UNIVERSITY OF THE PHILIPPINES
UPLBFI LOS BAÑOS FOUNDATION, INC.

June 30, 2018

DR. NICOMEDES P. ELEAZAR, CESO IV
Director
Bureau of Agricultural Research
Diliman, Quezon City

Dir. Eleazar,

Good day!

We are pleased to submit the copy of the final report for the project entitled "***Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR and MIMAROPA***". This is a product of one-year assessment of climate resiliency in Agriculture of Benguet and Mindoro.

We are also submitting herewith the soft copies of the report, the Final Audited Financial Report and Monitoring and Evaluation Form saved in a compact drive (CD).

We deeply appreciate all the help you have given to our institution during the course of the project and we hope to work with you again in future undertakings. Thank you very much!

Sincerely yours,

Dr. Casiano S. Abrigo, Jr.
Executive Director

UPLBFI Bldg., A. Aglibut Avenue
College, Laguna, Philippines 4031
UPLBFI
www.uplbfoundation.org
T/F No.: (63-49) 536-3688/6265
Email: uplbfoundation@yahoo.com

June 30, 2018

DR. CASIANO S. ABRIGO, JR.
Executive Director
UPLB Foundation Inc.
University of the Philippines
Los Baños, Laguna

Dear Dr. Abrigo:

Greetings! I am pleased to submit the final technical report for the research project funded by DA-BAR entitled: ***"Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR and MIMAROPA"*** as a product of one-year assessment on climate resiliency in the province of Mindoro and Benguet.

This report

Thank you very much and more power.

Sincerely,

Elizabeth Supangco
Project Leader

EXECUTIVE SUMMARY

The Adaptation and Mitigation Initiative in Agriculture (AMIA) is the Department of Agriculture's (DA) chief integrated effort to contribute to the national government's agenda of addressing climate change threats in the country's agriculture sector. Under the leadership of the DA System-wide Climate Change Office (SWCCO), this project entitled "Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR and MIMAROPA" was implemented to support the AMIA 2 in assessment, targeting and prioritization of climate resilient agri-fisheries technologies and practices in CAR and MIMAROPA.

The project specifically aimed to: strengthen capacities for CRA methodologies of key research and development organizations in the region; assess climate risks in the region's agri-fisheries sector through geospatial and climate modelling tools; determine local stakeholders' perceptions, knowledge and strategies for adapting to climate risks; document and analyze local CRA practices to support AMIA 2 knowledge-sharing and investment planning; and support the DA-RFOs in the establishment of AMIA baseline for outcome monitoring and evaluation (M&E) of CRA communities and livelihood. This year-long undertaking has resulted in two (2) major outputs for both provinces of Benguet and Mindoro: 1) Climate-Resilient Agri-fisheries (CRA) - an assessment of traditional and CRA cropping practices used by the farmers through Cost-Benefit Analysis; and 2) Climate Risk Vulnerability Assessment (CRVA) - sensitivity and vulnerability assessment of crops (e.g. rice, corn, banana, coffee, etc.) of the region as well as adaptive capacity of the provinces' agricultural sector in the effects of climate change in the Philippines.

DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Research
RDMIC Bldg., Elliptical Rd. Cor. Visayas Ave., Diliman, Q.C. 1104
Phone Nos.: (632) 928-8624 & 928-8505 • Fax: (632) 927-5691
Email: barrdegrants@bar.gov.ph • Website: http//www.bar.gov.ph

FINAL COMPLETION REPORT

A. BASIC INFORMATION

1. Project Title:
   Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting and Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR and MIMAROPA

2. Proponent (s):

Name:	Elizabeth Supangco
Designation:	Assistant Professor
Organization:	Department of Agricultural Economics, College of Economics and Management, University of the Philippines Los Baños
Address:	Los Baños, Laguna
Phone and email:	betheus@yahoo.com

3. Implementing Agency
   3.1. Lead Agency: University of the Philippines Los Baños Foundation Inc. (UPLBFI)
   Head of Agency: Dr. Casiano S. Abrigo, Jr.
   Name of Proponent(s): Elizabeth Supangco
   Contact Details: betheus@yahoo.com
   3.2. Collaborating Agency: UPLB; DA-CAR Region; LGU – Agriculture Office; Benguet State University (BSU); DA – MIMAROPA Region
4. Project Duration
   4.1 Approved Duration (Y/M): 2017 April – 2018 April
   4.2 Actual Duration (Y/M): 2017 July – 2018 July
   4.3 Start Date of Implementation: 2017 July
5. Project Site(s)
   5.1 Province: Benguet in CAR and Oriental Mindoro in MIMAROPA
   5.2 City/Municipality: CAR: Atok and Buguias; MIMAROPA: Naujan and Bulalacao
   5.3 Barangay: **Atok**: Buytao, Abiang, Sapuan, Cattubo, Paoay; **Buguias**: Lengaoan, Bayoyo, Natubleng, Sinipsip; **Naujan**: Dao, Sta. Isabel, Laguna: **Bulalacao**: Maujao, Cambunan, Nasukob
   5.4 Geocode
6. Project Funding
   6.1. Total Approved Budget: 2,003,619.84
   6.2. Total Amount Released: 1,803,257.85
   6.3. Agency Counterpart
   6.4. Actual Expenses:
   6.5. Unliquidated Balance:

7. RDE Agenda Addressed: Development of Unified Vulnerability Suitability Assessment (VSA) for all areas; Development of crop modelling tools for predictive use especially for high value crops.

8. Expected Technology or Information:

a. Vulnerability to climate risk maps at municipal level in CAR and MIMAROIPA
b. New methodology for assessing climate impacts to crops
c. Decision- support platform

9. Description of Technology/Information:

a. Key climate risk identified for CAR and MIMAROPA agriculture sector and vulnerability of target farming systems assessed
b. Contribute to the national online searchable CRA portal (CRA) in MIMAROPA and CAR- pool of CRA technologies and practices, drawn from general compendium, available through Web-based hub

10. Target Beneficiaries/Users: Agriculture and fishing communities in project areas, DA

11. Tags/Keywords: Climate-resilient; agri-fisheries; adaptation; mitigation; local knowledge and practices.

B. TECHNICAL DESCRIPTION

1. Rationale

1.1. Problem Statement

The Adaptation and Mitigation Initiative in Agriculture (AMIA) seeks to enable the Department of Agriculture (DA) to plan and implement strategies to support local communities in managing climate risks – from extreme weather events to long-term climatic shifts. Spearheaded by the DA system-wide Climate Change Office (DA SCCO), AMIA Phase 1 in 2015-16 implemented activities to strengthen DA's capacity to mainstream climate change adaptation and mitigation strategies in its core functions of R&D, extension, and regulation. It is also designing complementary activities for building appropriate climate responsive DA support services.

With AMIA Phase 2 in 2015-16, the next big challenge is making climate-resilient agri-fisheries (CRA) an operational strategy through field-level action that directly involves, and impacts on the livelihoods of, farming communities. AMIA2 aims to invest in the launching of CRA communities -- as the initial target sites for action learning, supported by an integrated package of climate services and institutions, within a broader food system/value chain setting. The program is launching an integrated and multi-stakeholder effort to operationalize CRA at the community level in 9 target regions.

The AMIA2 program framework consists of 8 key clusters of inter-related activities, whose cumulative and combined results are envisioned to help AMIA achieve its goal for 2016 and beyond. For each cluster, a set of projects and activities would be designed towards operationalizing the AMIA framework.

Cluster 1: Enabling environment
Cluster 2: Vulnerability assessment and risk targeting
Cluster 3: Developing knowledge pool of CRA options
Cluster 4: CRA community participatory action research initial phase
Cluster 5: Enhancing services and institutions
Cluster 6: Integrating CRA in food systems and value chains
Cluster 7: Implementing CRA on scale
Cluster 8: Knowledge Management for result

The AMIA2 framework provides overall guidance in the planning and design of research and development interventions in 16 target regions.

1. Region I Ilocos
2. Region II Cagayan Valley
3. Region III Central Luzon
4. Region IVA Southern Luzon
5. Region IVB Southern Luzon
6. Region V Bicol
7. Region VI Western Visayas
8. Region VII Central Visayas
9. Region VIII Eastern Visayas

10. Region IX Zamboanga Peninsula
11. Region X Northern Mindanao
12. Region XI Southern Mindanao
13. Region XII SOCCSKSARGEN
14. Region XIII CARAGA
15. ARMM
16. CAR
17. Region XVIII Negros Island

Successful implementation of AMIA2 at the regional level requires the strong collaboration and support of key research and development institutions within the region. This proposed project enables AMIA2 to establish and mobilize regional teams, each led by a local State University/College (SUC), and in partnership with the corresponding Department of Agriculture - Regional Field Office (DA-RFOs).

1.2. PESTLE or SWOT

Strengths: DA's nation-wide network of regional AMIA focal points, AMIA1 outputs serve as initial approximation of climate-risk vulnerability. DA-SWCCO also benefits from the increasing participation by state universities and colleges that brings more academic and research skills on climate change research.

Weaknesses: AMIA1 outputs primarily focus on risk exposure (hazard), data sources and analytical methods need further validation and higher-level resolution. Despite the efforts on data collection last AMIA2, the project still faces limited availability of data, especially on crop occurrences and adaptive capacity.

Several documented CRA practices still need to be fully assessed ex-ante for relative costs/benefits, nor prioritized for relevance to location-specific climate risks and value chain for all regions in the country. Moreover, existing CRA assessments are focused on productivity and the production system.

Opportunities: Climate-change adaptation a priority agenda of the broader agri-fisheries sector in the country.

There is also increased awareness of and demand for relevant CRA practices by stakeholders – from local communities to national policy makers.

Threats: Impacts of climate change are urgent, critical challenges requiring immediate response and action. Good relationship between SUCs and DA-RFOs should be in place to make sure that project outputs are used.

2. Narrative Summary

2.1. Potential Impact or Goal

CRVA results are critical to AMIA's next-stage planning and design of a multi-regional project for action research and development to build CRA communities. The resulting information would support AMIA strategic decisions in targeting key climate risks for which specific communities in priority commodities/systems/landscapes in each region. It also guides AMIA in establishing the framework for results-based monitoring and evaluation of AMIA achievements, i.e. community-level outcomes and responsive policies and institutions.

Climate-resilient, productive livelihoods in agri-fisheries communities through cost - effective investment planning for CRA interventions in CAR and MIMAROPA.

2.2. Outcome or General Objective/Purpose:

The overall objective was to assess, target and prioritize climate-resilient agri-fisheries (CRA) technologies and practices in the CAR and MIMAROPA Regions in support of AMIA2+. The specific objectives of the project are as follows:

1. To strengthen capacities for CRA methodologies of key research and development organizations in the region;
2. To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools;
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks;
4. To document and analyze local CRA practices to support AMIA2 knowledge-sharing and investment planning;
5. To provide support to DA-RFO in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood.

2.3. Expected Output

The following is the list of expected outputs from the project:

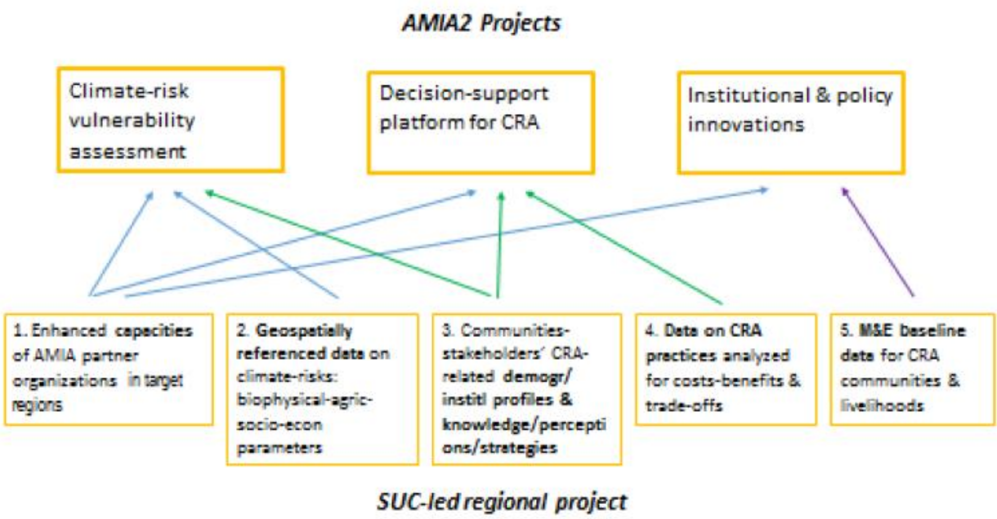
1. Capacitated local team/institution for methodologies in CRVA decision-support platform
2. Geospatially-based analysis of climate vulnerability
3. Participatory vulnerability assessment for climate risks
4. A comprehensive documentation and assessment on the sharing of local CRA practices
5. Recommendations for establishing AMIA baseline for outcome monitoring and evaluation (M&E) of CRA communities and livelihoods

2.4. Scope and Limitations/Constraints

The project was able to contribute to the overall AMIA2 program framework, by contributing specific outputs to targeted national-level research projects. It has five key components:

1. Capacity strengthening for CRA research & development
2. Geospatial assessment of climate risks
3. Stakeholders' participation in climate adaptation planning
4. Documenting & analyzing CRA practices
5. AMIA baseline study for monitoring & evaluation

These project components were designed to be directly aligned with the research agenda of three AMIA2 projects: 1) climate-risk vulnerability assessment (CRVA), 2) decision-support platform for CRA, and 3) institutional and policy innovations.



3. Review of Related Literature

3.1. Body Text

According to the Philippine Statistics Authority (2016), the Cordillera Administrative Region or CAR is composed of six provinces and two cities namely Abra, Apayao, Benguet, Kalinga, Ifugao, Mt. Province, and Baguio City. It is bounded by Ilocos Norte and Cagayan in the North, Pangasinan and Nueva Ecija in the south, Cagayan Valley in the east, and the Ilocos Region in the west. Located at the northern part of Luzon, CAR boasts an astounding mountainous topography and rugged terrain which significantly contribute to the low climate temperature in the region. Having said that, this region experiences Type II & III climate condition.

Due to its vast agricultural plains across the region, CAR is also known for its agriculture produce. It has an agricultural land area of 177,839 hectares which is largely shared by crop lands. Among its major crops are palay, corn, and cabbage. In 2013, the region is named as the top cabbage producer in the country.

CAR, however, also faces the threats of climate change. According to UNDP (2012), CAR is regarded as one of the areas in the country that are most vulnerable to climate change. These natural disasters, in turn, have been continuously affecting the agriculture sector of the region. Recurring intense calamities often result to frequent erosions, landslides, and even crop susceptibility to diseases which pose a huge impact on the crop production in CAR. Benguet, in particular, experiences problems on vulnerability to landslides, soil nutrient depletion, and crop failure due to extreme temperatures (Fernandez, 2015).

In this light, Fernandez (2015) cited that several efforts were established to address this growing problem. One of the projects, spear headed by the DA and FAO is titled, "Enhanced Climate Change Adoptation Capacity of Communities on Contiguous Fragile Ecosystems in the Cordilleras." It aims to capacitate the local stakeholders more through teaching of good practices in Benguet and Ifugao that improve local coping mechanisms to climate impacts such as floods, droughts, diseases, and others.

On the other hand, the MIMAROPA region, also regarded as Region IV B, lies along the Southern Tagalog region in Luzon. It is comprised of five island provinces namely; Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon, and Palawan. It has mountainous terrain with irregular coastlines and wide agricultural plains (DA-RFU,n.d.).

Hailed as the Treasure trove of Southern Luzon, MIMAROPA is potentially a food haven in the country (DTI,2016). MIMAROPA has a total land area of 2,962,087 hectares with 542,218 hectares of it designated for agriculture. Although palay and corn are its primary produce, the region is known for its rich calamansi and seaweed production. Other yields include coffee, mango, coconut, banana, root crops, and rambutan among others (PSA,2016).

Characterized by types I & II climate condition, the region experiences nearly wet season throughout the year (PSA,2016). Having the Philippines as one of the most vulnerable countries in the world, MIMAROPA is not spared when it comes to extreme natural events. With this, the region initiated efforts in addressing climate change. One of the initiatives made in the region aimed to enhance the capacities of the local communities in preparing them for the adverse effects of climate change alongside with the conservation of the region's natural resources (PIA MIMAROPA,2016).

3.2. References

Adger, W., Kelly, M., Ninh, N. (2001). Environment, Society, and Precipitous Change. Living with Environmental Change. Vol.1, pp.3-19

Braun, J., Wheeler, T. (2013). Climate Change Impacts on Global Food Security. Science Vol. 341, pp.508-513

CIAT-CCAFS (2015). Guidelines for Climate-Risk Vulnerability Assessment. Cali, Colombia.

Challinor A., et al. (2014). Climate Variability and Vulnerability to Climate Change: A Review. Global Change Biology. Vol. 20, pp. 3313-3328

GIZ (2014) The vulnerability sourcebook. Concept and guidelines for standardised vulnerability assessments. GIZ.

Nelson, G. C., Rosegrant, M. W., Koo, J., Robertson, R., Sulser, T., Zhu, T., Ringler, C., et al. (2010). The Costs of Agricultural Adaptation to Climate Change. Washington D.C.

Reddy, P. (2015). Climate Resilient Agriculture for Ensuring Food Security. Springer India.

Reynolds, M., Ortiz, R. (2010). Adapting Crops to Climate Change: A Summary. Climate Change & Crop Production. Vol. 1, pp.1-9

4. Methodology per Objective

4.1. Approved Objectives

The overall objective is to assess, target and prioritize climate-resilient agri-fisheries (CRA) technologies and practices in the CAR and MIMAROPA Regions in support of AMIA2+. The specific objectives of the project are as follows:

1. To strengthen capacities for CRA methodologies of key research and development organizations in the region;
2. To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools;
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks;
4. To document and analyze local CRA practices to support AMIA2 knowledge-sharing and investment planning;
5. To provide support to DA-RFO in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood.

4.2. Methodology

This research project employed various methods under each key activity conducted for every objective.

Objective 1: To strengthen capacities for CRA methodologies of key research and development organizations in the region.
Methodology:
1. Participation in a series of trainings, workshops and learning events organized by AMIA 2++ project that focused on: CRVA, CRA prioritization and M&E.
2. Provision of training support to key research and development stakeholders in the region through intra-regional training that covered key learning contents from the national level trainings.

Objective 2: To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools.
Methodology:
1. Collection and organization of georeferenced data on vulnerability to climate risks of the region's agri-fisheries sector covering climate risk exposure, sensitivity and adaptive capacity.
2. Regional-level preliminary analysis through Geographic Information System (GIS) and climate modelling.
3. Participation in national-team level joint analysis of cross-regional data.

Objective 3: To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks.
Methodology:
1. Organized a series of stakeholders' meetings and focus group discussion (FGD) for supplementary data collection, CRVA preliminary result validation and planning and prioritization of CRA.

Objective 4: To document and analyze local CRA practices to support AMIA2 knowledge-sharing and investment planning.
Methodology:
1. Conduct of semi-structured survey with local stakeholders for the identification and documentation of CRA practices as well as other relevant secondary data.
2. Analysis using Cost-Benefit and Trade-Off tools as input for prioritization and investment planning.

Objective 5: To provide support to DA-RFO in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood.

Methodology:
1. Coordination with DA-Regional project team in support for the RFOs
2. Conduct of a structured survey for baseline data on the target CRA communities and livelihoods identified by AMIA 2+

Table 1. Activities conducted per objective

Objectives		Activities conducted
1	Strengthen capacities for CRA methodologies of key research and development organizations in the region	• Workshop on: o Capacity strengthening on CRVA o Capacity strengthening on CRA prioritization o Capacity strengthening on CRA knowledge hub o Capacity strengthening on CRA M&E
2	Assessment climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools	• Data collection: o Secondary data collection for exposure-sensitivity o Secondary-primary data collection for adaptive capacity o Preliminary data analysis cross-regional/national data analysis workshop
3	Determination of local stakeholders' perceptions, knowledge & strategies for adapting to climate risks	• Validation: o Regional and community-level CRVA stakeholder's validation o Regional and community-level CRA stakeholder's validation
4	Documentation and analysis of local CRA practices to	• Survey and Analyses: o Key Informant Interview (KII)

	support AMIA2 knowledge-sharing and investment planning	on CRA practices o Cost-Benefit Analysis (CBA) and Trade Off Analysis o Knowledge sharing event on CRA o Planning workshop for AMIA2
5	Support the DA RFOs in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood	• Coordination with the DA RFOs o Re-echoing of results to RFOs of MIMAROPA and CAR.

<u>Objective 1. Strengthen capacities for CRA methodologies of key research and development organizations in the region</u>

The project team was able to participate on all of the trainings given by International Center for Tropical Agriculture (CIAT) on the first quarter of the project. These were done to equip the team on the interventions to be done for the project. Also, potential sites were identified in this stage.

<u>Objective 2. Assessment climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools</u>

The project team conducted secondary data gathering on both provinces of Benguet and Occidental Mindoro to acquire data on exposure-sensitivity and adaptive capacity. This was done with the help of RFOs and the LGU of Atok and Buguias for Benguet and Naujan and Bulalacao for Occidental Mindoro.

Utilization and analysis of data were done using GIS and climate modelling tools that were taught and given by CIAT through a series of workshops and meetings with the GIS specialists of the project.

<u>Objective 3. Determination of local stakeholders' perceptions, knowledge & strategies for adapting to climate risks</u>

This was done through workshops and seminars to the stakeholders of Atok, Buguias, Naujan and Bulalacao as study sites. For CRVA, validation was done through mapping of crop location and occurrence of climate risks on the area. On the other hand, CRA validation was done though focused group discussions and site visits to the actual plantation of CRA practices in the area.

This was collaborated with the RFO and the LGU of the study sites and was spearheaded by the project leader as well as all of the specialist of the project.

<u>Objective 4. Documentation and analysis of local CRA practices to support AMIA2 knowledge-sharing and investment planning</u>

Key Informant Interview was done with the Provincial Agriculturist, Regional Field Officer, Local Government Units of the study area and among others for additional knowledge on the CRA practices. Furthermore, all of the questionnaires from the 240 respondents of the study sites were encoded and analysed using tools such as Cost Benefit Analysis and Trade Off analysis.

Results were then presented on the knowledge sharing workshops that were attended by the project team which were spearheaded by CIAT. Also, comments and suggestions regarding the collected data were raised in these activities. Then, all of the results were then re-echoed back to the LGUs of the study sites. All the comments were addressed and integrated on the report.

