraying starts on October. Harvesting of those induced on August and September starts from December until early February. Harvesting of mangoes for summer or those late induced would start from March to April. Rice and corn are the main crops grown in the community. Rice is planted during the rainy season from late May until June and harvested September to October. After rice, two cropping of yellow corn follows. This is possible because of the presence of shallow and deep-well irrigation system. Planting of corn immediately starts after rice is harvested. Corn is harvested from Smaller plots are devoted to vegetable production especially the "Pinakbet" ingredients such as hot pepper "sili", eggplant, bittergourd, and stringbeans.

Barangay Paitan and Caboluan have different cropping pattern. In Barangay Caboluan, mango trees are induced from October to November but not earlier. Flower induction coincides with the typhoon season. Heavy losses occur when typhoon hits at flowering and kernel size stage. Rice, on other hand, is planted for two consecutive cropping seasons in irrigated and once in non-irrigated or rainfed areas. Corn follows as second and third crop, respectively. In rainfed areas, their land is fallowed for two to three months.

B. Assessment of Sensitivity to Climate Hazards. Analysis of the biophysical sensitivity potential of Barangay Paitan reveals that mango, rice-corn, and vegetable areas are sensitive to climate-related hazards at varying levels or magnitude of damage to crops . Mango is highly sensitive to pest outbreak and dew formation due to low temperatures. It is also sensitive to Typhoon or strong wind because of its potential damage to flowers and developing fruits. But it is less affected by drought, heavy rain, and flood. Drought is not a big factor in rice and corn because of the adequate source of irrigation water from shallow-tube and deep-well system. However, both are highly sensitive to typhoon, heavy rain, and flood.

"Pinakbet" vegetables in Barangay Paitan are more sensitive to typhoon, heavy rain, and flooding. Too much rain increases soil moisture which favors bacterial wilt and fungal wilt infections on solanaceous crops such as hot pepper, eggplant and tomato.

In Caboluan, mango is less affected by flood, drought, and pest outbreak but sensitive to typhoon, heavy rain and dew brought by low temperature (Tool 4b). Compared to yellow corn, rice is more sensitive to typhoon, heavy rain, drought, and pest outbreak. Farmers are now planting varieties of yellow corn that are more resistant to lodging and water logging, tolerant to drought, and resistant to corn borer (BT).

In Paitan and Caboluan, agriculture is the main source of income of the residents comprising 99%. However, this is also the most climate sensitive. Others depend on other sources such as business, government and private employee, and tricycle driver.

Socio-economic sensitivity potential of both barangays is high with all identified hazards scoring 5. This means that because the residents are mostly farmers or their business. depend on farming, they are highly sensitive to climate hazards in terms of income. Hence, climate change related events could potentially affect the lives of these residents. The combined sensitivity potential of the biophysical and socio-economic status of the two communities reveals that Barangay Paitan are most sensitive to typhoon, pests, and dew caused by low temperatures whereas Barangay Caboluan are most sensitive to drought and flood. This is because Barangay Caboluan has fewer deep-well irrigation and they are prone to flooding because of lack of physical barrier between them and their farms.

C. Adaptive Capacity Assessment. In terms of Adaptive Capacity, Barangay Paitan has higher adaptive capacity than Barangay Caboluan because of higher literacy rate, early warning system, and communication system. Barangay Paitan has an early warning system from the Agno flood control agency. According to the barangay official, the flood warning comes from the municipal office and is relayed to barangay captains. Barangay captain then designate barangay police and councilors to relay the warning to their constituents.

In Barangay Caboluan, available labor force is 4-5 per household. These are a general knowledge of the hazards in their community but they have no effective community early warning system. They still depend on LGU for information. Support system especially from the LGU is also good. Availability of resources to adapt to climate change or wealth level is also high.

Analysis of the technological adaptations of the two barangays reveals that farmers lack technological adaptations to reduce the effect of climate-related hazards. Farmers rely much on pesticides which are not sustainable. They also lack technological skills and knowledge on some mango production technologies. They do not know the solution to some of their pest problems. The support system according to them from the local agriculture office is minimal. There is also lack of infrastructure to support their production such as adequate irrigation system. There are NIA irrigation canals in Paitan but it does not serve them. It serves the neighboring town In Caboluan, irrigation canals are dry during the summer. Hence, additional deep-well irrigation system is needed according to them.

D. Vulnerability Assessment. The summary of the vulnerability index for Barangay Paitan reveals that the community is most exposed to Typhoon and Heavy Rain both with exposure score "very frequent". The barangay has been hit by strong typhoons, most notable is Typhoon Pepeng which poured heavy rain equivalent to a month of rain during rainy season. However, they are moderately resilient because of their higher adaptive capacity. Vulnerability assessment reveals that mango production areas in Barangay Paitan are more resilient to climate change than rice and corn production areas because of its perennial nature less sensitivity to hazards except typhoon, pest, and dew.

The summary of the vulnerability index for Barangay Caboluan reveals that the community is most exposed to Typhoon, Heavy Rain, Flood, Pest, and Dew with exposure score of 5 or "very frequent". The barangay was also hit by strong typhoons, most notable is Typhoon Pepeng which poured heavy rain equivalent to a month of rain. However, they are moderately vulnerable because of their lower adaptive capacity. They have no dikes or barriers between their farms and the streams that traverse their community. They also lack communication system. According to barangay officials, they used to have a two-way radio for communication.

Table 3. Vulnerability Assessment Results using the VAST-Agro in Paitan, Sta Maria Pangasinan.

Variables	Typhoon	Heavy rain	Flood	Drought (due to El Niño)	Pest Outbreak	Dew (due to cold temp)
Scores						
Exposure (ES)	5	5	1	1	3	1
Sensitivity (SS)	4	3.5	3.5	3	4.5	4
Adaptive Capacity (ACS)	41	36	39	41	36	41
Maximum Scores						
Exposure (MES)	5	5	5	5	5	5
Sensitivity (MSS)	5	5	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45	45	45
Indices						
Exposure (EI)	1.000	1.000	0.200	0.200	0.600	0.200
Sensitivity (SI)	0.800	0.700	0.700	0.600	0.900	0.800
Adaptive Capacity (ACI)	0.911	0.800	0.867	0.911	0.800	0.911
Potential Impact Index (PII)	0.900	0.850	0.450	0.400	0.750	0.500
Vulnerability Index	0.011	-0.050	0.417	0.511	0.050	0.411
Qualitative Description	Moderately Resilient	Moderately Vulnerable	Highly Resilient	Highly Resilient	Moderately Resilient	Highly Resilient
Over-all Vulnerability Index	**0.233**					
	Moderately Resilient					

Table 4. Vulnerability Assessment Result for Caboluan Sta Maria Pangasinan.

Variables	**Typhoon**	**Heavy rain**	**Flood**	**Drought (due to El Niño)**	**Pest Outbreak**	**Dew (due to cold temp)**
Scores						
Exposure (ES)	5	5	5	1	5	5
Sensitivity (SS)	3.5	3.5	5	4.5	3.5	3
Adaptive Capacity (ACS)	31	31	34	32	31	36
Maximum Scores						
Exposure (MES)	5	5	5	5	5	5
Sensitivity (MSS)	5	5	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45	45	45
Indices						
Exposure (EI)	1.000	1.000	1.000	0.200	1.000	1.000
Sensitivity (SI)	0.700	0.700	1.000	0.900	0.700	0.600
Adaptive Capacity (ACI)	0.689	0.689	0.756	0.711	0.689	0.800
Potential Impact Index (PII)	0.850	0.850	1.000	0.550	0.850	0.800
Vulnerability Index	-0.161	-0.161	-0.244	0.161	-0.161	0.000
Qualitative Description	**Moderately Vulnerable**	**Moderately Vulnerable**	**Moderately Vulnerable**	**Moderately Resilient**	**Moderately Vulnerable**	**Not Vulnerable**
Over-all Vulnerability Index	**-0.094**					
	Moderately Vulnerable					

E. Potential Interventions

Table 5. Proposed Site-Specific Adaptation Measures for Barangay Paitan, Sta. Maria, Pangasinan

Hazards	Site-Specific Measure for Mango, Rice, Corn	Responsible Agency
Typhoon	Implement Mango Production Technologies to reduce the effect of typhoon including timing of flower induction, and pruning (top pruning).	Farmers, MAO, PSU
Heavy Rain	Installation of automatic rainfall monitoring device Provision of mechanical dryer	DOST-PAG-ASA DA, PhilMech
Flood	Construction of dikes along the Agno river bank to protect the adjacent agricultural lands from erosion and flooding Installation of automatic rainfall monitoring devices	DPWH DOST-PAG-ASA
Drought	Construction of irrigation canal and deep-well irrigation system	NIA
Pest Outbreak	Monitoring system for rodents Implement preventive measures and IPM for Mango including bagging, pruning, and sanitation	MAO, PSU, Farmers
Dew (due to low temp)	Implement best practices to reduce the effect of fog/dew including wag-wag method, pruning, and use of systemic fungicide as preventive measure.	Farmers, MAO, PSU

Table 6. Proposed Site-Specific Adaptation Measures for Barangay Caboluan, Sta. Maria, Pangasinan

Hazards	Site-Specific Measure for Mango, Rice, Corn	Responsible Agency
Typhoon	Implement Mango Production Technologies to reduce the effect of typhoon including timing of flower induction, and pruning (top pruning). Better communication system should be implemented at barangay level (they have no two way radios)	Farmers, MAO, PSU LGU-Sta. Maria, Prov. Gov’t
Heavy Rain	Installation of automatic rainfall monitoring device; Provision of mechanical dryer	DOST-PAG-ASA DA, PhilMech
Flood	Construction of dikes along the streams that traverse their community to protect them from floods; Installation of automatic rainfall monitoring devices; Use rice varieties tolerant to submerged condition	DPWH DOST-PAG-ASA Farmers, DA, PhilRice
Drought	Construction of irrigation/drainage canals and deep-well irrigation system; Use drought tolerant rice and corn varieties	NIA Farmers, DA, PhilRice
Pest Outbreak	Monitoring system for rodents; Implement preventive measures and IPM for Mango including bagging, pruning, and sanitation	MAO, PSU, Farmers
Dew (due to low temp)	Implement best practices to reduce the effect of fog/dew including wag-wag method, pruning, and use of systemic fungicide as preventive measure.	Farmers, MAO, PSU

VAST Agro 3. Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Brgy. San Agustin I, Naujan and Alcate, Victoria Mindoro Oriental[3]

About the Study Site

Banana is the major product of the Oriental Mindoro. All municipalities in the Province produce banana mostly as intercrop to perennial crops. The Province ranked 10 among the top banana producing Provinces in the Philippines yielding 168 tons of banana in 2008 (www.darfu4b.da.gov.ph). While export quality bananas like those produced in Davao and Bukidnon are not yet produced in Oriental Mindoro, dessert and cooking bananas consumed by its neighboring Provinces are usually sourced out from Oriental Mindoro. *Saba*, *Lakatan* and *Latundan/Solo* are the locally known planted cultivars. *Mindoro Lakatan* is of special dessert variety with orange meat and pungent odor.

