Scientific Capacity Building for Climate Impact and Vulnerability Assessments (SCBCIA)

FINAL REPORT

"Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments"

Reference: CIA2009-02-Pulhin




APN
Asia-Pacific Network for Global Change Research
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Making a Difference

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

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CLIMsystems
Decision making in a climate changed world

University of the Sunshine Coast
Queensland, Australia

Project Reference Number: CIA2009-02-Pulhin
Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The reality of climate change calls for a need to understand how it might affect a range of natural and social systems, and to identify and evaluate options to respond to these effects (Ionescu et al. 2009). This has led to in-depth investigation of vulnerability and adaptation to climate change, which has become central to climate science, policy and practice. The capacity, however, to conduct vulnerability and adaptation assessment is still limited in the Philippines, particularly with gaps in downscaling simulated scenarios and mainstreaming research findings into policy- and decision-making (Sajise 2010).

This capacity development project trained key stakeholders in Albay in the conduct of impacts, vulnerability and adaptation assessment using a computer-based modeling system and participatory approaches. SimCLIM was used and developed for Albay (AlbayClim) as an innovative tool for assessing and creating climate change scenarios. This aided in characterizing future risks specific for the province.

Case studies were conducted in upland and coastal communities to demonstrate the assessment of impacts, vulnerability and adaptation to climate change and sea-level rise. The AlbayClim was complemented with participatory techniques to solicit knowledge and experiences of the local people. This put into context the source of vulnerability, as well as facilitated mainstreaming adaptive responses.

Objectives

This project generally aimed to build the capacity of local government officials, researchers, and the provincial government of Albay, in the Philippines, as a whole, in assessing the impacts of and their vulnerability to climate change, with the use of a computer modeling system and complemented by local knowledge.

Specifically, the project sought to:

1. Familiarize relevant stakeholders in Albay on the concepts of climate change;
2. Train the target audience, particularly the municipal planning development officers, on the use of SimCLIM customized for Albay (AlbayClim);
3. Introduce participatory approaches for assessing climate change impacts, vulnerability and adaptation;
4. Using case studies, demonstrate vulnerability, impacts and adaptation assessment to climate change and sea-level rise in selected areas in the province using participatory approach and a computer-based modeling system (AlbayClim); and
5. Investigate how to mainstream results of the assessment in adaptation planning.

Amount received and number years supported

The Grant awarded to this project was:
US$ 38,000 for 1 Year 2009/2010
(It should be noted that the project was granted with six-month no-cost extension.)

Activities undertaken

The project commenced with a Kick-Off Meeting held on January 15-16, 2010, in Legazpi City, Albay, to introduce the project to and draw support from relevant stakeholders, level-off expectations on expected outputs and institutional roles, present the data requirements for the SimCLIM modeling system, and assign coordinators to collect the needed data. After all the required data were collected, SimCLIM was customized for Albay (called AlbayClim) by partners from CLIMsystems. Training on the use of the customized modeling system was conducted on April 26-29, 2010, in Tabaco City, Albay. This was attended largely by planning development officers from the different municipalities of the province, as well as other local government units (LGU) staff. The participants were familiarized with the concepts of climate change, the various frameworks for its assessment, as well as introduced to participatory assessment techniques.

Using case studies, vulnerability, impacts and adaptation to climate change and sea-level rise were assessed in selected areas in Albay. The results of which were shared to various stakeholders in the province through a forum held on May 31, 2011, in Legazpi City, Albay. This aimed, among others, to validate the findings of the assessment and solicit ways to move forward and mainstream these to local adaptation planning. Likewise, the assessment tools, experiences and findings of the project were presented at the launching of the *Series of Consultation on Vulnerability and Risks Assessments Tools towards a Climate Change Resilient Philippines* on June 1, 2011, in Malacañang, Manila. This was the first among the series of lectures organized by the Climate Change Commission which aimed to scope all assessment instruments related to climate change and provide a platform to discuss experiences on adopting vulnerability and assessment tools.

Results

The project resulted in greater understanding of the concepts of climate change by the local stakeholders, and trained capacity in conducting vulnerability and adaptation assessment, particularly with the aid of AlbayClim. It also directly contributed to an important undertaking in the province for policy planning, which is the revision of their Comprehensive Land Use Plan (CLUP). Likewise, it paved the way towards enhanced methodologies and better tools for vulnerability and adaptation assessment, particularly addressing the two major gaps in climate change research in the country, i.e., downscaling climate change scenarios and mainstreaming research findings into policy- and decision-making (Sajise 2010).

Meanwhile, case studies were conducted in the upland communities of the municipality of Oas for climate change assessment and coastal communities of the municipality of Bacacay for sea-level rise assessment. The upland communities were highly exposed to typhoons and El Niño. The impacts of the above hazards to the upland communities were decline in agricultural production or total crop failure, less water yield and poor water quality, landslides, damages to properties, and malnutrition.

On the other hand, the coastal communities were affected by floods and storm surges during typhoon. Such hazard exposures led to damages to properties and agricultural areas, increased occurrences of illnesses, and salt-water intrusion. For both upland and coastal communities, adaptation strategies were mostly spontaneous and meant to bear the losses of the impacts.

Future climate change and sea-level rise scenarios generated through AlbayClim, using ensembles and SRES A1FI set at high sensitivity, presented a 4-5°C increase in temperature and about 10% increase in precipitation in 2100 in the *barangays* (basic political unit in the Philippines) where the upland communities are located, and 1.3-meter sea level rise in the same year in the eastern coast

of Albay, where lies the coastal communities. Given these results, long-term adaptation planning is in order, which should take into consideration improving the adaptive capacity of the concerned stakeholders.

Combining both computer-based modeling system and participatory approaches in the conduct of assessment proved useful as the former demonstrated the 'forward-looking' aspect of climate change. Meanwhile, the latter substantiated and put into context the vulnerability of the sector/group assessed, particularly taking into account the non-climatic factors. In the process, this approach made the local communities acquainted with the concepts of climate change. It also treated adaptation as a process through which measures are carried out, rather than merely the adaptation strategies themselves.

The presentation of the results among key stakeholders in Albay highlighted the relevance of the undertaking, particularly its contributions to the newly launched Climate Change Academy in the province, as well as the need to enhance understanding of the local people on the issues brought forth by the findings of the assessment. Meanwhile, the team's presentation in Malacañang yielded some considerations on how the Climate Change Commission and the country in general would pursue its climate research and development agenda, in particular, the formulation of the right research questions, distillation of best practices, formulation of national assessment guidelines, mentoring network (particularly from the experience of Albay), community-based approaches, and linkages with data-keepers.

Relevance to APN's Science and Policy Agenda

This project is supportive of the Science and Policy Agenda of the APN, particularly as it identified and developed tools and methodologies for enhanced assessments of climate change impacts, vulnerability and adaptation. Key stakeholders in the project site were also trained on the application of these tools and methodologies, for enhanced capacity in conducting assessments.

In term of bridging science and policy, results were linked to policy-making and adaptation planning. Specifically, outputs of the project directly contributed in the preparation of the Comprehensive Land Use Plan of Albay, and the findings of the case study assessments were shared to key stakeholders through a forum. Results and processes involved in this project would also contribute to the newly launched Climate Change Academy in the province. Successful partnership with the leading and sole policy-making body of the Philippine government on climate change, i.e., the Climate Change Commission, was also achieved, which guaranteed consideration of the project's methodologies and results to the climate change research and development agenda of the country.

As the project leader is also one of the Coordinating Lead Author of the Intergovernmental Panel on Climate Change for its Fifth Assessment Report, efforts would also be made to incorporate the findings in this assessment.

Self evaluation

In general, the project was implemented smoothly without any major difficulty. All collaborators significantly contributed towards the achievement of its objectives, and the key stakeholders in the province of Albay were also highly enthusiastic and actively participated in the project activities.

Potential for further work

While this project enhanced the capacity of the target audience to conduct assessment of impacts, adaptation and vulnerability to climate change using participatory approaches and a computer-based modeling system to aid in generating climate change scenarios, yet capacity in modeling potential impacts of the generated scenarios using impact models is still limited. This is an area that can be addressed in future capacity development activities, particularly exploring the availability of free wares to perform such functions and identifying experts who could provide training on their use.

Publications

Papers are currently being prepared for submission to peer-reviewed journals. A manual for conducting vulnerability and adaptation assessment, following the experiences and methodologies used in the project, will also be developed.

References

Please refer to the list of references in the Technical Report.

Acknowledgments

This project would not have been possible without the financial support provided by the Asia-Pacific Network for Global Change Research (APN) through its CAPaBLE Programme. Its successful implementation was owed to the active participation and generous assistance from the collaborators, both financial and in-kind, particularly from the Provincial Government of Albay, Center for Initiatives and Research on Climate Adaptation, and CLIMsystems, Ltd.

Aside from the major collaborators, the following people are also recognized for their significant contributions to the project: Dr. Peter Kouwenhoven of CLIMsystems; Prof. Maricel A. Tapia and Prof. Rose Jane J. Peras of the College of Forestry and Natural Resources, University of the Philippines Los Baños (UPLB); and Ms. Chandyllane G. Cantre of School of Environmental Science and Management, UPLB. Thanks are also due to Dr. Roger Concepcion, formerly with the Bureau of Soils and Water Management, for providing the soil data as input to the PlantGRO model and For. Angela A. Limpiada, for preparing the maps for sea-level rise.

The project team also acknowledges the partnership with the Climate Change Commission and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development which facilitated the presentation of the project's findings and experiences at the national level.

TECHNICAL REPORT

Preface

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (2007) put forth that evidences of a warming climate are unequivocal. This makes adaptation to climate change crucial as even with mitigation efforts, these would not recompense the stabilization of atmospheric concentrations of greenhouse gas (GHG) emissions and climate (Wigley 1989 in Schneider et al. 2001). However, in the midst of a general clamor for adaptation, equally receiving attention is bridging the gap between science-policy-practice for evidence-based responses to risks posed by climate change. The risk of maladaptation is feared to bring greater impacts if actions are not based on sound science (Lasco 2009). Thus, assessment of impacts and vulnerability to climate change is an important requisite for empirical-based strategies for adaptation, which are not merely reactive but geared towards planned and anticipatory responses.

The Philippine's National Framework Strategy on Climate Change (NFSCC) underscored the importance of enhanced vulnerability and adaptation assessments towards achieving its objective of building the adaptive capacity of communities and increasing the resilience of natural ecosystems to climate change. The formulation of effective and efficient assessment tools and improved mechanisms for addressing gaps and limitations are among its identified strategic priorities. To this end, this undertaking was highly timely and relevant not only in enhancing the capacity of local government units in conducting vulnerability and adaptation assessments in support of NFSCC's goals, but also in showcasing and demonstrating methodologies and tools that could be used to promote the climate change research and development agenda in the country.

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1.0 Introduction

The reality of climate change calls for a need to understand how it might affect a range of natural and social systems, and to identify and evaluate options to respond to these effects (Ionescu et al. 2009). This has led to in-depth investigation of vulnerability and adaptation to climate change, which has become central to climate science, policy and practice. The capacity, however, to conduct vulnerability and adaptation assessment is still limited in the Philippines, particularly with gaps in downscaling simulated scenarios and mainstreaming research findings into policy- and decision-making (Sajise 2010).

Competence for such assessments is important, particularly among local decision-makers who are at the forefront of actions for responding to these pressing issues, with climate change affecting sectors and societies differently. This is due to the variation in impacts among regions, difference in the characteristics of groups and sectors, and difference as well in the extent of their responses (Ionescu et al. 2009). Such creates a need for area-specific responses. It is crucial as well that the knowledge and experiences of the local people are considered, together with scientific or computer-based tools for assessment, to put into context the source of vulnerability. This facilitates adaptation which should be treated as a process through which measures are carried out, rather than considering it merely as the adaptation strategies.

This capacity building initiative was therefore conceptualized and implemented in response to the above need. The province of Albay was chosen as the study site as it is one of the most vulnerable provinces in the Philippines to the risks of climate change, being located in the pathway of typhoons and adjacent to the Pacific Ocean. The dependence of a significant portion of its population on primary industries such as agriculture, fisheries and forestry also increases the vulnerability of the province to the impacts of climate change. The risk of sea-level rise threatens as well hundreds of thousands of its population living along the coasts.

This project generally aimed to build the capacity of local government officials, researchers, and the provincial government of Albay, in the Philippines, as a whole, in assessing the impacts of and their vulnerability to climate change, with the use of a computer modeling system and complemented by local knowledge. Specifically, it sought to:

1. Familiarize relevant stakeholders in Albay on the concepts of climate change;
2. Train the target audience, particularly the municipal planning development officers, on the use of SimCLIM customized for Albay (AlbayClim);
3. Introduce participatory approaches for assessing climate change impacts, vulnerability and adaptation;
4. Using case studies, demonstrate vulnerability, impacts and adaptation assessment to climate change and sea level rise in selected areas in the province using participatory approach and a computer-based modeling system (AlbayClim); and
5. Investigate how to mainstream results of the assessment in adaptation planning.

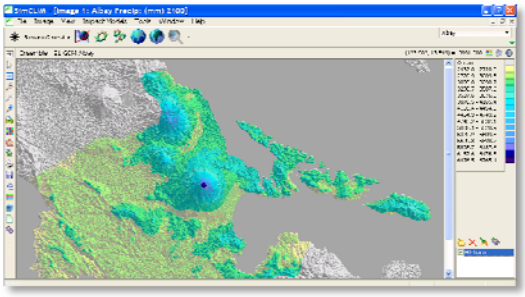
2.0 Methodology

2.1 Team Mobilization, identification of data needs and data collection

The project commenced with a Kick-Off Meeting held on January 15-16, 2010, in Legazpi City, Albay. This was attended by representatives from various government agencies and the academe in the province. The initial meeting aimed to introduce the project to and draw support from relevant stakeholders, level-off expectations on expected outputs and institutional roles, present the data

requirements for the SimCLIM modeling system, and assign coordinators to collect the needed data. Initiatives on climate change research and adaptation in Albay were also presented to identify areas for synergy and avoid duplication of efforts.

2.2 Customization of SimCLIM modeling system for the province of Albay



After collecting all the required data, partners from CLIMsystems Ltd. customized the SimCLIM modeling system for Albay, which was called AlbayCLIM.

SimCLIM is an "open-framework" software modeling system that can be customized and maintained by the users for examining the impacts of and adaptations to climate variability and change, including extreme events, and to attach impact models (Warrick et al. 2005). Its purpose is to link and integrate complex arrays of data and models in order to simulate the impacts of climate variations and change. It has a vertically integrated, one-way "top-down" structure that links global, local and sectoral models and data for examining the impacts of present climate variability and future climate change (Warrick 2007).

SimCLIM can be used to (CLIMsystems 2010):

- Describe baseline climate;
- Examine current climate variability and extremes;
- Assess risks – present and future;
- Investigate adaptation – present and future;
- Create scenarios of climate and sea-level change;
- Conduct sensitivity analyses;
- Project sectoral impacts of climate and sea level change;
- Examine risks and uncertainties; and
- Facilitate integrated impacts analyses.

2.3 Training in the concepts of climate change and use of SimCLIM

Training in the concepts of climate change, vulnerability and adaptation assessment, and the use of SimCLIM was held on 26-29 April 2010, in Tabaco City, Albay (See Proceedings of the Training in Appendix 4). This was attended largely by the planning development officers and staff from the different local government units of the province. Dr. Juan M. Pulhin presented an overview on vulnerability assessment as well as demonstrated some participatory techniques in conducting such. Dr. Rex Victor O. Cruz introduced the river basin approach in climate change adaptation and mitigation.

Through workshop activities and employing the participatory techniques shared by Dr. Pulhin, participants identified the issues, problems and concerns that they experienced in their respective jurisdictions in relation to climate and climate change. Among those noted were: floods due to

torrential rains, typhoons, storm surge, dry spells, rain-induced landslides, coral reef bleaching and rat infestation in farmlands. These gave the participants ideas on the focus of the vulnerability and adaptation assessments that they could implement in their areas.

Meanwhile, hands-on training on the use of customized SimCLIM for Albay, called AlbayCLIM, was led by Drs. Peter Urich and Peter Kouwenhoven from CLIMsystems, Ltd. Participants generated climate change and sea-level rise scenarios using various Global Circulation Models (GCMs), as well as conducted extreme events analysis and water tank modeling. Results of the climate and sea-level rise modeling were deemed highly useful in the revision of the Comprehensive Land Use Plan (CLUP) that the province was undertaking.

2.4 Actual impacts, vulnerability and adaptation assessment

Following the concepts learned in the training, two case study sites were chosen where the actual vulnerability and adaptation assessments were conducted from May to October 2011. These were the municipalities of Bacacay and Oas, which represent two of the three major landscapes in Albay, namely, coastal area and hilly, mountainous terrains, respectively. The focus on coastal and forest/upland communities for the actual assessment was due to the fact that these areas are among the most vulnerable ecosystems to climate change. These are where the so-called 'poorest of the poor' could also be found.

The Adaptation Policy Framework (APF) was used as a guide in conducting the assessment. This is a second-generation framework with more holistic approach towards impacts assessment and the ultimate goal of informing adaptation policy (UNDP/GEF 2004). Central to this is the assessment of current vulnerability, particularly from climate variability and extremes, placing emphasis on understanding current climate risks before moving to the 'uncertain territories of what lies ahead' (Dessai et al. 2005). The APF has five major components (boxes) linked by two cross-cutting components (adaptive capacity and stakeholder context) (Figure 1).

Based on the steps outlined in the APF, the following were the methods used in conducting impacts, vulnerability and adaptation, assessment of the coastal and upland communities:

Step 1. Scoping and designing an adaptation project. This entailed scoping the project, defining the objectives, establishing project team, reviewing literature, choosing appropriate methods, etc. Much of these were accomplished during the preparation of the proposal, the project's initial meeting and the succeeding collection of secondary data.

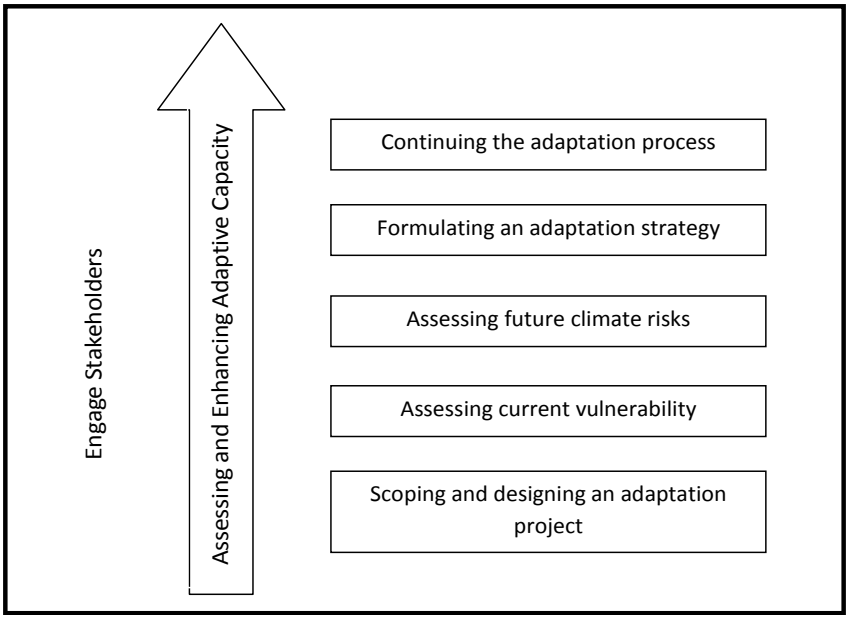


Figure 1. Outline of the Adaptation Policy Framework process.

Step 2. Assess current vulnerability. The assessment of current vulnerability of upland and coastal communities to climate change and sea-level rise, respectively, was done by employing a myriad of methods to allow for cross-checking and validation. These included field reconnaissance, secondary data gathering, key informant interviews, participatory rural appraisal techniques (group discussions, community mapping, etc.), and household survey. The participatory rural appraisal (PRA) techniques and the instrument for the household survey were also adapted with modification from the methods developed by the project leader, Dr. Juan M. Pulhin, under the Assessments of Impacts and Adaptation to Climate Change (AIACC) project supported by United Nations Environment Programme (UNEP) and Global Environment Facility (GEF), which was administered by Global Change System for Analysis, Research and Training (START).

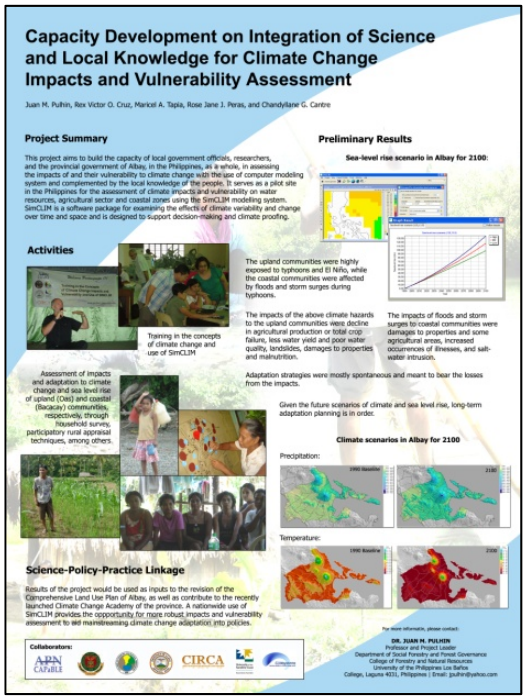
Step 3. Characterize future climate-related risks. Using the AlbayCLIM, climate change and sea-level rise scenarios were generated for the study sites. Climate change scenarios were developed for 2100 using a 21-GCM ensemble, Special Report on Emission Scenarios (SRES) A1FI, set at high sensitivity. Meanwhile, scenario for sea-level rise used 13-GCM ensemble, SRES A1FI, set at high sensitivity. Such parameters were used to come up with a worst-case scenario that could be anticipated by the local communities to better prepare them from the adverse effects of these likely events. The opinion of the local communities on the potential impacts of these feasible scenarios was solicited through PRA techniques and household survey.

Step 4. Develop adaptation strategies. Based on future climate and sea-level rise scenarios and the potential impacts of these according to the local communities, potential adaptation strategies were also sought from the same. These adaptation strategies were rated using the criteria indicators: effectiveness, cost, speed, technical feasibility, and acceptability (USAID 2007).