Objective 5. To provide support to DA-RFO in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood

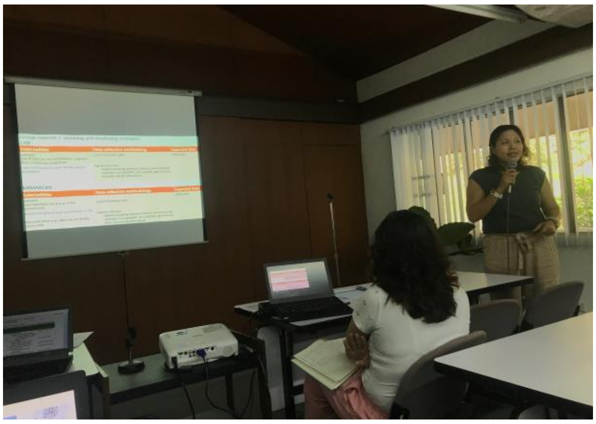
This was done through re-echoing of all the results to respective RFOs of the regions as well as provision of recommendations and other suggestions for the improvement of M&E of CRA communities and livelihood.

5. Specific Activities, Results and Discussion per Objective

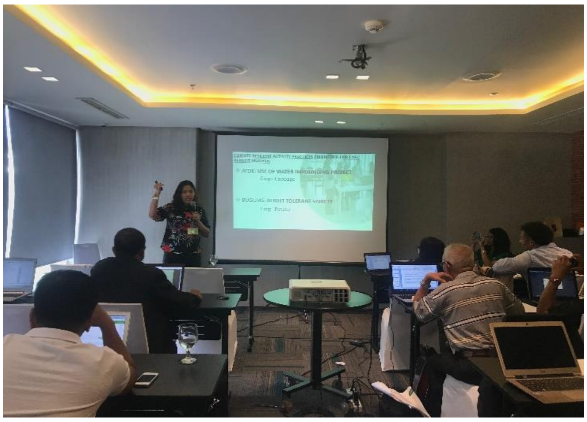
Objective 1. Strengthen capacities for CRA methodologies of key research and development organizations in the region

The project team collaborated with Benguet State University to support the implementation and research of CRA in the province of Benguet. The university warmly welcomed the project as one of their partners for its development.

Also, the project team was able to attend all the training workshop and seminars conducted and spearheaded by CIAT last July 24 – 25, 2017, August 15-16, 2017, January 17-19, 2018 and June 7-9, 2018. These workshop aimed to equipped all the SUCs on the responsibility and knowledge that they needed in pursuance of the project. Also, all of the updates and further information from the SUCs and updates on the methodologies were given on these events.

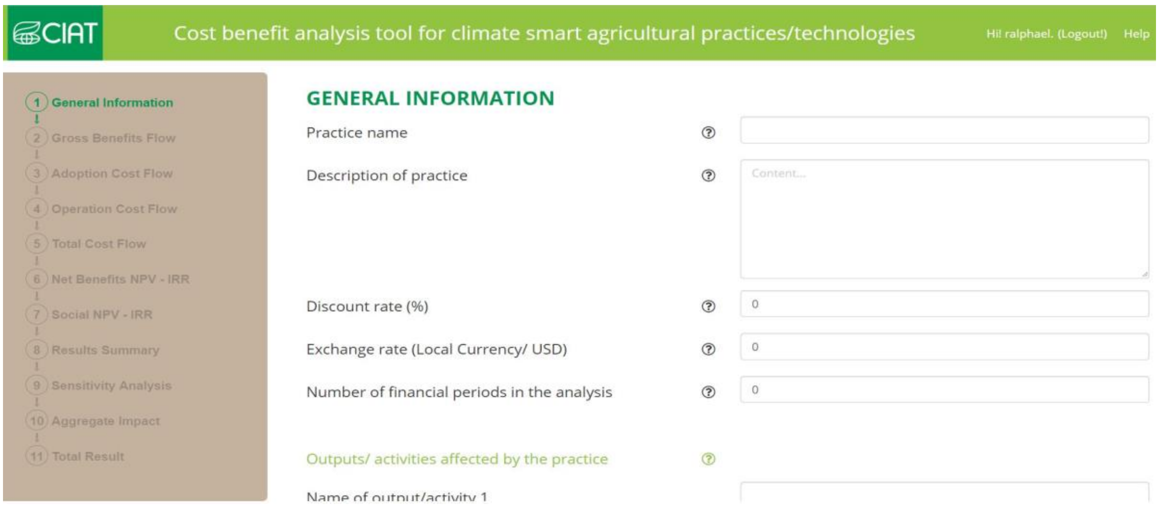


Prof. Supangco (Project leader) delivering updates of the project to SUCs and CIAT (photo taken on January 9, 2018 at UPLB)



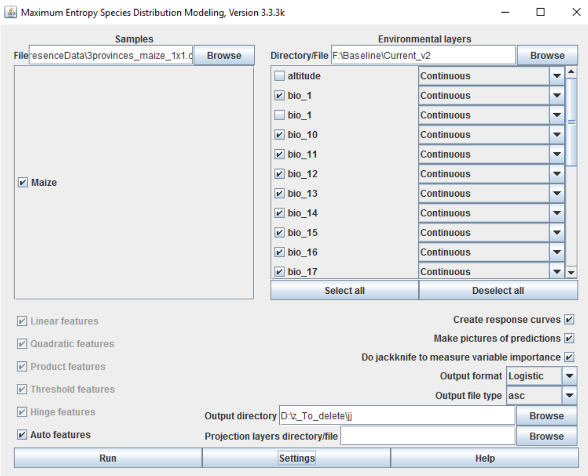
Prof. Supangco (Project leader) delivering the results of CBA to SUCs and CIAT (photo taken on June 7, 2018 at Quezon City Manila)

CIAT also introduced a program that can be accessed in their website called CIAT-CBA Tool. This tool was introduced to help the SUC encode the results of their interviews of CRA practices and come up with a comprehensive cost and benefit analysis of each site.

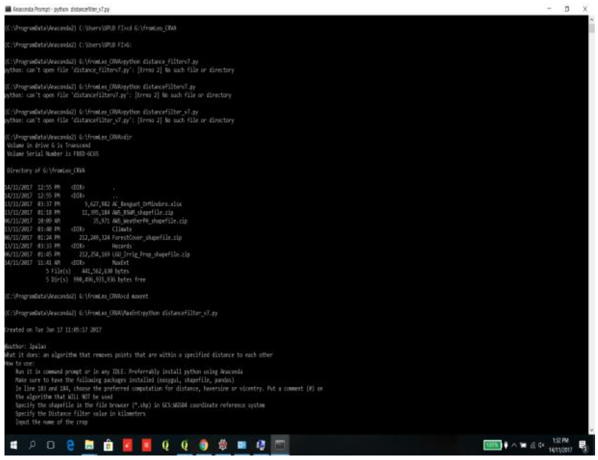


CIAT-CBA Tool for the analysis of CRA practices of the study sites (http://cbatool.ciat.cgiar.org/)

On the other hand, the project team was also able to attend workshop and trainings CRVA that were also spearheaded by CIAT on January 24-26, 2018. The SUCs were able to rely all the questions and inquiries regarding the use of GIS as a tool for assessing the vulnerability, sensitivity and adaptive capacity of the study sites. GIS Specialists from CIAT introduced various tools that were used for the assessment.



Sample of application (MaxEnt) used for sensitivity, vulnerability and adaptive capacity of the study sites.



Anaconda application used for the computation of sensitivity analysis of the study sites.

Objective 2. Assessment climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools

The project team was able to collect data and conduct validation through workshops and visits to the study sites. Provincial Agriculturists of the provinces, GIS Specialist of RFOs and LGUs of both CAR and MIMAROPA (August 14 and 31, 2017 for MIMAROPA; August 25-26, 2017 for CAR). The team also conducted workshop on crop occurrence on various distances which helped the GIS specialist of the project to identify where do crops such as rice, corn, banana, calamansi, etc. occur on the parts of the provinces.

Prof Supangco together with GIS Specialists from CIAT Philippines

Dr. Lumbres (GIS Specialist AMIA 2++) conducting crop occurrence workshop in Benguet

Objective 3. Determination of local stakeholders' perceptions, knowledge & strategies for adapting to climate risks

The team conducted validation activities through FGD on both study sites. This was done to further have information regarding the CRA practices of the municipalities. Also. CIAT helped the team to come up with a comprehensive questionnaire that was used for acquiring information on farmers that practice traditional and CRA methods in agriculture. FGD also helped GIS Specialists for the CRVA to locate and quantify crops that are present in the area.

Included in the questionnaire are various data that helped the specialists assess the CRA practice of the farmers such as type of crops, number of cropping season, CRA practices done and among others. All of this are vital for the conduct of CBA of the crops.

Prof Tolentino (Socio-Economist) and Ms. Fame Ramal (Agriculturist) AMIA2++ conducting FGD on farmers in Mindoro

Crop occurrence workshop and FGD being conducted in Benguet.

Objective 4. Documentation and analysis of local CRA practices to support AMIA2 knowledge-sharing and investment planning

The project team conducted KII on major stakeholders for the agriculture sector in Mindoro and Benguet. These include the Provincial Agriculturist, RFOs, MAO of the municipalities and among others.

After which, the project team then processed the data with the use of tools such as Statistical Package for the Social Sciences (SPSS), Microsoft Excel and among others. The processed data then transferred to the platform made by CIAT for further analysis.

The processed data were analysed and were presented and re-echoed on each of the municipalities (May 23, 2018 for Benguet and June 13, 2018 for Mindoro) to inform them on the results and gain their comments and suggestions as well as opinions to further validate the data.

Objective 5. To provide support to DA-RFO in the establishment of AMIA baseline for the outcome monitoring and evaluation (M&E) of CRA communities and livelihood.

The project team were able to provide support to DA RFOs of both provinces by relying all the results of CRA and CRVA of the areas. The team were able to give recommendations to respective RFOs for the establishment of AMIA baseline for the M&E of CRA communities and livelihood.

Also, RFOs were able to give their comments on the results for the improvement of final report of CRAs and CRVAs of the municipalities.

Re-echoing workshop for CRA and CRVA in MIMAROPA

Re-echoing meeting with RFO of MIMAROPA

C. Summary of Findings

On the first quarter of the project, the team was able to attend and incorporate learnings from CIAT that was used for the methodology of the project. For CRA, the project team was able to acquire knowledge on CIAT CBA Tool that was used for the analysis of the responses from the farmers that practice CRA and traditional agriculture. For the CRVA, the team was able to mobilize the gathered data from the municipalities and came up with vulnerability, sensitivity and adaptive capacity of the crops to climate change hazards.

The team was able to gather data from the municipalities of Naujan and Bulalacao for the province of Mindoro and Atok and Buguias for the province of Benguet. For the CRA Assessment, the team was able to assess four (4) CRA and traditional practices as well as crops of the municipalities to climate change. From the results of FGD and KII, the team was able to encode as well as analyse the data.

The results were then presented on every workshops and trainings conducted by CIAT. This was done to give an update to other SUCs as well as gather comments from them as well as CIAT for further improvement of the results. Then, on the last quarter of the project, the team was able to re-echo the results to the municipalities concerned. All the comments and validation were incorporated on the final report of CRA and CRVA.

PROJECT MANAGEMENT

Updated Workplan Schedule

Starting Date: ***April 3, 2017***		**Completion Date:** ***April 2, 2018***		**Duration:** ***12 months***					
Activity No.	**Major/Sub-Activity**	**Anticipated Results**	**Lead Responsible Person(s)**	**Resources Required**	Schedule of activities				
					Year 1				
					Q1 April to July	Q2 August to October	Q3 November to January	Q4 February to April	EX
	Component 1								
1.	Participate in CRVA trainings conducted by CIAT and other implementing agency	6 project staff participated the CRVA training	ESupangco; GIS Specialists; Socio-Economist; Agrifisheries Specialists	Fund Info Materials					
2.	Participate in the training on CRA prioritization	6 project staff from UPLB participated the training Identified 1 site for CRVA	ESupangco; GIS Specialists; Socio-Economist; Agrifisheries Specialists	Fund Info Materials					
3.	Participate the training on CRA knowledge hub development	6 project staff from UPLB participated the training on knowledge hub development Developed at least 1 IEC material on	ESupangco; GIS Specialists; Socio-Economist; Agrifisheries Specialists	Fund Info Materials					

		CRA knowledge of the community							
4.	Participate in the training on CRA M&E	6 project staff from UPLB participated the training on knowledge hub development	ESupangco; GIS Specialists; Socio-Economist; Agrifisheries Specialists	Fund Info Materials					
	Component 2								
5.	Collect secondary data for exposure-sensitivity	Conducted 1 FGD with 15 participants Collected and consolidated the biophysical and socio-economic data on CRA communities Formulated CRVA guidelines (c/o CIAT)	GIS Specialist	Fund CRA/CRVA guidelines Questionnaire Snacks/meals Documentation supplies Maps					
6.	Collect secondary-primary data for adaptive capacity	Conducted 1 FGD with 15 participants Conducted KI surveys to 30 participants in pilot area	GIS Specialist	Fund CRA/CRVA guidelines Questionnaires					

		Collected and consolidated socio-economic data on CRA communities Developed CRVA guidelines		Snacks/meals Documentation supplies					
7.	Preliminary data analysis	Number of processed data using approved standards Number of GIS-generated maps using approved standards	ESupangco; GIS Specialist; RA	Computers Disks Supplies					
8.	Participate cross-regional/national data analysis workshop	6 project staff from UPLB participated in the workshop on cross-regional/national data analysis	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist	Fund Info materials					
	Component 3								
9.	Regional-level CRVA stakeholders' validation	Conducted 1 regional level FGD/validation meeting attended by 15 participants	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist; RA	Fund Questionnaires Snacks/meals					

				Documentation supplies					
10.	Community-level CRVA stakeholders' validation	Conducted 1 community level FGD/validation meeting attended by 15 participants	To be named	Fund Questionnaires Snacks/meals Documentation supplies					
11.	Regional level CRA stakeholders' validation	Conducted 1 regional level FGD/validation meeting attended by 30 participants	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist; RA	Fund Questionnaires Snacks/meals Documentation supplies					
12.	Community-level stakeholders' validation	Conducted KI surveys to 30 participants in pilot area Conducted 1 community level FGD/validation meeting attended by 30 participants	To be named	Fund Questionnaires Snacks/meals Documentation supplies					

	Component 4								
13.	Key informant survey on CRA practices	Conducted KI surveys with 30 respondents Identified at least 2 CRAs commonly practiced by the farmers	To be named	Fund Questionnaires Snacks/meals Documentation supplies					
14.	Cost-benefit and trade off analyses	Conducted CBA & trade-off analyses in 2 CRA practices	To be named	Computer Disk Supplies					
15.	National knowledge-sharing event on CRVA and CRA	6 project staff attended the national knowledge-sharing event on CRVA and CRA	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist	Fund Info materials					
16.	Attend training on CRA workshop	6 project staff attended the workshop	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist	Fund Info materials					
17.	Participate Planning	6 project staff attended the	ESupangco; GIS	Fund					

	workshop for AMIA 2+	workshop	Specialist; Socio-Economist; Agrifisheries specialist	Info materials					
	Component 5								
18.	Survey on target CRA communities & livelihoods on M&E indicators	Conducted KI surveys to 30 respondents per pilot site	To be named	Fund Questionnaires Snacks/meals Documentation supplies					
19.	Cross-regional/national data analysis workshop	6 project staff attended the workshop	ESupangco; GIS Specialist; Socio-Economist; Agrifisheries specialist	Fund Info materials					
*									

Monitoring and Evaluation

MONITORING AND EVALUATION FORM

Project Title:	Regional CRA assessment, targeting & prioritization for AMIA in CAR and MIMAROPA	Period covered:	April 3, 2017 – June 30, 2018
Proponent:	UPLBFI	Agency:	UPLB

Potential Impact:						
Narrative Summary	Objectively Verifiable Indicators	Actual Accomplishments	%	Influencing Factors and/or Problems Encountered	Action Taken	Significant Findings and/or Remarks
Outcome: Assessment, targeting and prioritization of Climate resilient agrifisheries' technologiesand practices in CAR and MIMAROPA regions in support of AMIA 2						
Potential Output 1 Enhanced capacities of AMIA partner organizations in the region	At least 2 personnel each from CAR and MIMAROPA regions can generate CRVAs database and maps.	-Hired staff and specialist (see list of personnel -Training program/inception meeting	100%	- Delayed CIAT Training (1st Training: July 24 – 25, 2017)	- Moved and rescheduled activities based on the delay of training	Present the project brief: BSU and MIMAROPA

Potential Output 2	Documented at least 2 mechanisms (knowledge/perception/strategies) of the local stakeholders in CAR and MIMAROPA regions on CRA	-Conduct of courtesy visit and scheduling of mapping workshop with DA-RFO and Provincial agriculturist -Prepared the draft questionnaire - Coordination with Municipal and Provincial Officers for the data gathering schedules -Finalizing the 2 Climate Resilient Activities per provinces	100%	- Weather condition - Tight schedule of the DA RFOs	- Rescheduling of the mapping workshop	
Geospatially referenced data on climate-risks	One geospatially referenced data base which include biophysical, agricultural and socioeconomic parameters of CAR and MIMAROPA Regions CRA is generated at the end of the project duration					

Potential Output 3 Profile on community's CRA strategies is generated	Demographic/institutional profile of a CRA in CAR and MIMAROPA regions were produced by the end of project duration.	- Gathered baseline data from the farmers that uses traditional and CRA agriculture.	100%			
Potential Output 4 Data on CRA practices	100% of the documented CRA practices were analyzed for cost-benefits and trade-offs	- Scheduling of FGD workshop and interviews with the concern municipalities in CAR and MIMAROPA. - CRA results were analyzed and reflected to CIAT CBA tool.	100%	- There were delays on CIAT trainings as well as additional requirements that cannot be comprehensively accomplished in the given remaining time and resources	- Moved and rescheduled activities based on the delay of training	- Re-echoed activities and results to key stakeholders of both provinces (Occidental Mindoro and Benguet)
Potential Output 5 Baseline indicators for M&E of CRA communities and livelihood formulated	Baseline indicators for M&E of CRA communities is in placed by April 2018.	- Results of CRA and CRVA of both MIMAROPA and CAR were discussed with the RFOs for M&E of CRA communities and livelihood formulated.	100%	-	-	-

Management	Financial	Other
• Delayed trainings due to delayed release of funds. • Changes in methodologies from CIAT that caused delays on CRA and CRVA data • Additional requirements were given by CIAT (externalities) which cannot be accomplished due to time and resources constraint.	• No problems nor issues were encountered on financial aspect of the project.	

Submitted by:

ELIZABETH SUPANGCO
Project Leader

Audited Financial Statement

UPLBFI
UNIVERSITY OF THE PHILIPPINES
LOS BAÑOS FOUNDATION, INC.

AUDITED FINANCIAL REPORT
As of April 11, 2018

Project Title:	**Climate-resilient agri-fisheries (CRA) assessment, targeting and prioitization for the adaptation and mitigation initiative in agriculture (AMIA) in CAR and MIMAROPA (RE17-0018)**
Proponent:	University of the Philippines Los Baños Foundation, Inc.
Lead Agency:	Department of Agriculture-Bureau of Agricultural Research (DA-BAR)
Check No./Amt.	ADA (Php1,803,257.85)
Date	3/29/2017; 6/30/2017 & 9/29/2017
Project Duration:	April 1, 2017-June 30, 2018

Expense Code	Approved Budget Realignment	Amount Released	Cumulative Expenditures	Balance to Date
		1,803,257.85		
I. Personnel Services (PS)				
A. Salaries and Wages	247,241.92		223,584.04	23,657.88
B. Honoraria	105,600.00		88,000.00	17,600.00
Sub-total	**352,841.92**		**311,584.04**	**41,257.88**
II. Maintenance and Other Operating				
Expenses (MOOE)				
A. Traveling Expenses	386,613.30		420,144.24	(33,530.94)
B. Communications	18,465.18		18,465.18	-
C. Supplies and Materials	39,944.75		36,427.75	3,517.00
D. Professional Services	750,000.00		562,500.00	187,500.00
E. Others	243,789.25		132,645.29	111,143.96
Advances to Project			52,370.02	(52,370.02)
Sub-total	**1,438,812.48**		**1,222,552.48**	**216,260.00**
III. Equipment Outlay (EO)	33,000.00		33,000.00	-
IV. Administrative Cost	178,965.44		162,023.44	16,942.00
Total	**P 2,003,619.84**	**1,803,257.85**	**P 1,729,159.96**	**P 274,459.88**
Fund Balance			**P 74,097.89**	

Prepared by:

Perlita L. Maligalig
Project Accountant

Certified correct:

Marilou C. Atanante
Internal Auditor
CPA License No. 0067794
PTR No. 041924

Noted by:

Casiano S. Abrigo, Jr.
Executive Director

Elizabeth Supangco
Project Leader

Evaluation Sheet

Bureau of Agricultural Research
DEPARTMENT OF AGRICULTURE
REPUBLIC OF THE PHILIPPINES
e-mail: rd@bar.gov.ph website: www.bar.gov.ph

File Date:	December 15, 2017
Last Reviewed:	November 17, 2017
Last Monitored:	Not yet monitored

EVALUATION

Title: CLIM-2017-01

Climate-Resilient Agri-Fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) in CAR and MIMAROPA

Evaluators:

DR. LUIS REY VELASCO – Evaluator, UPLB
DR. EDRALINA SERRANO – Evaluator, UPLB
DR. FELINO LANSIGAN – Evaluator, UPLB
ENGR. ROBERTO VILLA – Evaluator, CELPA
MR. VICENTE DAYANGHIRANG – Evaluator, DA-ATI
MS. CYNTHIA DE GUIA – Technical Staff, PDD, DA-BAR
MS. CANDICE GUILARAN – Technical Staff, PDD, DA-BAR
MS. AMAVEL VELASCO - Technical Staff, PMED, DA-BAR
MR. DANIELLE JOSEPH SISICAN – Technical Staff, PMED, DA-BAR

Objectives / Expected Output	Comments / Suggestions
Objective/ EO 1 To strengthen capacities for CRA methodologies of key research and development organizations in the region;	• Completed attendance to capacity building of stakeholder (individuals and institutions). • The stated output/objective statement, strengthening the capacities of project staff is more of an input or part of the major activities under the project. Capacity development/ enhancement should be focused on the local (LGU) staff/farmer beneficiaries. • The objective one should be the EO of CIAT not the project itself. • It is important to document the experiences, lessons learned, needs and problems encountered to see how we can capacitate the identified stakeholders. Please incorporate this in the presentation. This will serve as reference for the next conduct of learning events.
Objective / EO 2 To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools;	• Was able to complete crop occurrence workshop but not yet on exposure sensitivity and adaptive capacity. • Still finalizing schedules of FGD meetings to be able to collect, validate CRVA and prioritized CRA. • In addition the extent of damage/disaster as may be brought about by extreme weather condition to the agriculture sector particularly in the priority areas were not sufficiently discussed as well as those issues /problems that the farmer may have to face in the future. • The need to define the approach in the selection/identification

	of priority sites/ communities.
Objective / EO 3 To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks;	• Still finalizing questionnaires for FGD to be able to systematize and analyze the data using cost benefit and trade-offs. • Present result highlights. • Attach the survey forms used. •
Objective/ EO 4 To document and analyze local CRA practices to support AMIA2 knowledge sharing and investment planning; and,	• Present the practices (results) and insights (analysis). • Please specify what qualifies a climate resilient practice. What are the indicators and parameters used to say that it is a climate resilient practice? • Specify what are the criteria and indicators for ranking the identified CRA practice? Also, indicate possible criteria as basis for selecting CRA practices that will be subjected to cost-benefit analysis. • It was suggested that the CRA practices identified should be related to certain hazards. Contextualize this by identifying what hazard is the practice linked to and how it works. This is in the premise that CRA practices should address the problems in the community.
Objective/ EO 5 To establish AMIA baseline for outcome monitoring and evaluation (M&E) of CRA communities and livelihoods.	• Please reword this objective to, "*To provide support to DA-RFO by providing data in establishing AMIA baseline for outcome monitoring and evaluation (M&E) of CRA communities and livelihoods.*"

Management

- The project started last April 2017 and is expected to be completed on April 2018.