San Agustin I, Naujan. San Agustin I is one of the oldest barangay of the Municipality of Naujan. Its terrain is generally flat and 95.7% of its total 433.93 hectare area is classified as agricultural. Of the agricultural land, 218 hectares are planted to rice with the rest planted to various crops including banana, fruits trees and vegetables. Farming is the major source of livelihood in the community.

Alcate, Victoria. Alcate is home to the Main Campus of the Mindoro State College of Agriculture and Technology (MinSCAT), the major institution of higher learning within the Province. It is also the second largest barangay on the Municipality of Victoria in terms of land area with a total hectarage of 2,722.00 subdivided into 14 sitios. A total of 62.27% of the total land area is considered upland with a registered elevation of at least 30 meters above sea level. Of the total upland area, 1566.53 hectares are planted to various permanent crops, mostly fruit-bearing trees; 51.39 hectares are forest lands, mostly confined to the MinSCAT forest reservation; and 77.08 are idle lands or cogonal areas. Of the 1027.74 hectarage of lowland areas, 413.36 are considered agricultural lands. Of these, 177 are classified as irrigated ricelands and the rest are planted to multiple crops of coconut, banana and some areas for vegetables, corn, peanuts, and mango.

Site: San Agustin I, Naujan

A. Exposure Assessment

There are 4 identified climate change hazards affecting San Agustin: typhoon, heavier rain, higher prevalence of pests and diseases, and drought .Over the last 10 years, typhoon had an occurrence of at least once a year. Heavier rains had also been observed to occur every year since 2001, which was observed to coincide with higher incidence of rat infestations as well as more destructive golden kuhol. Rainfall peaks on the months of October and November, but during the months of March and April, extreme dryness was experienced from 2002-2006 with most of the irrigation canals drying up.

B. Sensitivity Assessment

a. Biophysical Sensitivity. Rice had been listed to be sensitive to all the 4 climate hazards (Table 2.2). Lodging of rice plants occurs during typhoons. Heavy rains during the booting stage results to low percentage of grain filling. Yellowing of leaves was also observed with prolonged water immersion

[3] Based on the report of Mervin L. Icalla and Katherine P. Sanchez-Escalona, Mindoro State College of Agriculture and Technology

of rice fields which was most probably due to zinc deficiency. Recently, the attack of brown leaf hopper and army worm resulted to damage of an estimated 5% of the total rice area of the community. A decrease in yield was observed with the drying of the irrigation canal during drought season.

Banana was listed to be sensitive to typhoon, heavier rains, and increased incidence of pest and diseases. Typhoon destroys the plants while heavier rains increase the incidence of disease. Particularly, *Fusarium* wilt had been identified as the most prevalent disease that affects banana.

Small-scale vegetable production was identified be sensitive to typhoon, heavier rain, and drought. Typhoons and heavier rains induce fruit fall and decrease bearing capacity of plants. The decreased irrigation water availability also decrease the realized yield of vegetable plantations.

Other crops identified to be sensitive to typhoons are coconut and other fruit trees in the area such as mango and citrus. Fruit fall are induced by the climate hazard. On the other hand, animals were identified to be sensitive to heavier rains and drought. In the former climate hazard, animals had "rheumatism" attacks while stroke becomes prevalent during drought.

Typhoon affects more than 5% of the total agricultural area of San Agustin, while heavier rains lend hazards to more than 30% of the total agricultural area. Pests and diseases and drought affect more than 7% and 25% of the total agricultural land, respectively. Among the hazards, drought was computed to have high biophysical sensitivity potential, the other hazard having low to very low sensitivity potential given limited impacts.

b. Socioeconomic Sensitivity. Eighty percent of the community income is solely from agriculture. This is quite understandable with the use of more than 95% of their land are to agriculture. Only 1% is from non-climate sensitive sources. This results to very high socioeconomic sensitivity potential to all climate change related hazards.

C. Adaptive Capacity

Available labor is low with most of the farm labors in San Agustin are hired. The prevailing system is called "talok-ani" where transplant cost is passed off for the chance to harvest with a sharing scheme of 7:1. Literacy rate is very high which is also mirrored with the very high general knowledge of the hazards. Resources that enable them to access information are also highly available with an estimated 99% of all households having either cell phones, television sets or radios. Effectiveness and efficiency of early warning system is high with Community Disaster Risk Reduction Management Plan already in place. So far, however, only the Church's bell is used as a warning system. System of dissemination is also high that is spearheaded by the Barangay Officials. Support system is also high with the availability of multicab and patrol car. Wealth level is moderately high.

Technological adaptations to typhoon include early harvesting whenever feasible, and pruning of leaves of accessible banana plants (around the house). Chemical spraying is resorted to control pests and diseases if individual picking would not suffice. Diseased banana plants are cut down with the hope that the sucker will be better. The cost-intensive installation of water pump is done during drought with most farmer saying that profit is almost nil given very high fuel cost.

D. Vulnerability Assessment

The community is not vulnerable to typhoon. While exposure scores to both climate change related hazards are high, adaptive capacities are also high. However, the community registered a moderately vulnerable score to increased rainfall mostly due to low adaptive capacity. Overall vulnerability index is moderate.

Table 7. Vulnerability Assessment Results Using the VAST-Agro in San Agustin I, Naujan, Mindoro

Variables	Typhoon	Heavier rain	pest
Scores			
Exposure (ES)	5	5	5
Sensitivity (SS)	3	3.5	3
Adaptive Capacity (ACS)	36	31	36
Maximum Scores			
Exposure (MES)	5	5	5
Sensitivity (MSS)	5	5	5
Adaptive Capacity (MACS)	45	45	45
Indices			
Exposure (EI)	1	1	1
Sensitivity (SI)	0.6	0.7	0.6
Adaptive Capacity (ACI)	0.8	0.69	0.8
Potential Impact Index (PII)	0.8	0.85	0.8
Vulnerability Index	0	-0.16	0
Qualitative Description	Not Vulnerable	Moderately Vulnerable	Not Vulnerable
Over-all Vulnerability Index	**-0.05**		
	Moderately Vulnerable		

Alcate, Victoria

A. Exposure Assessment

a. Climate Hazards. Oriental Mindoro is under Modified Corona Classification Type III where seasons are not very pronounced with relative dryness from November to May and wet for the rest of the year (http://kidlat.pagasa.gov.ph). However, the municipality of Victoria in general, and Brgy. Alcate in particular had rains evenly distributed throughout the year with peaks on November to December most probably due to orographic modification. Dryest months are April and May. Barangay Alcate is exposed to 4 climate-related hazards: flood, heavier rainfall, drought, and higher incidence of pest and diseases. The paradoxical situation of flooding and drought/extreme dryness had been occurring yearly since 2001. The Magasawang Tubig River, one of the biggest river in Oriental Mindoro is almost always expected to top its banks anytime between October to February and be "dead" from April to May. Heavier rains had also been occurring since 2006 and pests and diseases had been attacking fruit-bearing trees since 2008. Typhoon Caloy back in 2006 was the only eventful weather disturbance that was ever noted as the area is a valley and relatively protected from winds.

B. Sensitivity

a. Biophysical sensitivity. Flood threatens a 9.6% of the total agricultural area planted to rice, vegetable, corn, banana and other permanent crops, and peanuts. All crops are affected by increased rotting except for bananas where sheet erosion by flood waters carries away plants. Erosion by flood constitutes 7.6% of the total agricultural area threatened by flood.

b **Socioeconomic sensitivity.** Eighty percent (80%) of household have incomes sourced solely from agriculture. This is mostly from rice farming and orchard and animal husbandry. Those that mix agriculture with climate sensitive sources like tricycle driving constitute 12.5% of the households while those that source their income from agriculture combined with employment and other non-climate sensitive sources constitute 6.5 % of the total community households. A mere 1% had non-climate sensitive sources which are mostly those who are employed abroad.

C. Adaptive Capacity

Family labor is available. Large part of the agricultural land is planted to permanent crops, maintenance requires limited labor. Literacy rate is very high and knowledge to climate related hazards scored as high. Availability of resources such as cellular phones, radios, and television sets are also very high with almost all household having either of the gadgets. Early warning system is present initiated and maintained by Barangay officials and support system is also in place with purchase of equipment already budgeted. Wealth level is moderately available.A consistent adaptation measure done by the barangay is the institutionalization of a warning system which include text brigade and house to house visit. An installed water meter warns the community of impending flood. For crops, pruning and propping lessens damage during typhoons.