Step 5. Continuing the adaptation process. This step involves maintaining, monitoring, evaluating and sustaining the initiatives started by the adaptation project. This is a commitment of the project team not only for the province of Albay but for national initiatives as well, which shall go beyond the completion of this capacity building activity, particularly with strong partnerships developed among the institutions involved in the project.

2.5 Dissemination of the results

Results of the assessment, including the methodologies and project processes, were disseminated to various audiences through different communication channels. Two papers from the project's case studies were presented at the International Conference on Forestry Education and Research in the Asia-Pacific Region (http://www.jericotolentino.com/fored.uplb.edu.ph/), held on 23-25 November 2010, at the Southeast Asia Regional Center for Graduate Study and Research in Agriculture (SEARCA). These were: "Vulnerability and Adaptation Assessment to Climate Change of Upland Communities in the Municipality of Oas, Albay, the Philippines" and "Coastal Communities and Mangrove Forests in the Face of a Changing Climate: The Case of Bacacay, Albay, Philippines".



A project poster was exhibited during the College of Forestry and Natural Resources (CFNR) Alumni Homecoming and Loyalty Day.

The project results were disseminated to key stakeholders in Albay through forum/dialogue held on May 31, 2011, which was hoped to aid them in local adaptation planning. This event coincided, as well, with the signing of the Memorandum of Agreement (MOA) between the Provincial Government of Albay and Bicol University for the administration of the Climate Change Academy in the province, the first in the Philippines and perhaps in Southeast Asia. The project processes and findings were immediately seen to significantly contribute to the thrusts and activities of the newly launched academy.

Findings, experiences and best practices from the project were also presented at the national level during the launch of the Climate Change Commission's *Series of Consultation on Vulnerability and Risks Assessments Tools towards a Climate Change Resilient Philippines*, held on June 1, 2011, at the Mabini Hall, in Malacañang Compound, Manila. This event aimed to scope all assessment instruments related to climate change and provide a platform to discuss experiences on adopting vulnerability and assessment tools. Thus, tools and methodologies used in the project would be among those considered for use by the Commission's Technical Panel of Experts in the promotion of the climate change research and development agenda of the country through the National Climate Change Agenda Program (NCCAP) of the Philippine Government.

In addition to the above, many of the activities of the project were also covered by local and national media, which were captured in print, TV, radio and online (internet) news (See Appendix 8 for news articles and features in relation to the project).

3.0 Results & Discussion

3.1 Case Study: Coastal Communities

The assessment of the impacts of sea-level rise on coastal communities was conducted in *Barangays* Poblacion 1, Cagraray, and Cawayan in the municipality of Bacacay, Albay. During the reconnaissance survey conducted by the project team, it was observed that the mangrove forest in Poblacion 1 was denuded with only a number of standing mangrove species left. The foreshore is almost occupied by settlement and commercial areas. Cagraray and Cawayan, on the other hand, are connected by a vast mangrove forest, although with some portions already converted particularly in the latter *barangay*. Further conversion is, however, prevented by an ordinance passed that prohibited future construction of houses in the mangrove area. The Department of Environment and Natural Resources (DENR) has conducted several mangrove reforestation activities as well.

Farming and fishing are the major livelihood activities in the three coastal communities. Educational attainment of the respondents from two of the communities surveyed (Poblacion 1 and Cawayan) was mostly elementary or high school level, with very few being able to reach or graduate from college.

Study Sites for the Assessment of Impacts and Vulnerability to Sea-Level Rise

Poblacion 1

Cagraray

Cawayan

In terms of their current vulnerability to hazards in relation to rising sea levels, typhoons and storm surges were identified to have adversely affected the coastal communities. This also led to floods in some areas. Remarkable among which was Super Typhoon Reming (International Name: Durian) which hit the province of Albay in November 2006. According to the residents in Poblacion 1, storm surge caused by the typhoon reached as high as 3 meters which left massive destruction in their community.

Storm surges caused by typhoons and floods brought about by these storm surges, extreme precipitation and runoff negatively affect various sectors in the coastal communities. These sectors together with the impacts of the above hazards are presented in Table 1. It should be noted however that Cagraray was not affected by storm surges as it is surrounded and protected by a vast area of mangrove forest.

Table 1. Impacts of typhoons with storm surges and floods (associated with storm surges, extreme precipitation and runoff) on the coastal communities in Bacacay, Albay.

Sector	Impacts
Water Resources	Damage to water pipes; Poor water quality
Human Health	Prevalence of water-borne diseases and flu
Fisheries	Damage to boats, fish cages (storm surge only), fish gears and other equipment
Agriculture	Washed out crops; Increased salinity of water in rice fields
Human Settlement	Destruction of properties
Mangroves	Uprooted mangroves

Following the results of the community mapping exercise, various socio-economic groups were identified residing in the three coastal communities. These were: rich farmers, poor farmers, fisher folks, businessmen, laborers, and government employees. Among these, rich farmers, poor farmers and fisher folks were considered with the highest vulnerability, given the dependence of their livelihood activities on weather conditions. Businessmen and laborers have medium level of vulnerability, while government employees have the least level of vulnerability since regardless of seasons, their income was not affected.

At present, the seawalls in Poblacion 1 and Cawayan constituted their major adaptation to protect them from storm surges and floods. This is mainly due to the lack of the natural protective barriers, such as mangroves, in these areas due to deforestation. Cagraray, however, did not have to spend at all for such purposes as they are vastly enveloped by healthy mangrove forests which shielded them from the impacts of the above hazards. Meanwhile, other adaptation practices that the coastal communities employed to address the impacts of storm surges and floods above are presented in Table 2.

Table 2. Current adaptation practices of coastal communities to address impacts of typhoons with storm surges and floods.

Sector	Adaptation Practices
Water Resources	Boiling of water
Agriculture	Timing of planting/harvesting activities (if feasible)
Human Health	Provision of medicine, immediate response, monitoring
Fisheries	Boat reconstruction, loans, securing boats before typhoon, finding alternative livelihood
Tourism (boat rental)	Boat reconstruction, loans
Human settlement	House reconstruction (concrete and elevated); Loans; Evacuation of people and livestock, and securing properties before typhoon comes; Riprap reconstruction/Seawall
Mangrove	Pruning activities before typhoon; Reforestation

Sea-level rise scenario generated using the AlbayCLIM presented a 1.3-m rise in sea-level in 2100 which already included water expansion and tectonic movements. Actual observation of sea-level rise in the eastern coast of Albay from historical data, with an average of 8.33 mm annually, was also considered in the above projection. Such figure also indicated a significant increase in sea level in the area through time, which is much higher than the global average of 3.77 mm annually.

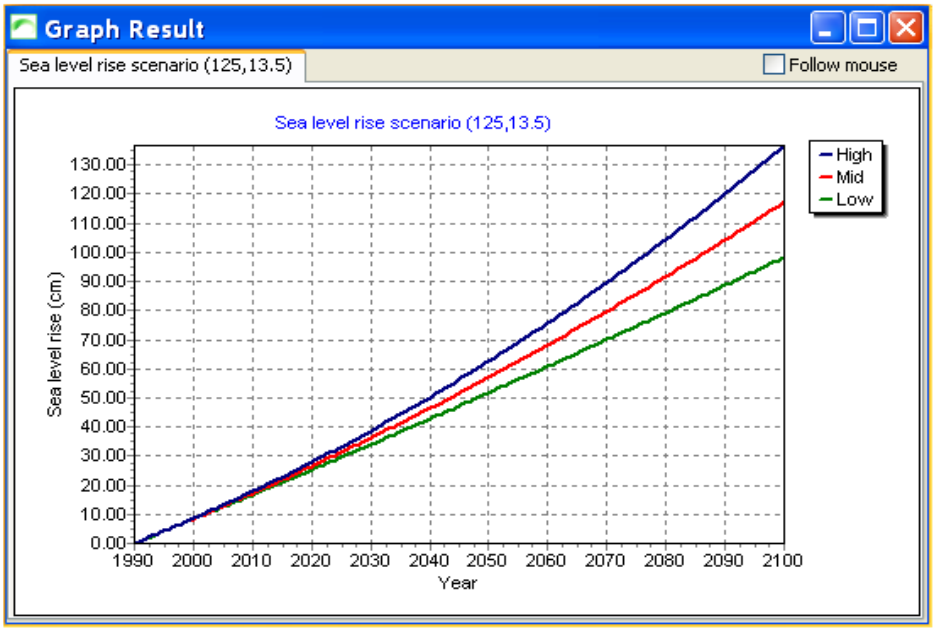


Figure 2. Sea-level rise in the eastern coast of Albay generated from AlbayCLIM.

The impacts of such scenarios particularly on areas which would be submerged in waters were modeled using Geographic Information System (GIS) software and available sea-level rise simulators on the internet (www.flood.firetree.net). The latter, however, had some limitations particularly being able to simulate sea-level rise at 1-m increments only. Nevertheless, the exercises yielded interesting results, particularly highlighting the protective benefits from mangrove (Figures 3-5).

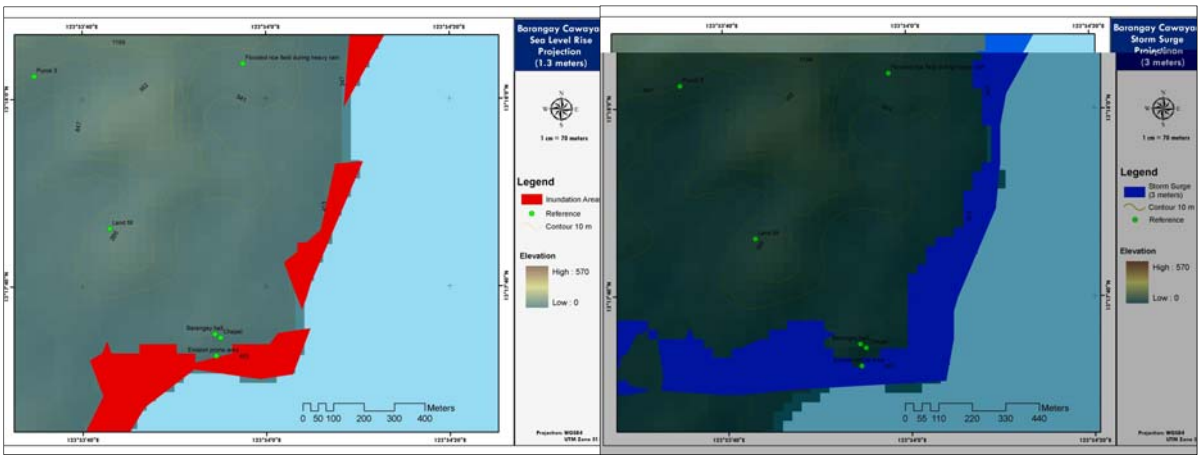


Figure 3. Impacts of 1.3-m sea-level rise (left) and 3-m storm surge given a 1.3-m sea-level rise (right) in Cawayan, Bacacay, Albay.

Figure 4. Poblacion 1 at 0-m (left) and 1-m (right) sea-level rise (Source: www.flood.firetree.net). Some areas, particularly rice fields, get flooded already at present during high tides. This was among the vulnerable areas identified by the local community.

Potential adaptation strategies were also sought from the coastal communities, given the likely impacts of a 1.3-m sea-level rise. These were rated using criteria indicators, namely, effectiveness, technical feasibility, cost, speed and acceptability. The community members were also asked to give corresponding weights to each criterion, totaling 100 points. This somehow gave an indication on the important factors or considerations of the community in selecting an adaptation strategy.

Figure 5. Cagraray at 0-m (left) and 1-m (right) sea-level rise (Source: www.flood.firetree.net).

Table 3. Potential adaptation strategies in Cawayan given a 1.3-m sea-level rise.

Adaptation Strategies	Indicators					
	E (50%)	TF (5%)	C (5%)	S (10%)	A (30%)	Total
Filter water	50	5	5	10	30	90
Finding other water sources	50	3	5	10	30	88
Boiling of water	50	5	5	10	30	90
Dumping near agricultural areas	45	3	2	5	15	70
Gradual adjustment of fishermen to SLR	50	5	5	10	30	100
Dumping	50	5	2	8	30	95
Relocation to higher grounds	45	5	2	7	20	79s
Construction of higher and longer seawall	50	5	1	6	30	92
Mangrove reforestation	50	5	5	10	30	100

E = effectiveness; TF = technical feasibility; C = cost; S = speed; A = acceptability | SLR = sea-level rise

Table 4. Potential adaptation strategies in Cagraray given a 1.3-m sea-level rise.

Adaptation Strategies	Indicators					
	E (20%)	TF (20%)	C (10%)	S (30%)	A (20%)	Total
Reforestation	20	15	3	30	20	88
Population control	20	20	10	10	10	70
Construction of health center	20	10	10	15	20	75
Finding alternative livelihood sources	20	20	10	30	20	100
Provision of relocation site	20	10	1	10	5	46
Planting of more mangrove species	20	15	8	10	20	63

Table 5. Potential adaptation strategies in Poblacion 1 given a 1.3-m sea-level rise.

Adaptation Strategies	Indicators					
	E (50%)	TF (5%)	C (5%)	S (15%)	A (25%)	Total
Boiling of water	45	5	5	15	25	95
Replacement of old pipes	50	3	2	15	25	95
Resorting to other crops	50	2.5	5	15	25	97.5
Dumping	50	5	5	10	25	95
Fishpond establishment	50	5	1	10	20	86
Medical preparedness	50	5	1	12	25	93
Shrimp breeding	50	5	1	10	20	86
Natural fishing	50	5	2.5	15	25	97.5
Limit development in mangrove areas	45	2	3	7.5	25	82.5
Strict enforcement of regulations	50	2.5	2	15	20	89.5

Given the results above, it was obvious that exposure and sensitivity of local communities to storm surges and potentially to future sea-level rise were heightened by the destruction of mangrove. These increased as well the cost for adaptation in the form of construction of sea-wall, as demonstrated in the cases of Poblacion 1 and Cawayan. Decision-makers and policy-makers in the municipality of Bacacay, therefore, need to include land- and sea-use zoning in their local development plans. The adaptation strategies identified by the communities also provided a rich source of information to which relevant stakeholders could draw from.

3.2 Case Study: Upland Communities

The assessment of impacts, adaptation and vulnerability to climate change was conducted in *Barangays* San Antonio and Bogtong, in the municipality of Oas, Albay. These upland communities were chosen as they were both recipients of the Community-Based Forest Mangement (CBFM) program of the government, a national strategy of the country to promote sustainable forest management and equity in the uplands. The program's main feature is granting organized communities access to forest resources under long-term tenure provided they employ environment friendly, ecologically sustainable, and labor-intensive harvesting methods (Pulhin et al. 2005). The choice of these upland study sites also allowed for checking the robustness of this existing government policy under climate change, which is also consistent with the APF approach.

The major climate variability and extremes experienced by the upland communities were typhoons and El Niño. Following a timeline analysis of these events, the community members could still recall typhoons and drought seasons from the 1950s and 1960s, respectively, which precisely matched the records of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

Farming is the major occupation of most residents in the upland communities which is largely on rain-fed farms. Among the agricultural practices were monocropping and mixed/intercropping (some on slashed-and-burned areas). The majority of the households surveyed only attained elementary level of education. Residential lots and farmlands were mostly government-owned, and houses were also made from light and native materials, such as wood, bamboo, and coconut or *anahaw* leaves (for roofing purposes). Water was sourced from deep-well pumps, and from the rivers that surround both communities. Walking, carabao (water buffalo)-pulled cart, and motorcycle were the modes of transportation, despite the significant distance of the communities from the town proper (about 30 km). The inadequacy of basic services, such as health, education, road systems, was also apparent in both upland communities.

Pictures showing slashed-and-burned farm area (top), deep-well pump as source of water (left, below) and motorcycle as means of transportation (right, below).

Reconnaissance survey in the communities revealed degraded forests, of which some were subjected to slash-and-burn farming. The areas where the upland communities were situated also have slope of 30% and above. This explained as well the prevalence of erosion, which were rated from moderate to severe.

Women in Barangay Bogtong, sharing their experiences on the impacts of typhoons/El Niño

Among the impacts of typhoons and El Nino to the upland communities were damages to crops resulting in significant yield reductions or total crop failure, death of livestock, pest infestation in farms, landslides, poor water quality and less water yield, malnutrition among children, destruction of properties, and women bearing much of the brunt of these events forcing them to leave their family and find work outside the community.

Meanwhile, some of the adaptation strategies employed by the upland communities were off-farm labor, waiting for the rain, dependence on other livelihood activities such as copra production, use of water pump, planting root crops, asset disposal, boiling of drinking water, planting trees, using dead/uprooted trees for fuelwood, among others. What can be observed, however, from these practices is that they were mostly spontaneous responses and meant largely as well to accommodate or bear the impacts/losses.

Root crops intercropped with rice and corn as one of the adaptation strategies in the communities.

The CBFM program implemented in these areas, which were supposed to promote healthy forest environment, sustainable livelihoods and equity, and as such could be considered as a 'no-regret' adaptation policy to climate change, did not bring tangible benefits to the communities. These were mainly caused by immense shortcomings in its implementation and poor facilitation of community organizing activities. Added to this were concerns on peace and order in the areas and practically their inaccessibility due to absence of road systems. This made extension and field works prohibitive among the pertinent government agencies.

A summary of the interactions of various factors that contributed to the vulnerability of the upland communities to present climate risks is presented in Figure 6. Such interactions were illustrated using the adaptation policy assessment framework adapted with modification from Fussel and Klein (2006). The figure shows that apart from exposure, sensitivity, and adaptive capacity to climate change (which were considered the defining factors of vulnerability), non-climatic factors such as peace and order situation and socio-economic conditions of the local communities also played a significant role in determining the vulnerability of a group or sector. Likewise, provision of basic services (such as health, education, road system, and livelihood opportunities) also contributed in increasing the adaptive capacity. The interactions of various factors also showed that much of the vulnerability determinants to climate change of the upland communities pointed to the fragility of their environment due to degraded forests and high dependence on agriculture in the absence of alternative livelihood, which were compounded by constraints in adaptive capacity coupled with largely band-aid approaches to adaptation.

Following the results of the AlbayCLIM scenario development, the future presented the upland communities with a ~10% increase in precipitation and 4-5˚C increase in temperature in 2100 using A1FI scenario (Figures 7 and 8). However, it was apparent that the upland communities found it difficult to imagine the impacts of these future feasible events, with answers solicited for the potential impacts of these scenarios reflecting the current effects of climate vulnerability and extremes previously experienced rather than exhibiting the (gradual) increase in precipitation and temperature. This is, nevertheless, understandable as the events asked were far from what they have experienced before.

Even so, future adaptation strategies were asked from the upland communities, and were rated using the same criteria indicators used for the coastal communities (Tables 6 and 7).

Despite the shortcomings in the implementation of CBFM in San Antonio and Bogtong, it could still be considered as a fitting policy where climate change concerns can be mainstreamed. The success of the said program in some upland areas in the Philippines is a testament to this (Pulhin et al. 2008). As such, it remains a promising approach not only in promoting sustainable forest management, equity and livelihood, but also in improving the adaptive capacity of the upland communities to respond to climate change. However, there is a need to make CBFM more climate change responsive and apt for the changing times, especially by including climate-proofing activities. With improvements in the program's facilitation and implementation measures, it could very well prove to be an indispensable strategy for climate change adaptation, particularly by promoting community-based adaptation.

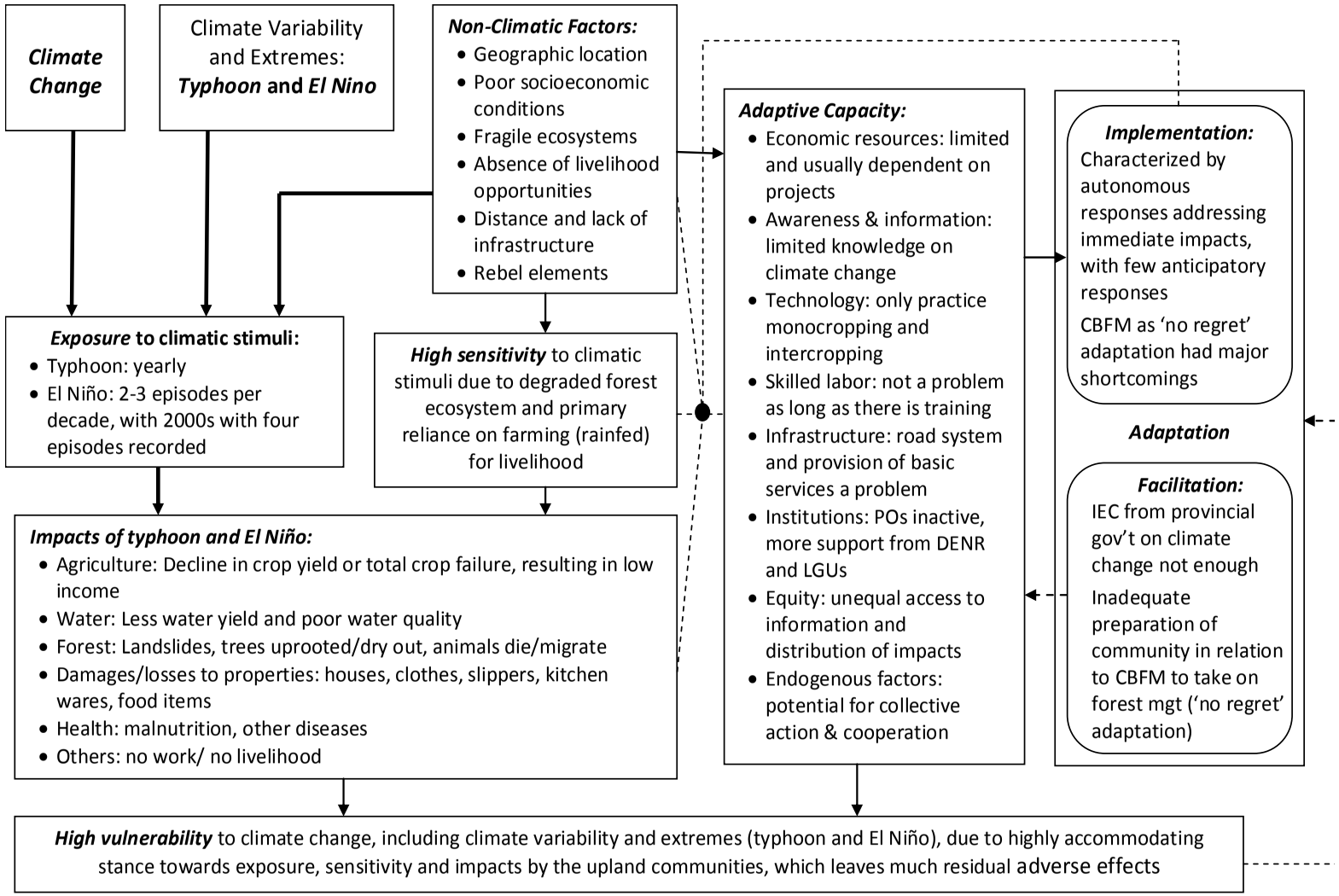


Figure 6. Interrelationships of various factors affecting the vulnerability of the upland communities in Oas, Albay, to Climate Change.