Financial

- The project's total approved budget amounts to Php2,003,619.84 with a total release of PhP1,803,257.85.
- The remaining 10% of the total budget amounting to PhP200,361.99 will be released after project completion.
- As of latest Audited Financial Report (AFR) dated November 9, 2017, there is a cumulative expenditure of PhP890,898.96 and a total unexpended balance of PhP912,358.89.

Others

- The province of Benguet is already included in the on-going project of another group (not part of CIAT consortium). The project, Enhancing the sustainability of upland village farming in Benguet through vulnerability assessment, policy analysis and natural resource conservation education, covers the main agricultural areas in the municipalities of Atok and Buguias municipalities which are the major production areas of vegetables.
- After assessing the vulnerabilities of the communities/municipality, only then can the RFO identify the appropriate CRA practices.
- Provide result highlights for each objective. Devise criteria for selecting CRA practices for cost benefit analysis and risk analysis.

Recommendation

- The project is good for continuation provided that comments and recommendations are taken into consideration.

Submitted by:

DANIELLE JOSEPH G. SISICAN
PEO II, Alternate Climate Change Focal, PMED

MS. AMAVEL A. VELASCO
Climate Change Focal, Asst. Head, PMED

Noted by:

MS. SALVACION M. RITUAL
OIC-Head, PMED

Approved by:

DR. NICOMEDES P. ELEAZAR, CESO IV
Director

Annexes

ANNEX 1

Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA

Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA

Project Leader: Elizabeth Supangco-Dela Paz
Agriculture Specialist: Angelee Fame Ramal
Socio-Economist: Charis Mae Tolentino-Neric
Research Assistant: Ralphael Gonzales

Introduction

The Philippines is rich in natural resources and mineral deposits where almost half of its total land area is covered with forest. The country has a fertile and arable land as well as extensive coastlines where diverse flora and fauna exist. Agriculture plays an integral role in the Philippine economy as it shares 9% of the country's gross domestic product. In 2016, the total export earnings from agricultural products had a value of US$ 5.28 billion. The top commodities being exported by the country are rice, corn, fresh banana, fresh pineapple and fresh mango (PSA, 2017). However, the country, being archipelagic, is challenged by several climatic phenomenon and natural disasters. Prolonged dry or wet seasons, flooding or drought and the abrupt change in temperature and precipitation patterns are some climate hazards which may affect human and livelihood. Moreover, the significant loss in agricultural production caused by these hazards poses a critical economic situation and food security. As part of the sustainable development goal established by the United Nations, impacts of climate change towards food security and life on earth will be addressed through appropriate adaptation and mitigation strategies (DILG 2011).

The creation of climate-resilient agriculture (CRA) technologies is introduced globally to address the impacts of climate change in agriculture. CRA is an approach where agricultural systems are transformed, enhanced and reoriented to support food production system and food security under extreme and variable climatic conditions. CRA technologies are practices which are available and applicable to the conditions in the area. These practices are climate change solutions taken in a pragmatic and impact-focused manner. Adaptation of the stakeholders to these practices requires resiliency in order to also mitigate the impacts of climate change while increasing productivity and sustainability (Lipper 2014).

OBJECTIVES

1) to identify the climate risks affecting crop production in Oriental Mindoro;
2) to evaluate the impacts of identified CRA practices in the community; and
3) to analyze the costs and benefits of the CRA practices.

Location

MIMAROPA is part of the Southern Tagalog region which is adjacent to the National Capital Region. It lies at the center of the Philippine archipelago which is bounded by the West Philippine Sea, Tayabas Bay, Sibuyan Sea and Sulu Sea. MIMAROPA is composed of five island provinces namely Mindoro, Marinduque, Romblon and Palawan. One of its island provinces, Marinduque, serves as the country's geographical reference center.

Oriental Mindoro which is one of the five provinces of MIMAROPA region. It is situated at the eastern portion of the region which is 140 kilometers southwest of Manila. The province is composed of 14 municipalities, 12 of which are located in the coastal regions of the island. Calapan is the only city in the province which is classified as a third class city. It serves as the entry point to the island and considered as the economic growth center of the province (MIMAROPA PCIP).

Land area and socio-economic sector

Oriental Mindoro is known as the Rice Granary and Fruit Basket of Southern Tagalog. Its landscape is characterized by various land forms ranging from flat to undulating plains, hills and mountains. This kind of landscape serves as an enabling factor for the province to diversify its commodities. The Bureau of Agricultural Research identified rice, corn, calamansi, banana and coconut as the top five crops produced in the province. Likewise, farmers are also engaged in livestock production such as carabao, cattle, duck, chicken and goat. Moreover, Oriental Mindoro is also rich with inland and coastal resources, where fishing and aquaculture are practiced (MIMAROPA PCIP).

The island province has a total land area of 436,472 hectares with 844,059 inhabitants. Being an agricultural province, 54% of its total land area is devoted for agriculture and fisheries. Out of 190,763 households in the province, 54% are farmers, 8% are fishermen and 4% are engaged in both. The rest are engaged in service related livelihoods (BAS 2010, MIMAROPA RDP 2011).

Climate and Geohazards

According to the PPDO of Oriental Mindoro, the province has two types of climate. Type I climate occurs as pronounced wet and dry season while the Type III has no pronounced season (relatively dry from November to April, and wet for the remaining months). The province has an average rainfall of 2476 mm annually. Due to its geographical location, Oriental Mindoro is highly prone to natural calamities such as typhoons and earthquakes. Moreover, its landscape and biophysical characteristics pose some climate risks in the area, such as flooding due to prolonged rains which varies within the months of October to February. It is also at risk to the onslaught of prolonged dry spell with no distinct month of onset.

These hazards are limitations and threats to the existing livelihoods and developments in the province. Agricultural production is the most susceptible to the effects of these hazards and majority of the population rely on farming.

Methodology

Crop Identification

A coordination meeting was held last August 31, 2017 at Calapan City, Oriental Mindoro together with the MAOs and RFO. Priority crops in the province were identified by the group namely rice, calamansi and banana. However, all MAOs and RFO identified rice as their top priority from the list since one-fourth of the total land area of the province is devoted to rice production and rice is considered as their major commodity.

Identification of Study Area

The rice coordinator from the Provincial Agriculture Office suggested the municipality of Naujan to be one of the study areas since it is the top rice producing municipality of the province. The municipality of Bulalacao was similarly identified by the rice coordinator, but it has a different climate type compared to the other municipalities.

Identification of climate risk in the study area

Focus group discussions (FGDs) were conducted last November 17 and 20, 2017 in each of the municipalities of Naujan and Bualacao, respectively. Each FGD was participated by the following: agricultural technician from the Municipal Agriculture Office, barangay agriculture representative, farmer cooperative head, farmer association head, barangay worker and four farmers. Climate risks and natural phenomenon experienced by each of the municipalities were discussed during the FGDs. A list of existing adaptation and/or mitigation strategies practiced in the area were also identified (Appendix 1).

Data gathering for Benefit and Cost of Particular Practices

Farmer surveys were conducted after the identification of climate risks and CRA practices. Participants in the survey include both CRA and non-CRA practicing farmers. The questionnaire used was the one provided by CIAT but the team modified the tool according to its applicability to the specific CRA practice.

Analytical Tool

Profitability of engaging in CRA was determined using cost and return analysis. The online Cost-Benefit Analysis tool prescribed by CIAT was used to determine the project's NPV, IRR, and payback period. Comparison of means using t-test was done in order to determine if there is a significant difference in the costs and returns between the CRA and non-CRA users.

Results and Discussion

1. Identification of CRA Practices

In 2017, the total rice harvested area in Oriental Mindoro was 105,509 hectares with an average production of 4.2MT/ha in both irrigated and rain fed areas. Farmers cultivate an average of 1.4 hectares of rice farm during dry season and 1.36 hectares during wet season. According to a study conducted by Yusongco in 2015, farmers in Oriental Mindoro were able to yield 5.6T/ha during dry season and 5.06T/ha during WS. Moreover, majority of the farmers cultivate PSB Rc 18 and NSIC Rc 218 during dry and wet season, respectively. This only shows the potential of the province in rice production (NSIC 2012).

A. Naujan, Oriental Mindoro

Naujan covers 27% of the total rice production area in the province with a total of 30,136 hectares. The average farm size in the area ranges from 2 to 3 hectares and majority of the farmers are tenants of the farm. Results from the survey showed that Naujan farmers practice two cropping seasons annually. It is a coastal municipality and situated near Naujan lake which is surrounded by several river systems. With this, Naujan serves as a catch basin during rainy season. The identified climate risks associated in the area was flooding. Naujan experiences loss of production due to delayed planting time. This is one of the impacts of prolonged flooding caused by heavy rainfall and/or frequent occurrence of typhoon in the area.

CRA practice: Use of early maturing variety

Selection of suitable rice variety is an essential adaptation option in rice farming. Philippines has a wide range of rice varieties developed to address the impacts of climate change. Some of which are the use of submergence-tolerant, drought-tolerant and early-maturing varieties.

One of the early-maturing rice varieties used by farmers in Naujan is PSB Rc10 (Pagsanjan) which has an average yield of 4.8MT/ha. Farmers prefer to use this variety in order to cover the shortened season due to flooding and finally catch up with the harvest season. PSB Rc10 can be harvested 106 days after seeding and it has a good milling recovery of 66.62%. Another variety which can withstand flooding is PSB Rc18 (Ala). It can survive in complete submergence for 5 to 7days and can be harvested 123 days after seeding. This long grain variety is preferred by farmers due to its high yielding property with an average yield of 5.1MT/ha. The use of both varieties reduces the risk of production losses due to potential damages of the standing crop during flooding. It also increases the resiliency of the farmer to the adverse effects of climate change.

B. Bulalacao, Oriental Mindoro

The municipality of Bulalacao has an average rice production of 4.44MT/ha. The average farm size in the area ranges from 1.5 to 2 hectares where farmers own and/or rent the land. Bulalacao is situated at the southernmost part of the province which experiences prolonged dry period even during wet season. This scenario forced the farmers in the area to cultivate their land once year only which leads to high loss of income and production.

CRA Practice: Rice-Onion Crop Rotation

Farmers in Bulalacao practice crop rotation to address the adverse effects of drought. Crop rotation is an indigenous practice in agriculture which gained success for thousands of years and counting. This practice is the successive growing of different crops in a specified order on the same land in a sequential manner. In general, crop rotation is considered as a mitigation strategy in pest management. It also enhances soil fertility, reduces chemical inputs and preserves the productive integrity of the soil; all of which can contribute in attaining the potential maximum yield of the crop. However, these benefits become secondary when considering the status of water management in the area. In a rice-based system, crop rotation is practiced to minimize production risks and losses in areas identified as drought-prone and/or rainfed. Some farmers in the municipality of Bulalacao adopted this practice to intensify land use and optimize production inputs throughout the year. Results from the survey showed that farmers practicing crop rotation can cultivate their land for both wet and dry seasons. Farmers were able to determine the appropriate crop to rotate with rice based on the rainfall pattern, its adaptation to the soil and market price. Considering these factors would make their production more cost-efficient which can potentially provide them higher income annually.

2. Cost Benefit Analysis

To determine the profitability of the CRA practice compared to the non-CRA practice, cost and return analysis was performed. Further, comparison of means using t test was done to analyze if significant differences between the CRA practice and the non-CRA practice exist.

A. Naujan, Oriental Mindoro

Table 1 shows the comparison of the costs and returns of rice production on a per hectare basis by type of practice in Naujan, Oriental Mindoro. It also shows the mean difference, standard error, and whether the mean difference is significantly different between traditional and CRA practice, for each cost and return item.

Farmer-respondents who do not use early-maturing varieties spend the most on seeds, which comprises two-thirds of the total cash costs incurred by these farmers. This is expected as these farmers commonly use high-yielding varieties, that are expected to cost higher compared to the expense for early-maturing varieties. Incidentally, the farmer-respondents who use early-maturing varieties also spend the most on seeds, although it contributes to only a little more than one-third of their total cash costs. The average seed cost of the traditional users amounted to Php 73,320.26 while that of the CRA users amount to only Php15,866.44.

Fertilizer (7.71%), fuel (5.05%), and payment for harvesting (3.84%) are the next three major cash cost items for the traditional users. Meanwhile, the next two biggest cash cost items for the farmer-respondents who use early-maturing varieties are payment for harvesting (7.7%) and planting (7.5%).

Table 1. Costs and returns of rice production by type of practice, Naujan, Oriental Mindoro, 2017

Per Hectare Analysis

ITEM	Traditional (n =31)	CRA (n=20)	Mean Difference	Standard Error	Sig.
COSTS					
CASH COSTS					
Seeds	73320.26	15866.44	57453.82	45988.67	0.218
Fertilizer	8428.75	6371.82	2056.92	1445.49	0.161
Pesticide	2227.87	1939.22	288.65	470.61	0.543
Labor					
Land Preparation	1597.74	1224.37	373.37	831.13	0.655
Seedbed Preparation	367.90	591.00	-223.10	393.42	0.573
Seed Sowing	80.23	349.36	-269.13	177.61	0.136
Seedling Care and Maintenance	311.94	492.50	-180.56	332.31	0.589

Per Hectare Analysis

ITEM	Traditional (n =31)	CRA (n=20)	Mean Difference	Standard Error	Sig.
Cleaning and Repair of Dikes	94.03	159.14	-65.11	125.75	0.607
Planting	2862.37	3308.58	-446.22	1070.80	0.679
Irrigation and Drainage*	319.35	20.00	299.35	164.50	0.075
Fertilizer Application	108.48	371.70	-263.23	274.59	0.343
Pesticide Application	562.90	672.50	-109.60	437.71	0.803
Weeding	616.37	828.36	-211.99	538.96	0.696
Field Monitoring	659.45	0.00	659.45	692.77	0.346
Harvesting	4191.57	3408.75	782.82	1127.81	0.491
Threshing and Cleaning	954.84	980.25	-25.46	658.34	0.969
Hauling	952.83	370.25	582.58	358.08	0.110
Other Costs					
Land Rental	2539.83	2176.63	363.20	1808.85	0.842
Hired Machinery*	629.95	0.00	629.95	351.32	0.079
Irrigation	993.06	174.18	818.89	503.23	0.110
Interest Payment	967.20	293.54	673.67	790.31	0.398
Food Cost	683.43	1223.22	-539.79	422.86	0.208
Fuel Cost	5513.09	2509.26	3003.83	1347.78	0.031
Transportation Cost	284.69	34.20	-649.51	728.79	0.377
Total Cash Costs	109268.10	44265.67	65002.46	45718.58	0.161
NON-CASH COSTS					
Labor					
Land Preparation	1916.88	170.72	1746.15	1209.27	0.155
Seedbed Preparation	305.92	262.09	43.83	273.60	0.873
Seed Sowing	80.23	349.36	-269.13	177.61	0.136
Seedling Care and Maintenance	83.89	91.83	-7.94	89.39	0.930
Cleaning and Repair of Dikes	71.77	101.76	-29.98	75.88	0.695
Planting	244.62	628.03	-383.41	372.29	0.308
Fertilizer Application**	364.94	1516.15	-1151.21	526.46	0.034
Pesticide Application*	469.70	1099.46	-629.76	351.48	0.079
Irrigation	576.45	284.38	292.08	439.89	0.510
Weeding	816.37	2675.96	-1859.59	1532.05	0.231
Field monitoring**	4058.84	11885.82	-7826.93	3193.26	0.018
Harvesting	125.81	150.00	-24.19	148.80	0.872
Threshing and Cleaning	12.90	90.00	-77.10	73.67	0.301
Hauling	37.10	0.00	37.10	32.26	0.256
Total Non-Cash Costs**	9165.42	19305.55	-10140.13	4810.40	0.040
TOTAL COSTS	118433.60	63571.22	54862.33	47522.71	0.254
RETURNS					

Per Hectare Analysis

ITEM	Traditional (n =31)	CRA (n=20)	Mean Difference	Standard Error	Sig.
CASH RETURNS					
Quantity Sold (kg)	8226.90	5504.08	2722.83	2561.45	0.293
Selling Price (Php/kg)	16.05	16.88	-0.83	1.11	0.460
Returns from Selling (Php)	135922.70	95546.84	40375.83	43958.31	0.363
NON-CASH RETURNS					
Home Consumption (Php)	9056.42	10087.81	-1031.39	3072.87	0.739
Given Away (Php)**	13063.26	5884.78	7178.48	3345.17	0.037
Reserved for Seeds (Php)	953.51	1061.88	-108.36	529.76	0.839
Total Non-Cash Returns	23073.19	17034.47	6038.73	4468.19	0.183
TOTAL RETURNS	158995.90	112581.30	46414.55	43382.68	0.290
RETURNS ABOVE CASH COSTS	49727.72	68315.63	-18587.91	67926.83	0.786
RETURNS ABOVE TOTAL COSTS	40562.31	49010.08	-8447.78	69857.53	0.904

Farmer-respondents who do not use early-maturing varieties spend more than double the total cash expenses of the EMV users. The former's total cash expenses is around Php 109,268.10 while that of the latter costs only around Php 44,265.67, a difference of around Php 65,002.46. A closer look at Table 1 reveals that the average seed cost incurred by the non-EMV users (Php 73,320.26) is even higher than the total cash costs incurred by the EMV users. This means that the non-EMV users really spend a lot on the seeds they use for rice production.

Field monitoring is the major non-cash cost item for both farmer-respondents who use EMV and for those who do not use EMV. This activity was found to contribute about 44% of the total non-cash costs for the traditional users and and 60% of the total non-cash costs of the CRA users.

It can also be seen from Table 1 that those who use EMV have statistically significantly higher non-hired cost for fertilizer and pesticide application, as well as field monitoring. This adds up to the total non-cash costs, as this value is significantly higher by Php 10,140.13 than the total non-cash costs incurred by the non-EMV users.

In terms of the total costs incurred, those who do not use early-maturing varieties have higher total costs as compared to those who use EMV. This is due to the higher cash costs paid by the traditional users than the CRA users.

The quantity sold as well as the cash returns received by the traditional users are higher compared to that of the CRA users. This finding is expected since the varieties used by the traditional users are mostly high-yielding hybrid varieties, as compared to the traditional varieties used by the CRA users.

The total non-cash returns (comprised of palay given away, stored for home consumption, and reserved for seeds) of the traditional users are also higher than that of the EMV users. In terms of total returns, that of the non-EMV users are also higher by Php 46,414.55 than that of the EMV users.

However, the last two indicators are probably missed out by the non-EMV users. Although they have higher returns compared to the non-EMV users, they also have higher total costs compared to their counterparts. Hence, the returns above cash costs and the returns above total costs of the CRA users are higher compared to that of the traditional users.

The results of the CBA Online Tool showing the NPV, IRR, and payback period of investing in early-maturing varieties can be seen in Table 2. The NPV of US$ -1,370.7 means that the project is not profitable. Since it is less than zero, it means that the additional benefits of investing in early-maturing varieties is less than the additional costs.

Table 2. Profitability indicators from the CBA Online Tool for Naujan, Oriental Mindoro

Indicator	Value	Indicator Meaning
NPV	-1,370.7	Not profitable; the incremental benefits from the use of EMV are less than the incremental costs
IRR	Not applicable	
Payback Period		

B. Bulalacao, Oriental Mindoro

The results of the cost and return analysis in Bulalacao, Oriental Mindoro is presented in Table 3. The traditional users are those who plant rice for one season only, and leave their rice fields unplanted for the next season, while the CRA users are those who plant rice during the first season, and onion in the next cropping season. It also shows the mean difference, standard error, and whether the mean difference is significantly different between traditional and CRA practice, for each cost and return item.

For both the traditional users and CRA users, fertilizer expenses take up bulk of their cash costs. Fertilizer expense contributes about 38% to the total cash costs incurred by the traditional users, and 24% of the total cash costs of the CRA users. Meanwhile, seed cost is the second major cash cost item paid for by all the farmer-respondents, taking up 11% of the total cash costs of those who do not practice crop rotation and 18% of the total cash costs of those who practice crop rotation.