D. Vulnerability Assessment

Alcate is rated as moderately resilient to all climate change related hazards except for drought which returned a score corresponding to the qualitative description of moderately vulnerable. Overall vulnerability index is moderately resilient. With high exposure scores to two climate hazards and the high dependence of local economy to agriculture, the area rated moderately resilient because of its large land area and the diversity of land use which increased the resilience index. Magnitude of crop damage wasreported as low and is attributed to multi-story cropping system practiced in the area.

Table 8.Vulnerabuilty Assessment Result using the VAST-Agro in Alcate, Victoria, Oriental Mindoro.

Variables	flood	Heavier rain	drought	pest and diseases
Scores				
Exposure (ES)	5	3	5	2
Sensitivity (SS)	2.5	3.5	3	3
Adaptive Capacity (ACS)	36.5	36.5	31.5	36.5
Maximum Scores				
Exposure (MES)	5	5	5	5
Sensitivity (MSS)	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45
Indices				
Exposure (EI)	1	0.6	1	0.4
Sensitivity (SI)	0.5	0.7	0.6	0.6
Adaptive Capacity (ACI)	0.81	0.81	0.70	0.81
Potential Impact Index (PII)	0.75	0.65	0.8	0.5
Vulnerability Index	0.06	0.16	-0.10	0.31
Qualitative Description	Moderately Resilient	Moderately Resilient	Moderately Vulnerable	Moderately Resilient
Over-all Vulnerability Index	**0.108**			
	Moderately Resilient			

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VAST Agro 4. Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Brgy. Samil and Kakawit, Lucban Quezon, Philippines[4]

About the Study Sites

Samil

Barangay Samil has a total land area of 581.4119 ha, situated 2.3 km away from Lucban Town Proper. It sits at the foot of Mt. Banahaw and is blessed with various river systems namely: Ilog samil, Angan Creek, Palilian creek and Botocan River.

Samil has a slightly rolling topography with pockets of scattered plains, the soil is generally sandy, clayey and loamy. The climate is cool and humid with an average of 285 rainy days a year. It has a high mean annual rainfall of 3.053mm.It has a total population of 542 comprised of 135 households. It has a workforce of 208, 180 of which are farmers.

The major income in the barangay is derived from coconut and rice farming. Coconut is the major crop and covers an area of 331.0478ha. rice fields cover around 178ha, 162ha of which represents irrigated lands. The area planted with rice is also used for vegetable production during in the off season. Growing vegetable is increasingly becoming popular because of the weather which is similar to that of Baguio and the Mt. Province. When vegetable harvests in these areas are not good, prices in Lucban becomes really high. Merchants that supply vegetables in Laguna, Lucena and Manila are regular visitors in the barangays mini trading centers.

Kakawit

Barangay Kakawit is around 8 km away from the town proper. Water resources available to the community are Malupak River, Alitap Creek, Malibago Creek and Talamsi Spring. It has a total land area of 577.3345ha. The topography is undulated to rolling and strongly rolling to steep hilly. Average Temperature range from 23.9ºC during November to March with temperatures often below20ºC to 27.9ºC in the months of April to October. The climate is characterized by a prolonged wet season with total annual rainfall of 4,470.4mm. The total population of the barangay is 365 composed of 70 households. It has a total employable population of 219.

In terms of Agricultural land use, around 540.8431ha is planted to coconut. Rice area covers around 427.2154ha, 72ha of which are not irrigated

A. **Assessment of Exposure to Climate-related Hazards**

a. Climate Hazards. Both Barangays identified Flooding and Typhoon as being the significant climate-related hazards that affected them.Since both experience 285 days of rainy days a year, flooding occurs even without typhoons.

Upon assessment, it appeared that both Barangays are very frequently exposed to Barangay Samil is only moderately exposed to flooding while Kakawit experiences flooding 10 times a year. This may be partly explained by its topography with very steep hills and with the rice fields situated in the plains below it.

[4] Based on the report of Ronaldo C. Garcia and Rey M. Jolongbayan, Southern Luzon State University

a. Seasonal Calendar. Despite the difference in biophysical characteristics**,** farming activities of the two communities and the likely occurrence of hazards are similar. For Barangay Samil, The main crop is coconut and rice with also large volumes of vegetables planted in between rice cropping, although there is a slow shift to planting different vegetables year round instead of rice. Planting starts in June and December to avoid the heavy rains from October to November. The same information was gathered in the case of Kakawit, although very few of the farmers in the barangay are in to vegetable production.

B. Assessment of Sensitivity to Climate-related Hazards

Samil has a moderate bio sensitivity potential while Kakawit has high. This maybe because Kakawit has a larger area planted with coconut and the damage caused can reach a magnitude of 80% in fallen nuts as described by the farmers.

C. Assessment of Adaptive Capacity

Samil lacks the system for disseminating information about hazards. Both barangays had no technological adaptation for flooding. Although the use of shelters in growing vegetables is known to the people of Samil, very few actually practice it due to prohibitive cost. For Kakawit, timing of Planting and Early harvest was considered as an adaptation to typhoon hazards as 60% of households practice it.

D. **Vulnerability Assessment**

Vulnerability to Occurrence of Typhoons. The Vulnerability indices indicated that both are Moderately Vulnerable to typhoon occurrences. The barangays both had maximum exposure index due to their high exposure to typhoons. Both barangays had moderate sensitivity scores due to their similar socioeconomic profiles. More than 60% of their households solely rely on agriculture and climate sensitive sources of income. Although Kakawit had a higher biophysical sensitivity score due to the extent of the damage brought to coconuts during typhoons, they had an adaptive mechanism for their rice areas hence had a higher Total Adaptive Capacity Index.

Vulnerability to Flooding. Samil is moderately resilient to flooding while Kakawit is Moderately Vulnerable. Both barangays have identical scores when it comes to Sensitivity and Total Adaptability. The Difference lies in the exposure index where Kakawit had an index of 1.00 which is the maximum. According to the community, flooding occurs almost 10 times a year. Again this is attributed to their topography. The farming areas are located in low lying plains making them susceptible to flooding. Another factor is the seeming lack of infrastructures projects in the area for diverting and controlling floodwaters. They do not even have their own barangay hall yet. The day care center serves as an informal meeting place for farmers. They also share health centers with two other nearby barangays. Samil on the other hand has well-built drainage systems and irrigation systems owing to its location. The National road bisects the barangay and is just 2.3 kilometers from the town center of Lucban.

D. Potential Interventions

Samil

The resilience of the agricultural systems and farming communities can greatly benefit from dissemination of technological agri-adaptation mechanisms in farming such improvised protected cultivation since it has been tried before. Organizing can probably bring down the cost of the said practice or a shift to high value vegetable production can justify the once prohibitive cost. The 60% of households relying solely on agriculture should diversify their income sources.

Kakawit

To increase the resilience of the farming communities in the barangay will call for provision of support infrastructures such as improvement of their irrigation and drainage systems to lessen the impacts of flooding. Farm diversification will also be a healthy option for them since they rely solely on coconut and rice. As with the case of Samil, they must venture into non climate sensitive sources of income as well. A shift to production of young coconuts of harvesting them as matured dehusked nuts would probably lessen the losses due to typhoons.

VAST Agro 5. Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Brgy. San Antonio, Nueva Valencia, Guimaras, Philippines[5]

About the Study Site

The Island Province of Guimaras is the home of the "Sweetest Mango". According to the 2000 census, it has a population of 30,716 people in 6,043 households. Located in Region 6, lying between the Island of Panay and Island of Negros, the Province is internationally known to produce the best mango in the world. Out of the 5 (five) municipalities in the Island Province, the Municipality of Nueva Valencia was chosen to be the site of the conduct of VAST-Agro. Nueva Valencia is a mango producing 4th class municipality in the province of Guimaras, Philippines. The barangay of San Antonio was selected for the assessment as per recommendation from the Local Government Unit, for it is the number one mango producing barangay of the Municipality.

A .Exposure Assessment

a. Identified Hazards. Three important climate hazards were identified by the community. Typhoon was experienced on the average of five (5) times every year with the exposure score of three (3). While, in every ten years, drought and erratic rainfall was frequently experienced 10 and 5 times respectively.

b. Climate Hazard Timeline. Chronological description of significant events that occurred in the community in the past was determined by the climate hazard timeline template. This helped identify the important climate trends, events, problems, impacts and community's adaption. Typhoon, drought and erratic rainfall were identified as climate related hazards that affect their crop- based agricultural production. In addition to this, one hazardous event was also identified by the community.

c. Seasonal Calendar. The seasonal calendar showed the list of production cycles and climate hazard occurrences throughout the year. The two distinct seasons, wet and dry season dictates the production cycle in the community. Wet season covers the month of May to October while dry season covers the month of November to April. Most of the crops are planted during the wet season starting on the month of May. The dry season favors the planting of vegetable crops and the flowering and fruiting of mango trees. Presently, farmers express concerns on the unpredictable precipitation patterns they are experiencing for it has incurred big damaged on the flowering and early fruiting stage of mangoes. Fruit production has drop to almost 90 to 100 percent causing a big lost in the part of mango growers. Effects of unpredictable precipitation include flower and fruit droppings and damaged on the bagging materials exposing the fruits to pest such as fruit flies and

[5] Based on the report of Jelly A. Brillon and Rod D. Tomambo, West Visayas State University

cecid flies. Furthermore, occurrence of fungal diseases in mangoes increases such as anthracnose and stem-end rot adding more to the production problems.

B. Sensitivity

a. Sensitive Areas/Crops. The areas or crops that were prone to damages were assessed by looking into its biophysical sensitivity potential. Hazards bought about by typhoon have the highest biophysical sensitivity potential.This affects crops such as mango, rice, banana, coconut, vegetables and corn. The hazard bought about by erratic rainfall causes damages on crops like mango, rice vegetables and corn. The least biophysical sensitivity potential was with hazards brought about by drought on mango, rice, coconut vegetables and corn. Typhoon and erratic rainfall was associated by the mango growers that greatly influence their production. Unpredictable rainfall patterns has affected the flowering induction activity of the farmers making them frustrated for some have to spray more than three times making farm inputs frustratingly high. Strong winds carried by typhoons causes fruit drops and fruit injury making production output below break-even situations. This situation results to farmers welcoming contractors to be involved in a sharing scheme production of mango to lessen the risk of spending so much on the inputs.