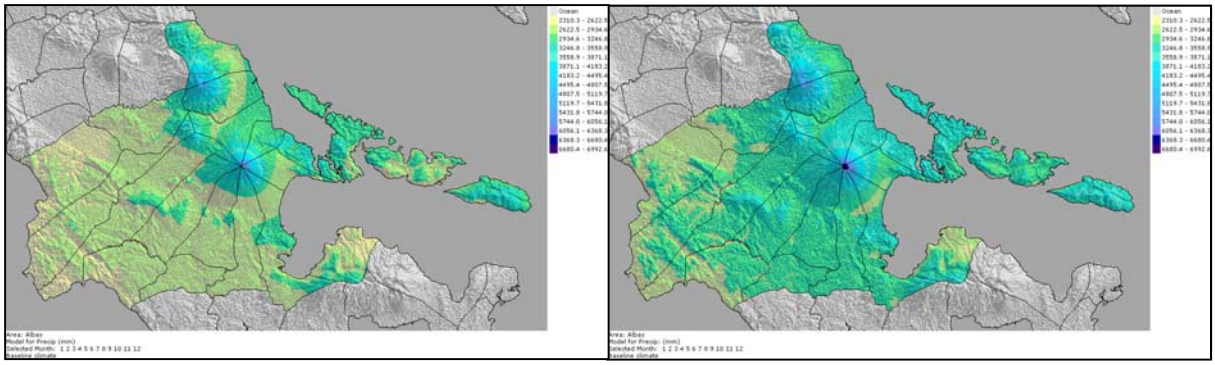


Figure 7. Results of AlbayCLIM baseline (left) and 2100 scenario (right) simulation for mean precipitation.

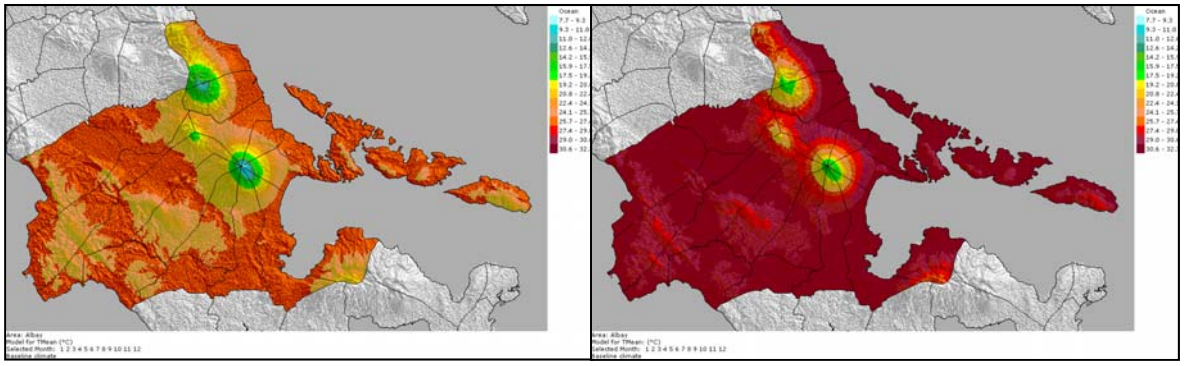


Figure 8. Results of AlbayCLIM baseline (left) and 2100 scenario (right) simulation for mean temperature.

Table 6. Potential adaptation strategies of Barangay San Antonio, Oas, Albay.

Sector	Adaptation Strategy	Vulnerability Considering Adaptation	Indicators					To-tal
			E (10)	TF (20)	C (30)	SCA (10)	S (30)	
Water	Get medicines* Construct/dig wells	Short time Effective	7 10	18 20	28 30	9 10	27 30	89 100
Agriculture	Early harvesting Farm-to-market roads	Depends on crop Current road system not effective in rainy season	7 5	15 10	29 20	10 10	30 20	91 65
Forest	Plant trees and bamboo	None as long as there are many trees	10	20	30	9	30	99

*For water-borne diseases

Table 7. Potential adaptation strategies of Barangay Bogtong, Oas, Albay.

Sector	Adaptation Strategy	Vulnerability Considering Adaptation	Indicators					To-tal
			E (50)	TF (3)	C (7)	SCA (10)	S (30)	
Water	Plant trees	Gradual solution to climate change vulnerability	50	3	5	10	15	83
	Prohibit tree cutting		50	3	7	10	30	100
	Dig deeper wells		50	1	5	10	20	86
Agriculture	Pest management	Still vulnerable; just need to bear with it	30	3	2	10	15	60
	Additional fertilizer		20	3	1	10	10	44
	Use of insecticides		20	3	1	10	20	54
	Change in crop species		50	3	5	10	15	83
Forest	Plant trees especially in sloping areas	Gradual solution to climate change vulnerability	50	3	5	10	15	83

3.3 Links of SimCLIM to Impact Models

As mentioned above, one of the strengths of SimCLIM is its "open-framework" system which allows attaching impact models. Among these is the software system called 'PlantGrO Spatial', which explores the relationships between detailed soil data, local climate conditions and plant requirements for development and productivity. A paper on "Understanding the link between detailed soil mapping and micro-climates and climate change to assist Albay and its constituents in planning" prepared by Dr. Peter Urich is attached in this report (See Appendix 9). This demonstrated linking AlbayCLIM and PlantGRO Spatial for future impact assessments. It aimed to incorporate the local climate and soil information into an integrated climate change impact assessment software system to assist with planning efforts in the province, based on the coupling of the PlantGRO model with the AlbayCLIM modeling system.

3.4 Overall Results and Outcomes

Overall, the project resulted in increased awareness of climate change concepts among local communities in the study sites, enhanced capacity to conduct impacts, vulnerability and adaptation to climate change and sea-level rise among key stakeholders and researchers using AlbayCLIM and participatory approaches, and contribution to the Comprehensive Land Use Plan of the province of Albay and the Climate Change Academy. The experiences from this, particularly the assessment process, would be put together in a publication that would serve as a guide or manual in conducting impacts, vulnerability and adaptation assessment to climate change.

Results from the assessments could be used as inputs to sea- or land-zoning activities in the municipality of Bacacay, as well as for improving the government programs in the uplands, particularly that of the CBFM.

Furthermore, the project demonstrated national impact as the tools and methodologies it employed for impacts, vulnerability and adaptation assessment were shared with key decision-makers and among those considered for enhancing the conduct of vulnerability assessments in the country.

4.0 Conclusions

This project aimed to build the capacity of local government officials, researchers, and the provincial government of Albay, in the Philippines, as a whole, in assessing the impacts of and their vulnerability to climate change, with the use of a computer modeling system and complemented by local knowledge. This was achieved through training in the concepts of climate change, participatory assessment techniques, and use of a modeling system called SimCLIM to examine the effects of climate variability and extremes and future climate scenarios. Case studies were conducted to demonstrate the assessment process.

What can be gleaned from the project is the importance of integrating the so-called science-based approaches (which in this project is represented by the computer modeling system) and the knowledge and experiences of the local people (through participatory techniques) in assessing impacts, vulnerability and adaptation to climate change. More often than not, the context of vulnerability may not be adequately represented by its generally known defining factors of exposure, sensitivity and adaptive capacity. Deeper investigation of the intricate interactions in a community reveals non-climatic factors that increase or perpetuate the vulnerability of a certain group to climate- and climate change-related hazards. It is important to be aware of these factors as it is at the community or local level where the locus of the battle against climate change lies.

On the other hand, the future presents an uncertain picture, which is beyond the experience and comprehension of the local communities. This is where the so-called scientific tools such as computer modeling systems could come in to aid in providing a glimpse of what is likely to happen. While much literature would suggest that these uncertainties are not hindrances for planning ahead, nevertheless, the currently available computer-based tools which could simulate feasible future scenarios and impacts could facilitate in making informed decisions and long-term adaptation planning. Such approach captures as well the “forward-looking aspect” of climate change.

5.0 Future Directions

Enhanced vulnerability and adaptation assessment is one of the means by which the NFSCC hopes to achieve the national goal of climate change resilient Philippines. Central to this is the development of effective tools and methodologies to carry out these investigations, and building the capacity of key stakeholders and officials in applying these. This has already started in the province of Albay, which is hoped to be replicated in other local government units and sectors, hopefully following the approved national guidelines for vulnerability, risks and adaptation assessment.

While the conduct of assessments is an important step towards the achievement of the above goal, it should be ensured as well that the right research questions are asked, as emphasized at the consultation meeting in Malacañang. More importantly, end users should also have the capabilities to apply the data and information obtained from the assessments to adaptation planning.

As climate variability and extremes continue to thwart current development efforts in many developing countries like the Philippines as well as threaten the achievement of more sustainable future, the integration of science and local knowledge to allow for a more robust vulnerability and adaptation assessment will be indispensable in enhancing current and future adaptations. The methods and tools explored in this project would hopefully be a useful building block in conducting a more robust vulnerability and adaptation assessment for a more climate resilient Philippines.

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Appendices

APPENDIX 1.

Funding Sources outside the APN

Partners from the Provincial Government of Albay and Center for Initiatives and Research on Climate Adaptation generously shouldered the meals and accommodations of some participants during the training and other meetings, as well as the airfare of some members of the project team for the Bicol Regional Forum. They also provided in-kind support in the form of meeting supplies, logistical assistance and human resources. Such contributions could be estimated in the region of US$ 15,000.

The team of Drs. Peter Urich and Peter Kouwenhoven from CLIMsystem, Ltd. also contributed tremendously by sharing their expertise and training key stakeholders in Albay on the use of SimCLIM for free, installing licensed AlbayCLIM softwares to 33 users without additional cost, and shouldering their round-trip tickets and travel expenses for some meetings. Such huge support readily comes close to US$ 210,000.

Scientists from the University of the Philippines Los Baños readily lent their expertise, as well, to the project at no cost.

APPENDIX 2.

Young Scientist Corner

Through this APN CAPaBLE Project, I was trained on the methods for conducting vulnerability and adaptation assessment to climate change and sea-level rise. The project provided me with ample opportunities to further hone my skills in rapid rural appraisal and secondary data gathering. This exposed me to the central role of local community knowledge in determining current and future climate change impacts, vulnerability, and adaptations. Likewise, the SimCLIM training also acquainted me with climate modeling and creating scenarios. The new knowledge and skills that I acquired proved very helpful in the thesis manuscript that I am currently working on.

Ms. Chandyllane G. Cantre
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I am also thankful as the experience with the APN project also provided me the opportunity to participate for the first time as a presenter in an international conference (International Conference on Forestry Education and Research). As a young scientist, this marked a milestone in my career, particularly to have the chance to present a research work of which I am a part, as well as to interact with experienced and new scientists in the field.

APPENDIX 3.

Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments

Kick-Off Meeting
15-16 January 2010

University of the Sunshine Coast
Queensland, Australia

CIRCA
CENTRE FOR INITIATIVES AND RESEARCH ON CLIMATE ADAPTATION

APN
CAPaBLE

Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments

Program

January 15 (Friday)

9:00 – 9:30	Arrival and Registration	
9:31 – 9:45	Welcome Remarks	Hon. Joey Salceda, Governor, Albay
9:46 – 10:15	Project Overview, Q &A	Dr. Juan M. Pulhin, Professor and Project Leader, CFNR-UPLB
10:16 – 10:30	Coffee Break	
10:31 – 11:00	Overview of SimCLIM Systems and Data Requirements, Q & A	Dr. Peter Urich, Adjunct Associate Professor, USC – Australia and Managing Director, CLIM Systems
11:01 – 11:30	Climate Change Projects and Related Initiatives in Albay, Q & A	Mr. Nong Rangasa, Director, CIRCA
11:31-12:30	Preparation of Work Plan	
12:31-12:45	Closing Remarks	Dr. Rex Victor O. Cruz, Professor and Dean, CFNR-UPLB
12:46-2:00	LUNCH	
2:00 -5:00	Collection of climate data requirements for SimCLIM and related secondary information	Project Team

January 16 (Saturday)

7:00 – 12:30	Visit to potential case study sites	
12:30 – 1:30	Lunch	
1:30	Travel back to UPLB	

APPENDIX 4.

TRAINING IN THE CONCEPTS OF CLIMATE CHANGE IMPACTS AND VULNERABILITY AND USE OF SIMCLIM

Proceedings of the Training Conducted under the APN Project
"Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments"
(CIA2009-02-Pulhin)

26-29 April 2010
Carolyna Hotel and Restaurant
Tabaco City, Albay

INTRODUCTION

Climate change impacts and vulnerability in the Philippines vary depending on the area's geographic location, climate system (the country has four climatic classification), and socio-economic condition. As such, while assessments at the national level give a picture of the overall impacts of climate change in the country, which may thereby result in enabling policies for appropriate plans and actions, responses on the risks and threats need to be area-specific in order to effectively address the climate change-related concerns. Furthermore, with the decentralization policy, the Philippine local government units, particularly at the provincial level, are at the forefront of actions for responding to climate change impacts and risks. It is therefore necessary to capacitate them on how to conduct climate change impacts and vulnerability assessment in their respective jurisdictions to enhance their preparedness strategies. A close collaboration among the scientists/researchers, local government units and the local communities, with the aid of a computer modeling system, is crucial to ensure a comprehensive assessment of the risks, threats and needs.

Climate simulation models are important for enhancing our understanding on past and present climate creating scenarios of future climate change, and examining risks attributed to predicted changes in climate. Results of climate model simulations are useful for improving plans and developing preparedness strategies that aid in increasing resilience on risks posed by the changing climate. This training will use SimCLIM as the climate modeling system for conducting an integrated assessment of the vulnerability to and impacts of climate change in the province of Albay.

SimCLIM is a computer model system for examining the effects of climate variability and change over time and space. This model system has an "open-framework" feature which allows users to customize the model for their own geographical area and spatial resolution and to attach impact models. It has the capacity to assess baseline climates and current variability and extremes. Aside from these, SimCLIM can also be used to: a) assess present and future risks; b) investigate present and future adaptation; c) create scenarios of climate and sea-level change; d) conduct sensitivity analyses; e) project sectoral impacts of climate and sea level change; f) examine risks and uncertainties; and g) facilitate integrated impact analyses. SimCLIM is designed for bridging the gap between science and policy/planning, particularly to support decision making and climate proofing in a wide range of situations where climate and climate change pose risk and uncertainty. (Source: www.climsystems.com/simclim/about.php)

In view of the above, and in order to develop the local capacity of the different municipalities in Albay to conduct climate change impacts and vulnerability assessments, a training in the concepts of climate change impacts and vulnerability, and the use of the SimCLIM modeling system was conducted to:

- Articulate key concepts related to climate change impacts, vulnerability and adaptation;
- Have a working knowledge on the use of SimCLIM modeling system as a tool for vulnerability and adaptation assessments using the case of Albay province; and
- Develop an action plan for the actual conduct of impacts and vulnerability/adaptation assessments using SimCLIM system and participatory assessment tools in selected case study areas

DAY 1 – 26 April 2010

The training opened by welcoming the participants, who were largely composed of the planning development officers/staff from the different municipal local government units of Albay (please see participants list), the SimCLIM trainers from New Zealand, and the staff of Center for Initiative and Research on Climate Adaptation (CIRCA) and University of the Philippines Los Baños (UPLB). The training was part of the project **Capacity Development on the Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments"** supported by the Asia-Pacific Network for Global Change Research (APN) and led by the College of Forestry and Natural Resources, UPLB, in collaboration with the Provincial Government of Albay through CIRCA and the University of the Sunshine Coast in Australia, through its partnership with CLIMsystems Ltd.

Dr. Juan M. Pulhin, professor at the College of Forestry and Natural Resources (CFNR) and the project leader, gave a brief welcome remark and proceeded with the overview of the project. He also explained the objectives of the training and its relevance to the Comprehensive Land Use Planning (CLUP) that the province is currently undertaking. He continued with a presentation on the overview of vulnerability assessment, giving a review on the science of climate change and concepts related to vulnerability. He concluded by emphasizing the importance of vulnerability assessment for enhancing local adaptation as well as the need to combine climate change science/scenario-based analysis with local knowledge for a more robust assessment.

Dr. Peter Urich, Managing Director of CLIMsystems Ltd., presented on the origins of the SimCLIM modeling system which started in New Zealand, and how it has evolved through time. He also highlighted the different features of the modeling system, which included multiple runs and sensitivity analysis, easy update, and its being integrated in the decision-making process.

A workshop followed to solicit from the participants the climate related-issues and problems present in their areas and how these are addressed (or their suggestions for addressing these). The participants were grouped according to their provincial district and were given thirty (30) minutes to complete the exercise. Each group was asked to present their outputs.

For District 1, which is composed of the municipalities of Tiwi, Malinao, Tabaco, Malilipot, Bacacay and Sto. Domingo, the climate-related hazards that they experienced are flooding due to torrential rains, typhoon, storm surge and dry spell, which all affect the social, economic and environment sectors in the areas. These issues are addressed through reforestation of forest and mangrove areas, regular ocular assessment, retrofitting, through information, education and communication (IEC), among others.

In District 2, constituting the municipalities of Legazpi City, Daraga, Camalig, Manito and Jovellar, typhoons and water-related hazards such as tidal surge, flash floods and rain-induced landslides were the main issues identified. Options for adaptation to these events were resettlement of affected residents along the coastline, reforestation, strict implementation of zoning policies and national building code, infrastructure projects (sea wall, elevation of roads, grouted ripraps), among others. The absence of distinct wet and dry season in the district is also seen as a concern which was intended to be addressed through planting of drought-resistant crop varieties and improving the irrigation systems.

Meanwhile, participants from District 3 of the province, composed of the municipalities of Guinobatan, Jovellar, Oas, Ligao, Pioduran, Polangui and Libon, cited five climate-related issues and problems in their areas. These were: drought, typhoon, rat infestation, heavy rains and coral reef bleaching. Rat infestation was seen as a climate-related phenomenon as the hot temperatures drive away their natural predator (the snakes) making the population of these farm pests flourish. Suggested responses for the identified problems are: cloud seeding and planting of drought-resistant crops during drought; upgrading of evacuation centers and re-orientation of MDCCs and BDCCs to prepare for typhoons; intensification of rat control for rat infestation; establishment of flood control facilities for heavy rains; and construction of artificial coral reefs (culverts) for coral reef bleaching.

With the climate-related issues in the different districts of Albay already identified, Dr. Peter Urich oriented the participants on the step-by-step approach to conducting vulnerability and adaptation assessment. He presented the Intergovernmental Panel on Climate Change (IPCC) seven-step process towards impacts, vulnerability and adaptation assessments, as well as the different adaptation frameworks. In ending, he stressed the importance of mainstreaming the results of these assessments through win-win situations by using a variety of tools to reach 'local' goals.

DAY 2 – 27 April 2010

On the second day, new participants from other municipalities in Albay were acknowledged, as well as the presence Dr. Rex Victor O. Cruz, dean of CFNR-UPLB. The training continued with presentations about the SimCLIM integrated modeling system, creating a synthesis of the assessments, and developing capacity for climate change adaptation through SimCLIM given by Dr. Peter Urich. He explained the uses of SimCLIM, how it works, the outputs that it generates, and its advantages over other climate models. Dr. Urich also shared the process of making a synthesis and provided a checklist for ensuring its completeness. Meanwhile, with regards to developing adaptation strategies, a methodological framework on climate change adaptation through integrated risk reduction was discussed, as well as the process of its implementation.

After the above presentations, a hands-on training on the use of customized SimCLIM for Albay (called AlbayCLIM) ensued led by the trainers, Drs. Peter Kouwenhoven, CLIMsystems Associate, and Peter Urich. This included exercises on starting the software, familiarization with its interface, exploring the global database, and options for printing and exporting the results to other computer applications. It was also emphasized that trainees should have a clear understanding of the different emission scenarios following the IPCC Special Report on Emission Scenarios (SRES). The participants were given time to explore the modeling system on their own, while the two trainers went around to see their progress as well as to take questions from them.

DAY 3 – 28 April 2010

Invited experts shared knowledge and information on the current practices in the country on climate change modeling and vulnerability and adaptation assessment. Dr. Flaviana Hilario, Weather Service Chief of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), gave a talk on the "Development of Climate Change Scenario in the Philippines". She started with the definition of basic terms used in scenario development and explained the four emission scenarios reported by the IPCC. She also described the basic requirements for running global climate models (GCMs), and the need and methods for downscaling GCM outputs to study the impacts of climate change on a specific area. She shared that the currently available GCM used by PAGASA is **P**roviding **RE**gional **C**limates for **I**mpact **S**tudies (PRECIS), based on the Hadley Centre's regional climate modeling system. It was, however, noted that running such GCM takes close to three months to generate only one scenario (A1B) until the year 2050, and which are many times hampered by power fluctuations.

Dr. Rosalina de Guzman, Assistant Weather Specialist Chief of PAGASA, discussed the climate risks/vulnerabilities and climate change scenario for the Bicol region. According to her, trends of increasing hot days and warm nights, more frequent extreme events, and tropical cyclones with wind speed greater than 150 kilometers per hour (kph) especially during an El Niño event were among the manifestations of global warming at the local scale. She also highlighted the extreme climate/weather events experienced lately in the Philippines, especially focusing on the climatic trends in the Bicol area. Seasonal rainfall in the Bicol region, based on PAGASA modeling, was projected to change by almost 25% during the wet months of June, July and August in 2050 and by almost -20% during the dry months of March, April and May. A maximum increase of 2.2˚C in the

mean temperature during the dryer months was also projected in the Bicol area. Hence, the need for adaptation which requires an understanding of the vulnerabilities and impacts of climate change was stressed.