Table 3. Costs and returns of rice production and rice-onion production in Bulalacao, Oriental Mindoro, 2017

Per Hectare Analysis

ITEM	Traditional (n =28)	CRA (n=31)	Mean Difference	Standard Error	Sig.
COSTS					
CASH COSTS					
Seeds***	3012.61	13618.25	-10605.65	1994.3	0.000

Per Hectare Analysis

ITEM	Traditional (n =28)	CRA (n=31)	Mean Difference	Standard Error	Sig.
Fertilizer***	10137.5	18197.85	-8060.35	1585.63	0.000
Pesticide***	2405.21	5294.94	-2889.74	1007.48	0.006
Labor					
Land Preparation***	983.98	7154.97	-6170.98	2091.02	0.005
Seedbed Preparation***	206.55	787.31	-580.75	194.22	0.004
Seed Sowing***	165.48	842.76	-677.28	244.53	0.008
Seedling Care and Maintenance**	38.69	360.1	-321.41	149.1	0.035
Cleaning and Repair of Dikes*	122.02	339.26	-217.24	119.46	0.074
Planting***	2122.39	7091.99	-4969.59	1010.15	0.000
Irrigation and Drainage	148.81	382.76	-233.95	255.22	0.363
Fertilizer Application	153.49	448.99	-295.51	221.4	0.187
Pesticide Application	129.93	261.87	-131.95	105.1	0.215
Weeding**	71.78	403.4	-331.62	153.76	0.035
Field Monitoring	42.86	831.8	-88.94	750.05	0.297
Harvesting***	1908.82	4257.72	-2348.9	742.66	0.003
Threshing and Cleaning***	563.2	24.8	538.4	164.22	0.002
Hauling***	463.34	1362.49	-899.15	270.61	0.002
Other Costs					
Land Rental	568.21	345.67	222.53	439.99	0.615
Hired Machinery**	332.42	1193.05	-860.63	367.43	0.023
Irrigation**	518.33	1569.97	-1051.65	440.45	0.020
Interest Payment	19.64	605.87	-586.22	380.1	0.129
Food Cost***	1023.25	3405.26	-2382.01	707.87	0.001
Fuel Cost***	1211.25	6248.21	-5036.95	706.92	0.000
Transportation Cost	148.81	80.62	68.19	91.15	0.458
Total Cash Costs***	26498.56	74821.41	-48322.85	5374.77	0.000
NON-CASH COSTS					
Labor					
Land Preparation	300.89	551.8	-250.91	301.69	0.409
Seedbed Preparation***	118.75	620.14	382.19	238.96	0.040
Seed Sowing	116.67	687.31	-570.64	453.86	0.214
Seedling Care and Maintenance	1449.22	994.9	454.32	628.96	0.473
Cleaning and Repair of Dikes	1202.88	1833.65	-630.77	860.49	0.467
Planting	298.4	552.59	-254.19	352.96	0.474
Fertilizer Application***	406.96	1312.81	-905.84	198.44	0.000
Pesticide Application***	327.04	3307.91	-2980.87	616.28	0.000
Irrigation	887.9	1055.59	-167.69	447.71	0.709
Weeding***	283.75	2347.71	-2063.96	744.5	0.008

Per Hectare Analysis

ITEM	Traditional (n =28)	CRA (n=31)	Mean Difference	Standard Error	Sig.
Field monitoring***	4547.17	19395.34	-14848.17	2174.17	0.000
Harvesting***	0	1858.33	-1858.33	657.77	0.007
Threshing and Cleaning	83.33	73.73	9.6	95.44	0.920
Hauling	54.42	33.3	21.12	27.85	0.451
Total Non-Cash Costs***	10077.4	34625	-24547.7	4079.98	0.000
TOTAL COSTS***	36575.95	109634	-73058.06	6770.93	0.000
RETURNS					
CASH RETURNS					
Quantity Sold (kg)*	1235.46	3493.15	-2257.69	1155.17	0.056
Returns from Selling (Php)**	18849.59	99572.08	-80722.49	39266.99	0.044
NON-CASH RETURNS					
Home Consumption (Php)	13458.34	13427.93	30.42	2997.71	0.992
Given Away (Php)	23721.55	24375.39	-653.84	6429.16	0.919
Reserved for Seeds (Php)	538.43	277.05	261.38	233.97	0.269
Total Non-Cash Returns	37718.32	38080.37	-362.05	7049.7	0.959
TOTAL RETURNS**	56567.91	137652.4	-81084.53	39152.69	0.043
RETURNS ABOVE CASH COSTS	30069.36	66771.79	-36702.43	38883.15	0.349
RETURNS ABOVE TOTAL COSTS	19991.96	31959.19	-11967.22	39457.57	0.7628

Payment for planting and harvesting are the top two biggest labor cost items of the traditional users, while land preparation and planting are the two major labor cost items paid for by the CRA users. There also exists a significant difference in the average cost paid for by the CRA and non-CRA users in these three activities. The hired labor expenses incurred for land preparation, planting, and harvesting by CRA users is significantly higher by Php 6170.98, Php 4969.59, and Php 2348.9, respectively, than that of the traditional users. It was also found out that the CRA users spend more on material and labor cash cost items compared to the traditional users, and this can be explained by the cash costs incurred in the planting of onion by the CRA users.

There also exists a significant difference in the cash costs incurred by the traditional and CRA users in terms of hired machinery, irrigation, food cost, and fuel cost, wherein those who practice crop rotation spend more on these items. The total cash costs incurred by the CRA users is higher by Php 48,322.85 than that of the traditional users, and this difference is statistically significant at 1%.

For both groups of respondents, field monitoring is the biggest non-cash cost item, taking up 45% of the total non-cash costs for the traditional users and 56% of the total non-cash costs for the CRA users. There also exists a significant difference in this item as CRA users spend more time monitoring their fields compared to the traditional users, and this is due to the extra monitoring needed for onion.

The total non-cash costs of the CRA users (Php 34,625) is higher than that of the traditional users (Php 10,077.4), and this finding is statistically significant at 1%. In terms of the total costs incurred, CRA users spend thrice more than the traditional users, the average difference being Php 73,058.06, which is significant at 1%.

The cash returns of the traditional users are Php 80,722.49 less than that of the CRA users, and this difference is significant at 5%. Again, this is heavily driven by the returns received from selling onion, which is considered a high value crop. Moreover, the total returns of the those who practice crop rotation is also significantly higher than that of the traditional users.

Finally, the returns above cash costs and the returns above total costs of the CRA users are also higher than that of their counterparts, by Php 36,702.43 and Php 11,967.22, respectively.

The results of the CBA Online Tool showing the NPV, IRR, and payback period of investing in crop rotation can be seen in Table 4. The NPV US$ 10,059.6 means that the project is profitable. Since it is greater than zero, it means that the additional benefits of investing in crop rotation is higher than the additional costs. The IRR of 188.40% indicates that investing in crop rotation is more profitable than putting the money for investment in the bank, while it will only take two years for the farmers to pay back the initial investment in crop rotation.

Table 4. Profitability indicators from the CBA Online Tool for Bulalacao, Oriental Mindoro

Indicator	Value	Indicator Meaning
NPV	US$ 10,059.6	Profitable; since it is greater than 0, it means that the incremental benefits is higher than the incremental costs
IRR	188.40%	Profitable; since it is higher than the current discount rate (8.5%), it means that is more profitable to practice crop rotation than just putting the money in the bank
Payback Period	2	The number of years it takes to pay back the initial investment is 2.

SUMMARY AND CONCLUSION

The use of early-maturing varieties is a very important adaptation strategy especially in areas susceptible to flooding, like Naujan, Oriental Mindoro. While it is unusual that farmers revert back to this practice because of the presence of high-yielding varieties, the results of this analysis revealed that farmers who use early-maturing varieties have higher yield compared to those who are not using these types of varieties. Based on the results of the cost and return analysis, the total returns of the non-EMV users are higher than the total returns of the EMV users, however, the former's costs incurred are also higher. Hence, the EMV users still have higher returns above cash costs and returns above total costs than the non-EMV users.

On the other hand, crop rotation, specifically rice-onion production, is practiced by the farmers as a mitigating strategy in order to address the adverse effects of drought. In a rice-based cropping system, crop rotation is practiced to minimize production risks and losses, and in order to intensify land use and production inputs throughout the year, as practiced by the farmers in Bulalacao, Oriental Mindoro. Further, results of the cost and return analysis revealed that farmers will earn more if they will practice crop rotation. They are also expected to incur more costs, but the higher returns will more than make for this addition in costs.

RECOMMENDATIONS

The effects of climate change have been very apparent in both Naujan, and Bulalacao, Oriental Mindoro. Hence, the loss of crops due to natural disasters such as typhoons (Naujan) and drought (Bulalacao) cannot be avoided. For both municipalities, it is recommended that farmers have their crops insured to the Philippine Crop Insurance Corporation. This is important in order for them to protect their crops, and cover the risks that may be brought about by natural disasters.

Specific to Naujan, Oriental Mindoro, extensive information dissemination should be done by the municipal and provincial agriculturist, and even the DA-RFO to let farmers know that reverting back to the use of early-maturing varieties would make them better off (in terms of profit) than by using high-yielding varieties. Farmers may just be blinded by the marketing strategies of hybrid companies – the reason why they use these new high-yielding varieties, but to cope with the effects of climate change, it is recommended that they shift back to the use of early-maturing varieties. Moreover, the average seed costs incurred by the non-CRA users is higher than that of the CRA users – another reason for the farmers to revert to the use of early-maturing varieties.

For the farmers in Bulalacao, Oriental Mindoro, the use of small-scale irrigation systems like water pumps, small farm reservoirs and small water impounding project is recommended for these farmers to still be able to plant even during periods of drought. In addition, it is also recommended that these farmers be granted access to loans especially for onion production. It was found out that the material and labor costs of the CRA users are higher than that of the non-CRA users, and this is because of the fact that onion is very expensive to produce. If farmers will be given more access to credit, then they are expected to still earn for the next cropping season, rather than just produce rice for the first cropping season.

LITERATURE CITED:

1) Bureau of Agricultural Statistics 2010. Philippine Statistics Office.
2) Department of Interior and Local Government. 2014. Climate change in the Philippines.
3) Lipper L, McCarthy N, Zilberman D, Asfaw S, Branca G (2014). Climate Smart Agriculture Building Resilience to Climate Change. Natural Resource and Management Policy. Food and Authority Organization of the United Nations. Vol. 52
4) National Seed Industry Council. 2012. Rice varieties adaptable to abiotic stress conditions. Department of Agriculture. Bureau of Plant Industry.
5) MIMAROPA Regional Development Plan 2011. Regional Office National Economic and Development Authority.
6) Philippine Statistics Authority. 2017. Agricultural exports and imports. Republic of the Philippines.
7) Provincial Commodity Investment Plan. Region IVB. Department of Agriculture. Philippine Rural Development Project.
8) Provincial Planning Development Office. Region IVB. Philippine Information Agency.
9) Yusongco CG, Beltran JC, Santiago JIC, and Relado RZ. 2016. Baseline Characterization of PhilRice-Mindoro Satellite Station. National Rice Research and Development Highlights. Philippine Rice Research Institute.

Appendix 1. Long List of CRA Practices for the Municipalities of Oriental Mindoro

Municipality	CRA Practice	Description
Naujan	*Use of early maturing rice varieties	Flooding due to prolonged period of rain causes delay of planting. Farmers use early maturing varieties to catch up with the planting season.
	Use of hybrid varieties	Hybrid rice varieties are high yielding and tolerant to several diseases. Farmers in Naujan cultivate hybrid rice to prevent and overcome damages from diseases. Similarly, some hybrid varieties are lodging tolerant which mitigates the effect of strong winds during typhoon.
	Organic farming	Organic farming basically means farming with no chemical inputs. The use of chemicals in any agricultural setting causes several negative effects to farm land, environment and human health. Inorganic fertilizers produce high levels of greenhouse gases which amplify global warming. In addition, pesticides and fertilizers contributes to water and air pollution affecting humans, animals and living organisms. Practicing organic farming improves, restore and preserve soil fertility and structure. GHG emissions will be reduced and human health will be safe from chemical toxicity.
Bulalacao	Direct seeding	This practice is common in rice cultivation. Several reasons in doing this practice include less labor needed, less input needed, limited time in raising seedling for transplanting and to cope with the dry season. Farmers in Bulalacao practice direct seeding because of the above mentioned reasons.
	Use of different rice varieties	There is a wide range of rice varieties in the Philippines which are created depending on the specific condition of the area. More often, farmers practice trial and error until suitable variety is found.
	Early planting season	armers practice adjusted planting season depending on the weather pattern in the area. Early planting season in Bulalacao is done to prepare for the anticipated prolonged dry season.
	*Rice-Onion crop rotation	This practice is considered as a mitigation strategy in pest management. It also enhances soil fertility, reduces chemical inputs and preserves the productive integrity of the soil. All which can contribute in attaining the potential maximum yield of the crop. However, these benefits become secondary when considering the status of water management in the area. In a rice-based system, crop rotation is practiced to minimize production risks and losses in areas identified as drought-prone and/or rainfed.

CRA Practices that were chosen by the project team to assess.

Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR

Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in the Cordillera Administrative Region

Project Leader: Elizabeth Supangco-Dela Paz
Agriculture Specialist: Dr. Janet Pablo
Socio-Economist: Charis Mae Tolentino-Neric
Research Assistant: Ralphael Gonzales

RATIONALE

Cordillera Administrative Region (CAR) has abundant natural resources and contributes highly in terms of agriculture and mining in the Philippines. One of the provinces in the region which has a very vibrant agriculture is Benguet. The province has been known as the "Salad Bowl of the Philippines" due to its topography, which makes it highly suitable for agricultural production, most especially, for vegetable production. Benguet is characterized by mountainous terrain of peaks, ridges, and canyons with a temperate and generally pleasant climate. This makes agriculture a major source of employment for the people in the province, with at least half of the total labor force engaged in vegetable farming.

Eighty percent of the total demand for vegetable in the metropolis is produced by Benguet. Cabbage and potato are two of the priority crops in Benguet. As of 2016, 86% and 90% of the regional production of cabbage and potato, respectively, were produced from the province (PSA, 2017). The major producers of highland vegetable crops in the province are the municipalities of Atok and Buguias. Atok specializes in cabbage production and was able to produce around 23,000 metric tons of cabbage in 2016 while Buguias is more engaged in potato growing, and was able to produce around 65,000 metric tons of potato in the same year (Benguet Agricultural Profile, 2017).

Manifestations of climate change are apparent in Benguet. The province has become more prone to landslides, drought, and soil erosion. It has been experiencing persistently strong heavy rains, typhoons, flooding, and frost. These are the results of climate change, which greatly affects their agricultural activities and livelihood and eventually, their productivity and income. Based on the records of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) Agro-meteorological Station in La Trinidad from 1976 to 2009, observed changes in climate in the area were higher temperature, warmer noon and colder afternoons, longer drought periods, and irregular rainfall (Calora et al, 2011).

Among the provinces in CAR, Benguet is considered as the most vulnerable to landslides, which can potentially have negative impact on almost 60 percent of its total land area. Drought is also a major problem in the province. This causes the delay of planting of farmers as farmers would have to wait for the water or rain for irrigation. When there is lack of water supply during their production, a common practice that farmers do is to borrow hose and water pump to water their crops. Some also request for water delivery in their gardens. The practice of water scheduling is being followed as not everyone has a water pump, hose, and power sprayer to use. Prolonged dry spell causes an increase in the number of plant pests and diseases. This also leads to yellowing or blackening of leaves, stunted growth, and smaller size of plants. Another problem they commonly face is soil erosion (Benguet Socio-Economic Profile, 2007). The Bureau of Soils reported that 81 percent of its lands are classified as severe. Soil erosion often results to constant road closures due to washed out and eroded roads. Road closures affects the product price due to losses incurred during the waiting time since these agricultural commodities are highly perishable.

The farming community faces economic impacts like costly repair of terraces due to expensive cost of rock materials for terracing; lower yield and crop quality resulting in reduced farm revenues; increased cost of inputs in an effort to increase yield and crop quality; and for some farmers, hindrance to continuous cropping during the dry season due to lack of irrigation. This reduces income of farmers, resulting to the increasing demand for supplementary off-farm employment for both men and women (Laurean, et al., 2017).

Benguet farmers, on the other hand, employ adaptation strategies to combat the adverse effects of climate change. These include frequent watering to compensate for water loss due to higher evapotranspiration rates and changes in work schedules by going to the farms earlier than usual to avoid the heat of the sun (Calora, Jr., et al., 2011). According to the Benguet Provincial Agriculturist, as cited by Lapniten (2015), farmers' coping mechanisms with events like this include digging large holes and lining them with large plastic sheets or tarpaulins to act as catchment basins during the rainy season.

A closer study in Benguet State University (BSU) identified eight villages in the province, which were considered to be susceptible to the effects of climate change. These include: Tinongdan of Itogon, Kamog of Sablan, Loo of Buguias, Balakbak of Kapangan, Guinaoang of Mankayan, Ampusongan of Bakun, Madaymen of Kibungan and, Cattubo of Atok (Fagyan, 2017). Thus, this study was proposed to be conducted in two of the identified municipalities of Benguet, Atok and Buguias.

OBJECTIVES

1) to identify the climate risks affecting crop production in Benguet;
2) to evaluate the impacts of identified CRA practices in the community; and
3) to analyze the costs and benefits of the CRA practices.

METHODOLOGY

A series of meetings with the MAO and the Department of Agriculture-Regional Field Unit was conducted to gather preliminary data and information regarding the

identification of study sites and the adaptation strategies employed by farmers. The climate hazard exposure and technological adaptation or CRA identification was done through the conduct of community meeting in Atok, Benguet and focus group discussion in Buguias, Benguet. Structured questionnaires were used to gather data from CRA and non-CRA practitioners in both municipalities. Profitability of engaging in CRA was determined using cost and return analysis. The online Cost-Benefit Analysis tool prescribed by CIAT was used to determine the project's NPV, IRR, and payback period. Comparison of means using t-test was done in order to determine if there is a significant difference in the costs and returns between the CRA and non-CRA users.
The crops chosen for the study were those identified as priority crops by the Department of Agriculture – Regional Field Office of the Cordillera Region, which is based on the volume and area of production. During the inception meeting for Benguet, potato, cabbage, rice, and camote were identified as the priority crops; however, potato and cabbage were prioritized for the CRA identification, as these are the top commodities produced in Benguet. On the other hand, the study areas were selected based on their vegetable production, gathered from the PSA, DA-RFO CAR, and the provincial and municipal agricultural offices.

During the inception meeting, climate risk and adaptation and mitigation strategies were identified based on reports and research and extension activities conducted in study areas, which include the use of greenhouse or tunnelling, organic vegetable production, water harvesting, irrigation, windbreak, and others. The CRA practices of the farmers for both crops were validated during the FGD with the farmer stakeholders and the Municipal Agriculture Office Staff. A workshop was also conducted to determine the exposure database for the climate-resilient agri-fisheries assessment with the PAO and MAO's technical staff.

RESULTS AND DISCUSSION

Crop and Locale of Study

Cabbage and white potato are popular vegetable cash crops grown in Benguet by small, medium, and large scale farmers. They are grown for food and income generation because they are among the crop ventures with a very lucrative return on investment.

Climate Risk and Mitigation and Adaptation Strategies

<u>Site A: Atok, Benguet</u>

<u>Assessment of Exposure and Sensitivity to Climatic Hazards</u>

The identified climatic hazards during the focus group discussion with the farmers and local officials were mainly the occurrence of landslide, drought, hailstorm, frost, and strong winds.

Landslide occurs due to continuous monsoon rain, heavy rain, and typhoon. This reduces the plantation areas, especially if the area is sloping. Road closures are also frequent during landslides due to the blocking of farm-to-market roads. Undelivered harvest is a common problem faced by the farmers. It was estimated than an average of 50 percent reduction in the volume of leafy vegetables is experienced by the farmers. This reduction is eventually converted into losses in income. When the supply available in the market is affected, prices of the commodities in the market are also affected.

Drought and a change in the usual pattern of dry and wet season are now experienced in Atok. The dry season is normally occurring in the month of April; however, drought is now also experienced even in October, where the usual wet season is expected to occur. Since vegetable cultivation is rainfed-dependent, production is limited during the absence of rainfall. Farmers resort to cultivate a limited area depending on the water harvested or available irrigation water in the locality. Others would plant crops that require less water or crops that are tolerant to drought such as camote, gabi and raddish.

Another hazard experienced is the occurrence of hailstorm especially in the three barangays of Atok: Paoay, Abiang, and Cattubo. Hailstorm normally occurs in the locality during February to March; but during the last two years, it was observed that hailstorm occurs some time in September, which is the onset of rainy season. The magnitude of damage of hailstorm during the initial heading stage of cabbage is about 90%. Cabbage does not continue to form head while there is hailstorm.

Moreover, frost happens for about three months from December to February in the same barangays. The farmers also identified strong winds occurring during the months of October to December to be damaging to crops. Two weeks of strong winds is the most detrimental to plants and is affecting three barangays, which are major growers of cabbage. On the other hand, frost occurrence causes about 5 to 30% reduction in the production of cabbage as claimed by farmers when around 1 mm of ice covers the leaves and worse if the frost persists for about 3 days.

Generally plants are sensitive to strong winds, which causes breakage in plants. Some are even uprooted especially with continuous strong winds. Strong winds occurring during the vegetative stage of the cabbage plants results to about 95% damage and if the occurrence is during the heading stage, only about 80% of the plants can be salvaged.

All of the above climate related hazards were claimed to be damaging to crop production however, farmers rated the absence of rain or prolonged drought as the most damaging as the farmers that rely on rainfall for their irrigation can be delayed in their planting or may not plant for that cropping season.

Assessment of Mitigation and Technological Adaptive Capacity

Benguet farmers employ several adaptation strategies on the adverse effects of climate change. Establishment of drainage canals is necessary to direct water movement to prevent soil erosion. For hailstorm and frost, the most common adaptation done by farmers is to irrigate or spray the plants with water before the sun rises to thaw the ice deposits on the leaves. The cabbage seedlings are protected from hailstorm by using black net as cover. However, farmers mentioned that there is no adaptation strategy yet for strong winds. The government's intervention such as provision of few greenhouses for common use is limited to seedling and nursery, and only for cutflower production.

During the dry season, improvised rainwater harvester, called "kwelo" is one of the adaptation strategies employed by the farmers. During the rainy season, farmers improvise catchment basins by digging large pits lined with large plastic sheets or used tarpaulins for rainwater harvesting. Concrete water tanks are also built by some farmers who can afford its cost. Depending on the amount of rainwater harvested, farmers are able to cultivate a limited area for vegetable production.

Improving the rainwater harvester to be the farmers' source of irrigation is expected to increase farmers' yield and income even during longer drought periods and irregular rainfall. Irrigation water is also needed not only during drought but also when frost occurs, as practiced in the municipality of Atok. The availability of the facility enhances the resilience of the vegetable farmers as it was claimed to be an effective strategy to cope with climate change in vegetable-producing areas.

Site B:Buguias, Benguet

Assessment of Exposure and Sensitivity to Climatic Hazards

One of the climate related hazards identified by the respondents in Buguias municipality was the occurrence of strong typhoons, which is usually experienced during November. For the last three years, however, strong typhoons are now observed to occur at any month of the year in the municipality. Strong typhoons cause significant damage to crops including flooding that leads to rotting.

Although prolonged dry season was identified as the most damaging climate hazard experienced by the farmers, increased incidence of pests and diseases was also observed during the dry season, further aggravating the loss in production. Higher population of leafminer, thrips, aphids and scab are affecting the potato plants. Hence, farmers result to increasing the frequency of pesticide application, which further increases the input expenses of the farmers in both upland and lowland areas of the municipality.