On the other hand, the effects of drought to mango production are not much of an issue. Dry season or less precipitation favors the flowering and the fruiting capability of mangoes in the area. Crops like rice, vegetables and corn were identified by the community to be vulnerable to the effects of drought. The community is a rain-fed area making them dependent on rain as a major water source for their agricultural production. Identified water source was individual ground well and the irrigation system of National Irrigation Authority serving only 30 rice growers within the barangay. This water source cannot fully provide the needs of the farmers for even in the dry months, no more water runs through these sources.

b.Sensitivity of Income Sources to Climate Hazards and Percent Households Engaging. Majority of the households, that is 70% are engaged in agriculture as their main source of livelihood followed by laborers/others with 10% while other livelihoods sources such as government employment, business, weaving and charcoal making involves 10% of the total household respectively. Among of the identified hazards, typhoon affects most of the enumerated income source except for household engaged to as government employee and as a laborer, while drought and erratic rainfall greatly affects agriculture related livelihood only.

c. Percentage of Income from climate-sensitive Sources. Income sources that are coming from agriculture and other climate sensitive livelihoods are seen to be sensitive to climate hazards. Income from agriculture has the highest number of household engaging with 70% followed by income from non-sensitive sources with 15%. An agriculture + non-climate sensitive income source involves 10% of the household while agriculture + climate sensitive income source involves 5% percent of the total households

d**. Socioeconomic Sensitivity Potential.** The degree of sensitivity to the hazards can be calculated on the proportion of the sensitive area relative to the total agricultural area of the community. The larger the sensitive area, the more sensitive the community is. Over all, prevalence and magnitude of hazards- typhoon, drought and erratic rainfall has similar effect on the socioeconomic activity in the community with an equal score of 4.

e. Average Sensitivity Score. The average sensitivity score by typhoon was the highest suggesting a very high impact in the community's agricultural activities while impacts by drought and erratic rainfall has an equal effect on the community.

C. Adaptive Capacity Assessment

a. Socioeconomic variables. The adaptive capacity of the community was assessed based on the capacity that enables people within the community to adjust to climate change, moderate potential damages, take advantage of opportunities, or cope with the consequential effect of a certain hazards or events. For number of family labor the score was three (3) suggesting a high availability in family labor. Literacy rate was also high with a score of five (5). General knowledge on hazards and availability of resources was very high with a score of five (5) suggesting the awareness and coping mechanism of the community is very notable. In contrary, presence of warning system and the dissemination of hazards to the community have a score of zero (0) indicating that no warning systems were present and the local unit of the barangay did not organize a facilitative community based emergency response team/unit. Presence and accessibility of support systems have a score of three (3) indicating the accessibility of the area by any means of transportation and communication. This includes access to provincial and national roads and to include the presence of several ports for sea navigation and trade. Wealth level was also high with a score of 4 indicating that majority of the population can afford to spend for adaptation cost bought about by certain climate related events or hazards.

b.Technological Adaptations. Although all of the people in the community are knowledgeable to some of the technological adaptation, its proportion to the implementing household was very in proportionate. Drought and erratic rainfall both scored zero (0) while in the case of technological adaption for typhoon the score is four (4) indicating that the community implements some measures in countering the effect of the hazards. Example of this is pruning and providing support columns for banana and mango trees during typhoons.

c. Total Adaptive Capacity . The score for adaptive capacity and technological adaptation was summed up to get the total adaptive capacity score. The results indicate that among the identified hazards the community has already adjusted and provided some adaptation measures to the effect of typhoon compared to the effects bought about by drought and erratic rainfall.

D. Vulnerability Assessment

Results suggest that the community is vulnerable to the effects of typhoon and erratic rainfall as to their crop production. On the other hand, vulnerability index score for the effect of drought to the agricultural production of the community suggest that the community is moderately vulnerable. If the identified hazards will be continually experienced by the community, the magnitude of damage will be on the large scale in the near future if no strategy or mitigation activities will be implemented at present.

E. Potential Interventions

The community strategic location gives them the opportunity not to rely on mango as their main agricultural crop. Located on the coastline, Barangay San Antonio is blessed with rich marine life that made fishing an alternative source of livelihood aside from crop based agricultural production making livelihood opportunities feasible if inland production is affected or vis-à-vis. Aside from that, the community propagates other crops as food and income source making them more resilient to the impacts of climate change. Diversification of crops is one of the adaptation strategies that address climate change impacts. The cultivation of other crops like langka and cashew would help augment the income of the people.

Table 9. Vulnerability Assessment Result using the VAST-Agro in San Antonio Nueva Valencia Guimaras Iloilo.

Variables	Typhoon	Drought	Erratic rainfall
Scores			
Exposure (ES)	3	5	3
Sensitivity (SS)	5	4	4
Adaptive Capacity (ACS)	25	25	25
Maximum Score			
Exposure (MES)	5	5	5
Sensitivity (MSS)	5	5	5
Adaptive Capacity (MACS)	45	45	45
Indices			
Exposure (EI)	0.6	1	0.6
Sensitivity (SI)	1	0.80	0.80
Adaptive Capacity (ACI)	0.56	0.56	0.56
Potential Impact Index (PII)	0.80	0.90	0.70
Vulnerability Index	-0.24	-0.34	-0.14
Over-all Qualitative description	Moderately Vulnerable	Moderately Vulnerable	Moderately Vulnerable
Over-all Vulnerability Index	**-0.24**		
	MODERATELY VULNERABLE		

Index Value0.71- 1.00 =Extremely Resilient; 0.41- 0.70=Highly Resilient;0.01- 0.40 =Moderately Resilient; 0=Vulnerable; -0.40- -0.01=Moderately Vulnerable, -0.70- -0.41=Highly Vulnerable; -1.00- -0.71= Extremely Vulnerable;

The vulnerability index score for all the identified hazards: typhoon, erratic rainfall and drought suggest that the formulation of mitigation measures for the impact of climate change. Considering the overall rating of the community which is moderately vulnerable, it is still on the danger of shifting its condition down to the more vulnerable level if no adaptation and mitigating strategy is implemented. The barangay officials and the LGU of Nueva Valencia must frame out an effective and efficient adaptation and mitigation strategies to address this problem in the future. One recommendation would be the identification and rehabilitation of the present water source in the community. This will include watershed mapping to identify tributaries and water path that will complement water harvesting practice and technology. Moreover, irrigation system must be well designed to cater and served more farmers. Proactive planning, that is, must include short and long term adaptation measures to address the present dilemma on mango production. Crop insurance could be one of the suggestions and the practice of IPM for respective crops. Moreover, as a coastal barangay, more research and development program must be done in marine fisheries technologies. A more resilient marine barangay must go along with a more resilient crop based agricultural production. This will build a more resilient and adaptive Barangay San Antonio to the imminent impacts of climate change in the future.

VAST Agro 6: Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Brgy. Jayubo, Lambunao, Iloilo, Philippines[6]

About the Site

Located in Central Iloilo, 48 kilometers from Iloilo City is the Municipality of Lambunao and Jayubo is one of its top producing agricultural sites with a total land area of 3,352.149 hectares in which 75% of it is devoted to agricultural production. The soil in the area is fertile which is suitable to various types of agricultural crops. Predominance of loam classification makes it conducive to farming. The major agricultural products are banana followed closely by rice, coffee and corn. It has two pronounced season, wet from May to October, dry during the rest of the year.

A. Exposure to Climate Hazards

a. **Frequency Occurrence of Identified Hazards.** There are four climate hazards identified by the community. These are typhoons, drought, erratic rainfall, and pest incidence. Typhoon was experienced at an average of three times per year which means it rarely occurs in the community. Data further shows that drought occurs three times per 10 years and exposure score also shows that its occurrence is rare. Erratic rainfall and pest incidence occurred five and ten times respectively every ten years. This means that erratic rainfall frequently occurs and incidence of pest is very frequent.

The identified pests present in the area are banana weevil (*Cosmopolites sordidus*), banana leaf roller (*Erionota thrax*) and bunchy top disease. Looking into optimal temperature, a shift in temperature affects insects physiological activities especially in the production of metabolites that increases the metabolic activities of the insect in terms of reproduction. Considering the life cycle of insect which covers only a number of days, population can easily increase in a short period of time as temperature increases. The farmers associated pest incidence as climate hazards because of the increase of damage as prolonged dry conditions continue to be experience by the area. Disease problem like bunchy top was more of a quarantine problem. Farmer tends to plant banana seedlings coming from outside sources unaware of the risk of disease contamination. Presently wide area of banana planted in the community has already been infected. The disease is countered by the farmers by burning the infected plants.

b. Climate Hazard Timeline. Chronological description of significant events that occurred in the community in the past was determined by the climate hazard timeline. This helped identify the important climate trends, events, problems, impacts and community's adaption. Typhoon, drought and erratic rainfall were identified as climate related hazards that affect their crop- based agricultural production.

c. Seasonal Calendar. The two distinct seasons, wet and dry season dictates the production cycle in the community. Wet season covers the month of May to October while dry season covers the month of November to April. Most of the crops are planted during the wet season starting on the month of May. The dry season favors the planting of vegetable crops and upland rice varieties. Presently, farmers express concerns on the unpredictable precipitation patterns and the occurrence of pest and diseases that incurred big lost in profit especially in the case of banana production. Damage brought about by hazards has different effects on the respective growing stages of crops.