Former PAGASA Director, Dr. Leoncio Amadore, meanwhile, presented a model for assessing risk to typhoon wind damage through mapping. The framework of risk being a function of hazard (potentially harmful condition) and vulnerability (susceptibility to impact damage) was used to generate a typhoon risk map. The model simulated the location, maximum winds, direction/speed of movement, radius and size/shape of an Idealized Typhoon Damaged Model (ITDM) to come up with a typhoon wind profile which became the basis for the degree of hazard. Vulnerability, on the other hand, was measured in terms of physical, socio-economic and political-institutional factors, which in the case of the above research was indicated by the type of structures at the locality impacted to/by strong winds. A vulnerability map was generated showing areas at the municipal level with the most number of *nipa* houses. The typhoon wind profile simulation was overlaid to the vulnerability map which resulted in a risk map of typhoon wind damage. Nevertheless, Dr. Amadore admitted that such typhoon risk mapping model was limited to wind damage risk, areas on flat/ocean surface and residential structures only. Further improvements to the model could include features to measure damage by storm surge and floods, considering all types of structures and vegetation, among others.

After the three presentations, an open forum ensued which centered on concerns of data and information availability from PAGASA for better assessment and preparation to climate-related hazards. Representatives from PAGASA clarified that they have already given the Legazpi City climatic data, particularly for the SimCLIM training. Meanwhile, with regards to availability of research results/models, Dr. Hilario noted that they wanted the LGUs to utilize these rather than these remain on the shelves, and would work on recommending a capacity building for the LGUs.

A national framework strategy for climate change adaptation and mitigation focused on integrated river basin management was suggested by Dr. Rex Victor O. Cruz, Dean and Professor of CFNR-UPLB, in his presentation. According to him, river basin approach uses hydrologically defined (watershed) land unit for planning and management, jointly with ecologically defined (ecosystem) management unit. He underscored the significance of such approach as water from watersheds underpins security of human well-being. He also discussed the three-phase procedure for such strategy, which included basin profiling, formation of multisectoral river basin authority, and the integrated basin plan implementation.

Mr. Jose Carlos Torres from the Municipal Planning Development Office of Oas raised that poverty is the reason for our vulnerability and stressed the very urgent need to make decisions with regards to the impacts of climate change. It was also acknowledged that climate change has somehow become

a catalyst for the people to take action and to act soon. Meanwhile, Dr. Cruz underscored the significance of CLUP in guiding the actions or responses that we need to take.

The afternoon of Day 3 was devoted to more hands-on training on the AlbayCLIM, focused on sea level rise. Dr. Peter Kouwenhoven explained that the threat of sea level rise comes from the melting of the ice caps and due to thermal expansion. He, however, emphasized that some places would experience higher rise in sea level than others due to another factor, i.e., tectonic activities or vertical land movement. Such factor is already incorporated in the SimCLIM modeling system.

For the modeling exercise, Dr. Kouwenhoven, together with Dr. Urich, led the participants to creating a sea level rise scenario. First he guided the participants to importing the Legazpi City climatic data into the AlbayCLIM. Using the impact models, the sea level rise trend in Legazpi City was generated and graphed. The trainers also walked the participants through generating a sea level rise scenario for 2050. After the guided exercise, the participants were again given time to explore sea level rise scenarios in different periods using different emission scenarios. Participants were then asked to think about the implications of such results in their own districts, as well as their suggestions for potential adaptation strategies.

The representative from District 1 reported that based on the sea level scenario generation exercises that they performed, a 1.3-m sea level rise would put the entire district into a disaster, with the lush agricultural production areas, fishing districts, commercial centers and tourism areas all endangered. Among the sectors that would be affected are the social (settlement, institutions, utilities), economic (agricultural, commercial and industrial areas), and environmental management sectors. Some of the adaptation strategies that they proposed were: relocation of settlement sites, land use regulation, construction of sea walls and shoreline buffer zones, provision of livelihood, massive mangrove reforestation, and intensive solid waste management program.

For District 2, impacts of sea level rise and potential adaptation measures were assessed in terms of its effects on the socio-economic, biophysical, and institutional sectors. On the socio-economic side, potential risks were identified to be water-borne diseases, loss or damage to life and properties, decreased value of tourism sites, intrusion of sea water into potable water sources, and adverse effect on freshwater fish production. Adaptation measures suggested for these issues were: making medicines available, establishment of additional health centers in safe locations, tapping alternate water sources, and providing livelihood options. Impacts on the biophysical aspect were noted to be

the damages on infrastructure, mangroves and coral reefs. Among the responses for these were strict enforcement of zoning policies, conservation of mangrove and protected areas, provision of relocation sites, and construction of seawalls and other infrastructures. The group also provided an institutional approach in addressing the above problems through IEC on climatic risks and hazards and providing risk sharing safety nets for possible affected areas.

In the meantime, District 3 representative explained that a sea-level rise of 0.5 meter by 2050 would mean a need to relocate the main road in their district. Such measure would also mean livelihood generation in their area as traversing the road itself could become a tourist attraction as it passes through Burias Pass, a known tourist spot. Another representative from the group also presented pictures that showed how vulnerable the district would be to potential sea level rise, and the current efforts to prevent such through construction of sea wall and conservation strategies.

DAY 4 – 29 April 2010

SimCLIM hands-on training continued on Day 4 with focus on extreme event analysis and water tank model. With the use of extreme event analysis, extreme daily rainfall event, extreme daily mean temperature (including extreme minimum and maximum temperatures) can be historically observed, together with their return periods. Results from such analysis were seen important in, for instance, anticipating the occurrence of such extreme events (such as high temperature or excessive rainfall) within a certain time frame. The probability of such events happening within a suggested period (say in 10 years) can also be calculated.

The water tank model, on the other hand, "simulates the performance of a water tank system using time-series rainfall data" and analyzes "the adequacy of design features of water tank system". By specifying in the "model inputs" the daily water consumption, water tank size and water catchment area, the number of longest dry periods can be calculated as well as the number of dry period larger than the critical dry period. The user could also change the features of the inputs above as adaptation options to reduce risks of the tank running dry.

After the exercises on the extreme event analysis and water tank model, Dr. Urich presented on the topic of coast care as a potential adaptation strategy for sea level rise, sharing the case of the Bay of Plenty in New Zealand. He highlighted that coastal systems are at "front line" of climate change and climate-related risks are often increased by unsound development. He cited the problem of sand erosion in New Zealand which was resolved through the introduction of native dune binding plants. The approach for addressing such problem was community-based in nature and required long-term commitment, but such efforts already paid off in the area. The said adaptation strategy was proven to be not only cost-effective, but successful in increasing the dune and beach areas. A simulation of the impacts of sea level rise under A2 emission scenario until 2100 also showed its resilience to sea level rise.

Following the "science/scenario modeling" part of the vulnerability and adaptation assessments to climate change using SimCLIM, Dr. Pulhin presented another assessment method which involves local knowledge through participatory techniques. Different participatory/exploratory and modeling/decision support tools were enumerated that could solicit valuable information from the

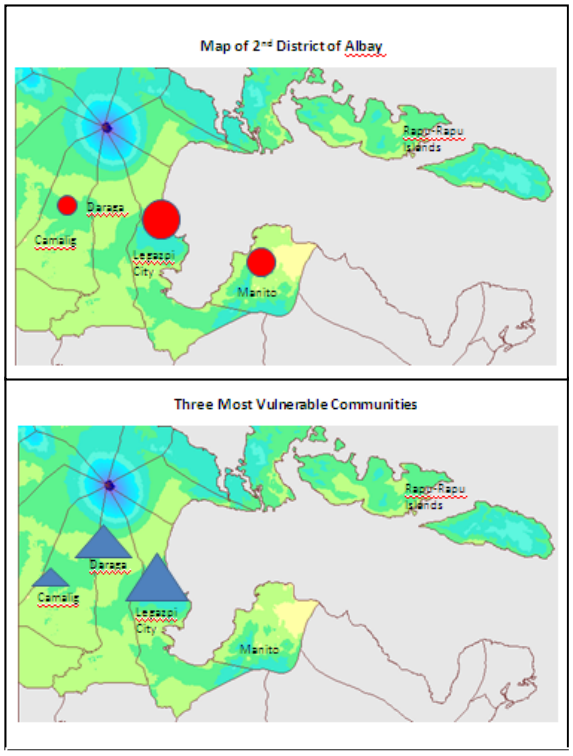
people, and how some of these were used for climate change and impacts assessments in Pantabangan-Carrangalan Watershed, in Nueva Ecija, Philippines. Based on information gathered from such approaches, vulnerable places and people were mapped, degree of impacts of climate extremes and vulnerabilities to various people groups were described, and their adaptation strategies identified. It was underscored that "combining participatory methods with modeling/decision-support tools provides a more robust vulnerability/adaptation assessment for more effective planning".

The participants again grouped themselves according to their district to conduct a climate change impacts and vulnerability assessment in their respective areas using participatory techniques. Using "local experts' judgment", they were asked to identify the top-three most vulnerable areas and people in their district with the degree of vulnerability indicated by the size of different shapes (circle for area and triangle for people). In District 1, the municipality of Malinao was identified as the most vulnerable due to exposure to storm surges and high precipitation. People living along the coasts, many are found in Tiwi, Malinao and Tabaco City, were also seen as highly susceptible to climate-related risks.

Typhoons, floods and landslides were among the climate-related risks of high concern in District 2. Among the municipalities in the area, however, Legazpi City, Camito and Camalig were identified by the participants as the top-three most vulnerable to these events. On the other hand, people from Legazpi City, Daraga and Camalig were the most vulnerable, according to the participants.

The local assessment of District 3, in the meantime, named Pioduran, Pulangui and Libon as the highly vulnerable municipalities to climate-related risks, particularly to flooding. The vulnerable people were found in Guinobotan, Ligao, Oas, Polangui and Libon based on the participants' analysis of the extent of damage in these areas. Many of these people at risks are also located along the coastline.

After training the participants on both "science/modeling-based" and "participatory-oriented" approaches to impacts, vulnerability and adaptation assessments to climate change, Dr. Pulhin presented the major activities that still need to be done, particularly for the provincial assessment as part of the project, and in relation as well to their ongoing CLUP revision. Deadlines were also set for the completion of outputs for each task ahead.



Results of group exercise of District 2 showing the top three most vulnerable areas and communities.

The training concluded with Dr. Juan Pulhin, Dr. Peter Urich, and Mr. Nong Rangasa of CIRCA, thanking and congratulating the participants for a very successful capacity development on the methods of climate change impacts, vulnerability and adaptation assessments through the use of SimCLIM and participatory techniques. It was underscored that this is another significant step in the aim to climate-proof the province of Albay, and it was ensured that the team from UPLB,

CLIMsystems and CIRCA would fully support the LGUs, and the province at large, towards such end throughout the completion of the project and beyond. Meanwhile, each trainee received a "Certificate of Completion" in recognition of their participation in the training.

With the promising results of SimCLIM, discussions are now ongoing to use the modeling system to conduct climate change impacts and vulnerability assessment nationwide. If this pushes through, the Philippines would be the first to conduct such an assessment in Southeast Asia using SimCLIM.

ACKNOWLEDGMENT OF SUPPORT/CO-FUNDING

This training demonstrated not only the development of the capacity of the provincial government of Albay in carrying out climate change impacts and vulnerability assessments with the ultimate aim of climate-proofing the province, but also the strong partnership among the collaborators that led to the resounding success of this activity. Indeed, the conduct of the training would not have been possible without the generous support received from the Provincial Government of Albay through the Center for Initiatives and Research on Climate Adaptation (CIRCA) headed by Mr. Nong Rangasa, for shouldering the meals and accommodations of some of the participants throughout the duration of the training. This, together with their in-kind contributions such as providing training supplies, logistical support and human resources, is roughly estimated at US$ 8,000-10,000.

The team of Dr. Peter Urich and Dr. Peter Kouwenhoven from CLIMsystems Ltd. also contributed tremendously by sharing their expertise and training the participants on the use of SimCLIM for free, installing licensed AlbayCLIM softwares to 33 users without additional cost (one license costs US$ 5,000), and shouldering the round-trip ticket of Dr. Peter Kouwenhoven. Such huge support readily comes close to US$ 200,000.

Thanks are also due to all the speakers for sharing their time, knowledge and expertise, particularly the representatives from PAGASA for providing at no cost the climatic data for Legazpi City in Albay. The smooth operation of the training was also owed to the assistance provided by the staff of CFNR-UPLB and CIRCA, and more importantly the cooperation of all the participants from the different municipalities in Albay.

MORE PHOTOS FROM THE TRAINING

Dr. Juan Pulhin and Dr. Peter Urich interviewed by the local media before the training…

Participants registering as they arrive (left) and those eagerly waiting for the start of the training (below)

Dr. Pulhin giving the welcome remarks

Participants taking down notes and attentively listening to the speakers…

Group exercises and presentations…

Hands-on training on the use of SimCLIM…

Graduation…

LIST OF PARTICIPANTS

No.	Name	Designation	Office Address
1	Aldino Bazar		LGU - Pioduran
2	Annalie de Guzman		LGU - Tiwi
3	Antonio B. Cabais	CPDO Staff	LGU - Tabaco
4	Arsenio B. Bibon	Municipal Planning Development Coordinator	LGU - Bacacay
5	Carol Joy Sorla		PGA - CIRCA
6	Chandyllane G. Cantre	Graduate Student/Graduate Assistant	UPLB
7	Dennis Leo b. Miranda		CIRCA
8	Dindo L. Abellano	Municipal Planning Development Coordinator	LGU - Manito
9	Dioscoro L. Acabado	PPOI	MPDO Ginubatan
10	Edmund C. Dantes	Municipal Planning Development Coordinator	LGU - Tiwi
11	Eduardo E. Uy Jr.		PGA - CIRCA
12	Eduardo Laguerta		PhiVolcs
13	Edwardson Ynota		CIRCA - Legazpi City
14	Efren Binamima Jr.		PGA - CIRCA
15	Eloisa C. Coper		LGU - Malinao
16	Emerente Sarion		LGU - Pioduran
17	Emmanuel de la Torre		LGU - Camalig City
18	Flaviana Hilario	Weather Service Chief	PAGASA
19	German J. Gonzaga	Municipal Planning Development Coordinator	LGU - Malinao
20	Herbert Ramasanta	Administrative Aide	LGU - Sto. Domingo
21	Jaime Ludovice		CIRCA - Legazpi City
22	Jasper J. Dugan	Administrative Officer II	LGU - Daraga
23	Jose Carlos C. Torres	Municipal Planning Development Officer	LGU - Oas
24	Joseph Jay L. Asor		LGU - Camalig City
25	Joseph Pulvinar	Administrative Assistant	LGU - Oas
26	Jovito Lobigan Jr.	Municipal Planning Development Staff	LGU - Oas
27	Juan B. Berces	CPDC	CPDO - Tabaco
28	Juan M. Pulhin	Professor and Project Leader	UPLB
29	Leonard Acosta	Documentalist	
30	Leoncio Amadore	Former PAGASA Director	IESM-UP
31	Lizardo Bilau	Municipal Planning Development Staff	MPDO - Malilipot

No.	Name	Designation	Office Address
32	Ma. Delia N. Dela Cruz	Planning Officer	LGU - Daraga
33	Maria Soledad T. Prena		LGU - Ligao City
34	Maricel A. Tapia	Instructor	CFNR-UPLB
35	Michael Margallo	Administrative Aide IV	LGU - Daraga
36	Miladee N. Azur	RESD	LGU - Legazpi City
37	Neil Redada	Municipal Planning Development Staff	LGU - Oas
38	Nick Sebastian		LGU - Pioduran
39	Noel Ordona		LGU - Pioduran
40	Nong Rangasa	Executive Director	CIRCA, Albay
41	Olivia Mediado	CPDO Staff	LGU - Tabaco
42	Percival De Villa	Agriculturist II	PAS-DA Albay
43	Peter Kouwenhoven	Associate	CLIMsystems, New Zealand
44	Peter Urich	Managing Director	CLIMsystems, New Zealand
45	Priscilla Galicia		LGU - Legazpi City
46	Rex Victor O. Cruz	Dean and Professor	CFNR-UPLB
47	Rey Nasol	Journalist	Inquirer
48	Rodel Purcia		CIRCA - Legazpi City
49	Romeo B. Cabria	Municipal Planning Development Coordinator	LGU - Sto. Domingo
50	Romeo SJ Tolosa	MDCC	Polangui
51	Rosalina de Guzman	Assistant Weather Specialist Chief	PAGASA
52	Rose Jane J. Peras	Asst. Professor	UPLB
53	Russel Pillas	Engineering Staff	LGU - Oas
54	Salvador B. Apinado	CIRCA staff	PGA - CIRCA
55	Tirso C. Paguio	Municipal Planning Development Officer	LGU Ginubatan
56	Walder Losabia		LGU - Pioduran
57	Xyvier D. Quiapos		LGU - Ligao City

APPENDIX 5.

BICOL REGIONAL FORUM
31 May 2011 at OCD Conference Room, Camp Simon Ola
Legazpi City, Albay, Philippines

PROGRAMME

Part I 0830-0900	Registration	
	Memorandum of Agreement (MOA) between Province of Albay and Bicol University (Climate Change Academy for LGUs in the Philippines)	**HON. JOEY SARTE SALCEDA** Albay Governor **DR. FAY LEA PATRIA M. LAURAYA** BU President
Part II	Invocation National Anthem	
	Welcome Remarks	**DIR. RAFFY ALEJANDRO, JR.** Regional Director OCD & RDRRMC RV
	Inspirational Message	**DR. JOEY SARTE SALCEDA** Albay Governor UN Senior Global Champion *on DRR & CCA*
	Brief Review of the APN Project "Capacity Development on the Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments"	**DR. JUAN M. PULHIN** Professor and Project Leader College of Forestry and Natural Resources (CFNR), University of the Philippines Los Baños (UPLB)
	Assessment of the Impacts of Climate Change Using PlantGRO	**DR. PETER URICH** Managing Director, CLIMsystems Ltd. University of Sunshine Coast, Queensland, Australia
	OPEN FORUM /COFFEE BREAK	
	Application of SimCLIM in the preparation of Comprehensive Land Use Plan in Selected Municipalities in Albay	**DR. REX VICTOR O. CRUZ** DEAN/ Professor, CFNR-UPLB IPCC LEAD AUTHOR
	Vulnerability and Adaptation Assessment to Climate Change and Sea Level Rise Using SimCLIM: Case Studies in Selected Areas in Albay	**DR. JUAN M. PULHIN** Professor and Project Leader, UPLB IPCC Lead Author
	Open Forum	

Master of Ceremony:
NONG C. RANGASA
Executive Director
CIRCA & Climate Change Academy for LGUs in the Philippines
Project Manager, JP United Nations MDG Achievement Fund 1656: Albay Demo

APPENDIX 6.

Other Partners:

University of the Philippines Los Baños - College of Forestry and Natural Resources through the Asia-Pacific Network for Global Change Research (APN) CAPaBLE Project "Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments"

Provincial Government of Albay through the Center for Initiative and Research in Climate Adaptation

To obtain copies of the presentations, visit **www.climate.gov.ph**

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Malacañang

CLIMATE CHANGE COMMISSION
CLIMATE CHANGE OFFICE

In partnership with

Department of Science and Technology (DOST)-
Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)

SERIES OF CONSULTATION ON VULNERABILITY AND RISKS ASSESSMENTS TOOLS TOWARDS A CLIMATE CHANGE RESILIENT PHILIPPINES

June 1, 2011, Wednesday
Mabini Social Hall, Malacañang Compound
San Miguel, Manila

PROGRAMME

Consultation Series #1:
SimCLIM, REDAS, and Other Emerging Tools

8:30-9:00 AM	Registration
9:00-9:30	Opening Program
	Welcome Remarks **Comm. Naderev M. Saño** *Climate Change Commission*
	Message and Rationale **Dr. Danilo C. Cardenas** *DOST- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)*
9:30-10:15	Vulnerability and Risks Assessments: Concept and Importance **Ms. Lourdes Tibig** *Manila Observatory/ Rice Watch and Action Network*
10:15-11:00	Introduction of the SimCLIM **Dr. Peter Urich** *CLIMsystems*
11:00-11:15	Coffee Break
11:15-12:00 NN	Application of SimCLIM in the preparation of Comprehensive Land Use Plan (CLUP) in selected municipalities in Albay **Dr. Rex Victor Cruz** *UPLB-College of Forestry and Natural Resources*
12:00-1:00 PM	Lunch
1:00-1:45	Vulnerability and Adaptation Assessment to Climate Change and Sea Level Rise using SimCLIM: Case studies in selected areas in Albay **Dr. John Pulhin** *UPLB-College of Forestry and Natural Resources*
1:45-2:30	Open Forum
2:30-3:15	READY Project: REDAS (Rapid Earthquake Damage Assessment System) **Dr. Ma. Leonila Bautista** *DOST-PHIVOLCS*
3:15-3:30	Overview of DOST-ASTI Products and Services **Engr. Rene Mendoza** *DOST-Advanced Science and Technology Institute*
3:30-4:00	Open Forum
4:00-4:30	Ways Forward

Consultation on Vulnerability and Risks Assessments Tool
Towards a Climate Change Resilient Philippines
June 1, 2011/ 8:30AM – 430PM / Mabini Social Hall, Malacañang Compound, San Miguel, Manila

Where quality service is a way of life

Consultation Series #1: **SimCLIM, REDAS, and Other Emerging Tools**

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Bureau of Plant Industry - Los Baños National Crops R&D Center	Dr. Herminigilda Gabertan	5360104	
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UPLB-College of Forestry and Natural Resources	Dr. John Pulhin *(Resource Person)*	0928283035	jpulhin@yahoo.com

APPENDIX 7. PowerPoint Presentation

Vulnerability and Adaptation Assessment to Climate Change and Sea-Level Rise using SimCLIM: Case Studies in Selected Areas in Albay

Objectives of the Presentation

- Demonstrate V&A assessment to climate change and sea-level rise using case studies in Albay
- Present the potentials of combining SIMCLIM and participatory techniques in conducting V & A assessments

Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments

Collaborators

- University of the Philippines Los Banos
  - College of Forestry and Natural Resources
- Provincial Government of Albay
  - Center for Initiatives and Research on Climate Adaptation
- CLIMsystems Ltd.
- University of the Sunshine Coast – Australia

V&A Assessment Study Sites:

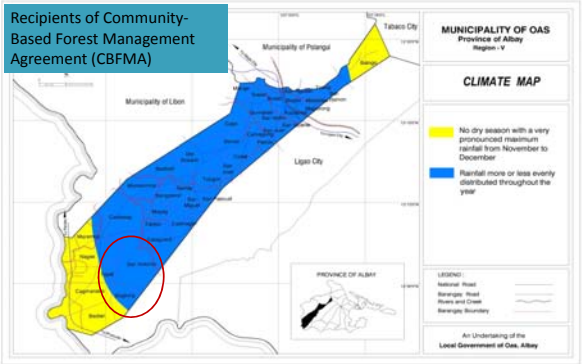
Focused on communities in forests and coastal zones:

Forest/Uplands: Brgys. San Antonio and Bogtong in Oas (under Community-Based Forest Management)

Coastal Zone: Brgys. Poblacion 1, Cawayan and Cagraray in Bacacay (Cagraray Island has 45 km. coastal area)

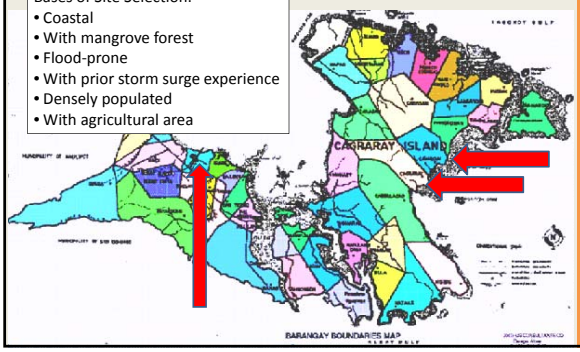
Location of the Forest/Upland Communities Study Sites: Brgys. San Antonio and Bogtong, Oas, Albay

Recipients of Community-Based Forest Management Agreement (CBFMA)

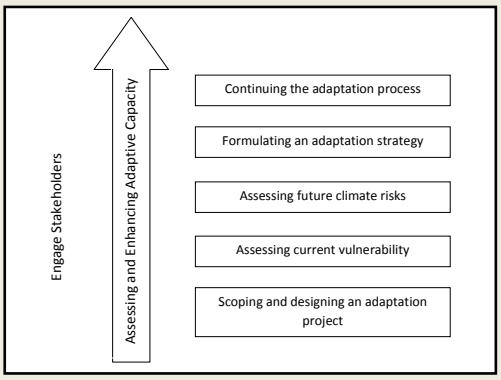


Location of the Coastal d Communities Study Sites: Brgys. Poblacion 1, Cawayan and Cagraray, Bacacay, Albay

Bases of Site Selection:
- Coastal
- With mangrove forest
- Flood-prone
- With prior storm surge experience
- Densely populated
- With agricultural area



The Adaptation Policy Framework (APF)



Methodology

Kick-Off Meeting of the Project on Jan. 15, 2010

Step 1. Scoping the vulnerability and adaptation assessment

- Scoping the project, defining objectives, establishing project team, reviewing literature, choice of approach of methods, etc.