Assessment of Mitigating and Technological Adaptive Capacity

Several adaptation options were identified by the farmers in Buguias such as organic farming, mixed farming, mulching, use of sacks or net screens for wind break and use of resistant varieties.

Farmers in the higher elevation areas of Buguias adapted the use of resistant varieties to pest and diseases. Late blight is the most devastating potato disease, where fungicide spraying is necessary especially during the wet season cropping. Frequency of application is almost twice a week that adds up to about 50% of the total cost of production.

The Northern Philippine Rootcrops Research and Training Center (NPRCRTC) of Benguet State University recommended the use of late blight resistant potato varieties. BSU PO3 "Igorota" is a locally-bred (Philippines) potato variety, which is moderately resistant to late blight and leaf miner. The farmers commonly call this variety LBR which stands for late blight resistant. This variety has a high dry matter content suited for both table use and processing, matures in 110 days and has a potential yield of 25-35 tons per hectare. However, the variety is only planted in the higher elevation areas of the municipality, as farmers claim that the variety easily rots during transport, which leads to higher postharvest losses.

Aside from Igorota, Solibao (PO4) is a variety that exhibits high levels of resistance to late blight, showing a negligible infection of 1% as compared to other potato varieties. The variety has a maturity of 90-120 days, with an actual yield of 18-40 tons per hectare and a potential yield of 40 tons per hectare.

Cost Benefit Analysis

To determine the profitability of the CRA practice compared to the non-CRA practice, cost and return analysis was performed. Further, comparison of means using t test was done to analyze if significant differences between the CRA practice and the non-CRA practice exist.

Atok, Benguet

Table 1 shows the comparison of the costs and returns of cabbage production on a per hectare basis by type of practice in Atok, Benguet. It also shows the mean difference, standard error, and whether the mean difference is significantly different between traditional and CRA practice, for each cost and return item.

Table 1. Costs and returns of cabbage production by type of practice, Atok, Benguet, 2017

Per Hectare Analysis

ITEM	Traditional (n =15)	CRA (n=22)	Mean Difference	Standard Error	Sig.
COSTS					
CASH COSTS					
Seeds	5018.00	5680.76	662.07	1752.69	0.708
Fertilizer**	19048.33	26558.03	7509.70	3404.05	0.034
Pesticide	2665.39	2398.20	-267.19	1212.31	0.827
Labor					
Land Preparation	444.44	468.18	23.74	291.85	0.936
Seedbed Preparation	340.00	431.82	91.82	295.53	0.758
Seed Sowing	220.00	140.91	-79.09	172.95	0.650
Seedling Care and Maintenance*	0.00	479.55	479.55	273.75	0.089
Irrigation	906.67	1163.64	256.97	1204.11	0.832
Fertilizer Application	1088.52	967.05	-121.47	493.85	0.807
Pesticide Application	403.33	272.73	-130.61	276.62	0.640
Weeding	0.00	281.82	281.82	199.09	0.166
Field monitoring	0.00	27.27	27.27	24.25	0.269
Harvesting	1544.44	2806.82	1262.37	1008.08	0.219
Other Costs					
Land Rental	16111.11	15555.56	-555.56	8906.23	0.953
Food Cost	29423.61	31029.41	1605.80	7775.71	0.838
Fuel Cost	1952.78	2410.42	457.64	846.20	0.595
Transportation Cost	14333.33	25666.67	11333.33	8459.99	0.222
Total Cash Costs*	65215.06	72658.20	7443.15	12040.23	0.541
NON-CASH COSTS					
Labor					
Land Preparation	2434.07	2146.21	-287.86	719.84	0.692
Seedbed Preparation**	250.37	592.61	342.24	134.04	0.015
Seed Sowing	186.30	270.83	84.54	98.06	0.395
Seedling Care and Maintenance	1635.56	1667.05	31.49	451.61	0.945
Irrigation**	722.96	2506.06	1783.10	864.78	0.047
Fertilizer Application	2346.67	2010.23	-336.44	693.24	0.631
Pesticide Application	2368.15	3303.03	934.88	1107.73	0.404
Weeding	280.00	903.03	623.03	394.34	0.123
Field monitoring	18264.44	19881.06	1616.62	6979.02	0.818
Harvesting	593.33	1197.92	604.58	430.45	0.169

Per Hectare Analysis

ITEM	Traditional (n =15)	CRA (n=22)	Mean Difference	Standard Error	Sig.
Total Non-Cash Costs	29081.85	34478.03	5396.18	9279.01	0.565
TOTAL COSTS	94296.91	107136.20	12839.32	13661.05	0.354
RETURNS					
CASH RETURNS					
Yield (kg)**	11287.04	16421.21	5134.18	2573.02	0.054
Price	16.00	14.86	-1.14	2.56	0.658
Cash Returns*	172816.70	229179.50	56362.88	44999.18	0.219
NON-CASH RETURNS					
Home Consumption (Php)	122.83	87.31	-35.52	35.42	0.323
Given Away (Php)	96.10	91.73	-4.37	35.54	0.903
Total Non-Cash Returns	218.93	179.04	-39.89	63.19	0.532
TOTAL RETURNS*	157035.60	229358.60	72322.99	41549.25	0.091
RETURNS ABOVE CASH COSTS	91820.54	156700.40	64879.84	41012.41	0.123
RETURNS ABOVE TOTAL COSTS	62738.69	122222.40	59843.67	43229.50	0.178

* significant at 10%, ** significant at 5%, *** significant at 1%

It is noticeable that for both CRA and non-CRA adopters, food is the major cash cost item of the farmer-respondents. Food cost comprised 45% of the total cash costs of farmers who do not use rainwater harvester, and 43% of the total cash costs of those who use rainwater harvester. This means that these farmer-respondents exert extra care and money for their laborers and are willing to spend money on their food. Fertilizer expense comes in as the second biggest cash cost item, taking up 29% of the total cash costs of non-CRA adopters, and 27% of the total cash costs of the CRA users. The fertilizer expense of those who use rainwater harvester was significantly higher than those who do not use rainwater harvester, with a mean difference of Php 7,509.70. These two cost items together comprise about 70% of the total cash costs of the farmer-respondents.

Among the labor cost items, the two groups of farmers spent the most on harvesting, fertilizer application, and irrigation and drainage. Land rental and transportation cost are the third and fourth largest cash cost items as reported by the farmer-respondents. Meanwhile, the total cash costs incurred by the CRA users are also significantly higher than the non-CRA users, with a mean difference of Php 7,443.15. This means that those who use rainwater harvester spend more in producing cabbage than those who do not use rainwater harvester.

Field monitoring is the major non-cash cost item for both farmer-respondents who practice rainwater harvesting and for those who do not, taking up 63% of the total non-cash costs for the non-CRA users and 58% of the total non-cash costs for the CRA users. Field monitoring, though commonly performed by the farmers themselves almost on a day-to-day basis, is one of the most underestimated labor activities performed by the farmers. Farmers do not usually value this activity, but if compared with the other expense items, it also costs a lot.

Similar to the cash costs, the total non-cash costs of the CRA users are also higher than the total non-cash costs incurred by the non-CRA users.

In terms of yield, those who use rainwater harvester have significantly higher harvest compared to those who do not use it; the mean difference is about 5,132.18 kg. The cash returns of the CRA users is also significantly higher than the non-CRA users, with an average mean difference of Php 56,362.88. The total returns above cash costs and returns above total costs of those who use rainwater harvester are also higher than the returns of those who do not practice rainwater harvesting.

Table 2 presents the results of the CBA Online Tool showing the NPV, IRR, and payback period of investing in rainwater harvester for cabbage production. The NPV (2,966.55) means that the project is profitable. Since it is greater than zero, it means that the additional benefits of investing in rainwater harvesting is greater than the additional costs. The IRR of 18.09% indicates that investing in rainwater harvester is more profitable than just putting the money for investment in the bank. It will take nine (9) years to be able to pay back the initial investment for the rainwater harvester.

Table 2. Profitability indicators from the CBA Online Tool for Atok, Benguet

Indicator	Value	Indicator Meaning
NPV	US $ 2,966.55	Profitable; since it is positive, it means that the present worth of the incremental benefits is higher than the incremental costs
IRR	18.09%	Profitable; since it is higher than the current interest rate of 8.5%, it implies that it is more profitable to invest in the rainwater harvester rather than putting the money in the bank.
Payback Period	9 years	The number of years it takes to pay back the initial investment is 9.

Buguias, Benguet

The comparison of the costs and returns of cabbage production on a per hectare basis by type of practice in Buguias, Benguet is presented in Table 3. It also shows the mean difference, standard error, and whether the mean difference is significantly different between traditional and CRA practice, for each cost and return item. The CRA practice considered in this analysis is the use of blight-resistant potato variety, while the traditional users are those who not use this variety.

Seeds take up bulk of the cash costs incurred by both CRA and traditional users. Around Php 67,700 or half of the cash costs paid by the CRA users can be accounted for by seeds while around Php 80,235 or 41% of the total cash costs are incurred by the traditional users for seeds alone. In potato production, the quality of seeds is very important as it is linked to increased harvest. Wang (n.d.) noted that the use of good quality seeds can increase yield by 30 to 50%, as compared to using farmers’ seeds.

For those who do not use blight-resistant variety in potato production, fertilizers, land rental, and food cost are the next three biggest cash cost items contributing 14.5%, 10.2%, and 9.03%, respectively, to the total cash costs incurred by the traditional users. On the other hand, the next three biggest cash cost items for CRA users are food cost (16.2%), fertilizers (14.9%), and transportation cost (9.9%).

Table 3. Costs and returns of potato production by type of practice, Buguias, Benguet, 2017

Per Hectare Analysis

ITEM	Traditional (n =20)	CRA (n=13)	Mean Difference	Standard Error	Significance
COSTS					
CASH COSTS					
Seeds	80235.00	67700.00	-12535.00	17672.11	0.483
Fertilizer	28484.00	19981.54	-8502.46	5957.34	0.164
Pesticide	7515.93	9005.46	1489.53	2410.18	0.541
Labor					
Land Preparation	1264.38	850.96	-413.41	562.67	0.468
Planting	1040.00	1535.90	495.90	383.49	0.206
Irrigation*	0.00	355.13	355.13	195.84	0.080
Fertilizer Application***	0.00	210.98	210.98	75.79	0.009
Pesticide Application	1076.66	1207.69	131.03	856.14	0.879
Weeding	895.00	328.21	-566.79	513.94	0.279
Harvesting	3769.02	4232.05	463.03	1290.57	0.722
Other Costs					
Land Rental	20000.00	0.00	-20000.00	24946.59	0.429
Food Cost	17700.00	21666.67	3966.67	4287.51	0.418
Fuel Cost	2732.50	0.00	-2732.50	1713.33	0.121
Transportation Cost	10700.00	13333.20	2634.00	9793.16	0.790
Total Cash Costs	196058.80	134005.40	-62053.36	42010.75	0.150
NON-CASH COSTS					
Labor					
Land Preparation**	1188.75	2256.41	1067.66	395.54	0.011
Planting	1280.00	1538.46	258.46	402.67	0.526
Fertilizer Application	1308.75	1611.54	302.79	435.39	0.492
Pesticide Application	1385.00	2015.39	630.38	535.05	0.248
Irrigation***	0.00	4405.13	4405.13	874.48	0.000
Weeding	1015.00	574.36	-440.64	527.65	0.410
Field monitoring**	6727.50	16984.62	10257.12	4046.80	0.017
Harvesting	944.75	361.54	-583.21	360.99	0.116
Total Non-Cash Costs**	13849.75	25342.31	11492.56	4825.06	0.024
TOTAL COSTS	209908.50	159347.70	-50560.80	41964.21	0.237
RETURNS					
CASH RETURNS					

Per Hectare Analysis

ITEM	Traditional (n =20)	CRA (n=13)	Mean Difference	Standard Error	Significance
Quantity Sold (kg)	16335.00	18897.44	2562.44	6033.87	0.674
Price	32.00	29.76	-2.24	1.68	0.193
Cash Returns	517350.00	576733.30	59383.33	184989.50	0.750
NON-CASH RETURNS					
Home Consumption (Php)	705.56	372.15	-333.41	247.85	0.188
Given Away (Php)	716.13	1481.16	765.03	785.20	0.337
Total Non-Cash Returns	1421.69	1853.30	431.62	866.04	0.622
TOTAL RETURNS	518771.70	578586.60	59814.95	184854.90	0.748
RETURNS ABOVE CASH COSTS	321291.20	442727.90	121436.70	176244.20	0.496
RETURNS ABOVE TOTAL COSTS	308863.10	419238.90	110375.00	176476.60	0.5363

* significant at 10%, ** significant at 5%, *** significant at 1%

Among the labor costs paid for by the farmer-respondents, payment for harvesting is the biggest cash cost item, accounting for almost half of the total labor cash costs paid for by both CRA and traditional users. It can also be seen from Table 3 that there exists a significant difference in the irrigation labor expense of traditional and CRA users. This is mainly because traditional users rely on rain, while CRA users have more access to small-scale irrigation systems, hence they need to hire labor to irrigate their farms.

In terms of the total cash costs, those who do not use blight-resistant potato variety spend more compared to the CRA users. The traditional users spend around Php 196,058.8 as compared to the CRA users, who spend an average of Php 134,005.4.

Field monitoring is the biggest non-cash cost item for both traditional and CRA users. This activity took up 49% of the total non-cash costs for the traditional users and about two-thirds of the total non-cash costs for the CRA users. The mean difference between the traditional and CRA users for this activity is Php 10,257.12, and it is significant at 5%. This can be explained by the fact that CRA users spend more time monitoring their field compared to the traditional users because extra care is needed by the blight-resistant variety.

While the total cash costs of the traditional users are higher than that of the CRA users, the case for the total non-cash costs is the opposite. CRA users have higher total non-cash costs (Php 25,342.31) compared to the traditional users (Php 13,849.75), and this difference is significant at 5%.

It is also observable that the cash returns of traditional users (Php 517,350) are less than that of CRA users (576,733.3). In terms of home consumption, traditional users save more for their homes as compared to the CRA users, while for the quantity of harvest given away, CRA users have more compared to the traditional users.

Finally, CRA users have higher total returns, returns above cash costs, and returns above total costs than the traditional users, although the differences in these three items, is not statistically significant.

The results of the CBA Online Tool showing the NPV of investing in blight-resistant potato variety can be seen from Table 4. The NPVof US$ 3,019.52 means that the project is profitable. Since it is greater than zero, it means that the additional benefits of investing in blight-resistant potato variety is higher than the additional costs.

Table 4. Profitability indicators from the CBA Online Tool for Buguias, Benguet

Indicator	Value	Indicator Meaning
NPV	US$ 3,019.52	Profitable; since it is positive, it means that the present worth of the incremental benefits is higher than the incremental costs
IRR	Not applicable	
Payback Period		

SUMMARY AND CONCLUSION

Improving rainwater harvesting method of the farmers as source of irrigation would increase the yield and income of farmers especially during periods of drought and irregular rainfall. During the rainy season, farmers improvised catchment basins by digging large pits lined with large plastic sheets or used tarpaulins for rainwater harvesting (locally called "*kwelo*"). Concrete water tanks are also built by some farmers who can afford the cost and expenses. Depending on the rainwater harvested, farmers are able to cultivate a limited area for vegetable production.

The cost and return analysis results showed that those who use the rainwater harvester (*kwelo*) have significantly higher yield and cash returns compared to those who do not use *kwelo*. Moreover, the total returns, returns above cash costs, and returns above total costs of the CRA users are also higher than the returns of the traditional users. Based on the results of the CBA Online Tool, investing in rainwater harvester is highly profitable for the farmers in Atok, Benguet.

For Buguias, on the other hand, the use of PO3 potato variety can potentially increase harvest by being tolerant to the diseases. This practice significantly reduced the operational cost of farmers by about 50%. Based on the cost and return analysis, those who use the blight-resistant variety were found to have higher yield, cash returns, total returns, returns above cash costs, and returns above total costs.

RECOMMENDATION

The use of water harvesting technology is recommended in all vegetable production areas regardless of crops planted, especially in areas where water is a constraint for productivity as well as in areas where there is frost occurrence. The government through its line agencies and SUCs should expand the project on the distribution of small farm reservoirs or water tanks in drought- and frost-prone areas in the different vegetable and other priority crop production areas such as rice and corn. Aside from the use of rainwater harvesting technology to collect water, other technologies such as fog harvesting is recommended in Atok municipality since the relative humidity is high in some areas.

The use of blight tolerant potato variety is recommended in high elevation areas especially during wet or rainy season planting time. Other potato varieties should be evaluated for resistance to other pest and diseases aside from late blight and determine yield potential during the wet season planting, where pest and diseases are prevalent.

LITERATURE CITED

PHILIPPINE STATISTICS AUTHORITY. 2016. AGRICULTURE AND FISHERY STATISTICS. October 25, 2017. Retrieved on 21 March 21 2018 from http://rssocar.psa.gov.ph/agri culturereleases/2016%20Crop%20Production:%20Cabbage,%20Carrot%20and %20Pot ato.

CALORA, JR., F.G. ET AL. 2011. Biophysical Characterization and Socio Economic Profiling in Benguet, Philippines (Vulnerability and Adaptation Capacity Assessment SYNTHESIS REPORT). Retrieved on 21 March 2018 from https://issuu.com/mdgf1656/docs/bsu_synthesis_report_final.

DAVID .C. 2014. Frost attacks Benguet veggies, DA promised to help farmers. Retrieved on 21 March 2018 http://bayanihannews.com.au/2014/01/09/frost-attacks-benguet-veggies-da-promised-to-help-farmers/

FAGYAN.A.W. 2017. 8 villages in Benguet susceptible to climate change. Retrieved on 21 March 2018 from http://www.sunstar.com.ph/baguio/opinion/2017/06/07/8-villages-benguet-susceptible-climate-change-546212

FAST FACTS. Retrieved on 21 March 2018 from http://www.benguet.gov.ph/index.php/2- uncategorised?start=15.

LAPNITEN K.S. 2015. Drought takes toll on Benguet farms. Retrieved on 21 March 2018 from https://www.rappler.com/nation/91025-drought-toll-benguet-farms

LAUREAN C.P, BATANI S.R, TAD-AWAN B.A., FAGYAN A.W., LAGMAN C.A., NAGPALA A.L., BASALONG A.A., BARTOLO D., LUIS L.L., AND LIMWAS J. 2017. Building Farmers' Resilience in Disaster Prone Vegetable Terrace in Atok and Buguias, Benguet, Philippines. Proceedings of BSU RDE In-house Review 2017.

MALAMUG, J.F., CARLOS, E.D., TIW-AN, C.C., AND GUDAYEN, D.S. 2017. Alternative Crop Shelter Designs for the Production of High-Value Crops (Lettuce, Broccoli, and Strawberry) in the Highlands. 7th Joint HAARRDEC-CIERDEC and 27th HAARRDEC Regional Symposium on RDE Highlights (RSRDEH) for Agriculture, Forestry and Natural Resources (AFNR), Industry and Social Sectors and 1st Regional Student Research Congress.

MASANGCAY, T.D., JC Perez, MK Dalmo. 2009. Validation of Levels of Resistance of Potato Varieties Against Late Blight (*Phytophthorainfestans* (Mont) de Bary). Research report during the Agency In-House Review

PHILIPPINE DAILY INQUIRER. 2010. Benguet 2nd 'most vulnerable' province. Retrieved on 21 March 2018 from http://climatechange.searca.org/index.php/climate-change-latest- news/philippines/102-benguet-2nd-most-vulnerable-province

WANG, F. (n.d.). The Importance of Quality Potato Seed in Increasing Potato Production in Asia and the Pacific Region. Retrieved 3 July 2018 from the Food and Agriculture Organization's Website, http://www.fao.org/docrep/010/i0200e/I0200E10.htm

Appendix 1. Long List of CRA Practices in Benguet

Municipality	CRA Practice	Description
Atok	Drainage Canals	Landslides due to continuous monsoon rain, heavy rain and typhoons are claimed to cause the closure of farm-to-market roads and decrease planting area. Farmers suggest establishing and making proper drainage canals to direct the excessive water flow.
	Protected cultivation	Protected cultivation includes the use of greenhouse, macro or microtunnels or black net to protect the plant from continuous rains or strong typhoons as well as hailstorms, frosts and strong winds.
	*Water tank/ Rainwater Harvester	Availability of water is the major determinant and consideration before engaging in vegetable production. During drought or dry season, the production area is limited depending on the available water collected or could be pump from water sources thus limiting production. Farmers also identified that water is important during frost occurrence to have a ready water for spraying or sprinkling the crops covered with frost to thaw the ice. Around 70 to 95% recovery in cabbage was estimated if water is available during the occurrence of frost.
Buguias	*Use of resistant varieties	Increasing pest incidence and pest prevalence during the growing season was observed to be decreasing production and aggravated by the increase in production inputs such as pesticides. With the use of resistant varieties, frequency of chemical spraying are reduced thus increasing the returns or profit. The use of resistant varieties in combination with other control measures such as proper cultural management is still the best approach.
	Organic Farming	Organic farming allows integration of multiple crops and utilizes farm resources as farm inputs such as plant debris for compost fertilizers and botanical extracts for pests control. Organically-produced vegetables have increasing demand due to increasing awareness on the health hazards posed by the use of chemical inputs for the farmers and consumers. Around 5% of the

		farmers are into transition from conventional farming to organic farming.
	Wind breaker	Strong winds usually occur in November to March that coincides with the planting time for vegetable crops. Strong winds causes 75% or total yield loss in potato especially when plants are twisted during the tuberization. Net screen or sacks are spread and ends are tied in poles as temporary wind breaker to cover the farms. The establishment of the wind breaker during the occurrence of strong winds reduces the loss up to 65%. Frequent watering is also needed as there is higher transpiration and water dispersion during strong winds occurrences.

** CRA practices chosen by the team to assess*

ANNEX 2

Climate Risk Vulnerability Assessment Report for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA

Climate Risk Vulnerability Assessment Report for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA

Project Leader: Elizabeth Supangco-Dela Paz
Geographic Information System Specialist: Gillian Katherine L. Inciong
Research Assistant: Ralphael Gonzales

I. *Introduction*

A. Description of the study site

Climate change is considered a major global environmental problem and a great concern of developing countries like the Philippines. The report of Second National Communication (2009) stated that climate change is likely to threaten the following: food production, increase water stress, and decrease water availability as a result in sea-level rise. This could flood crop fields and coastal settlements. Most of the population in the Philippines is largely dependent on the agriculture sector, followed by forests and fisheries for their livelihood.