[6] Based on the report of Jelly A. Brillon and Rod D. Tomambo, West Visayas State University

B. Sensitivity

a. Sensitive Areas/Crops. The areas or crops that were prone to damages were assessed by looking into its biophysical sensitivity potential.Data on biophysical sensitivity potential and its corresponding score show that hazards brought about by typhoon and pest had the highest and same result of 5 which is very high. The same crops: upland rice, coffee, banana and corn were affected. Hazards brought about by drought and erratic rainfall got an equivalent score of two (2) which means upland rice and corn are less affected by drought. Likewise, upland rice is less sensitive to erratic rainfall.

b. Sensitivity of Income Sources to Climate Hazards and Percent Households Engaging. Majority of the households, that is 68% are engaged in agriculture only followed by Agri+Sales and Agri+Laborer/OFW in which 72% engaged into it. In Agri+Agribus and Agri+Employed 13% and 9% engaged respectively. Four percent served as laborer and another four percent as businessman/sales. Among the identified hazards typhoon affects most of the enumerated income source except for laborers and businessmen. This might be due to the fact the laborers are needed even if there's typhoon and businessmen can still transact through modern communication facilities even if the weather is not good. Table further shows that drought, erratic rainfall and pest affect agriculture but not businessmen, laborer including Agri+Laborer/OFW and Agri+Sales. Furthermore, data show that drought and erratic rainfall did not affect Agri+employed, and Agri+Agribusiness.

c. Percentage of Income from climate-sensitive Sources. Sixty eight percent (68%) of households in the community engage in agriculture only and eight percent each in other sources. The table further shows that pest incidence is 100% affecting agriculture only and not the other sources of income. Other hazards like typhoon, drought and erratic rainfall affect eight percent each of the sources of income except agriculture only.

Agriculture is the main livelihood of the community. This kind of income source is highly dependent on climate conditions and is therefore subject to change and variability. Non-climate sensitive sources of income have helped the community in addressing problems especially if hazards have occurred. Replanting and reestablishing of affected cultivated areas especially on the above mention crops was possible by the aid of outside sources especially remittance made by OFW and relatives working in the urban areas.

d. Socioeconomic Sensitivity Potential. The degree of sensitivity to the hazards can be calculated on the proportion of the sensitive area relative to the total agricultural area of the community. Data shows that prevalence and magnitude of hazard brought about by typhoon, drought and erratic rainfall has similar effects on the socio-economic activity in the community with an equal score of 4. On the other hand, pest incidence has a score of 5. The present problem on pest incidence has a great impact on the production and income of the area. According to the farmers this has been occurring since 2002 and the magnitude of damage is getting wider. No control measures have been addressed in this problem especially in pest like the banana weevil and leaf roller.

e. Average Sensitivity Score. The average sensitivity score by typhoon and pest incidence suggest a very high impact in the community's agricultural activities while by impact by erratic rainfall and drought had an equal effect in the community.

C. Adaptive Capacity Assessment

a. Socioeconomic Adaptive Capacity. The adaptive capacity of the community was assessed based on the capacity that enables people within the community to adjust to climate change, moderate potential damages, take advantage of opportunities, or cope with the consequential effect of a certain hazards or events. Availability of family labor is high. Literacy rate was also high. General knowledge on hazards and availability of resources was very high suggesting the awareness and coping mechanism of the community is very notable. Dissemination of hazards to the community is moderate. There is no warning system. The local unit of the barangay did not organize a facilitative community based emergency response team/unit. Presence and accessibility of support systems indicate the accessibility of the area by any means of transportation and communication. This includes access to provincial and national roads. Wealth level was also high indicating that majority of the population can afford to spend for adaptation cost bought about by certain climate related events or hazards.

b. Technological Adaptations. Although all of the people in the community are knowledgeable to some of the technological adaptation, its proportion to the implementing household was very in proportionate. Drought and erratic rainfall both scored zero (0) while in the case of technological adaption for typhoon the score is two (2) indicating that the community implements some measures in countering the effect of the hazards but still it is very low to mitigate the impacts affecting their crops. Pest/disease incidence such as damage brought about bunchy top that greatly affects the banana production in the community is countered by practicing field sanitation by burning the affected crops. This practice has a score of one (1) showing that the adaptation is very low in the effects of pest and diseases. This finding is also supported by the damaged brought about by banana weevil and banana leaf roller wherein the community has no knowledge in countering its effects.

c. Total Adaptive Capacity Score. The results indicate that among the identified hazards the community has a potential to adapt to the impacts of climate change, but on the other hand, more technologies or mitigating measures must be introduce to the community to counter the effects of the hazards brought about by the changing climate.

D. Vulnerability Assessment. The community is moderately vulnerable to the effects of typhoon but highly resilient to the impacts brought of drought and erratic rainfall. On the other hand, vulnerability index score for the effect of pest/disease incidence to the agricultural production of the community suggest that the community is moderately vulnerable. If pest/diseases incidence continues to occur in the community, it will be further remain a problem, worse, it will have a wider coverage that would spread or affect the neighboring barangays of Brgy. Jayubo if no strategy or mitigation activities will be implemented at present. Over all vulnerability index score of the barangay suggests the barangay is moderately vulnerable to the effects of climate change as regards to their agricultural production.

E. Conclusion and Potential Interventions

Barangay Jayubo faced high risk and low resilience to the adverse impacts of climate change with limited technological adaptation capacity especially on the crops grown like banana, rice, coffee and corn. The limitations brought by frequent exposure to extreme events, hardships faced by households, social factors such as unsustainable activities, land tenure ship issues, lack of awareness and minimal political support. The impacts of climate change are greatly felt by Barangay Jayubo from typhoon, drought, unpredictable precipitation pattern and destruction of crops brought about by pest and diseases, affecting their income source and lifestyle. The topography of the village makes it vulnerable to landslide plus their on-going activities with deforestation specifically the practice of kaingin for the cultivation of upland rice makes them more vulnerable.

Households of the community have grown to depend on external sources as an adaptation measures. Most households rely on the remittances sent from relatives working overseas or from the urban areas both as a regular source of income and to assist in the recovery from an extreme event. Money sent from family or relatives has gone towards purchasing food in the event brought about by the identified hazards or by replanting of the affected cultivated areas. There is a shared attitude amongst people in the barangay that there is little they can do to better cope with climate change risks without external assistance. Their outlook is that they can only respond to the damages that result from extreme events and hope that they are able to retain their livelihoods. The barangay have adapted to the impacts in a reactive manner and they see a greater need to implement measures to protect them from future disastrous events and increase their resilience to climate impacts. Priority measures identified to be implemented will help restore confidence and comfort to communities not only in reducing the risk but providing opportunities and empowerment.

Table 10. Results of the Vulnerability Assessment using the VAST-Agro in Jayubo, Lambunao, Iloilo.

Variables	Typhoon	Drought	Erratic rainfall	Pest Incidence
Scores				
Exposure (ES)	2	2	3	5
Sensitivity (SS)	5	2	2	5
Adaptive Capacity (ACS)	27	27	27	27
Maximum Score				
Exposure (MES)	5	5	5	5
Sensitivity (MSS)	5	5	5	5
Adaptive Capacity (MACS)	45	45	45	45
Indices				
Exposure (EI)	0.4	0.4	0.6	1
Sensitivity (SI)	1	0.40	0.40	1
Adaptive Capacity (ACI)	0.60	0.60	0.60	0.60
Potential Impact Index (PII)	0.70	0.40	0.50	1
Vulnerability Index	-0.10	0.20	0.10	-0.40
Over-all Qualitative description	Moderately vulnerable	Moderately Resilient	Moderately Resilient	Moderately Vulnerable
Over-all Vulnerability Index	**-0.05**			
	MODERATELY VULNERABLE			

Generally, the clear picture that the assessment is sending is that variability and the frequent occurrences of extreme events have a great impact in the future. Presently, the vulnerability index score of the community is moderately vulnerable. They should formulate mitigation measures for the impact of climate change. It is still on the danger of shifting its condition down to the more vulnerable level if no adaptation and mitigating strategy is implemented.

Proactive planning, that is, must include short and long term adaptation measures to address the present dilemma in their agricultural production in relation to climate change hazards. The following adaptation measures are recommended, to wit; the promotion of education and awareness program for the impacts of climate change. The community of must strengthen their agricultural knowledge, especially on the practice of IPM. Close coordination with the Municipal Agriculture Office must be established in addressing problems on pest and diseases especially on the case of banana; Diversification of crops is pushed and the practice of soil conservation measures in the upland such as terracing and alley planting; Sustainability issues must be address especially in the case of practicing "kaigin" in the area. This requires an in depth review for this is a social problem.

Alternative source of livelihood must be looked upon by the LGU of Lambunao with the strong commitment of the community.; Promote agroforestry and resilient crops.; Present source of water supply such as natural springs and the rivers traversing the barangay must be given emphasize. This will include short and long term planning for the rehabilitation and reforestation of the watershed in the area. Immediate action must be done in this aspect for the forest cover area in the barangay is fast diminishing.; Establish Ecotourism Site (2 Waterfalls in the Brgy.); The LGU of Lambunao and the local officials of the barangay should set aside political issues in extending services towards the people in the community.

VAST Agro 7: Climate Change Vulnerability and Adaptive Capacity Assessment Using VAST-Agro in Dagumbaan and Kuya, Maramag, Bukidnon, Philippines[7]

About the study Sites

Dagumbaan

Dagumbaan's land area comprises 11.4 % of Maramag. A portion of its area is within the buffer zone of Mt. Kalatungan Range Natural Park and is under the National IntegratedProtected Area System. In 2007, the agricultural land in barangay Dagumbaan was cultivated by at least 1,300 farmers. The three major crops were sugarcane, rice (irrigated and rainfed) and corn. The major fruit crops were rambutan, mango, santol, durian and banana. Chickens, ducks, swine, cattle and draft animals comprised the livestock inventory, with chickens having the highest population and draft animals the least. Tilapia was the major inland fishery product. Dagumbaan is considered as the agro- industrial center of Maramag due to the presence of about 320 hectares of banana plantation of Dole Skyland.