Methodology

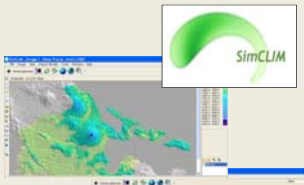
Step 2. Assess current vulnerability

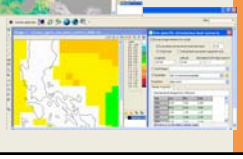
- Field reconnaissance
- Secondary data gathering
- Key informant interviews
- Participatory rural appraisal (PRA) techniques – FGDs, community mapping, etc.
- Household survey

Methodology

Step 3. Characterize future climate-related risks.

Climate change and sea-level rise scenarios generated using AlbayClim.





Climate change scenario – 21-GCM ensemble, SRES A1FI, high sensitivity

Sea-level rise scenario – 13-GCM ensemble, SRES A1FI, high sensitivity

Methodology

ADAPTION OPTION	EFFECTIVENESS	COST	TECHNICAL FEASIBILITY	SOCIAL AND CULTURAL FEASIBILITY	SPEED
Water conservation and demand management existing	High	Low	High	High	High
Level of service/future	High	Low	High	Low	Medium
Recycling - urban	Medium	High	High	Medium	High
Reuse - mining	Low	High	High	High	Medium
Reallocation of dam yield	Medium	High	High	Medium	High
Conjunctive use	Low	Low	High	High	Medium
Expand well fields	Low	Low	High	High	High
Build new dam	High	High	High	Medium	Low
Rainwater harvest	Low	Low	High	High	High

Step 4. Develop adaptation strategies

- Potential adaptation strategies sought through PRA and HH survey
- Used criteria indicators: effectiveness, cost, speed, technical feasibility and acceptability (USAID 2007)

Methodology

Step 5. Continuing the adaptation process

- Involves maintaining, monitoring, evaluating, and sustaining the initiatives started by the adaptation project.

Results of V&A Assessment:

UPLAND COMMUNIITES

Major Climate Variability and Extremes Experienced by the Upland Communities

Decade	Climate Variability and Extremes	
	Brgy. San Antonio	Brgy. Bogtong
1950s		1952 Typhoon Trix (respondents thought it was in 1949)
1960s	1968 Drought	
1970s		Occurrences of typhoons (not very strong)
1980s	1982 Drought 1987 Typhoon Sisang	1982 Drought (7 months with no rain) 1987 Typhoon Sisang 1987 Drought
1990s	1995 Typhoon Rosing	1998 Drought (6 months with no rain)
2000s	2006 Typhoon Reming 2006 Typhoon Milenyo 2007 El Niño /Drought 2010 Delayed Rains (*El Niño*)	2006 Typhoon Reming 2010 Delayed Rains/Extremely hot temperatures (*El Niño*)

Socioeconomic Characteristics of the Respondents

- Educational attainment: 67% elementary level or elementary graduate
- Farming is the major occupation (mostly rainfed)
- Agricultural practices: monocropping and mixed / intercropping (some on kaingin land)
- Assets: land/farms were government-owned and houses were mostly built of native material
- Water Sources: Deep-well pump or jetmatic
- Mode of transportation: Walking, carabao-pulled cart, and habal-habal (motorcycle)
- Inadequacy of basic needs and services
- Expenditure pattern: bulk spent on food, transportation, and education

Biophysical Characteristics

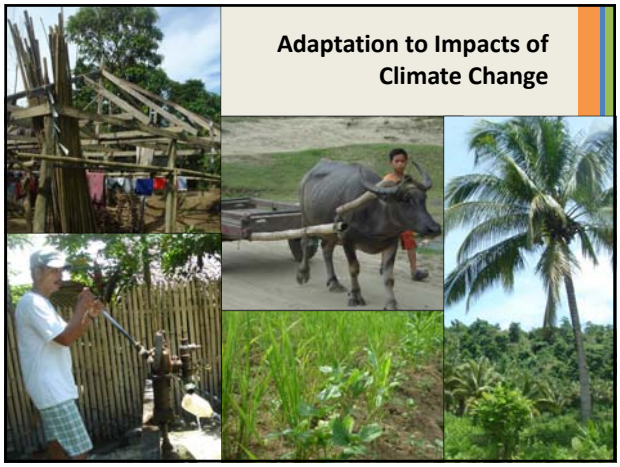
Degraded forest areas in San Antonio and Bogtong.

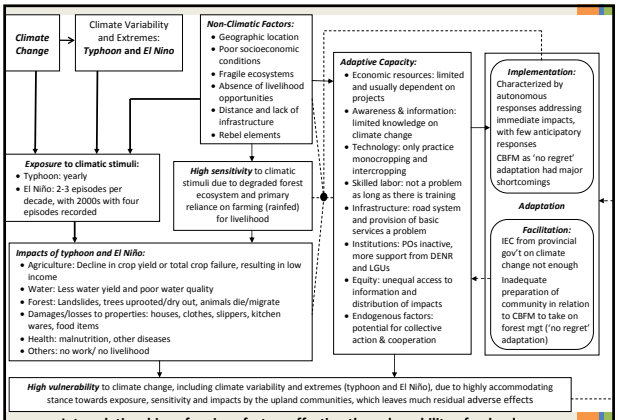
Impacts of Climate Variability and Extremes

Impacts of Climate Variability and Extremes

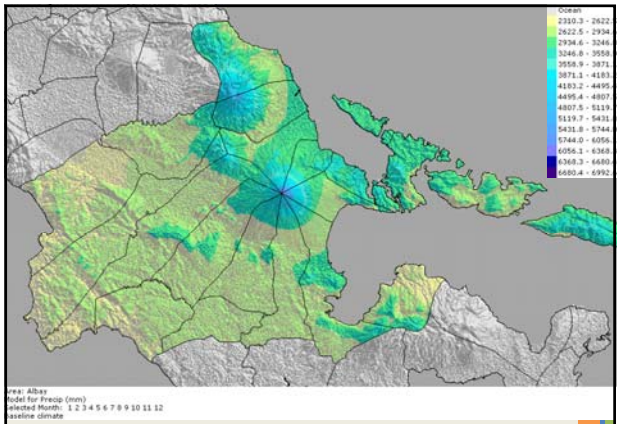
Health, Properties, Equity, etc.

Adaptation to Impacts of Climate Change

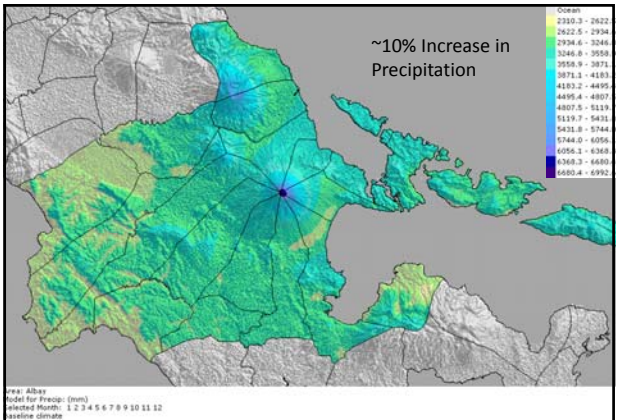




Interrelationships of various factors affecting the vulnerability of upland communities to climate change.

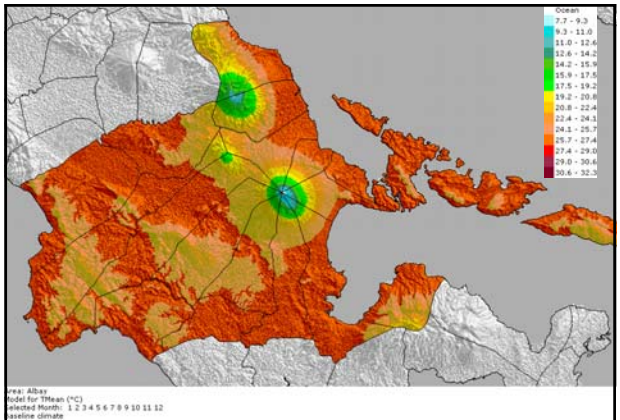


1990 Baseline Precipitation

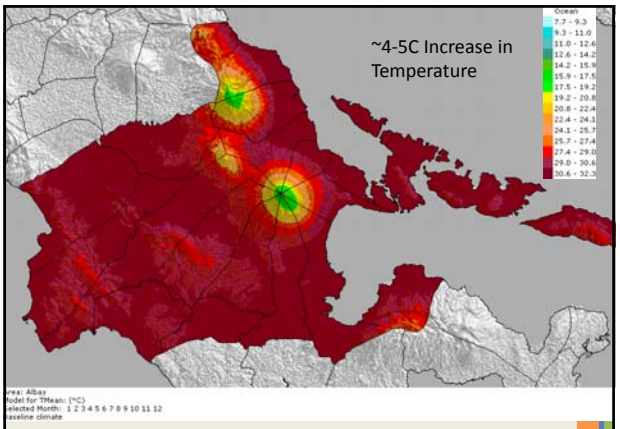


~10% Increase in Precipitation

2100 Precipitation, 21-GCM Ensemble, SRES A1FI, High



1990 Baseline Mean Temperature



2100 Mean Temperature, 21-GCM Ensemble, SRES A1FI, High

Future Adaptation Strategies, San Antonio

Sector	Adaptation Strategy	Vulnerability Considering Adaptation	Indicators*					Total
			E (10)	TF (20)	C (30)	SCA (10)	S (30)	
Water	Get medicines Construct/dig wells	Short time Effective	7 10	18 20	28 30	9 10	27 30	89 100
Agriculture	Early harvesting Farm-to-market roads	Depends on crop Current road system not effective in rainy season	7 5	15 10	29 20	10 10	30 20	91 65
Forest	Plant trees and bamboo	None as long as there are many trees	10	20	30	9	30	99

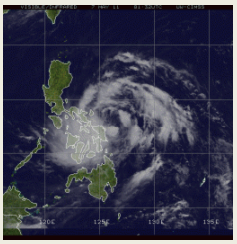
Future Adaptation Strategies, Bogtong

Sector	Adaptation Strategy	Vulnerability Considering Adaptation	Indicators*					Total
			E (50)	TF (3)	C (7)	SCA (10)	S (30)	
Water	Plant trees	Gradual solution to climate change vulnerability	50	3	5	10	15	83
	Prohibit tree cutting		50	3	7	10	30	100
	Dig deeper wells		50	1	5	10	20	86
Agriculture	Pest management	Still vulnerable; just need to bear with it	30	3	2	10	15	60
	Additional fertilizer		20	3	1	10	10	44
	Use of insecticides		20	3	1	10	20	54
	Change in crop species		50	3	5	10	15	83
Forest	Plant trees especially in sloping areas	Gradual solution to climate change vulnerability	50	3	5	10	15	83

Results of V&A Assessment

COASTAL COMMUNITIES

Hazards Coastal Communities in Study Sites Are Exposed to In Relation to Sea-Level Rise



Typhoons

Image Credit: PAGASA-DOST

Storm Surges

Image Credit: www.catalogue.sciencephoto.com

Poblacion 1 **Cagraray** **Cawayan**

- Major livelihood activities: Fishing and farming
- Forty percent of 124 survey respondents from Poblacion 1 and Cawayan believe sea-level is rising

Agricultural Area

Fish Cages

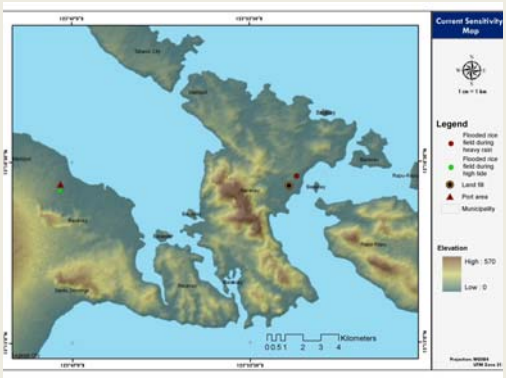
Impacts of Typhoon with Storm Surges* in the Coastal Communities

Sector	Impacts
Water Resources	Damage to water pipes; poor water quality
Human Health	Prevalence of water-borne diseases and flu
Agriculture	Washed out crops
Fisheries	Destruction of fish gears and fish cages
Human Settlement	Destruction of properties

*Except for Brgy. Cagraray which is protected by mangroves.

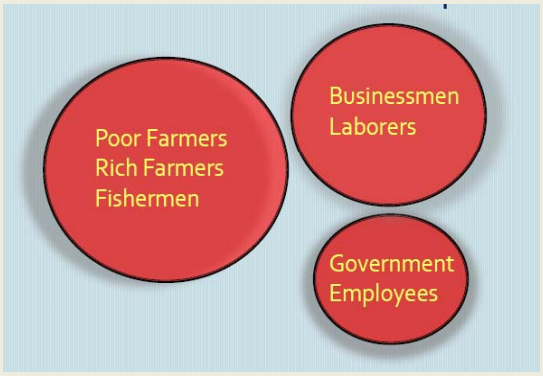
Impacts of Floods (associated with storm surges, extreme precipitation and runoff)

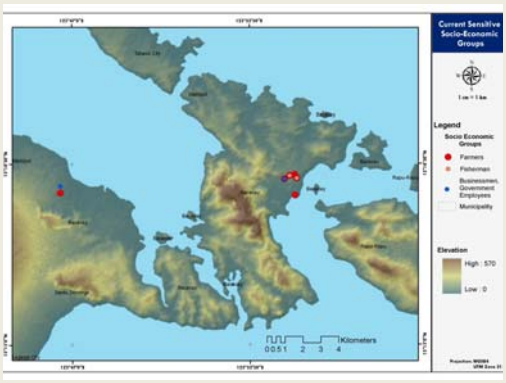
Sector	Impacts
Water Resources	Damage to water pipes; poor water quality
Human Health	Prevalence of water-borne diseases and flu
Fisheries	Damage to boats, fish gears and other equipment
Agriculture	Increased salinity of water in rice fields; Washed out crops
Human Settlement	Destruction of houses
Mangroves	Uprooted mangroves



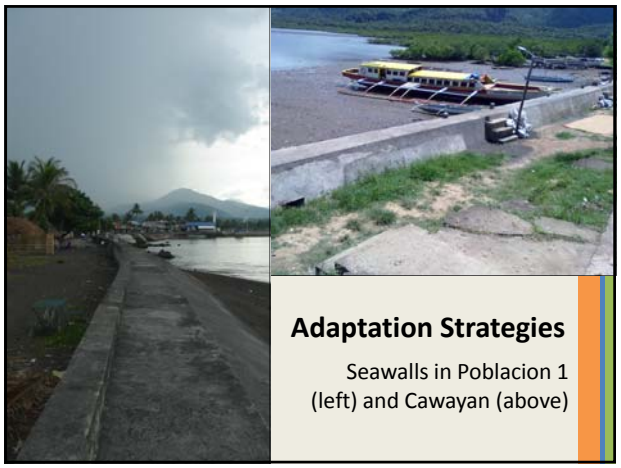
Study Sites showing location of rice fields that get flooded during heavy rains and high tide in Poblacion 1 and Cawayan

Vulnerable Socioeconomic Groups





Locations of vulnerable people in Poblacion 1 and Cawayan: Farmers and Fisher folks



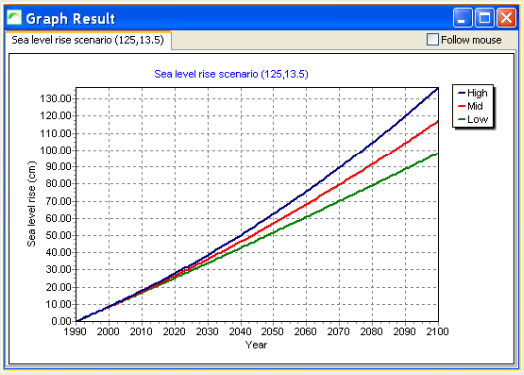
Adaptation Strategies

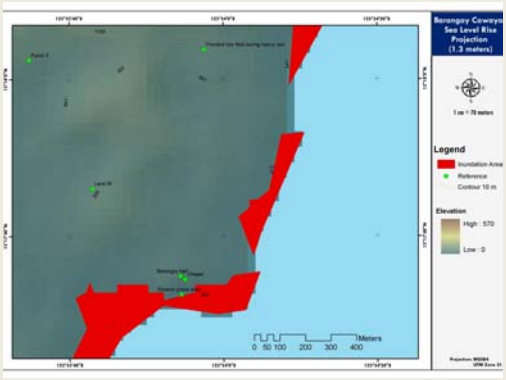
Seawalls in Poblacion 1 (left) and Cawayan (above)

Current Adaptation Practices

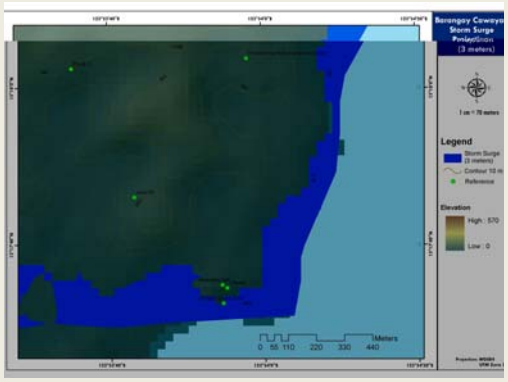
Sector	Adaptation Practices
Water Resources	Boiling of water
Agriculture	Timing of planting/harvesting activities
Human Health	Provision of medicine, immediate response, monitoring
Fisheries	Boat repair, loans, securing boats before typhoon, finding alternative livelihood
Tourism (boat rental)	Boat reconstruction; loans
Human settlement	House reconstruction (concrete and elevated); loans; evacuation of people, livestock and properties before typhoon comes; riprap reconstruction/seawall
Mangroves	Pruning activities before typhoon; reforestation