Region IV B, also known as the MIMAROPA region. It lies along the Southern Tagalog region in Luzon. It is comprised of five island provinces namely; Oriental Mindoro, Occidental Mindoro, Marinduque, Romblon, and Palawan.

MIMAROPA has a total land area of 2,962,087 hectares and 542,218 hectares is designated to agriculture. Although palay and corn are its primary produce, the region is known for its calamansi and seaweed production. Other yields include coffee, mango, coconut, banana, root crops, and rambutan among others (PSA, 2016). Characterized by types I and II climate condition, the region experiences nearly wet season throughout the year (PSA, 2016). Having the Philippines as one of the most vulnerable countries in the world, MIMAROPA is not spared when it comes to extreme natural events. With this, the region initiated efforts in addressing climate change. One of the initiatives made in the region aimed to enhance the capacities of the local communities in preparing them for the adverse effects of climate change alongside with the conservation of the region's natural resources (PIA MIMAROPA,2016)

Oriental Mindoro was selected to be the study site for the AMIA 2++. Oriental Mindoro lies 45 kilometers south of Batangas and 130 kilometers south of Manila. It is bounded on the North by Verde Island Passage; Maestro del Campo Island and Tablas Strait on the East; Semirara Island on the South and Occidental Mindoro on the West. It has a total land area of 4,238.38 sq.km. (PIA MIMAROPA, 2018).

B. Framework of CRVA (based on CIAT's framework)

The following presents an assessment of the three key dimensions of vulnerability for the agricultural sector:

1. Exposure: The nature and degree to which a system is exposed to significant climate variations (IPCC, 2014).
2. Sensitivity: The increase or decrease of climatic suitability of selected crops to changes in temperature and precipitation.
3. Adaptive Capacity: The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2014).

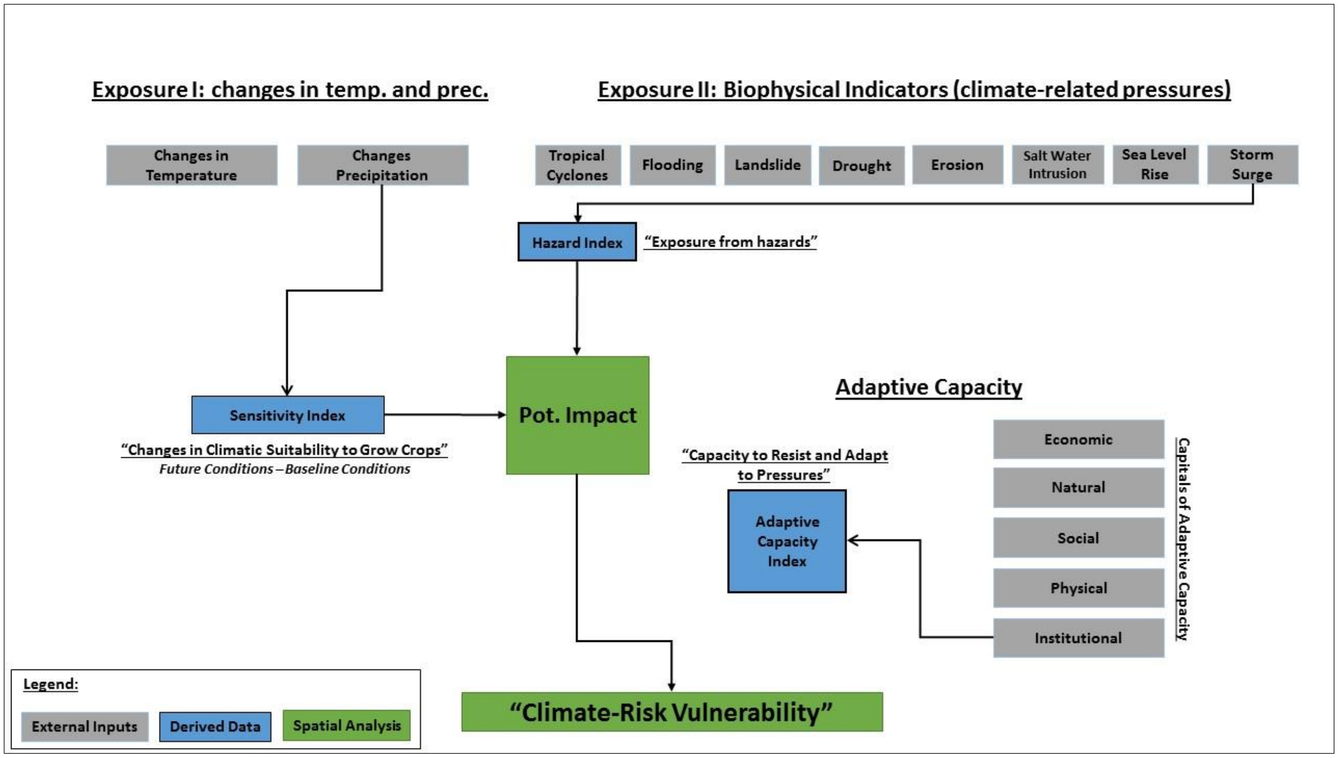


Figure 1. Climate Risk Vulnerability Assessment Framework.

II. *Methodologies of CRVA*

A. *Hazards*

a. *Overview of hazard dataset used*

In general, there are eight (8) identified natural hazards in the Philippines. These are the following: typhoon, flooding, drought, erosion, landslide, storm surge, sea level rise and saltwater intrusion. The hazard dataset used in this study was from the output of the previous Adaptation and Mitigation Initiative in Agriculture (AMIA) project of the Department of Agriculture. Table 1 summarize the hazard data, its source and resolution from CIAT.

Table 1. Overview of hazard dataset used for exposure component.

Parameter	Source	Unit of Measurement, spatial and temporal resolution
Typhoon	UNEP/UNISDR, 2013 (http://preview.grid.unep.ch/index.php?preview=data&events=cyclones&evcat=2&lang=eng)	1 kilometer pixel resolution. Estimate of tropical cyclone frequency based on Saffir-Simpson scale category 5 (> 252 km/h) from year 1970 to 2009.
Flooding	AMIA multi-hazard map / baseline data from Mines and Geosciences Bureau, Department of Environment and Natural Resources (MGB, DENR)	1:10,000 scale. Susceptibility of flood risk for Philippines from the past 10 years
Drought	AMIA multi-hazard map / baseline data from National Water Resources Board	Groundwater potential for the Philippines
Erosion	AMIA multi-hazard map / baseline data from Bureau of Soils and Water Management	1:10,000 scale. Soil erosion classified from low to high susceptibility
Landslide	AMIA multi-hazard maps / baseline data from MGB, DENR	1:10,000 scale. Landslide classified from low to high susceptibility
Storm Surge	AMIA multi-hazard maps / baseline data from Disaster Risk and Exposure Assessment for Mitigation, Department of Science and Technology (DREAM, DOST)	
Sea level rise	AMIA multi-hazard map	Assumption based on 5m sea level rise
Saltwater intrusion	AMIA multi-hazard map / baseline data from the NWRB	Groundwater potential for the Philippines

b. *Developing hazard weights*

The hazard scores used in this study was given by the partner agency of the project which is CIAT. It was adopted in the previous Adaptation and Mitigation Initiative in Agriculture project. During the workshops, it was agreed by the researchers and partner RFO's GIS focal person that hazard scores will be the same as the previous project.

Table 2.Hazard scores per Island group based from the previous Adaptation and Mitigation Initiative in Agriculture (AMIA) project.

Hazards	**Island Group**		
	Luzon (%)	Visayas (%)	Mindanao (%)
Typhoon	**20.00**	18.21	16.95
Flood	**19.05**	16.40	15.25
Drought	**14.25**	16.17	16.95
Erosion	**11.43**	12.57	12.71
Landslide	**8.57**	10.72	14.41
Storm Surge	**9.52**	10.39	8.47
Sea Level Rise	**5.71**	8.33	5.08
Saltwater Intrusion	**11.43**	7.21	10.17

B. Sensitivity

a. Crop selection and collection of occurrence data

A series of meetings with the Provincial Agriculture's Office and DA-Field Regional Offices was conducted to identify the crops that will be analyzed for climate suitability. There are three (3) crops identified in Oriental Mindoro. These are the following: banana, calamansi, and rice.

Participatory mapping approach was used to collect point data for crop occurrences. The participants were agricultural technicians and staff from the different local government units, representatives from the provincial agriculture's office, and Department of Agriculture-regional field office. The mapping exercise was conducted to rapidly collect data from the field. A map was provided with features such as road networks, river network, digital elevation model of the province, municipal and barangay boundaries and satellite imagery. A fishnet with 1 x 1 km grid size was also included in the map which the grid represents the climate resolution. The participants identifies the different crops that occur for each grid of the fishnet. A procedure was followed that for each crop, aside from the personal knowledge, it should be based on the current reports. Furthermore, the researchers asked the participants to bring the available data for the area, production and yield data at the barangay level. Only one occurrence record was allowed for the same crop, but multiple occurrences from different crops for each grid was allowed. The researchers also asked the participants to document the yield and categorically identify the crop occurrences with high, moderate and low yield based form the national yield averages reported by the Philippine Statistics Authority.

b. Baseline Climate Condition

There are twenty (20) bioclimatic variables available for the crop distribution modeling. For the case of Oriental Mindoro, only six (6) bioclimatic variables were considered for modelling. For the temperature parameters only annual mean temperature, isothermality, and temperature seasonality were used. While for the precipitation related parameters only annual precipitation, precipitation of wettest month, and precipitation of driest month were considered. Table 3 presents the description of each bioclimatic variables.

Table 3.Bioclimatic variables used in crop distribution modeling

Parameters	Description (O'Donnell, M and Ignizio, D. 2012)
Temperature Related	
Bio_1-Annual mean temperature	**Annual mean temperature derived from the average monthly temperature**
Bio_2-Mean diurnal range	The mean of the monthly temperature ranges (monthly maximum minus monthly minimum)
Bio_3-Isothermality	**Oscillation in day-to-night temperatures**
Bio_4- Temperature seasonality	**The amount of temperature variation over a given year based on standard deviation of monthly temperature averages**
Bio_5- Maximum temperature of warmest month	The maximum monthly temperature occurrence over a given year (time series) or averaged span of years (normal)
Bio_6- Minimum temperature of coldest month	The minimum monthly temperature occurrence over a given year (time-series) or averaged span of years (normal)
Bio_7-Temperature annual range	A measure of temperature variation over a given period.
Bio_8-Mean temperature of wettest quarter	This quarterly index approximates mean temperatures that prevail during the wettest season.
Bio_9-Mean temperature of driest quarter	This quarterly index approximates mean temperatures that prevail during the driest quarter
Bio_10- Mean temperature of warmest quarter	This quarterly index approximates mean temperatures that prevail during the warmest quarter
Bio_11-Mean temperature of coldest quarter	This quarterly index approximates mean temperatures that prevail during the coldest quarter
Precipitation Related	

Bio_12- Annual precipitation	**This is the sum of all total monthly precipitation values**
Bio_13-Precipitation of wettest month	**This index identifies the total precipitation that prevails during the wettest month.**
Bio_14- Precipitation of driest month	**This index identifies the total precipitation that prevails during the driest month**
Bio_15-Precipitation seasonality	This is a measure of the variation in monthly precipitation totals over the course of the year. This index is the ratio of the standard deviation of the monthly total precipitation to the mean monthly total precipitation and is expressed as percentage
Bio_16-Precipitation of wettest quarter	This quarterly index approximates total precipitation that prevails during the wettest quarter
Bio_17-Precipitation of driest quarter	This quarterly index approximates total precipitation prevails during the wettest quarter
Bio_18-Precipitation of warmest quarter	This quarterly index approximates total precipitation that prevails during the warmest quarter
Bio_19-Precipitation of coldest quarter	This quarterly index approximates total precipitation that prevails during the coldest quarter
Bio_20-Number of consecutive dry days	Consistent number considered as dry days

c. *Future Conditions*

Crop distribution were modeled for the present and future conditions to assess the degree of changes in crop suitability. Representative concentration pathway (RCP) 8.5 scenario based from IPCC Assessment Report 5 was used as basis for future projection of climate change by year 2050. RCP 8.5 is characterized as increasing greenhouse gas emissions over time. As ensemble of 32 global circulation models (GCMs) based from was used for this assessment to assess the impact of climate change to crops. All the data came from CIAT. They also processed the GMCs to generate 1km resolution climate database that can be used for ecological niche modeling. The climate database that was used in this project is available online: http://www/ccafs-climate.org/data_spatial_downscaling/.

d. *Model Implementation*

Maxent Model was used to assess the sensitivity of crops to climate. Climate and climate change suitability of crops was assessed using these two step process: First, the model was run and assessed for baseline conditions. Climate and climate change suitability of crops was assessed using a twostep process: First, the model was run and assessed for baseline conditions. We employ two ways to assess the performance of the mode; 1) value of the "Area under curve" or AUC if greater than 85%, and 2) visual inspection where a crop is reported to be present. Second, if those criteria for step 1 was satisfied, then we run it for future conditions. Before we run each instance of Maxent, we filter geographic records of presence data. We remove points that are within a specified distance from each other using a script made by the CIAT personnel. This is to reduce point spatial autocorrelation due to high point density which can affect model performance (over fit).

C. Adaptive Capacity

A wide secondary data collection from the different sources were used for the needed indicators per capital. The National Competitive Council (NCC) provided an extensive and up-to-date database. Furthermore, the values of the indicators were integrated in the shapefile municipal boundaries. Each of the indicators were normalized and were treated with equal weights. The sum of the 34 indicators provided the final adaptive capacity index. Five equal breaks were developed to establish the thresholds: 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High), and 0.80-1.00 (Very High).

Table 4. Indicators used in analyzing adaptive capacity.

Attribute Capital	Indicator	Source
Economic	Inflation Rate	PSA, 2014
	Cost Electricity Firms and Customers	NCC, 2015
	Diesel Price	NCC, 2015
	Agricultural Minimum Wage (Plantation)	NCC,2015
	Agricultural Minimum Wage (No Plantation)	NCC, 2015
	Number of Rural Banks	NCC, 2015
	Number of Finance Cooperative	NCC, 2015
	Number of Microfinance Institutions	NCC, 2015
	Total Banks and Finance Institutions	NCC, 2015
Natural		
	Forest Cover	NAMRIA Land Cover Map
	Presence of Irrigation in LGUs	CIAT
Human (Health)	Number of Public Doctors	NCC, 2015
	Number of Public Health Service	NCC, 2015
	Number of Private Doctors	NCC, 2015
	Number of Private Health Service	NCC, 2015
	Number of Health Service Manpower	NCC, 2015
	Total Public Health Facilities	NCC, 2015
	Total Private Health Facilities	NCC, 2015
Human (Education)	Ratio of Public Teachers to Students	NCC, 2015

	Number of Public Secondary Schools	NCC, 2015
	Number of Private Secondary Schools	NCC, 2015
	Number of Public Tertiary Schools	NCC, 2015
	Public Vocational Schools	NCC, 2015
Physical	Total Road Network	NCC, 2015
	Road Density	NCC, 2015
	Percent of Household with Water Service	NCC, 2015
	Percent of Household with Electricity Service	NCC, 2015
Anticipatory	Telephone Companies and Mobile Service Providers	NCC, 2015
	Automatic Weather Station	ASTI, DOST, 2017
Institutional	Presence of office implementing CLUP	NCC, 2015
	Presence of DRRMP	NCC, 2015
	Presence of DRRMO	NCC, 2015
	Presence of EO and Ordinance	NCC, 2015
	DRRM Budget Allocation	NCC, 2015

D. *Climate risk vulnerability maps*

The climate risk vulnerability maps were formed using the following formula:

$$f(Haz, Sens, AC) = \sum_{n=i}^{n} \left(\left(Haz_{(w_h)} + Sens_{(w_s)}\right) + 1 - AC_{Wa}\right)$$

where: Haz=hazard index, Sens=sensitivity index ($_i$=crop), and AC=adaptive capacity index. W_h=weight given for hazard, W_s=weight given for sensitivity, and W_a=weight given for adaptive capacity.

Furthermore, the analysis for each component of vulnerability is subjective. Different weights or scenarios was set up by CIAT in order to validate the result of the assessment of vulnerability. The different weight proportions was shown in Table 5.

Table 5. Scenarios used is assessing climate risk vulnerability

Scenario	Sensitivity (%)	Hazard (%)	Adaptive Capacity (%)
1 (reference)	15	15	70
2	33.33	33.33	33.33
3	25	25	50
4	20	20	60

5	30	30	40

III. Results and Discussion

A. Hazard Maps

The Philippines is known to be situated in the Pacific Ring of Fire. On account of its geographical position as well as climate and geographical setting, the Philippines has been frequently hit by natural disasters. It is considered as one of the world's most natural disaster-prone countries due to high incidence of typhoons, floods, landslides, droughts, among others (Dait, 2013).

There are eight (8) hazards used in this project to come up with the hazard map or hazard index. These were the following: tropical cyclone, flood, drought, erosion, landslide, storm surge, saltwater intrusion, and sea level rise.

Tropical Cyclone

On the average, there are about twenty (20) typhoons that enter the Philippine Area of Responsibility every year (PAG-ASA, 2011). In the case of Oriental Mindoro, the municipalities of Socorro and Pola have very high exposure to tropical cyclone. While the municipalities located at the Southern part of the province have low exposure to tropical cyclone. There are the following: Bansud, Bongabong, Roxas, Mansalay, and Bulalacao. According to the DA-RFO of MIMAROPA, typhoons in Mindoro usually occur in the later part of the year but in the months of June to December is considered as the rainy season for the whole island.

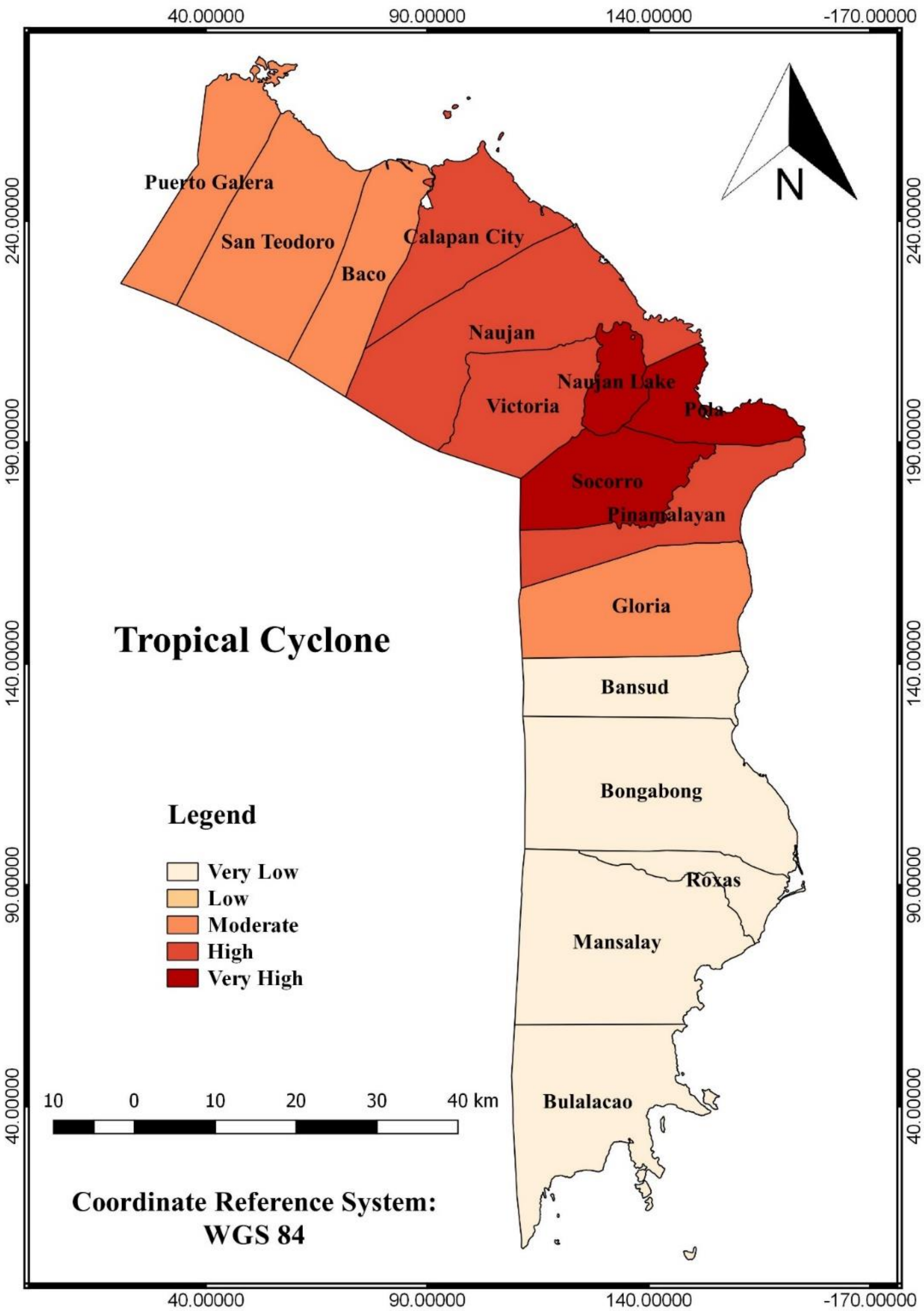


Figure 2. Tropical cyclone map of Oriental Mindoro.

Flooding

Flooding is one the major problem in the country during the rainy season or monsoon season. Typhoons also causes flooding in most of the areas in the country. Figure 3 shows that the most exposed municipalities in Oriental Mindoro were Calapan City and Roxas. While the following municipalities were considered had low exposure to flooding: Puerto Galera, San Teodoro, Pola, Gloria, Bansud, Mansalay, and Bulalacao.