Kuya, Maramag, Bukidnon

Barangay Kuya, an urbanizing community is dominated by rolling to hilly terrain. In 2007, agricultural land of barangay Kuya, which was utilized by at least 380 farmers, was about 51 % of the total land area. The three major crops were sugarcane (3,138 hectares), corn (749 hectares), and lowland and upland rice (430 hectares). Some areas were planted to tree fruits (rambutan, santol and durian), non-fruit-bearing trees (rubber and *Gmelina*), banana, pineapple and vegetables. Livestock and pasture area was about 13 % and 7 % of the agricultural area and barangay land area, respectively.

A. **Exposure Assessment**

a. Climate Hazards. Cliamte hazards have occurred in the barangay within the past 20 years based on the climate hazard timeline (data not shown). Three CC hazards are common to both barangays (flood, landslide and drought). Proximity of these two barangays may partly explain the shared hazards. Differences in exposure to CC hazards may be related to the gradient in elevation and gradient in terms of proximity to Mt. Kalatungan Range. Dagumbaan is nearer to Mt. Kalatungan and may have higher average elevation. Kuya is farther south of Mt. Kalatungan Range and may have lower average elevation.

Generally, both barangays are more exposed to CC hazards involving excessive rainfall. Only drought and rat infestation are correlated with rainfall deficiency. Rat infestation was considered as CC-related because rat damages were observed to worsen during prolonged dry period.

[7] Based on the report of Raul E. Margate and Ma. Stella M. Paulican Central Mindanao University

In barangay Dagumbaan, five CC hazards were identified: flood, landslide, drought, heavy rain and rat infestation. Exposure levels to flood and heavy rain are high based on the estimated frequency of occurrence. Exposure levels to landslide, drought and rat infestation are minimal.

Of the eight rainy months in Dagumbaan, heavy rains and floods usually occur in the months of August to October. CC can possibly extend the period with heavy rains, increase the frequency of heavy rains, and increase occurrence of flood-causing rains. Frequency of flood and landslide can likewise increase in relation to the frequency of heavy rains. May to July is the usual period with low amount of rainfall. Risks associated with drought are extended dry periods and more frequent occurrence of extended dry periods.

Four CC hazards were identified in barangay Kuya: flood, landslide, drought and *buhawi. Buhawi* is a vernacular term that can be translated to 'very heavy and intense rain with considerable duration that usually causes flood'. Technically, there is difficulty in translating this extreme event to English since we are not aware of any English word equivalent to *buhawi*. Exposure of barangay Kuya to flood is high; however, flooding has been isolated to the southwest part of the barangay when Baguic-ican River overflows. Rice fields along the Baguic-ican River are highly exposed to inundations. Exposure of barangay Kuya to landslide and *buhawi* is moderate, while exposure to drought is minimal. Accordingly, there is a shift in precipitation pattern or climate type in barangay Kuya, from a type with distinct dry period to a type with no distinct dry period. Shift in rainfall pattern was generally regarded as positive since crop production and related activities can be extended throughout the year. Negative impacts of the shift included failure of some fruit crops to flower and bear, erratic flowering, and difficulty in producing mango fruits.

Exposure levels of both barangays to flood and drought are comparable. Ordinary heavy rains in Kuya was not viewed as hazard, however, a more extreme rain event, *buhawi*, was regarded as hazard. Barangay Kuya seemed more predisposed to landslides compared to Dagumbaan. Difference in exposure level to landslide is supported by presence of more sloping areas in Kuya than in Dagumbaan.

B. Sensitivity Assessment

a. **Biophysical Sensitivity**. Spatial crop distribution in barangay Dagumbaan was obtained from secondary data, FGD and post-FGD KI interviews. Secondary KI interviews revealed that oil palm (25 hectare), coffee (50 hectares) and cassava (30 hectares) were missed during the FGD. These crops were not included in the assessment of vulnerability and adaptive capacity. Estimates of the area planted to various crops during the FGD accounted for 80 % of the 3,650-hectare crop production area. Distribution of crop production area in barangay Kuya was from estimates during the FGD.

In both barangays, sugarcane dominates the crop production landscape, occupying almost half of the area. Cereal crops (rice and corn) are produced only in less than 20 % of the crop production landscape. The proportion of land area used for banana production in Dagumbaan is 10 % (320 hectares) while only 3 % (150 hectares) in Kuya. Fruit and vegetable crops, which are negligible in Kuya, are produced in more than 10 % of the crop production landscape in Dagumbaan. While absent in Dagumbaan, pineapple plantation is about 150 hectares in Kuya. Rubber plantations could be present only in Kuya.

Rainfall patterns of the two barangays are dissimilar. In Dagumbaan, rainfall is almost evenly distributed, with relatively dry months in May to July. Dry periods in Kuya are usually during January to March. The bimodal rainfall pattern in Kuya provides for the production of two cropping of corn and rainfed lowland rice per year. Corn and rainfed lowland rice in Dagumbaan are usually produced once yearly.

Small-scale banana growers in Dagumbaan plant banana during the months of April to December. Peak harvest of Dagumbaan's small-scale banana production occurs from July to December. Large-scale Cavendish banana plantations in barangays Dagumbaan and Kuya execute the various production operations year-round. Tomato is produced in Dagumbaan in significant hectarage as a high value crop intended for big cities. Tomato production starts in March and can extend until December. Peak of tomato harvest coincides with the rainy months of August to October. Cassava is becoming less preferred in Kuya due to laborious produce processing. Few cassava growers plant cassava such that harvesting will coincide with the dry months of January to March.

Only rice production is predisposed to considerable flood damage. This is probably due to the proximity of rice production areas to the rivers that usually swell during floods. Landslide damages rice, corn and sugarcane crops very slightly. Spatial separation of rice, corn and sugarcane areas from the landslide prone areas can partly explain the observed damage levels. Except for banana, all crops are easily damaged by drought causing 90 % yield reduction. Banana plantations are perceived to be capable of providing irrigation facilities during drought. Heavy rains that cause lodging of sugarcane and rice can decrease yields by at least 15 %. Fruit crops are damaged by heavy rains through abscission of flowers and immature fruits. Mangos have been drastically affected by heavy rains. Five percent damage from rat infestation was projected to occur during prolonged dry period.

Crops in Kuya can be dichotomously segregated based on damage by CC hazards: a) slightly damaged – banana, pineapple, rubber and cassava; and, b) considerably damaged – rice, corn, sugarcane, vegetable crops and fruit crops. Shifting to crops that are only slightly damaged by CC hazards is a tempting proposition for decreasing vulnerability. Flood caused considerable damage to rice, corn, sugarcane and vegetable crops. Only rice production is considerably susceptible to landslide. Crops aside from banana, pineapple and cassava are considerably damaged by drought. *Buhawi* caused more damage in rice than in any other crops.
In both barangays, banana plantations are perceived as unaffected by the identified CC hazards. Site selection and ability to establish adaptive and corrective measures may partly explain the observations. In both barangays, rice production is most prone to damage than any other crop. Among the common CC hazards, damage to drought is highest. More in-depth assessment is recommended to verify if rice and corn production in Kuya is really more prone to CC-related damage than in Dagumbaan

Estimates of flood damage to rice, corn and sugarcane in Kuya are higher than in Dagumbaan. The clayey soil type and higher proportion of sloping areas (>8 %) in Kuya may support the differences in flood damage estimates. Higher proportion of area with more than 8 % slope in barangay Kuya may partly explain the higher landslide damage estimates for rice and corn in Kuya.

Biophysical sensitivity ratings of crops in both barangays are generally low. However, biophysical sensitivity of crops to drought is considerably high in Dagumbaan. It may be necessary to evaluate the sensitivity of both barangays to drought comprehensively. Enhancement of technological adaptations to drought may be prioritized in barangay Dagumbaan.

b. Socioeconomic Sensitivity. Income sources from agriculture and agriculture-related activities are generally sensitive to CC hazards. The lists are not exhaustive, missing income sources from employment in banana and pineapple plantations. Income sources that are not negatively affected by CC hazards include furniture making, iron and metal crafts, welding shops, masonry, working overseas, and working in government offices. In Kuya, some income sources were identified to be positively affected by CC hazards. Masonry works increased when there are infrastructure damages caused by the CC hazards. During floods, increased consumption of bread was observed. Government employees were able to avail of financial assistance such as calamity loans because of widespread flooding in Mindanao.

Although many non-CC-sensitive income sources were identified, 80 % or more of the households in both barangays are dependent on income from agriculture, which is prone to CC hazards. Few households (15 to 20 %) engage in additional and/or alternative income-earning activities. For households with income sources from agriculture and non-CC-sensitive enterprise, about 50 % of the income is from non-CC-sensitive sources. Very few households (5 %) have income sources that are not likely affected by CC hazards. High dependence on agriculture as primary income source explains the high socioeconomic sensitivity ratings of both barangays to all identified CC hazard. Strategies in lessening socioeconomic sensitivity of barangays Dagumbaan and Kuya to CC hazards could be directed at providing, initiating or enhancing alternative non-CC- sensitive income sources.

c. Mean Sensitivity. The general scenario for both barangays is that biophysical sensitivity ratings are low but socioeconomic sensitivity ratings are high ,placing the mean sensitivity ratings at moderate. Drought in Dagumbaan however has high biophysical, socioeconomic and mean sensitivity ratings. Extension works toward drought sensitivity mitigation may be intensified.

C. Adaptive Capacity

Generally, Dagumbaan has a slight adaptive capacity advantage over barangay Kuya. Adaptive capacity of barangay Dagumbaan is better than that of barangay Kuya in terms of knowledge and awareness of CC hazards, availability of transportation and communication resources, wealth level, and technological adaptations.

In comparing Dagumbaan and Kuya on availability of transportation and communication resources, some factors failed to support the differences. Barangay Dagumbaan is inferior to Kuya in terms of presence of adequate cellular phone signal and distance from highway. However, wealth level and average income per household will corroborate barangay Dagumbaan's superiority in this adaptive capacity variable. This difference can also be indicative of the limitations and difficulty in standardization of scores or ratings. Consequently, this will lead to limitations in comparing indices of different barangays.