SimCLIM Results: Sea-Level Rise

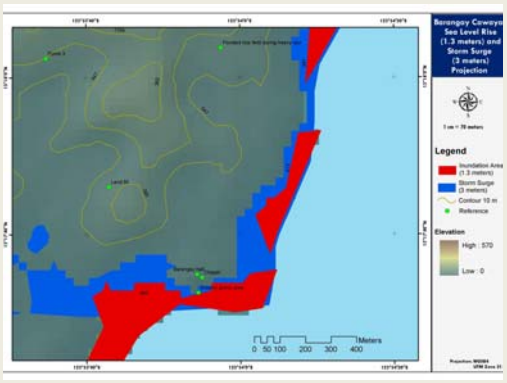




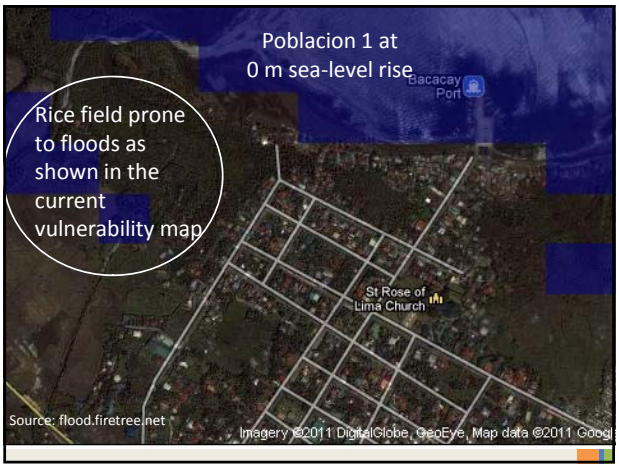
1.3-m sea-level rise in Brgy. Cawayan

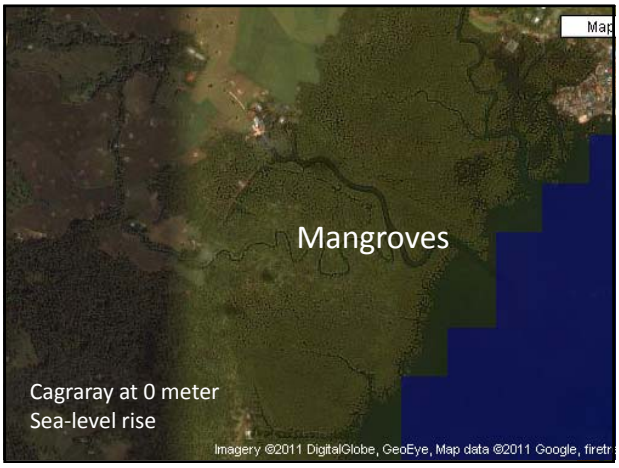


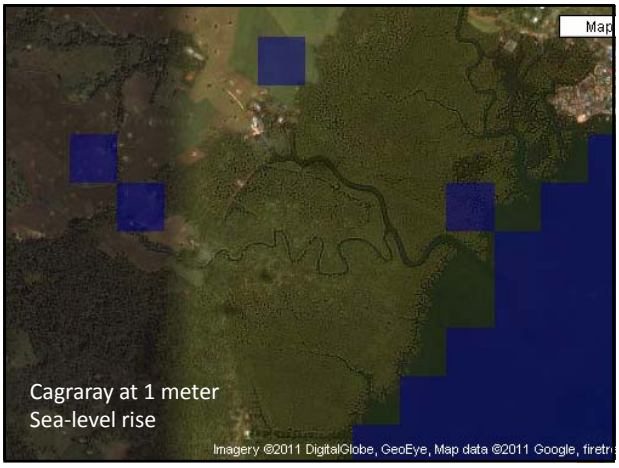
Projected Storm Surge (3 m) in Brgy. Cawayan given a 1.3-m sea-level rise scenario



Brgy. Cawayan: 1.3 meter sea-level rise and 3-meter storm surge projections







1.3-meter sea level rise

2-meter sea level rise

3-meter sea level rise

4-meter sea level rise

5-meter sea level rise

Future Adaptation Strategies, Poblacion

Adaptation Strategy	Indicators					
	E (50%)	TF (5%)	C (5%)	S (15%)	A (25%)	Total
Boiling of water	45	5	5	15	25	95
Replacement of old pipes	50	3	2	15	25	95
Resorting to other crops	50	2.5	5	15	25	97.5
Dumping	50	5	5	10	25	95
Fishpond establishment	50	5	1	10	20	86

Future Adaptation Strategies, Poblacion (con)

Adaptation Strategy	Indicators					
	E (50%)	TF (5%)	C (5%)	S (15%)	A (25%)	Total
Medical preparedness	50	5	1	12	25	93
Medical preparedness	50	5	1	12	25	93
Shrimp breeding	50	5	1	10	20	86
Natural fishing	50	5	2.5	15	25	97.5
Limit development in mangrove areas	45	2	3	7.5	25	82.5
Strict enforcement of regulations	50	2.5	2	15	20	89.5

Future Adaptation Strategies, Cagraray

Adaptation Strategy	Indicators					
	E (20%)	TF (20%)	C (10%)	S (30%)	A (20%)	Total
Reforestation	20	15	3	30	20	88
Population control	20	20	10	10	10	70
Construction of health center	20	10	10	15	20	75
Finding alternative livelihood sources	20	20	10	30	20	100
Provision of relocation site	20	10	1	10	5	46
Planting of more mangrove species	20	15	8	10	20	73

Future Adaptation Strategies, Cawayan

Adaptation Strategy	Indicators					
	E (50%)	TF (5%)	C (5%)	S (10%)	A (30%)	Total
Filter water	50	5	5	10	30	90
Finding other water sources	50	3	5	10	30	88
Boiling of water	50	5	5	10	30	90
Dumping near agricultural areas	45	3	2	5	15	70
Gradual adjustment of fishermen to sea-level rise	50	5	5	10	30	100

Future Adaptation Strategies, Cawayan (con)

Adaptation Strategy	Indicators					
	E (50%)	TF (5%)	C (5%)	S (10%)	A (30%)	Total
Dumping	50	5	2	8	30	95
Relocation to higher grounds	45	5	2	7	20	79s
* Construction of a higher and longer sea wall	50	5	1	6	30	92
Mangrove Reforestation	50	5	5	10	30	100

*Present sea wall is 2-meter high and 100-m long.

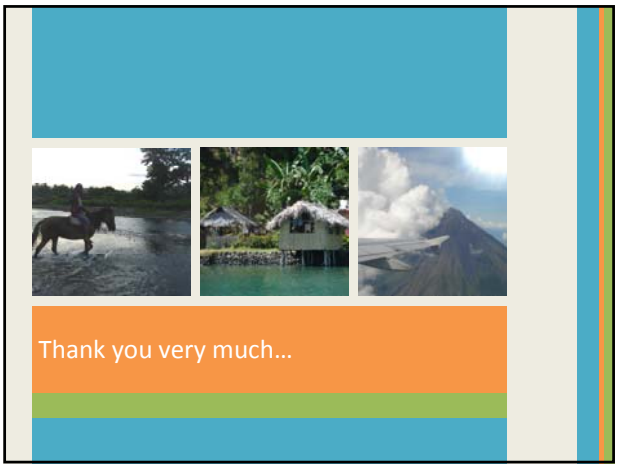
Conclusions

Upland Communities

- Vulnerability to climate variability and extremes affected/ exacerbated by non-climatic factors (multiple-stressors of vulnerability)
- It's difficult for the communities to imagine future impacts of changing climate to which they do not have prior experience
- Proposed responses driven by variability and extremes rather than long-term gradual changes

Coastal Communities

- Exposure and sensitivity of coastal areas to storm surges and potentially to future sea-level rise are heighted by destruction of mangrove forest
- The above increases adaptation cost (e.g. construction of sea-wall)
- Need to mainstream climate change in coastal zoning in local development plans


Thank you very much…

APPENDIX 8.

APN CAPaBLE PROJECT "IN THE NEWS"

Philippine Daily Inquirer

INQUIRER Southern Luzon

Editor Jun Bandayrel
Bureau Chief Floreño G. Solmiranc

Albay: Model for study of climate change adaptation

By Rey M. Nasol
Legazpi City

RESETTLEMENT HAS NOT STOPPED LEOPOLdo Nierva and his family in Guinobatan, Albay, from being constantly alert.

"Although we are safe here, we are always double-checking the stability of the hill with authorities," said Nierva, whose new house lies at the foot of a hill carpeted with greenery at the Barangay Mabogos relocation site.

Although the Niervas, along with close to 200 other families, have already moved to their new homes, they continue to be very vigilant in times of disaster to avoid becoming victims twice over, especially if a landslide occurs. They had lost their houses when a flash flood swallowed Regina Pacis, a densely populated block in Barangay Travesia.

"We want to get an assurance that there is no threat of a landslide," Pacis said.

The provincial government has a ready answer.

"This is where the Rapid Earthquake Damage Assessment System (Redas) software will be very useful by simulating scenarios in case of an earthquake that could trigger landslides," said Manuel Rangasa, executive director of the Center for Research and Initiatives on Climate Adaptation in Albay.

The data, he said, would be forwarded to the homeowners upon verification by the Mines and Geosciences Bureau.

THE MAURARO resettlement site in Guinobatan, Albay, is one of relocation sites for calamity victims.

REY M. NASOL

Success

Cedric Daep, department head of the Albay Public Safety and Emergency Management Office, said that despite the current backlogs in relocation, "we are able to attain success comparable to completely having transferred the calamity victims to their permanent resettlement sites."

He cited the active participation and support of the leaders and the people, and the prompt mechanisms that have already been institutionalized. This, he said, put Albay at the center stage of the climate change adaptation initiative.

Recently, the Asia Pacific Network for Global Change Research (APN), an international research group, chose Albay as a model for the study of the impact and the perceived defense against the threat of global warming.

The province will pioneer the climate change simulation research and study, jointly with the College of Forestry and Natural Resources (CFNR) of the University of the Philippines-Los Baños (UPLB).

Prof. Juan Pulhin of the CFNR's Department of Social Forestry and Forest Governance earlier told Gov. Joey Salceda in a letter that the APN approved the study, "Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments."

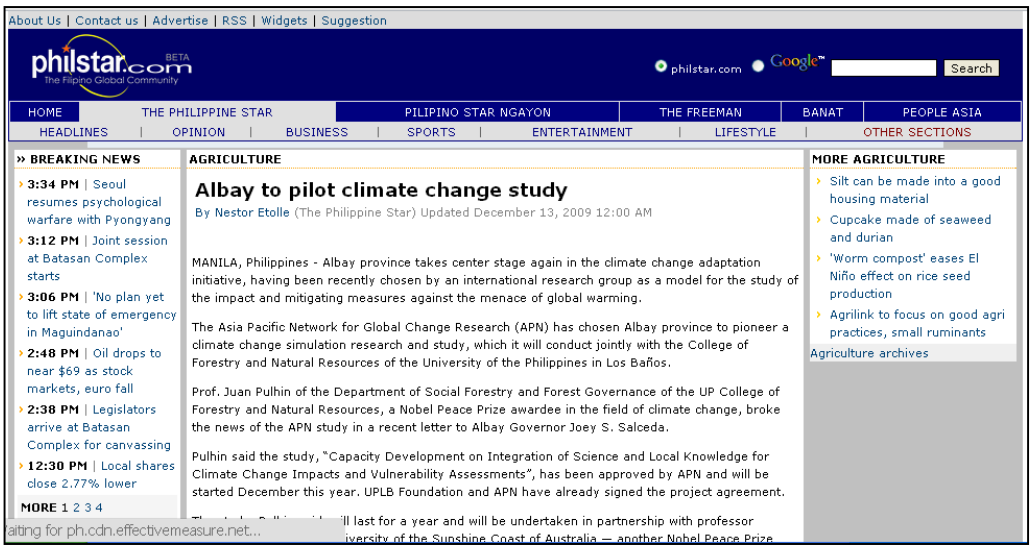
The study will start this month after the signing of an agreement between the APN and the UPLB Foundation. Pulhin said it will take one year in partnership with Prof. Richard Warrick of the University of the Sunshine Coast of Australia, a Nobel laureate for peace in the field of climate change.

Warrick designed the climate simulation model (SimCLIM) and would customize it for Albay's use in impact and vulnerability assessments and in adaptation planning.

Salceda initiated the campaign for climate change adaptation in 2008, when he hosted the first national conference on the subject in Legazpi City. A second conference was held in Manila two months ago.

PICTURE YOUR FAMILY

Philippine Star (Broadsheet's online version)



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- 3:34 PM | Seoul resumes psychological warfare with Pyongyang
- 3:12 PM | Joint session at Batasan Complex starts
- 3:06 PM | 'No plan yet to lift state of emergency in Maguindanao'
- 2:48 PM | Oil drops to near $69 as stock markets, euro fall
- 2:38 PM | Legislators arrive at Batasan Complex for canvassing
- 12:30 PM | Local shares close 2.77% lower

MORE 1 2 3 4

AGRICULTURE

Albay to pilot climate change study

By Nestor Etolle (The Philippine Star) Updated December 13, 2009 12:00 AM

MANILA, Philippines - Albay province takes center stage again in the climate change adaptation initiative, having been recently chosen by an international research group as a model for the study of the impact and mitigating measures against the menace of global warming.

The Asia Pacific Network for Global Change Research (APN) has chosen Albay province to pioneer a climate change simulation research and study, which it will conduct jointly with the College of Forestry and Natural Resources of the University of the Philippines in Los Baños.

Prof. Juan Pulhin of the Department of Social Forestry and Forest Governance of the UP College of Forestry and Natural Resources, a Nobel Peace Prize awardee in the field of climate change, broke the news of the APN study in a recent letter to Albay Governor Joey S. Salceda.

Pulhin said the study, "Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments", has been approved by APN and will be started December this year. UPLB Foundation and APN have already signed the project agreement.

ll last for a year and will be undertaken in partnership with professor

iversity of the Sunshine Coast of Australia — another Nobel Peace Prize

MORE AGRICULTURE

- Silt can be made into a good housing material
- Cupcake made of seaweed and durian
- 'Worm compost' eases El Niño effect on rice seed production
- Agrilink to focus on good agri practices, small ruminants

Agriculture archives

Waiting for ph.cdn.effectivemeasure.net...

http://balita.ph/2010/05/13/albay-first-province-to-use-simclim-software-to-examine-effects-of-climate-change/

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Albay, first province to use SimCLIM software to examine effects of climate change

May 13, 2010 7:38 pm

By Mike de la Rama

LEGAZPI CITY, May 13 — The province of Albay is the first provincial government unit in the country to use the customized SimCLIM software, a computer model system for examining the effects of climate variability and change over time and space.

Center for Initiative and Research Center for climate Adaptation (CIRCA) executive director Nhong Rangasa explained that SimCLIM is an open framework modeling system which allows user to customize the model for geographical area and spatial resolution and to attach models.

The software has the capacity to assess baseline climate and current variability and extremes, present and future risks, investigate present and future adaptation, create scenarios of climate and sea level change, conduct sensitivity analysis, impact and others.

CIRCA is proposing to the national government for the construction of a Customized SimCLIM software modeling system for the Philippines.

Rangasa said that it could be applied in the work programs of several agencies in the country.

A version of SimCLIM customized for the Philippines will include the statistical downscaled Global Climate Monitoring (GCM) patterns, rather than directly bilinear interpolated GCM patterns in that characterized earlier version of the software.

Rangasa further said that SimCLIM outputs are multifaceted and applicable to a wide range of planning and sustainable development application and sustainable development applications. "It is, perhaps, first and foremost, a tool for creating possible scenarios of climate change that are then linked with various sectors, such as coastal, agriculture, water, health and the planning required to reduce the risk borne by societies and environments as a result in shifts in climate."

Albay is the only province in the country using the SimCLIM software for revising the Comprehensive Land Use Plan.

Rangasa said Albay is moving advance in terms of climate change adaptation response.

Albay is the first province in the country to institutionalize CIRCA and declared as Global Local government Unit model for Climate Change adaptation by United Nations International Strategy Disaster Reduction Report 2009 and World Bank.

The province, through CIRCA, developed climate change integration in curriculum in all learning area, hosted two separate national conferences that resulted to the Manila Declaration as a tool for the early passage of disaster management bill and creation of the Climate Change Commission. (PNA)

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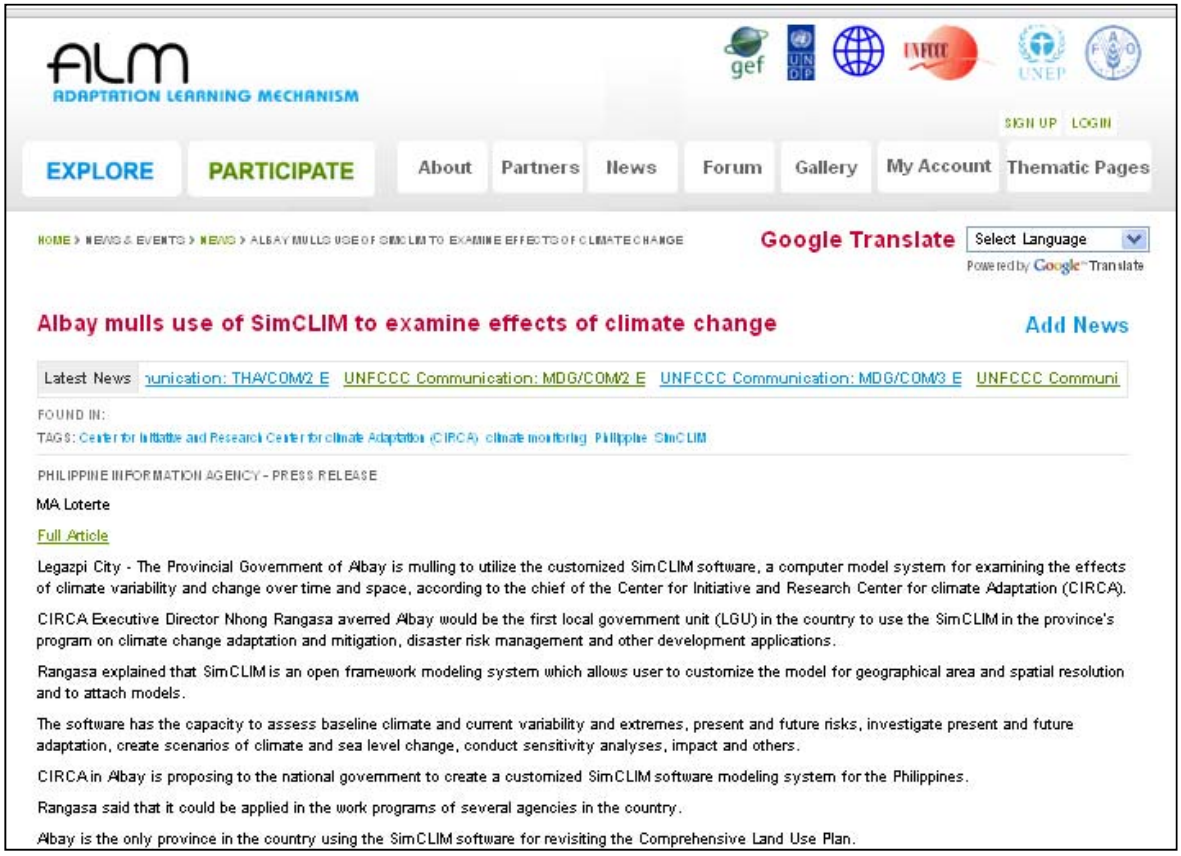

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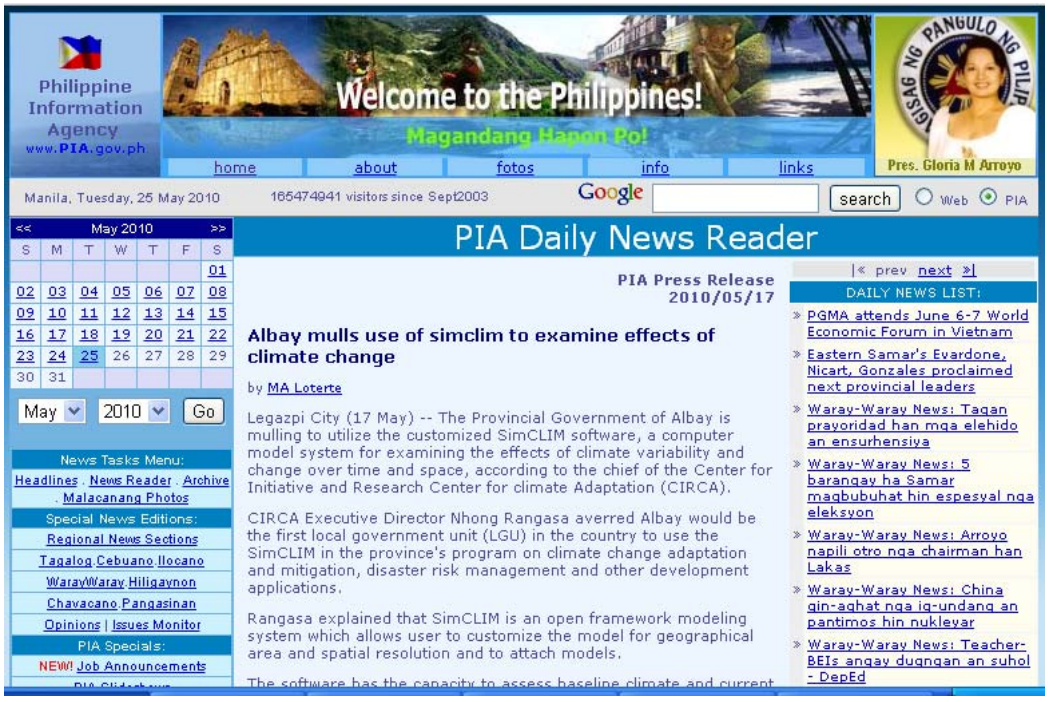


Climate Change Commission (CCC) website: http://www.climate.gov.ph/index.php/en/
Features the Consultation on Vulnerability and Risks Assessment Tools towards a Climate Change Resilient Philippines, held on 1 June 2011, Mabini Social Hall, Malacanang Compound, Manila

APPENDIX 9.

Understanding the links between detailed soil mapping and micro-climates and climate change to assist Albay and its constituients in planning

Peter Urich
CLIMsystems Ltd.

Introduction

Albay Province has been subject to intense landuse change pressures, and future climate change will make land-based resource planning and management even more challenging. Albay Province is concentrating its planning efforts to ensure resources are wisely used and that flood, landslide and other geotechnical hazards as well as food and economic security are considered. Albay Province clearly is not limited to constraining resource uses because of their adverse environmental effects, but rather wishes to enable the uptake of opportunities to use and develop a range of resources in ways that are environmentally sustainable and economically viable. Albay Province sees the need to play a key role by providing information, and advocating or allowing appropriate resource development pathways to reach such a sustainable planning and management goal.

The objective of the project is to incorporate the local climate and soil information into an integrated climate change impact assessment software system to assist with this planning effort, based on the coupling of the PlantGRO model with the ALBAYCLIM climate modeling system.

Background

A software system called 'PlantGRO Spatial' has been developed that links with ALBAYCLIM software. The former software package explores the relationships between detailed soil data, local climate conditions and plant requirements for development and productivity. A range of crop and tree files are preloaded in PlantGRO (1700 species) and are all available for further modification and customisation for Albay and Philippine conditions. The ALBAYCLIM software interacts with the PlantGRO climate files and these are then perturbed to reflect potential changes in climate and hence growing conditions. These variables can have obvious impacts on crop and tree adaptability and can provide insights as to which plants may benefit and be adaptable to Albay soil and climatic conditions with climate change.

In Albay, a government-funded (BSWM) soil and climate mapping programme has commenced to update base information in focused areas, to assist with the ongoing planning effort (Figure 1). This information has already proved invaluable for planning purposes but it needs to be integrated with the climate and crop information to gain a greater understanding of land productivity potential.