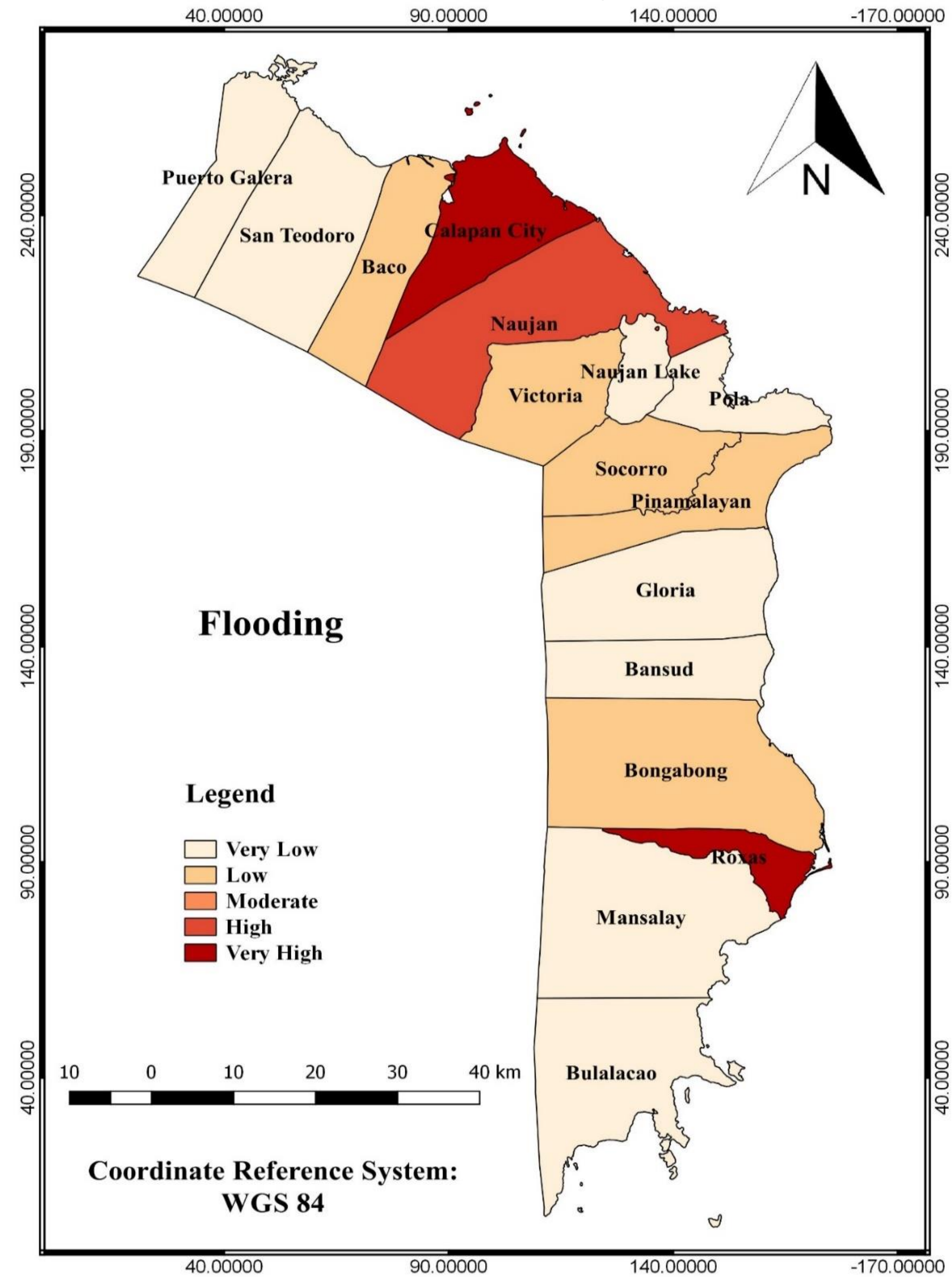


Figure 3. Flood map of Oriental Mindoro

Landslide

According to the USGS, landslide is the movement of a mass of rock, debris, or earth down a slope. Puerto Galera, San Teodoro, and Mansalay are highly exposed to landslide while Calapan City is the least to be exposed in landslide.

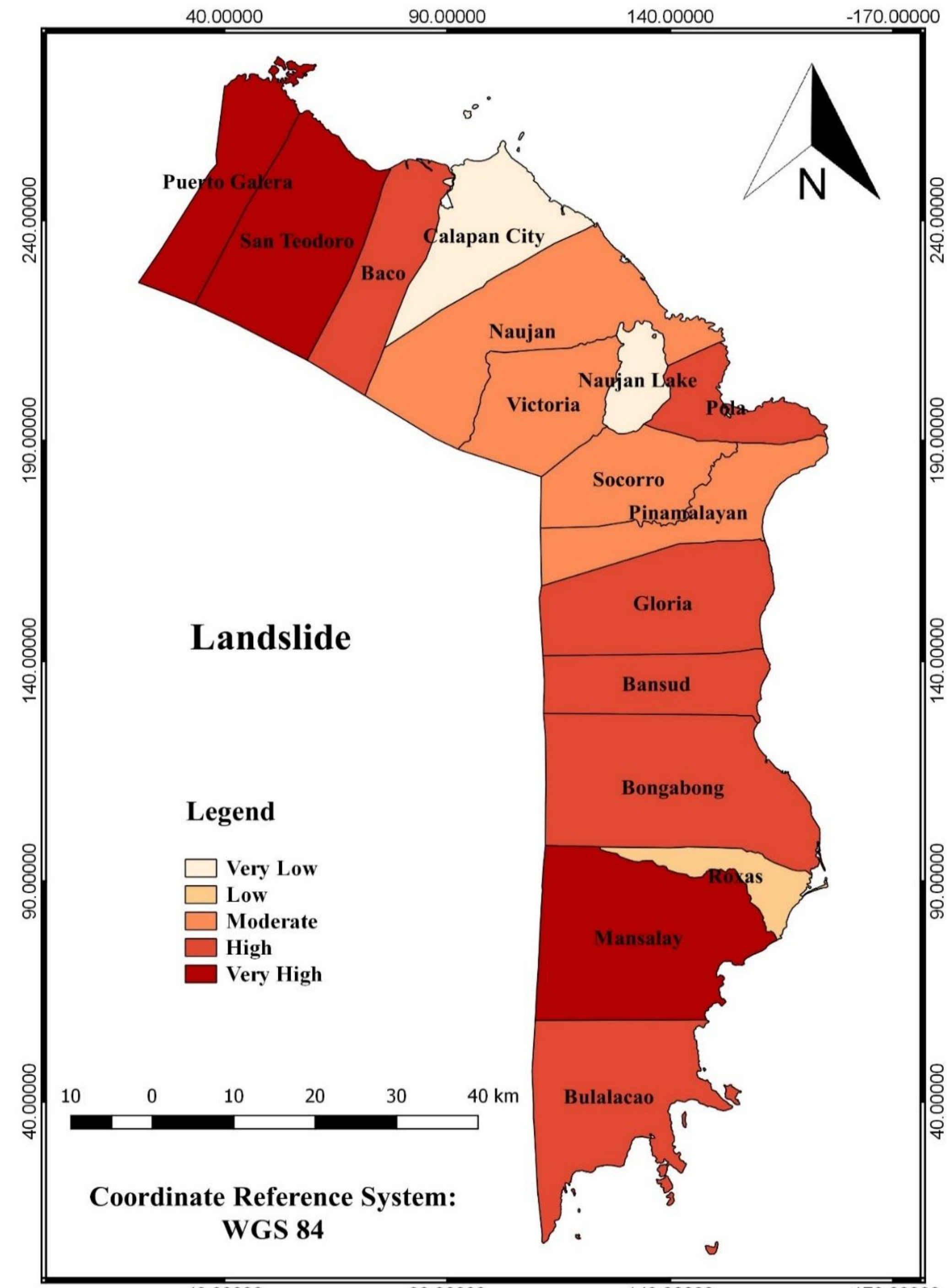


Figure 4. Landslide map of Oriental Mindoro.

Drought

Drought has a major impact in the agricultural sector. This hazard is also difficult to observe. The municipality of Bulalacao has the highest exposure while the municipalities of Puerto Galera, Calapan City, and Roxas were the least to be exposed in this hazard. According to the municipal agriculture officer of Bulalacao, the climate within the municipality is usually dry throughout the year.

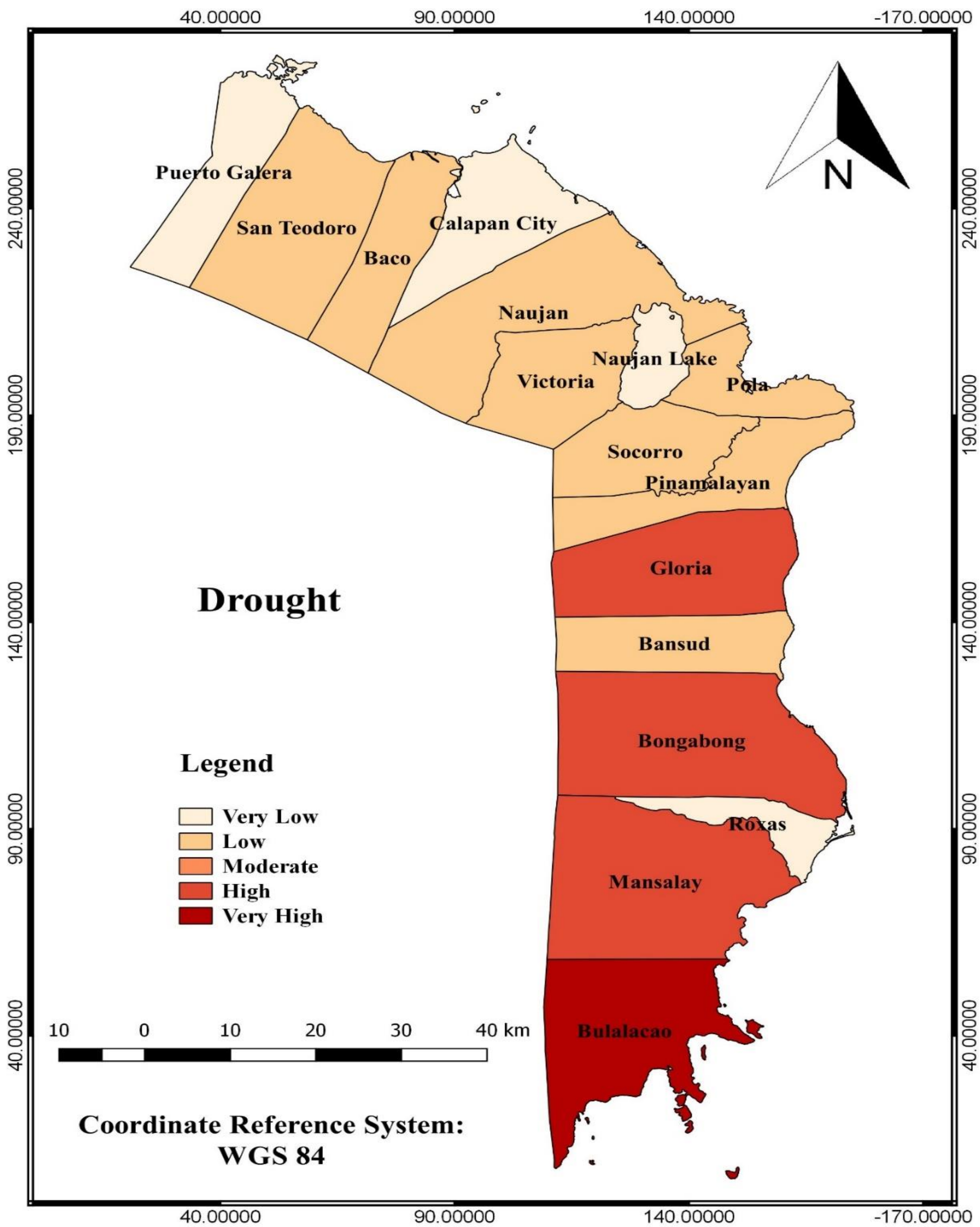


Figure 5. Drought map of Oriental Mindoro.

Erosion

Soil erosion is occurring process that affects all landforms. In agricultural sector, soil erosion refers to the wearing away of the topsoil by the natural physical forces of water and wind or through forces associates with farming activities such as tillage (OMAFRA, 2018). The municipalities of Socorro, Mansalay, and Bulalacao were the highly exposed to erosion. On the other hand, Calapan City is the least to be exposed in erosion.

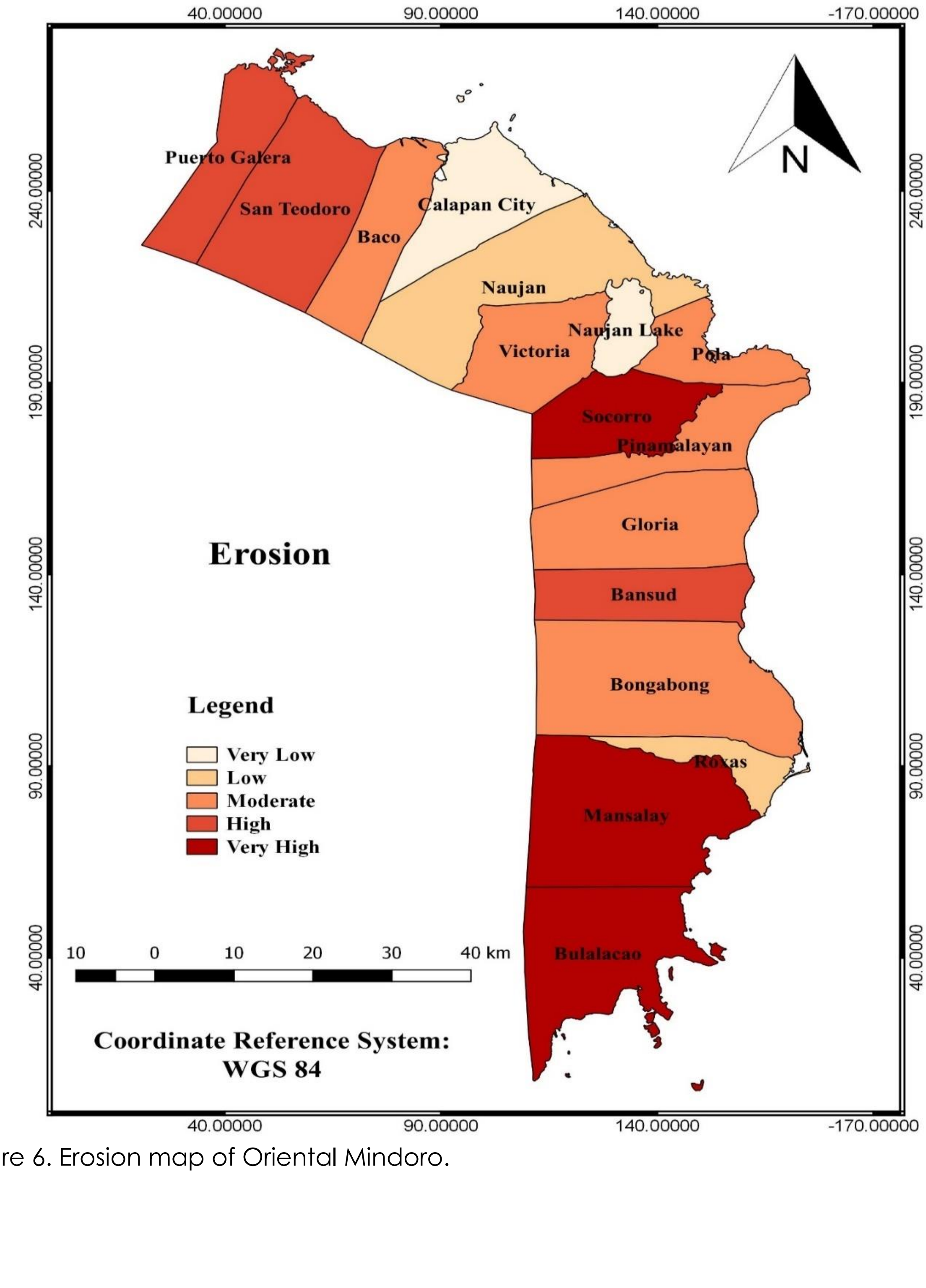


Figure 6. Erosion map of Oriental Mindoro.

Saltwater Intrusion

Saltwater intrusion decreases the freshwater storage in the aquifers, and can result in the abandonment of supply wells. Furthermore, saltwater intrusion occurs by many mechanisms, including lateral encroachment from coastal waters and vertical upcoming near discharging wells (USGS, 2018). The municipality of Gloria is highly exposed in saltwater intrusion while the other municipalities in Mindoro are not likely to experience saltwater intrusion.

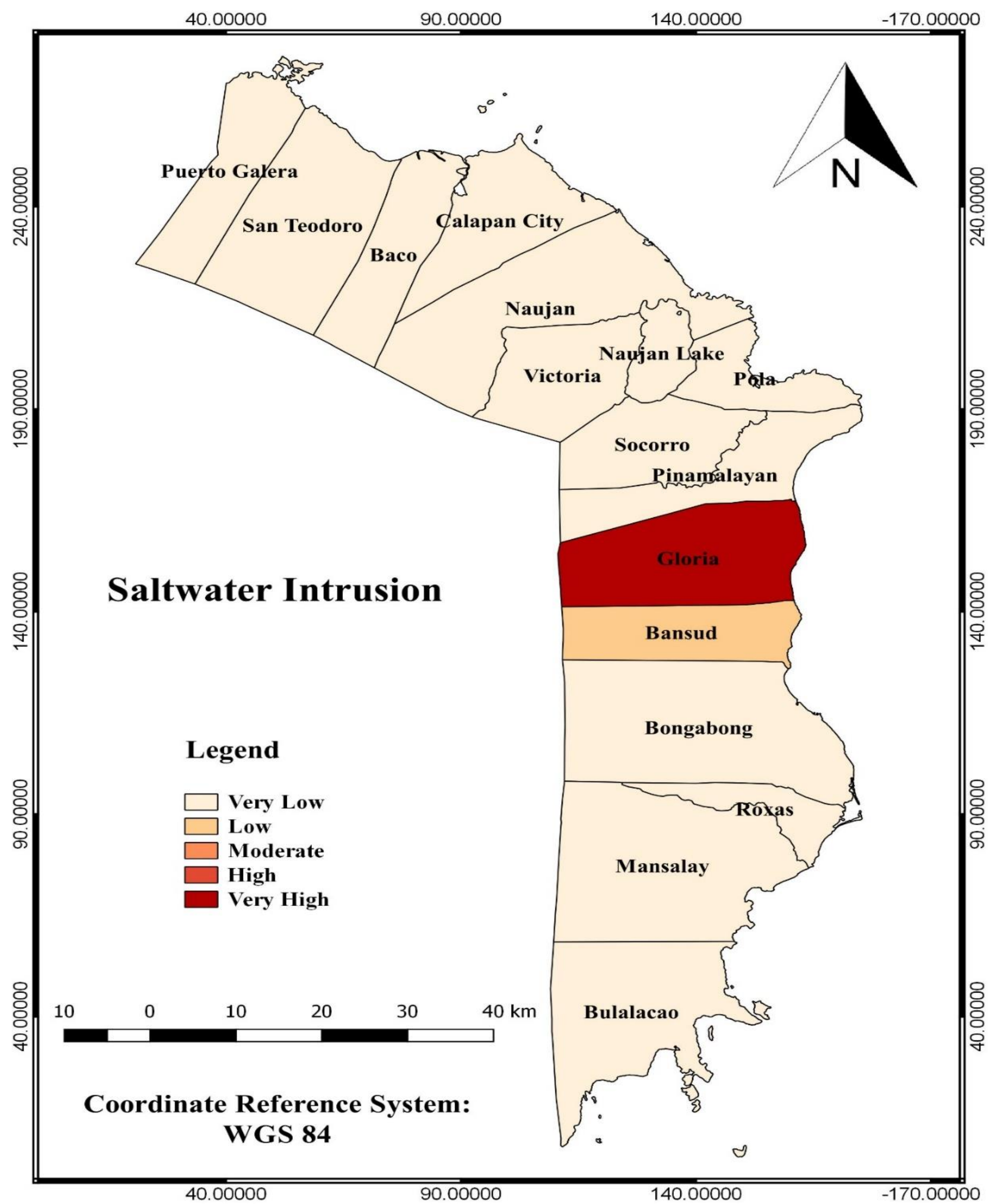


Figure 7. Saltwater intrusion map of Oriental Mindoro.

Sea Level Rise

Sea level rise is caused primarily by the two factors related to global warming: the added water from melting ice sheets and glaciers and the expansion of seawater as it warms (NASA). The municipalities of Baco and Calapan City are highly exposed to sea level rise.

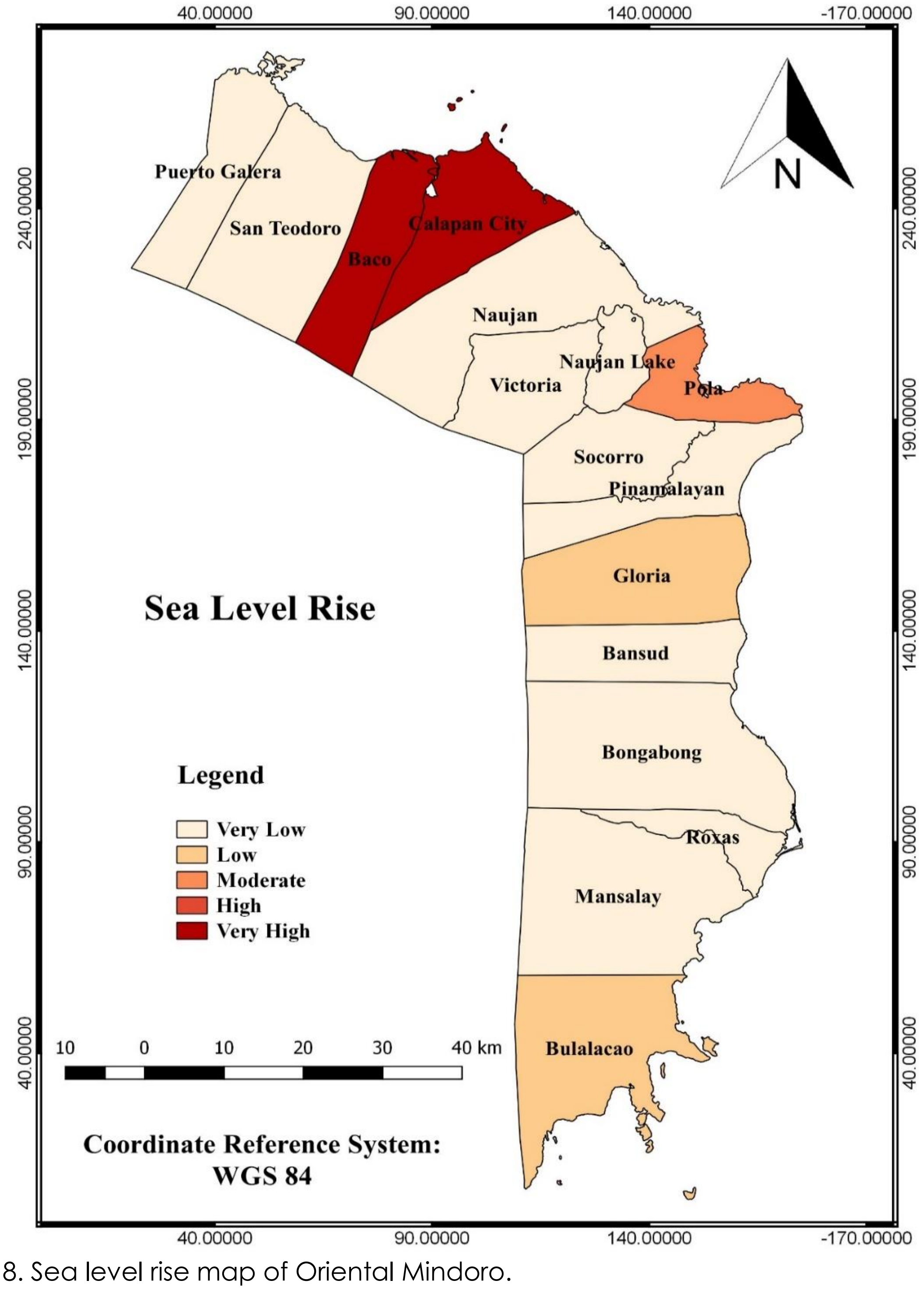


Figure 8. Sea level rise map of Oriental Mindoro.