Adaptive capacity of barangay Dagumbaan may be improved through: a) improving information dissemination systems about CC hazards; b) increasing knowledge and awareness of CC hazards; and, c) providing adequate early warning systems for CC hazards. Improvement in wealth level can also enhance the adaptive capacity of barangay Dagumbaan but can be more difficult to realize compared to those previously enumerated.

Weaknesses in barangay Kula's adaptive capacity are: a) knowledge of population on CC hazards; b) availability of resources for transport and communication; c) presence of adequate early warning systems; d) presence of systems for information dissemination regarding CC hazards; e) wealth level; and, f) crop production related technological ability. Adaptive capacity enhancement in barangay Kuya may start with improving knowledge and awareness, setting of adequate early warning systems, and dissemination and utilization of crop production technologies for CC adaptation.

Low biophysical sensitivity rating of both barangays to the identified CC hazards can partly explain the very low adaptive capacity ratings in: a) presence of adequate early warning systems; and, b) systems of information dissemination. Nevertheless, there could be small specific areas in both barangays that are CC hazard hotspots. These hotspots must be identified so adequate early warning systems can be installed and the people in proximity can be oriented of the risks.

Barangay Dagumbaan is likely ahead of barangay Kuya in crop production technological adaptations to CC hazards. Percentages of households that are aware and are implementing technological adaptations are higher in Dagumbaan than in Kuya. The quality of technological adaptations in Dagumbaan seems better than in Kuya. Disparity in the crop production related technological adaptations against CC hazards between the two neighboring barangays necessitates comprehensive assessment and review before implementation of any large scale adaptive capacity enhancement projects or programs. Effectiveness and appropriateness of technologies in Dagumbaan may need verification. Enhancement of technological adaptations in Kuya may start with awareness campaign and adequate dissemination of appropriate technologies.

D. Vulnerability

Crop production in barangays Dagumbaan and Kuya is 'moderately vulnerable' to CC This rating is due to the low to moderate exposure level to CC hazards, moderate sensitivity to
CC hazards and moderate adaptive capacity.

Moderate vulnerability of crop production in barangay Dagumbaan to flood and heavy rain is due to the high occurrence frequency of flood and heavy rain .Barangay Dagumbaan's moderate resilience to landslide, drought and rat infestation is largely due to low exposure levels, High potential impact of flood and heavy rain to crop production in Dagumbaan should be mitigated with more adaptation measures. Generally, reducing socioeconomic sensitivity and increasing adaptive capacity will likely reduce barangay Dagumbaan's vulnerability to CC hazards.

Crop production in Kuya is moderately vulnerable to flood, landslide and *buhawi* Frequent flooding contributes to the barrage's vulnerability to CC hazards. In-depth study and assessment of flooding in Kuya may be necessary. Moderate resilience of barangay Kuya to drought is largely due to low frequency of drought occurrence. Barangay Kula's vulnerability to CC hazards can be decreased by reducing socioeconomic sensitivity and increasing adaptive capacity.

Although the vulnerability of barangays Dagumbaan and Kuya are comparable, mitigation programs between these barangays may vary. Barangay Dagumbaan may focus on decreasing sensitivity to drought. To counteract the high exposure levels of barangay Dagumbaan to flood and heavy rain, adaptive capacity enhancement should be more intense for these hazards. In barangay Kuya, enhancement of adaptive capacity to the four identified CC hazards is recommended. However, more intense improvement in the adaptive capacity to flooding is necessary to neutralize the high occurrence frequency of floods. In both barangays, reduction of socioeconomic sensitivity will decrease vulnerability to CC. Barangay Kuya may need to invest more in improving its adaptive capacity than barangay Dagumbaan.

Table 11. Result of vulnerability assessment using the VAST-Agro in Dagumbaan, Maramag, Bukidnon

Indices	Flood	Landslide	Drought	Heavy Rains	Rat Infestation
Exposure (EI)	1.00	0.20	0.20	1.00	0.20
Sensitivity (SI)	0.60	0.50	0.90	0.60	0.60
Adaptive Capacity (ACI)	0.58	0.56	0.60	0.58	0.58
Potential Impact Index (PII)	0.80	0.35	0.55	0.80	0.40
Vulnerability Index	-0.22	0.21	0.05	-0.20	0.18
Qualitative Description	Moderately Vulnerable	Moderately Resilient	Moderately Resilient	Moderately Vulnerable	Moderately Resilient
Over-all Vulnerability Index	**0.002**				
	Moderately Vulnerable				

Table 12. Result of vulnerability assessment using the VAST-Agro in Kuya, Maramag, Bukidnon

Indices	Flood	Landslide	Drought	Heavy Intense Rains
Exposure (EI)	1.00	0.40	0.20	0.40
Sensitivity (SI)	0.60	0.60	0.60	0.60
Adaptive Capacity (ACI)	0.47	0.47	0.49	0.44
Potential Impact Index (PII)	0.80	0.50	0.40	0.50
Vulnerability Index	-0.33	-0.03	0.09	-0.06
Qualitative Description	Moderately Vulnerable	Moderately Vulnerable	Moderately Resilient	Moderately Vulnerable
Over-all Vulnerability Index	**0.083**			
	Moderately Vulnerable			

E. Conclusion and Potential Interventions

Crop production in both barangays is exposed to flood, landslide and drought (Table 3.13). Heavy rain and rat infestation are additional CC hazards in Dagumbaan. In addition, *buhawi* was identified as CC hazard in Kuya. CC hazards brought about by excessive rainfall are dominant in both barangays. Except for the high biophysical sensitivity of barangay Dagumbaan to drought, biophysical sensitivity of both barangays to the all other perceived CC hazards is low. Socioeconomic sensitivity of both barangays to all identified CC hazards is very high. Mean sensitivity of Dagumbaan to drought is high, while mean sensitivity of both barangays all other identified hazards is moderate. Adaptive capacity of both barangays ranges from slightly deficient to adequate. Barangay Dagumbaan has a slight adaptive capacity advantage over Kuya. Based on the exposure level, biophysical and socioeconomic sensitivity, and adaptive capacity, barangay Dagumbaan and barangay Kuya are 'moderately vulnerable' to CC hazards.

General recommendation to barangays Dagumbaan and Kuya for enhancement of resilience to CC hazards are the following: a) reduction of socioeconomic sensitivity; and, b) improvement of adaptive capacity. Socioeconomic sensitivity may be reduced through lesser dependence on agriculture and CC-sensitive income sources. Enhancement of awareness and knowledge to CC hazards, improved communication systems for disseminating information on CC and CC hazards, establishment of early warning systems in CC hazard hotspot areas, and improved accessibility to various support systems can potentially increase adaptive capacity.

Specific recommendations for barangay Dagumbaan are: a) employment of crop production technologies to decrease biophysical sensitivity to drought; and, b) intensification of adaptation measures to offset high exposure levels to flood and heavy rain.

Specific recommendations for barangay Kuya are: a) increase utilization of crop production technologies against CC hazards; and, b) intensification of adaptation measures to compensate for the high exposure level to flood.

E. Forum: Vulnerability Assessment in Different Crop-based Farming Systems using the VAST-Agro

The aim of this forum is to present, discuss and create awareness among different stakeholders, the academe and national agencies with important roles in climate change adaptation, the vulnerability to climate change of production areas of other major crops in the country that are not the usual object of interest in other vulnerability assessment studies done in the country. Also to draw more suggestions on how to best utilize these results as well as the methodology for planning and designing adaptation measures for agriculture.

After having heard and discussed the results of vulnerability assessment in different regions in the country by the CSU's, the VAST-Agro indeed was proven as a useful tool in understanding farmers' experiences on climate change and could pave the way to an effective plan and action to address the anticipated adversities of climate change and to lessen its impact on vulnerable production systems and farming communities.

There are a number of insights and suggestions that have been brought up in the course of the discussion on the methodology; on the production systems and on the areas assessed for vulnerability. These are categorized into the following items presented below.

Vulnerability Index (VI). Development of VI is a very fertile area for research. While there are a number of methodologies and vulnerability indices proposed, it is still new. The VAST Agro provides a composite index.

Variables to Measure Vulnerability. VAST-Agro suggests a number of variables to measure including experiences on exposure to climate-related hazards, biophysical and socio-economic sensitivity to the climate-related hazards and adaptive capacity of the community where knowledge and implementation of technological adaptation for agriculture are also included. While the sites where the VAST Agro was implemented are supposedly models of different crop-based farming systems (i.e. mango production areas in Pangasinan and Guimaras; banana-production areas in Mindoro and Bukidnon; highland vegetables and strawberry production areas in Benguet and coconut-based farming systems in Quezon), results of the assessment showed the variety of crops planted in the area and described in general the effect of the hazards in crop production. Each crop varies in several aspects (growth habits, requirements and growth stages) and the effects of the climate hazard on each crop also vary. This might merit the development of minimum set of variables for each crop when collecting information on the effect of climate change hazards on the production system, an improvement in the methodology that will be given much consideration and high priority.

Data Collection using the VAST-Agro. Focus Group Discussion (FGD) or non-formal data collection techniques pose several challenges when gathering information from the respondents. Thus, the VAST-Agro results can be highly influenced by the way questions are asked. As such, since the FGD will provide non-quantifiable results, VAST-Agro recognizes the necessity of backing-up information gathered with related information using other instruments like the following.

Collecting secondary data collection for climate, production, and socio-economic information prior to the conduct of the VAST-Agro is one way to understand and have a clear picture of the situation in the area before the assessment.

Interview with key informants (like the municipal/village officers) prior to the conduct of the VAST-Agro is very helpful not only for getting permission for the conduct of the VAST-Agro but also for gathering as much information on agricultural production, the farming community and municipal-level plans for climate change adaptation.Transect walk and spot maps are ways to get information about location of production areas, vulnerable groups in the community and resources that strengthen/weaken adaptive capacity.