Physical and Chemical Characteristics of Annam Series

Horizon	A	B	C1	C2	R
Depth (cm)	0-17	17-45	45-79	79-102	102 below
Ph (H_2O 1:1)	4.7	5.0	5.0	5.1	5.2
Ph ($CaCl_2$ 1:2)					
Available P (ppm)	0.9	0.2	0.1	-	-
Organic Carbon (%)	1.94	1.03	0.75	0.52	0.33
Organic Matter (%)	3.34	1.77	1.29	0.89	0.57
EC (mmhos/cm)	0.3	0.3	0.3	0.3	0.3
Exch. Bases (meq./100g)					
Ca	2.3	2.0	2.1	1.8	1.9
Mg	2.9	1.7	2.0	1.7	1.6
Na	0.2	0.4	0.4	0.5	0.5
K	0.4	0.2	0.2	0.1	0.1
Sum	5.8	4.3	4.7	4.1	4.1
Exch. Acid	17.2	16.1	16.3	15.3	15.3
CEC Sum	23.0	20.4	20.8	19.4	19.4
Base Satn.% (Sum)	25	21	23	21	21
CEC 4NNAc	12.1	10.3	10.3	10.4	10.4
Particle Size Distribution (%)					
Sand	21.6	11.6	11.6	11.6	11.6
Silt	28.8	22.8	20.8	18.2	16.8
Clay	49.6	65.6	67.6	69.6	71.6
Texture	Clay	Clay	Clay	Clay	Clay
WHC	74.5	67.2	76.4	73.3	68.3

Figure 1: Sample of soil survey data supplied by BSWM.

The tasks involved in this project include re-developing ALBAYCLIM to handle Arcview shapefiles. Previously, all the information incorporated into ALBAYCLIM needed to be reformated into unified grids for calculation. While standard soil data format is in polygon format, which in the case of Albay is in Arcview shape format, ALBAYCLIM is then required to be upgraded so that soil data can be used by the PlantGRO Spatial programme as a standard GIS layer. In addition,

local climate files, both baseline data and future change projections need to be modified to a format for inclusion in both PlantGRO Spatial and ALBAYCLIM software. Plant files can also be modifed to reflect local conditions. Finally, optimisation of the PlantGRO Spatial program can be undertaken when required during the project in order for it to map outputs more quickly and efficiently.

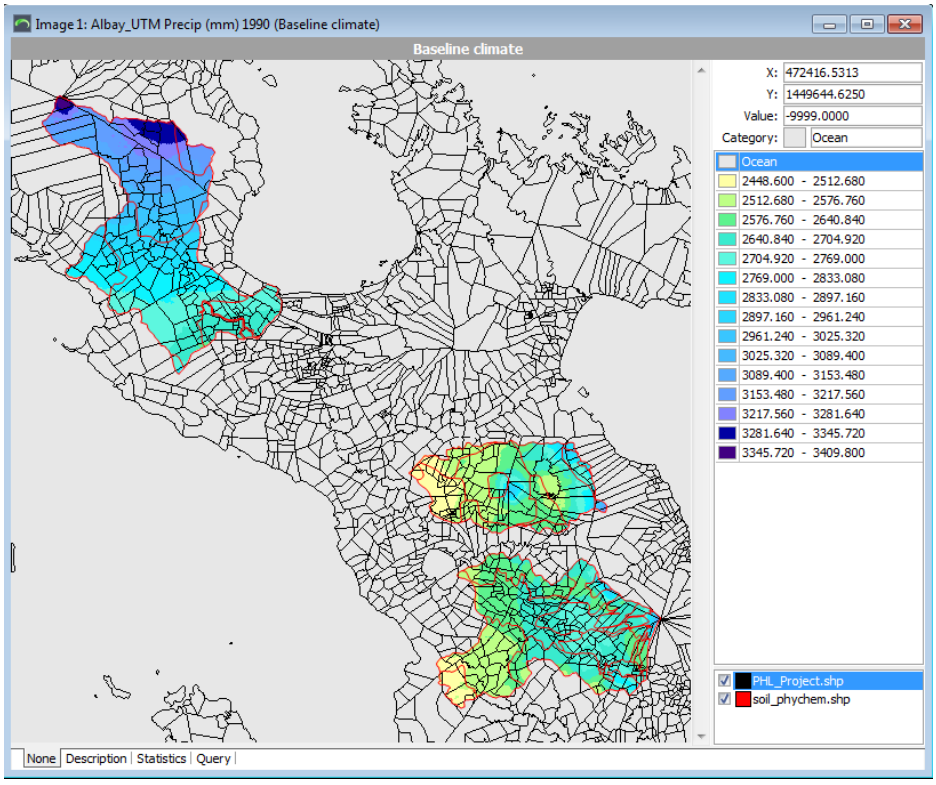
A training workshop will be carried out for various stakeholders in Albay to efficiently use the system and to add local climate and plant files.

Data and Models

Climate

Twenty-one statistically downscaled Global Circulation Model (GCM) outputs from IPCC CMIP3 were used to construct the future climate change scenarios. ALBAYCLIM also includes six greenhouse gas (GHG) Emission scenarios that were published by IPCC. One site for station data were used for site-specific climate change assessments. All climate data were reformated to ALBAYCLIM system format.

Figures 2 and 3 demonstrate the current and future climate conditions for the Albay and the wider Bicol region. The future projection was the median value of the 21 GCM ensemble result, based on the IPCC A1FI emission scenario with medium climate sensitivity. Under this climate change projection, the area will have a slightly increased precipitation (about 2 to 4, Figure 2) but a significantly warmer temperature (about 2ºC area-wide, Figure 3).



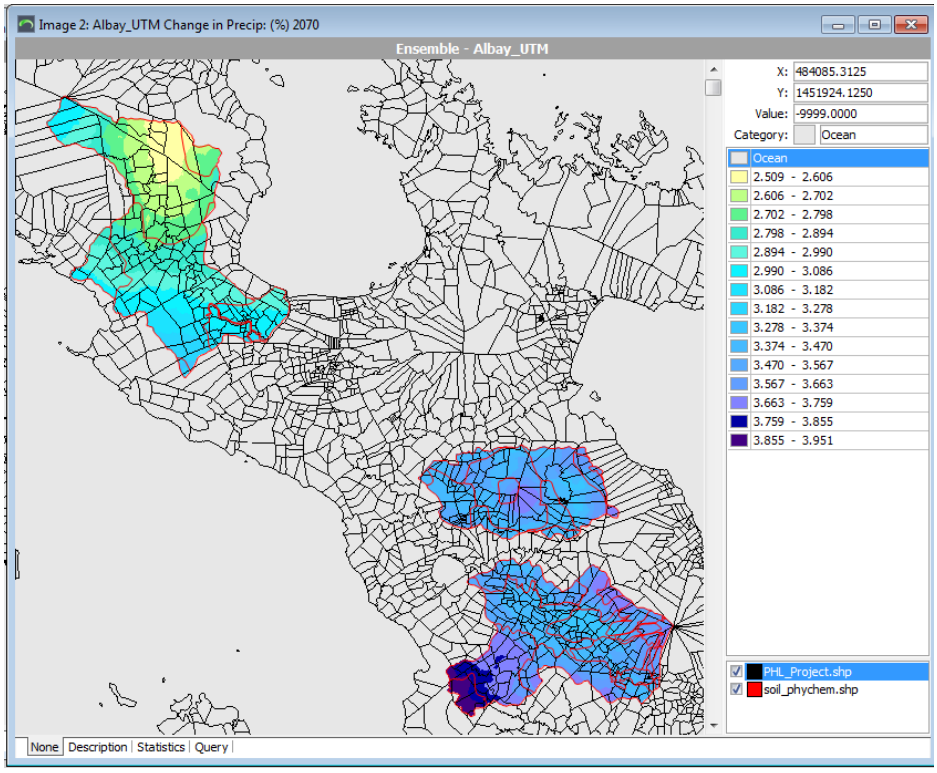


Figure 2: The annual precipitation for Albay and the region varies from around 2500 mm to 3400 mm and will only increase by approximately 2.0 percent on an annual basis by the yyear 2070 through the application of an ensemble of 21 GCM patterns with an A1FI SRES and medium climate sensitvity.

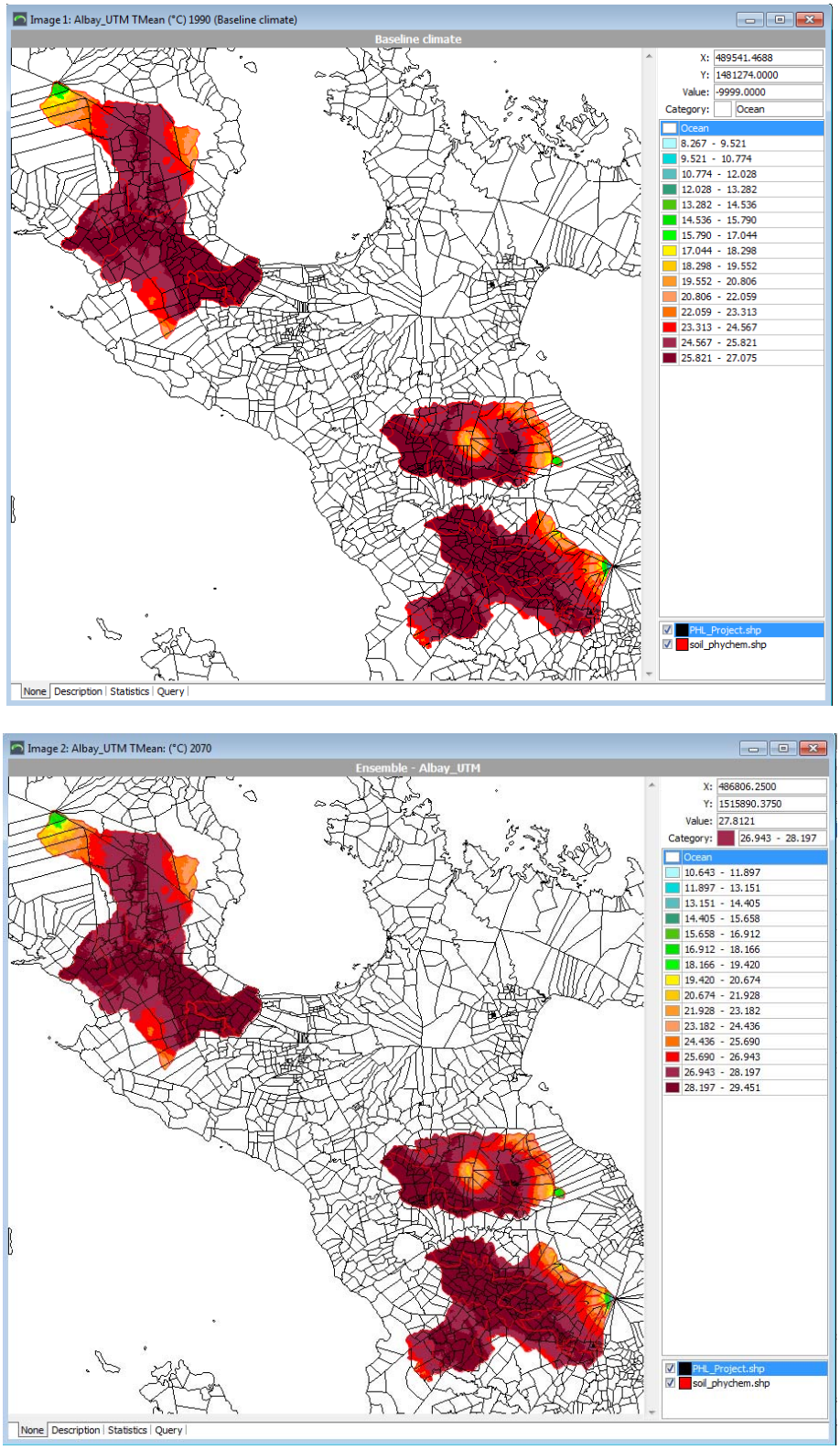


Figure 3: Baseline and 2070 annual mean temperature (ºC) of Albay Province and the region.

Soil

The soil data were collected by the Bureau of Soil and Water Management for the area of three watersheds in Albay. A total of 21 soil series were identified with soil attributes that related to the PlantGRO model (Figure 4).

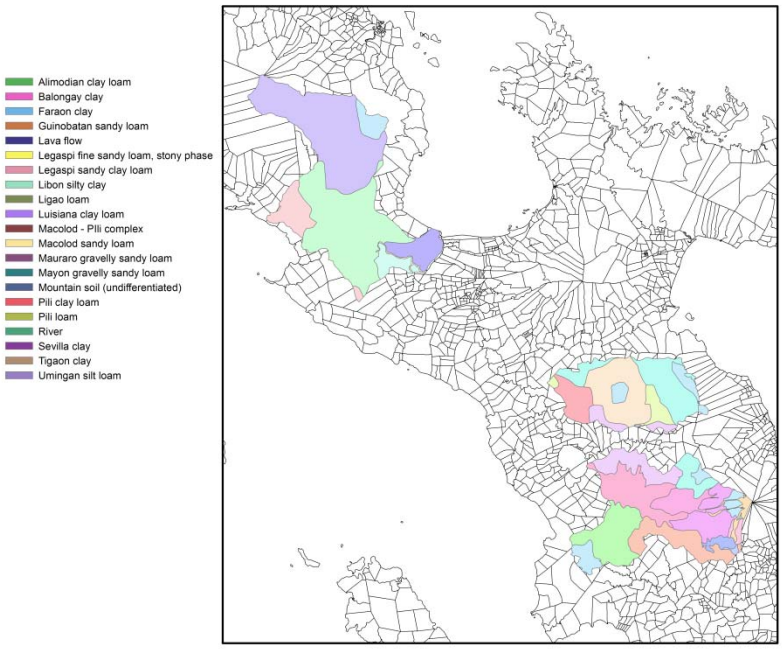


Figure 4: Soil type map of digitised areas in Albay and vicinity.

Plant

The PlantGRO model includes over 1700 crop and tree species plant files that can be used and further modified for Albay applications.

PlantGRO model

PlantGRO is a software program for exploring plant, soil and climate relationships. This program can assist farmers, foresters, agronomists, consultants, horticulturalists, aid agencies, teachers and students to meet the challenge of matching plants to soils and climates. PlantGRO is a versatile tool to assess the suitability of various climates and soils for different plants. The program is preloaded with over 1700 plant files (including annuals, perennials and tree species), over 40 soil files and greater than 180 site-specific climate files. A total of 23 parameters can be used in soil suitability analysis ranging from pH and cation exchange capacity to salinity and slope. The program is characterized with a user-friendly interface and the flexibility at which the

sample files can be edited and completely new files can be developed based on user-defined local data.

Another powerful feature of PlantGRO is its batch mode facility. Multiple plant, soil and climate files can be selected and checked from those available to assess one parameter in reference to the others quickly and efficiently. For example, multiple plant types can be run against soil and climate files to rapidly identify the best-adapted plants to a particular location. Output from this analysis is generated in MicroSoft© Excel spreadsheet format for excellent management and manipulation potential.

ALBAYCLIM

ALBAYCLIM is an integrated modeling system for assessing climate change impacts and adaptation. It is a computer model system for examining the effects of climate variability and change over time and space. It is designed to support decision-making and climate proofing in a wide range of situations where climate and climate change pose risk and uncertainty. A user customized ALBAYCLIM Open Framework System software package has the capacity to assess baseline climates and current variability and extremes. Risks can be assessed both currently and in the future. Adaptation measures can be tested for present day conditions and under future scenarios of climate change and variability. With the program, users can conduct sensitivity analysis and examine sectoral impacts of climate change. It supports integrated impact analysis at various scales.

The integration of ALBAYCLIM with PlantGRO allows a unique and also powerful analysis of the impact of climate change on plant suitability with soils. Climate change can thereby be factored into decision-making with regard to potential changes to cropping systems and tree growth. The powerful combination of ALBAYCLIM and PlantGRO software can provide data to make better-informed decisions for future sustainability and profitability.

Output

This section shows one example of using ALBAYCLIM/PlantGRO for macademia nut growing assessment.

In the PlantGRO main interface, select the macademia nut from the ‘Available Plants’ list, and input ‘13.00’ as the approximate latitude for Albay (Figure 5).

Figure 4: Spatial PlantGRO main interface.

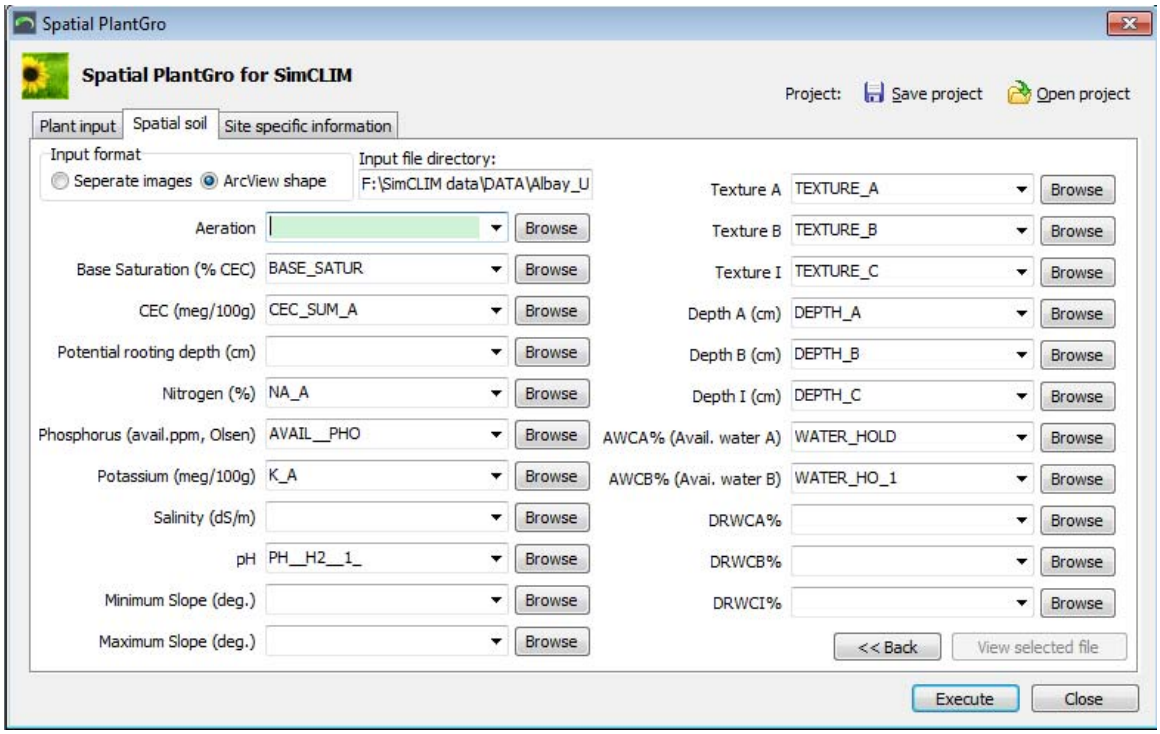


Figure 5: Spatial soil information input interface.

In the ‘Spatial soil info’ interfacce, select ‘arcview shape’ for soil data, then for each soil attribute select its corresponding field from the drop-down list. Blank input is used as default for attributes that do not have data, or users that choose not to input a value. In PlantGRO calculations, attributes that do not have a value will be treated as having no limitation on plant growth. The above settings can be saved as a PlantGRO project for future convenience by clicking ‘Save project’ on the top-left corner of the main window, and can be retrieved by clicking ‘Open project’ in future model run.

By clicking ‘Execute’ to start the PlantGRO model, the following windows contain all the required input information for generating future climate change scenarios. As default, the year 1990 is set as the baseline or current climate conditions (Figure 6). Other important options for climate change scenario generation are: GCM

patterns, global projection of mean temperature based on different greenhouse gas (GHG) emission scenarios, and climate sensitivity.

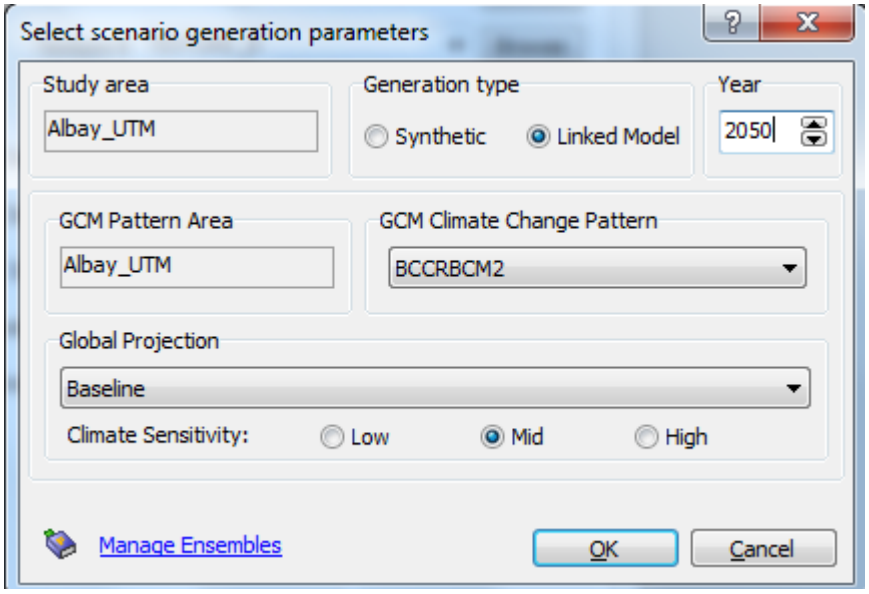


Figure 6: Climate change input interface.

For perenial crops, the PlantGRO generated for result images:

- the greatest limitation factor, which is the factor that has limited the crop grow the most during its growing period
- the growing suitability from dead (rated as 0) to most suitable (rated as 9). **Note:** PlantGRO calculates the greatest limitation factor even for areas where is it is not suitable
- the length of growing season
- the yield (if yield data is available and for annual crops only, not fruit trees and other perennials)

Figures 7 to 10 show the PlantGRO simulating result of macademia nut growth for current current conditions. In the case of macademia nuts there is no climate impact on suitability or greatest limiting factors are not altererd by the modest changes in monthly climate conditions. As indicated in Figure 8, currently the greatest limiting factor for macademia nut growing varies by soil type with solar radiation being limiting; however, most of the area still has a moderate suitablity (Figure 7). The suitability neither declines nor improves with climate change.

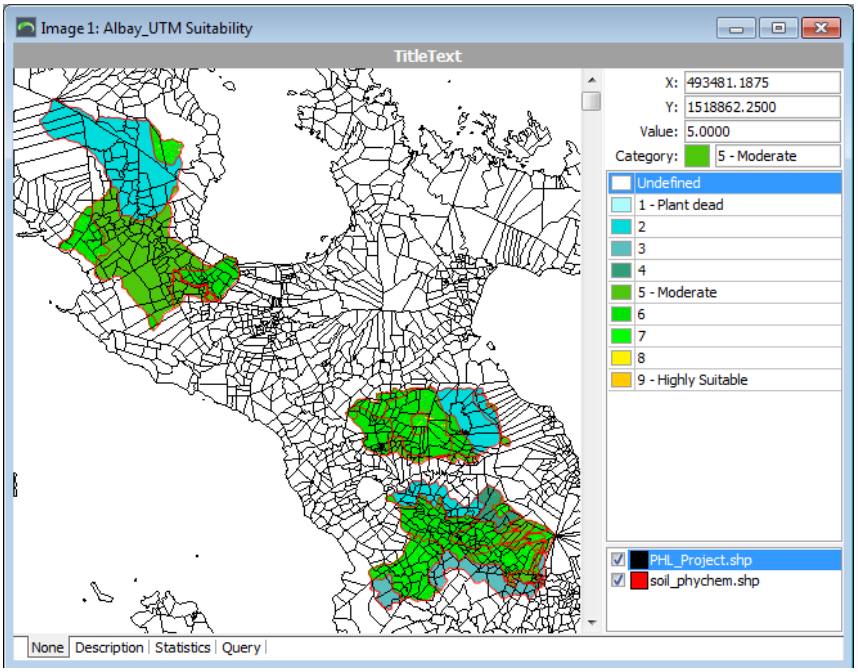


Figure 7: Macademia nut growing suitability over Albay and the wider region.

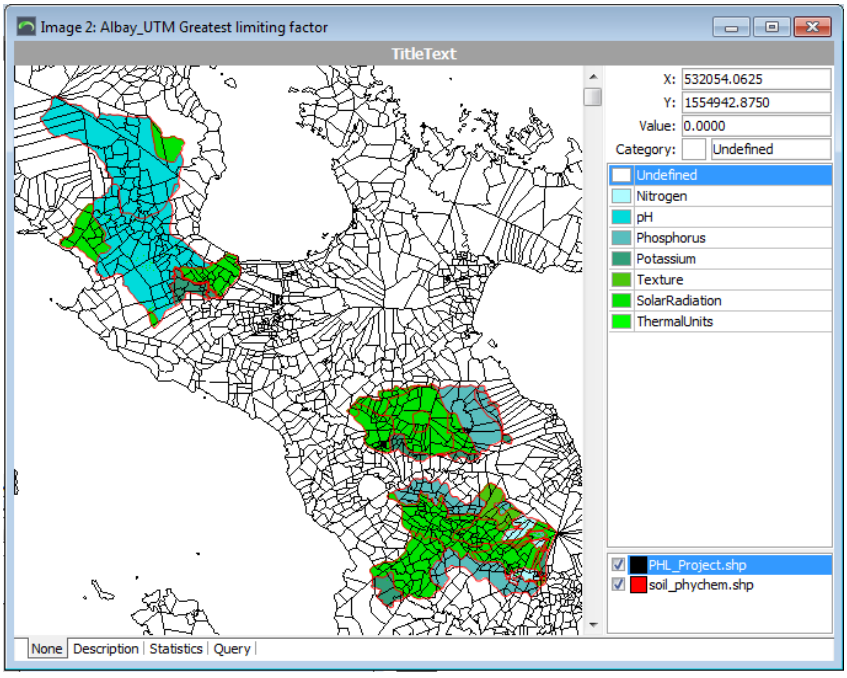


Figure 8: The greatest limitation factor for macademia nut growing in Albay and the wider region.

It is clear that rainfall and temperature changes in these largely marine-driven climates of the Bicol Peninsula will be moderate in relation to global changes. The value of ALBAYCLIM when linked with PlanGRO is realised through the process of

agro-prospecting and attempting to use the linkages between soil, climate and plant pysiology to search for alternative crops that could enhance the agro-biodiversity of the region in a climate and soil attuned manner. PlantGRO can in these cases be used as a first cut desktop tool for exploring opportunities for diversification.

An example of Goji berry is provided below. Goji berry, also known as wolfberry (Lycerium Chinense or Babarum) is recognised as an important food supplement. Goji berry has been recognized as improving the immune system, eyesight, circulation and balancing blood sugar levels. The eye health issues are widely known and publicized among those in the eye care industry (optometrists). This is owing to goji berries containing a substance called, Zeaxanthin. Zeaxanthin is primarily responsible for promoting eye health and scientific research and clinical studies have shown that those people who consumed Zeazanthin have less macular degeneration in their eyes as they age.

In the case of the Albay and the wider Bicol region there appear to be some areas more favourable to goji production than others. Using PlantGRO spatial one can see the greatest limiting factors and suitability ratings for goji growth in Albay with and without climate change (Figures 9 through 12).

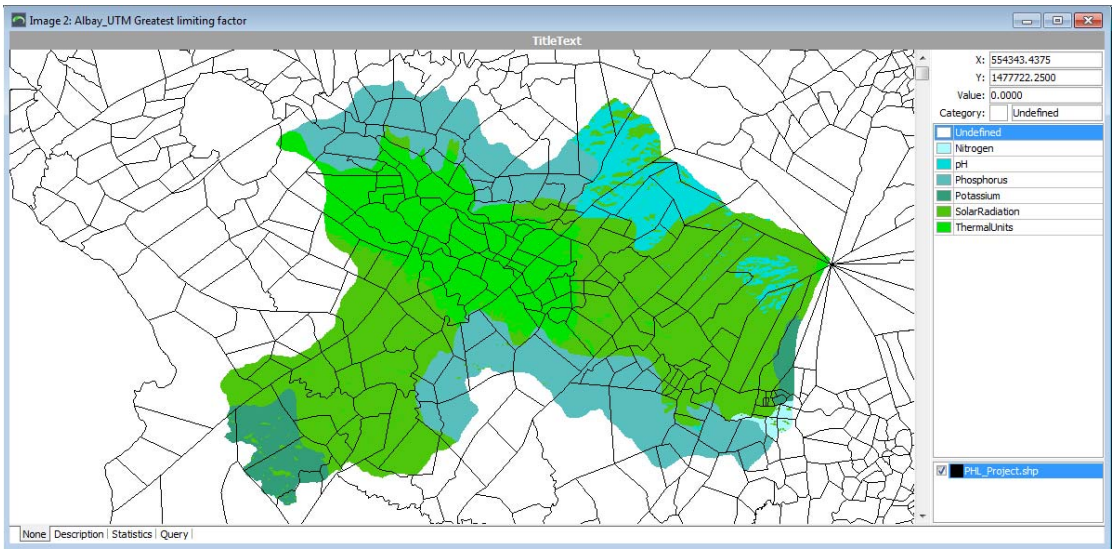


Figure 9: Greatest limiting factors for Goji plant in the Albay area of the Bicol region. The greatest limiting factors vary.

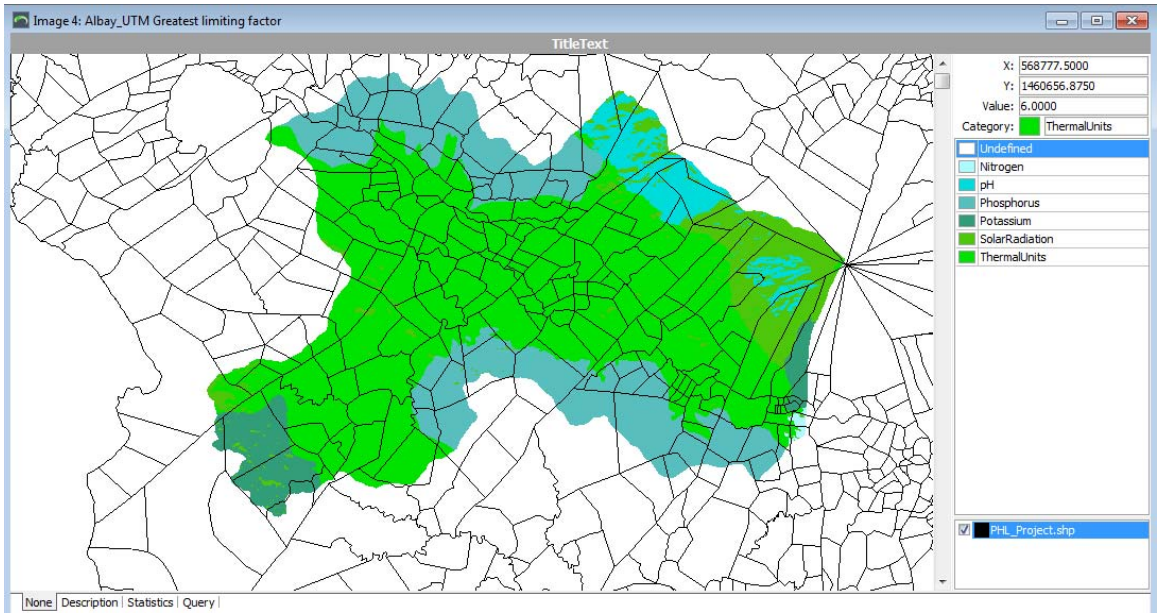


Figure 10: The greatest limiting factors change slightly under an A1FI climate change scenario with medium sensitivity applying a 21 GCM ensemble.

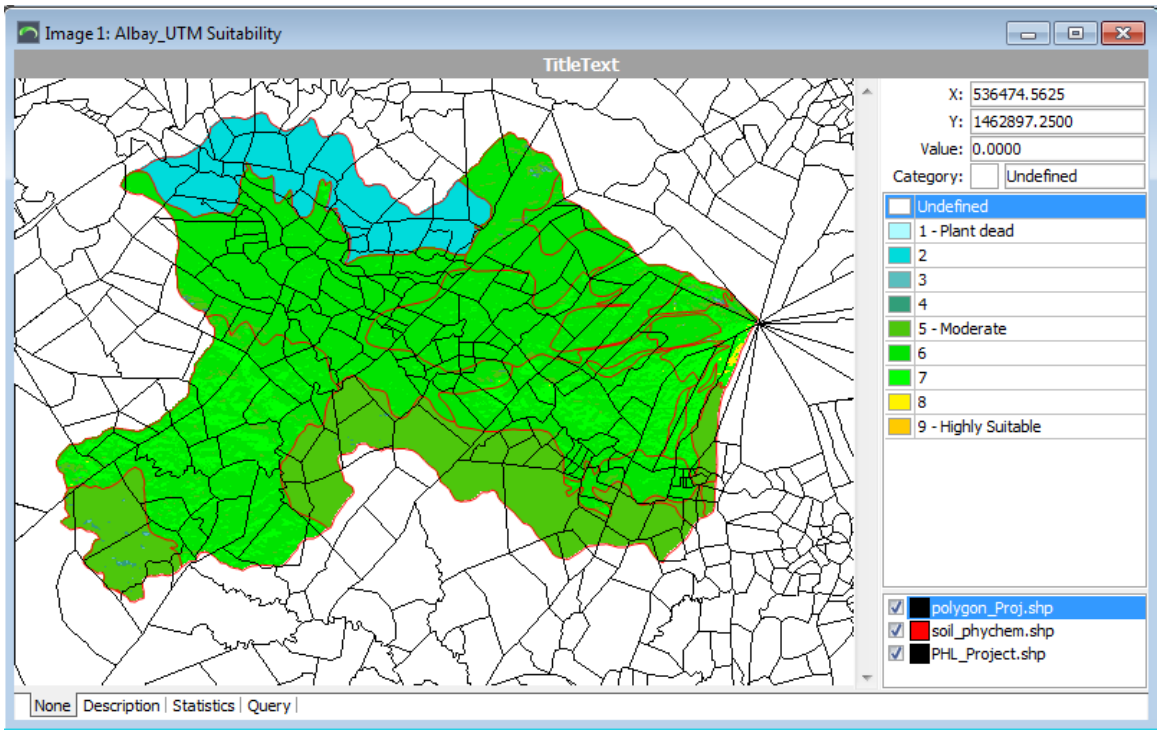


Figure 11: In spite of the limiting factors the plant is moderately suited to many area of this part of Albay.

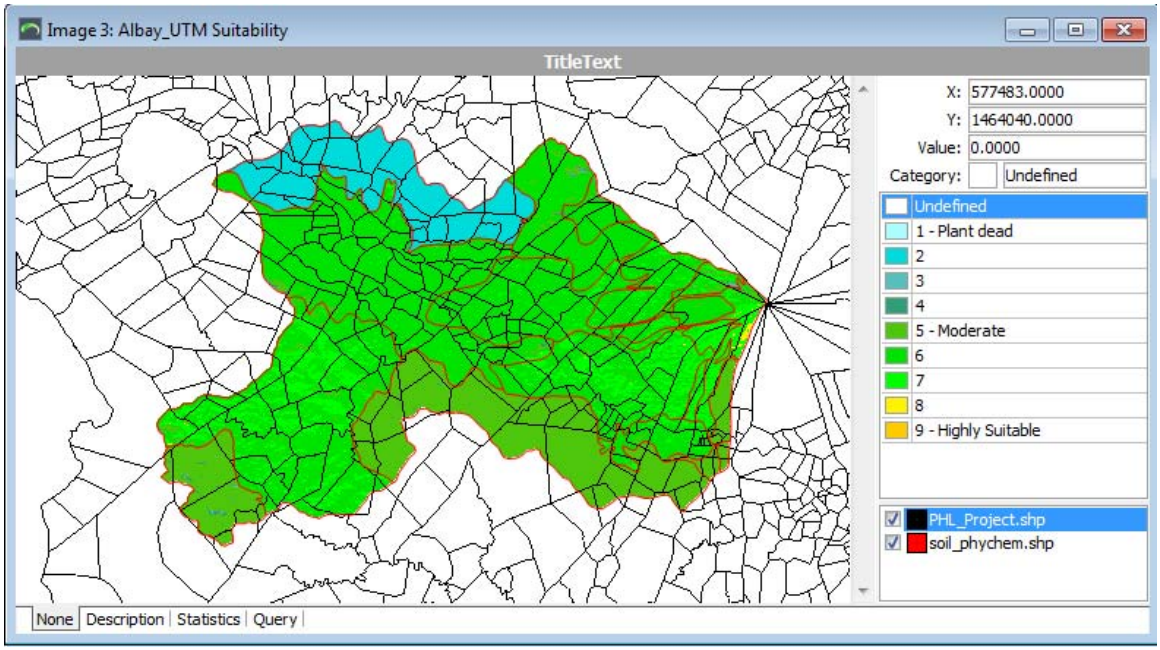


Figure 12: With climate change the goji plant remains moderately suited to many areas of this potion of Albay. An A1FI, medium sensitivity and 21 GCM ensemble were applied in 2070.

Detailed location-specific analysis can be carried out after the simulation is complete. Changing the ‘tab’ to the ‘site specific information’ in the model main interface and clicking on any of the resulting maps (or inputting the coordinate in the interface), will give a location specific simulaton result in the tables. As shown in Figure 13, for location of (541335.4, 1455441.4.0), the largest soil limitation factor is potassium (5) and pH (5). As this is a perennial crop the other limiting factors such a growing season and yield are not displayed but could be with an annual crop if queried.

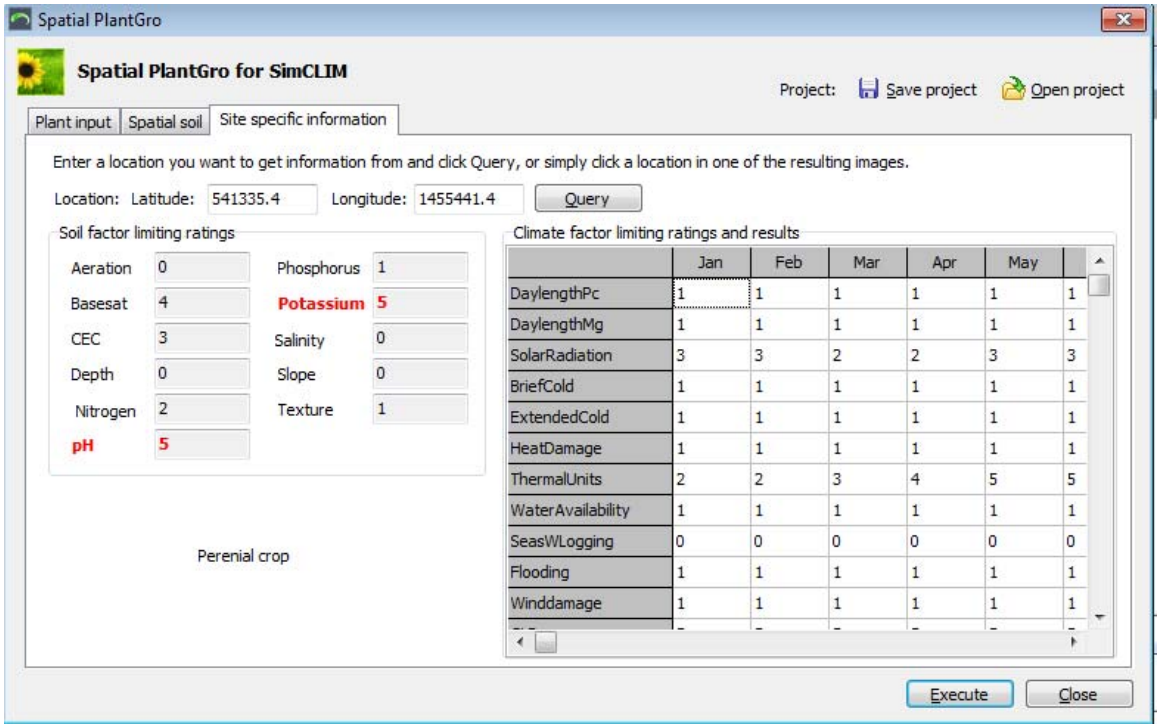


Figure 13: Site specific information.

Conclusions

This report demonstrates the application of coupling ALBAYCLIM and the PlantGRO system for crop growing assessment for Albay under both current and future climate change conditions. The system has good potential to serve Albay and the wide Philippines in its land use planning and management with scientifically-based information. There is particular relevence for doing rapid assessments of potential new crops and for testing these crops against soil and climate parameters both currently and with climate change. This type of analysis is however only meant to be indicative and once a range of potential crops and trees is indentified for potential application trials are still to be considered as well as local knowledge to avail of greater understanding of the socio-economi, cultural and biophysical limitations that might preclude adoption. It is also important to remember that PlantGRO can be used as a tool for further analysis of management options. For example, if phosphrous or pH are found to be limiting factors but all other factors are conducive to crop and/or tree growth, management options such as fertilization can be considered and factored into the model (through the alteration of soil files) and then the program can be rerun with consideration of changes in soil management.

However, there are limitations as the PlantGRO model can only simulate a crop-growing condition based on a notional relationship that is stored in plant files. Hence, the accuracy of the result is heavily dependent on the expertise of the development of the plant files. Furthermore, the PlantGRO model only has the ability to look into the impact of the average climate change on crops. ALBAYCLIM has the capability to simulate future climate extreme event changes, but further development is required to link them to crop modeling, which is also an important factor that needs to be taken into consideration in land use planning and management.

APPENDIX 10.

PROJECT POSTER

Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessment

Juan M. Pulhin, Rex Victor O. Cruz, Maricel A. Tapia, Rose Jane J. Peras, and Chandyllane G. Cantre

Project Summary

This project aims to build the capacity of local government officials, researchers, and the provincial government of Albay, in the Philippines, as a whole, in assessing the impacts of and their vulnerability to climate change with the use of computer modeling system and complemented by the local knowledge of the people. It serves as a pilot site in the Philippines for the assessment of climate impacts and vulnerability on water resources, agricultural sector and coastal zones using the SimCLIM modelling system. SimCLIM is a software package for examining the effects of climate variability and change over time and space and is designed to support decision-making and climate proofing.

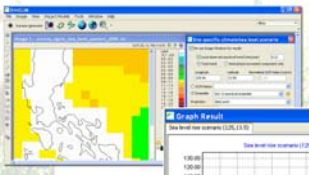
Activities

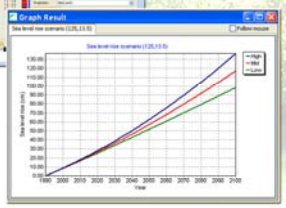
Training in the concepts of climate change and use of SimCLIM

Assessment of impacts and adaptation to climate change and sea level rise of upland (Oas) and coastal (Bacacay) communities, respectively, through household survey, participatory rural appraisal techniques, among others

Preliminary Results

Sea-level rise scenario in Albay for 2100:





The upland communities were highly exposed to typhoons and El Niño, while the coastal communities were affected by floods and storm surges during typhoons.

The impacts of the above climate hazards to the upland communities were decline in agricultural production or total crop failure, less water yield and poor water quality, landslides, damages to properties and malnutrition.

The impacts of floods and storm surges to coastal communities were damages to properties and some agricultural areas, increased occurrences of illnesses, and salt-water intrusion.

Adaptation strategies were mostly spontaneous and meant to bear the losses from the impacts.

Given the future scenarios of climate and sea level rise, long-term adaptation planning is in order.

Climate scenarios in Albay for 2100

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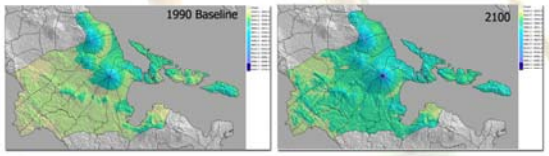

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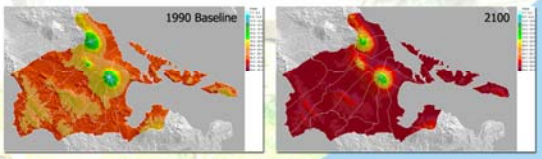

Science-Policy-Practice Linkage

Results of the project would be used as inputs to the revision of the Comprehensive Land Use Plan of Albay, as well as contribute to the recently launched Climate Change Academy of the province. A nationwide use of SimCLIM provides the oppportunity for more robust impacts and vulnerability assessment to aid mainstreaming climate change adaptation into policies.

Collaborators:

APN CAPaBLE · CIRCA · CLIMsystems

For more informatin, please contact:

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