In the Exposure assessment the use of timeline reflects CC related hazards to which the community is sensitive within a 10-year period.

For adaptive capacity assessment, support information on the roles and the extent of involvement of support institutions in the community can be further illustrated using the Venn-diagram. The use of this tool will probe further information on weaknesses of the community in terms of technological and community adaptation. For example: in Pangasinan, communities have no technological adaptation in spite of repeated exposure to the same climate related hazard. In Benguet, results of the VAST-Agro might be an important input to the plans being made by local risks and disaster management units.

Furthermore, seasonal calendar is one of the tools that can be used to further explain farmers' practices to avoid adverse impacts of climate related hazards such as adjustment of the planting date, stage of the crop which is most sensitive to the climate-related hazards (such as effect of flooding in mango in Pangasinan, pest/rat infestation or disease occurrence as influenced by climate as observed in Benguet, Pangasinan, Mindoro, Iloilo and Bukidnon.

Sensitivity to Climate Change . The term sensitivity, if referring to the crop, can be defined differently by crop experts. The VAST-Agro attempts to assess sensitivity of both the production system and the community (i.e. biophysical and socioeconomic sensitivity). The VAST-Agro thus, asses sensitivity of crop production systems based on its geographic location as affected by the hazards experienced and felt by the community. It is very interesting to see in one of the tools of the VAST-Agro the effect of the hazards for each crop in the production system in the area.

Spatial Scale for Vulnerability Assessment. While the VAST-Agro is designed for community level (i.e. barangay), it can also be used at the municipal level. Doing the VAST-Agro in all barangays in a given municipality will be able to rank the barangays according to vulnerability and explain such ranking. It will be very ideal though to do a vulnerability assessment at the watershed level.

Making Recommendations based on VAST-Agro Results. The results of the VAST-Agro do not intend to make a blanket recommendation for the site under study. It thus may serve as an initial basis for planning site specific adaptation measures for local agriculture.

Who should do the Vulnerability Assessment. The VAST-Agro can best be carried out by a multi-disciplinary team who may not be from the local government of the area under study.

4.0 Conclusions

This project provided an opportunity for agriculture experts from different agricultural state universities and colleges in the Philippines, national and international climate change experts, farming community, local planners/policy makers interact and be made even more aware of the climate situation in the country and likely impacts on Philippines agriculture and the need for site-specific and local adaptation measures for agriculture. This was even made clearer after a thorough understanding of local situation of agricultural production and farming communities facing climate adversities using a vulnerability assessment tool designed for local level assessment of agriculture areas and farming communities.

The VAST-Agro Methodology developed by the proponents from the Agricultural Systems Cluster of UPLB was refined through his project through the significant inputs and suggestions of national and international experts both in agriculture and climate change solicited during the series of meeting, seminars and forum conducted by the project and important inputs by the collaborating state universities and colleges during the training and workshop held before and after the implementation of the methodology in at least 12 sites and different production areas in the country.

Vulnerability assessment using the VAST Agro was done in production areas that are known for crops other than the staple crops in the country (i.e. rice and corn) like banana, vegetable, and mango. These crops are some of the important crops in the country that requires immediate and long-term adaptation measures. It can be noted however that while these areas are known for the said crops, using the vast agro methodology may actually include concerns for other crops in the area as well. Users of the VAST-Agro may tend to be excited over the calculation of the Vulnerability Index. While the VI will be very useful for local planners in setting priorities for adaptation measures, in-depth information about the sensitivity of the crops to specific hazards that can be captured using the VAST-Agro is equally important and must also be thoroughly done during data collection to make use of the VAST-Agro to its full potential.

Having provided the participating agriculture experts with updated knowledge on climate hazards confronting food and fiber production in the country and equipped them with both the tool and skill for assessing vulnerability of agriculture areas at the local level would enhance the roles of the participating SCUs in climate change adaptation for agriculture in their areas of concern not only through instruction and research but through development activities development activities that will address adaptation needs/requirement of specific farming systems in their regions.

Through the project activities, information about the vulnerability and need for adaptation measures for the farming systems were disseminated to the local policy makers (municipal and farming village heads), planners (municipal agriculture offices) and community members in at least 12 sites including mango and banana production areas in selected villages in the municipalities of Guimaras and Lambunao , Iloilo province; Victoria, Mindoro Oriental, Maramag Bukidnon, in coconut –based farming areas of Lucban Quezon; and in the highland vegetable and strawberry production of Tuba and La Trinidad, Benguet.

Information about the VAST-Agromethodology and the results of its implementation in different production areas in the country was also disseminated to other stakeholders inclosing agriculture specialists and climate experts in the academe and research and development institutions were also disseminated through seminars and forum held by the project and through participation of the both the proponents and the collaboration state universities in local and international conferences.

5.0 Future Directions

Explore the use of the VAST-Agro methodology for research and development on local management of agrobiodiversity

After having used the methodology to assess vulnerability of different production systems, the methodology proved to be useful as well for identifying potential intervention that will improve local management of agrobiodiversity.This will require improvement on the VAST-Agro methodology to focus more on the assessing sensitivity of various crop species including underutilized crops in particular areas to highlight impacts of CC on crops that contributes to food security and livelihood sources and crops that are resistant to climate stress whose potential uses could be harnessed as future source food and income, thus be able to identify potential interventions that will contribute to the enhancement of adaptation to climate change of the farming communities.

Training of agriculture experts from other state universities and colleges and from the local government units on the use of the VAST-Agro as an aid to planning adaptation measures for agriculture at the local level

Even before this project ended, there are a number of enthusiastic users of the VAST-Agro methodology, most of them coming from other state universities. For a moa effective and stronger collaboration among the agriculture specialists from the state universities and the municipal agriculture offices on planning for climate change adaptation of agriculture at the local level, it will be best to bring them all together in a venue where they will be equipped with knowledge, tools and skills on understanding climate change in the Philippines, likely impact on food production and identification of potential interventions for climate change adaptation.

Appendix (Attached PDF copies)

A. Directory of SCU Representatives and UPLB Staff

B. Sensitization Course on Adaptation Strategies for Enhancing Resilience of Different Agroecosystems to Climate Change (Program)

C. Vulnerability Assessment in Different Crop-based Farming Systems using the VAST-Agro (Program)

D. VAST-Agro (Slide Presentation)

<u>Funding sources outside the APN</u>

Agricultural Systems Cluster- UP Los Banos (ASC-UPLB) : counterpart contribution in terms of the use of facilities (including the Galvez Hall, ASC Lecture Hall and the FSSRI Training Room, Use of computer room, communication facilities, office space, electricity consumption) and logistic support (including use of vehicle and gasoline during the refinement and test of the VAST-Agro methodology in Magadalena Laguna and other short distance travels, driver, involvement of administrative staff for clerical, janitorial and other support services);
The Southeast Asian Regional Center for Graduate Studies and Research in Agriculture (SEARCA): staff involvement (photo and audio documentation) and presence; the use of the SAM-Arng Hall as venue for the said course, use of the electronic bulletin, billboard and allocating a space in the SEARCA-KC3 Website for the public advertisement of the activity; Waived registration for the participation in the International Conference Climate Change Adaptation for Food and Environmental Security.
The Office of the Dean of the College of Agriculture, UP Los Banos (CADO-UPLB): meal provision during the welcome banquet of the sensitization course.
Rice Department of Thailand- Office of the Deputy Director General: logistic support (airport transfer on arrival to hotel, transport within BKK during the visit to agencies; gasoline and driver);
Research Center for Geotechnology, LIPI- Bandung: logistic support (transport from LIPI Bandung to IPB Bogor and CCROM-SEAP)
Pangasinan State University (PSU) Office of the Vice-President: Logistic support to project team

during the field work in Pangasinan; site selection and initial site visit to the sites;
Mindoro State College of Agriculture and Technology (MINSCAT) Office of the President: Logistic Support to project team during the field work, transportation, staff support during the field work in Mindoro;
Central Mindanao University (CMU): Logistic support duirng field work in Maramag Bukidnon; transportation, gasoline and staff support during site selection and initial site visit;
Southern Luzon State University: logistic support during the site selection and initial site visit; supplies and materials during the conduct field activity in Lucban Quezon;
Benguet State University -College of Agriculture: Partial support for logistics and transportation during the site selection and initial site visit;
West Visaya State University- Office of the Director for Research: Partial support for transportation during the site selection and initial site visit/arrangement with the local community heads.

Glossary of Terms

ACS	Adaptive Capacity Score
ACI	Adaptive Capacity Index
ASC	Agricultural Systems Cluster
Brgy	Brangay (Village)
CA-DO	College of Agriculture - Office of the Dean
BSU	Benguet State University
CC	Climate Change
CCROM-SEAP	Center for Climate Risk and Opportunity Management in SE Asia and Pacific
CMU	Central Mindanao University
DA	Department of Agriculture
DPWH	Department of Public Works and Highway
ES	Exposure Score
EI	Exposure index
FGD	Focused Group Discussion
LGU	Local government Unit
MAO	Municipal Agriculture Officer
MACs	Maximum Adaptive Capacity Score
MES	Maximum Exposure Score
MINSCAT	Mindoro State College of Agriculture and Technology
MSS	Maximum Sensitivity Score
NIA	National Irrigation Authority
OFW	Overseas Filipino Worker
PAGASA	Philippine Atmospheric geophysical and Astronomical Services Administration
PCARRD	Philippine Council for Agricultural Resources Research and Development
PII	Potential Impact Index
PSU	Pangasinan State University
SCUs	State Universities and Colleges
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SLSU	Southern Luzon State University
SS	Sensitivity Score
SSNM	Site Specific Nutrient Management
S&T	Science and Technology
WVSU	West Visaya State University
VAST-Agro	Vulnerability and Adaptive Capacity Assessment in Different Agroecosystems
VI	Vulnerability Index