Storm Surge

According to NOAA, storm surge is the abnormal rise in seawater level during a storm. It is measured as the height of the water above the normal predicted astronomical tide. The surge is caused primarily by a storm's winds pushing onshore. The amplitude of the storm surge at any given location depends on the orientation of the coast line with the storm track, intensity, size and speed of storm. Calapan City is considered as highly exposed in storm surge. While the following municipalities are not likely to be affected by storm surge: Puerto Galera, San Teodoro, Victoria, Socorro, and Bansud.

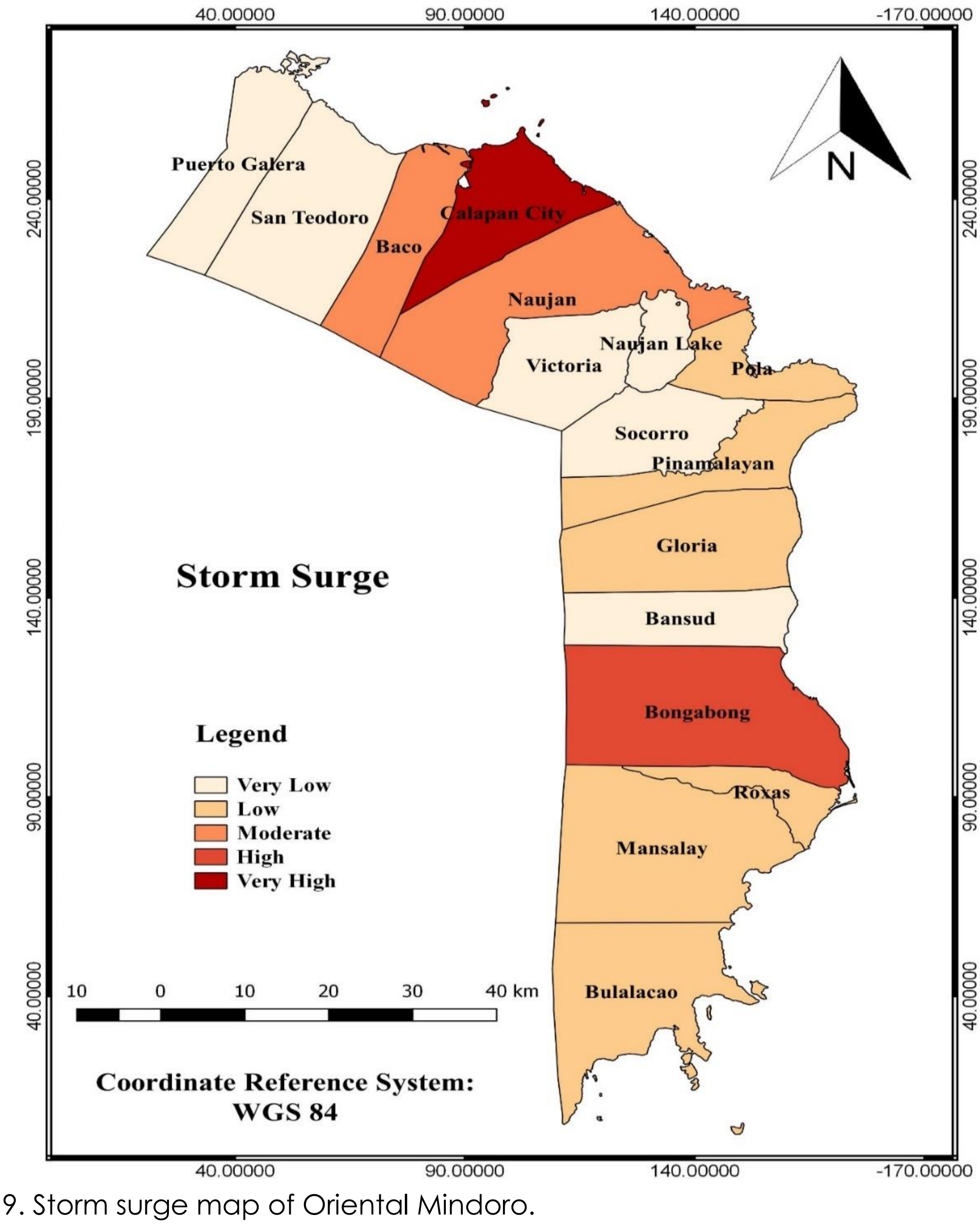


Figure 9. Storm surge map of Oriental Mindoro.

Hazard Map

The eight (8) hazards were summed up to come up with the over-all hazard map of Oriental Mindoro. It shows that the municipalities of Gloria and Bulalacao are highly exposed to hazard while Puerto Galera and Roxas have a very low exposure to hazard.

Table 6. Summary table for Hazard Map

	CLASSES IN EXPOSURE				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
Municipalities	Gloria Bulalacao	Bongabong	Bansud Mansalay	San Teodoro Baco Calapan City Naujan Victoria Pola Socorro Pinamalayan	Puerto Galera Roxas

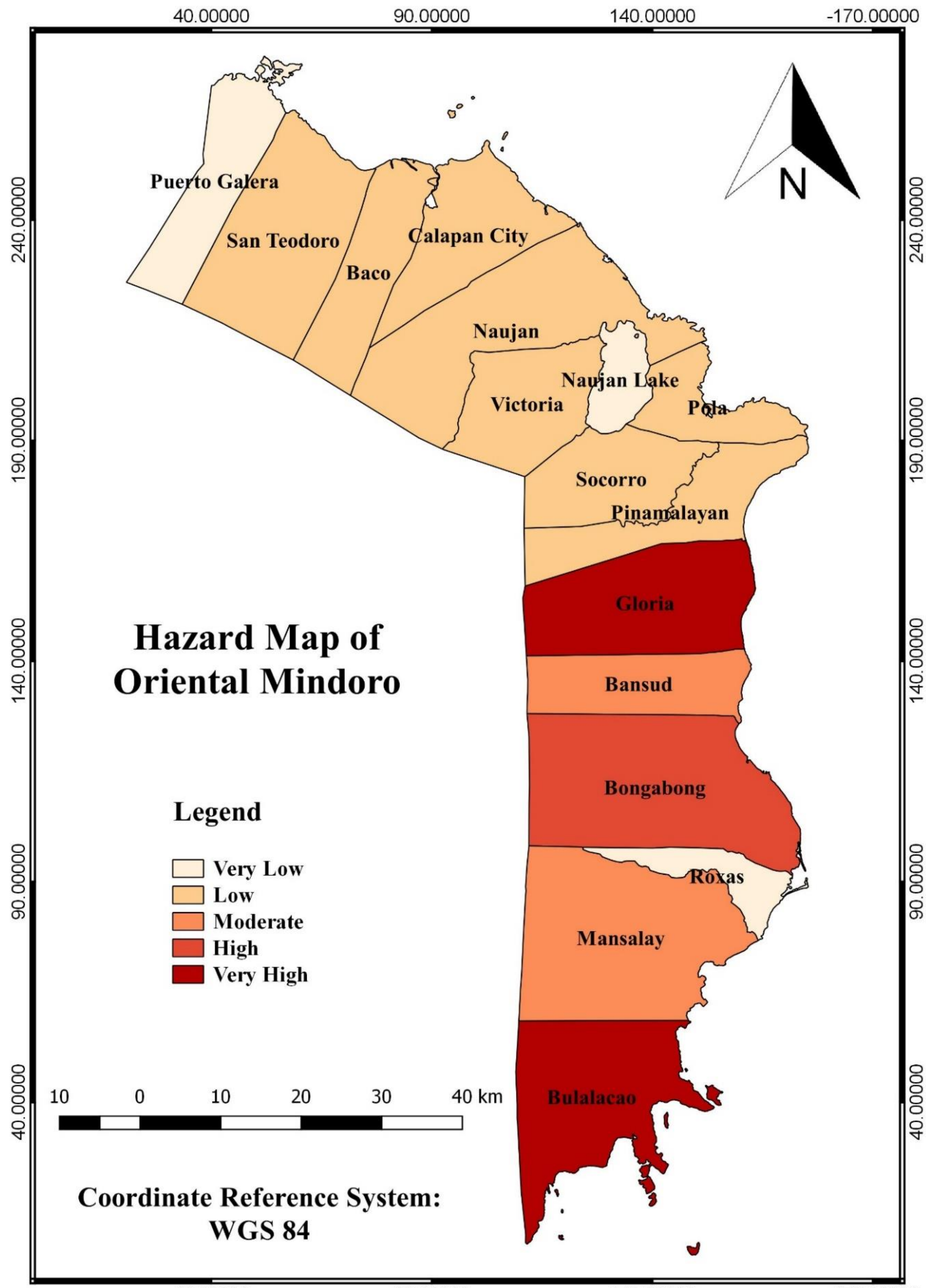


Figure 10. Hazard map of Oriental Mindoro.

B. *Sensitivity maps with different scenarios*

The results shows the changes in climatic suitability for banana, calamansi and rice. In addition, we filter geographic records of presence data. It removes points within a specified distance from each other. In the case of Oriental Mindoro, the following distance (2km, 5km, and 10km) were considered in the analysis of sensitivity.

Banana

Table 7. Sensitivity classification of banana with different scenarios.

Distance Filter Scenario	**CLASSES IN SENSITIVITY**				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
No Filter	Puerto Galera Mansalay	San Teodoro Bansud	Baco Bongabong	Pinamalayan Gloria	Calapan City Naujan Victoria Pola Socorro Roxas Bulalacao
2km distance	Mansalay	Puerto Galera Bansud Bongabong	San Teodoro Baco Roxas	Gloria	Calapan City Naujan Victoria Pola Socorro Pinamalayan Bulalacao
5km distance	Mansalay Bulalacao	Bongabong	Puerto Galera Bansud Roxas	San Teodoro Baco Pinamalayan Gloria	Calapan City Naujan Victoria Pola Socorro
10km distance	Mansalay Bulalacao	Bansud Bongabong Roxas	Puerto Galera Gloria	San Teodoro Baco Victoria Socorro Pinamalayan	Calapan City Naujan Pola

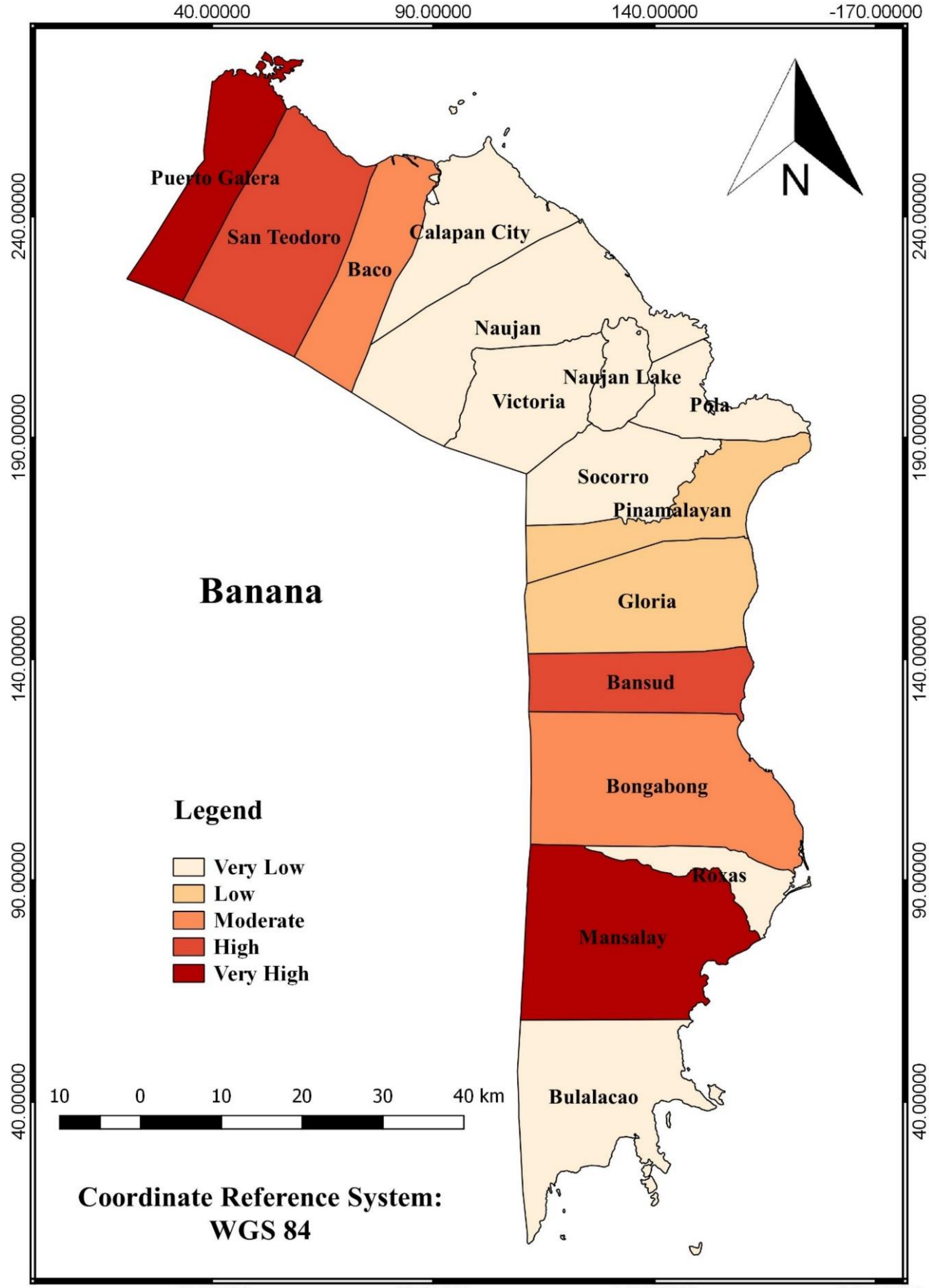


Figure 11. Sensitivity map of banana without filtering.

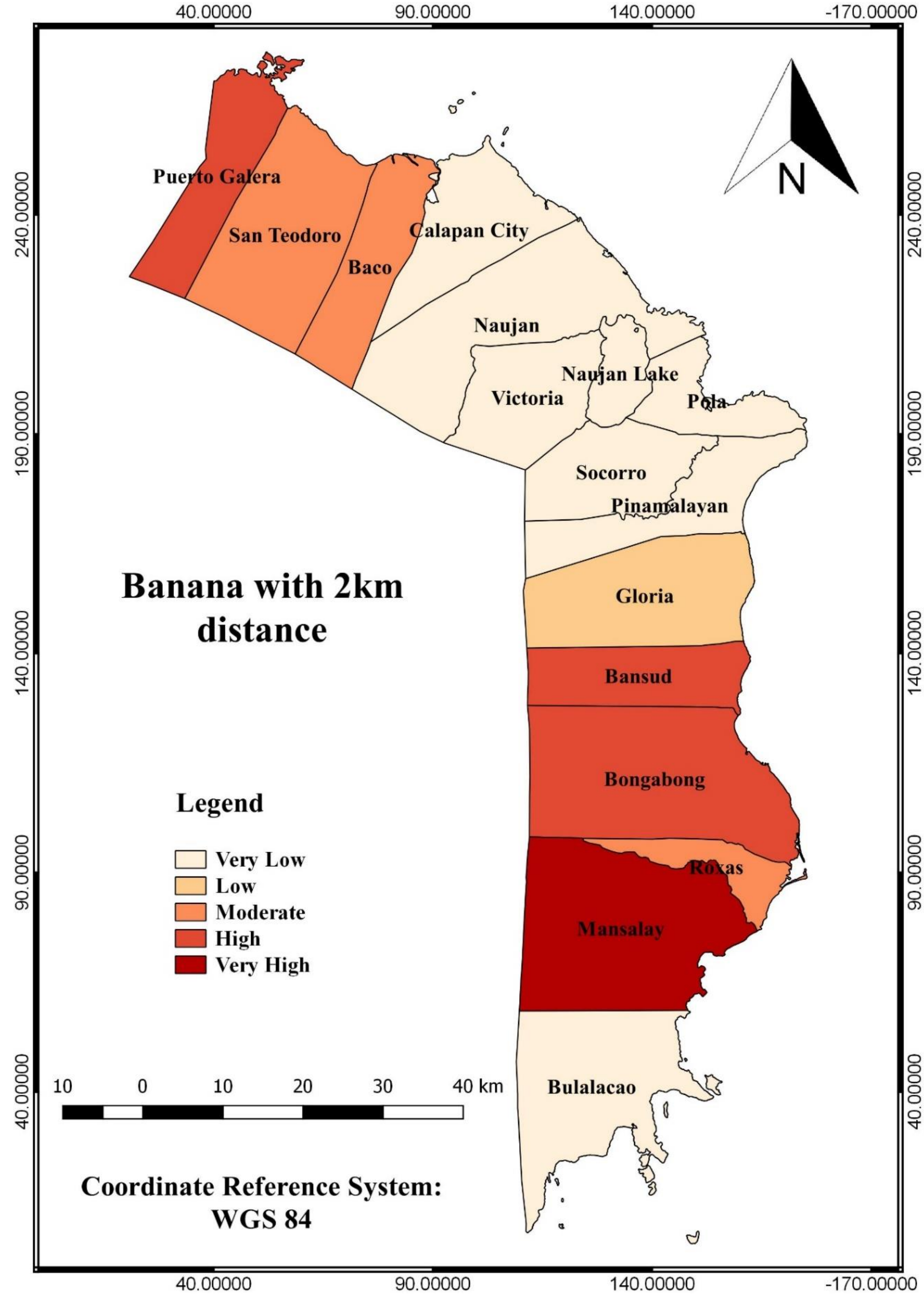


Figure 12. Sensitivity map of banana with 2km distance filtering.

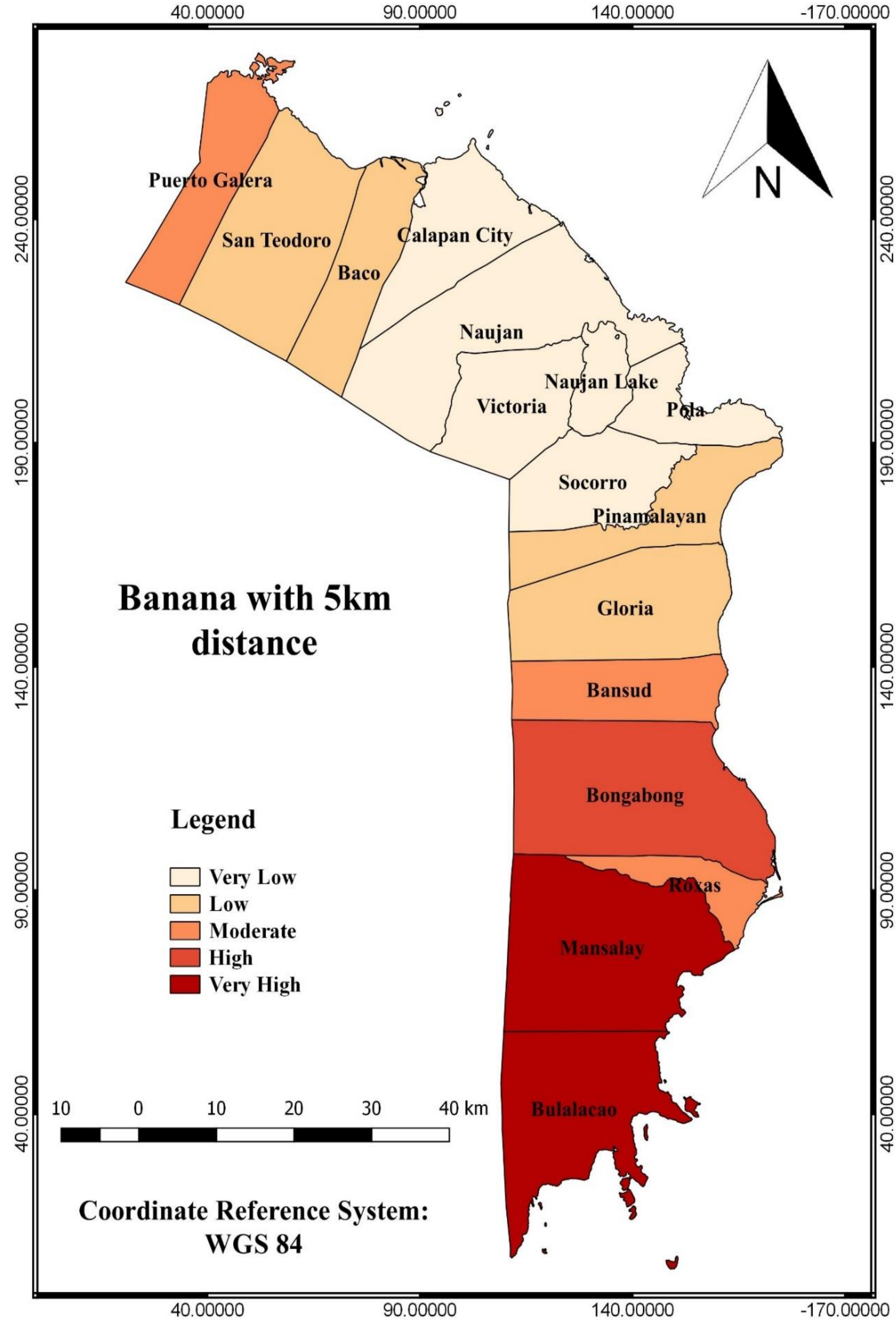


Figure 13. Sensitivity map of banana with 5km distance filtering.

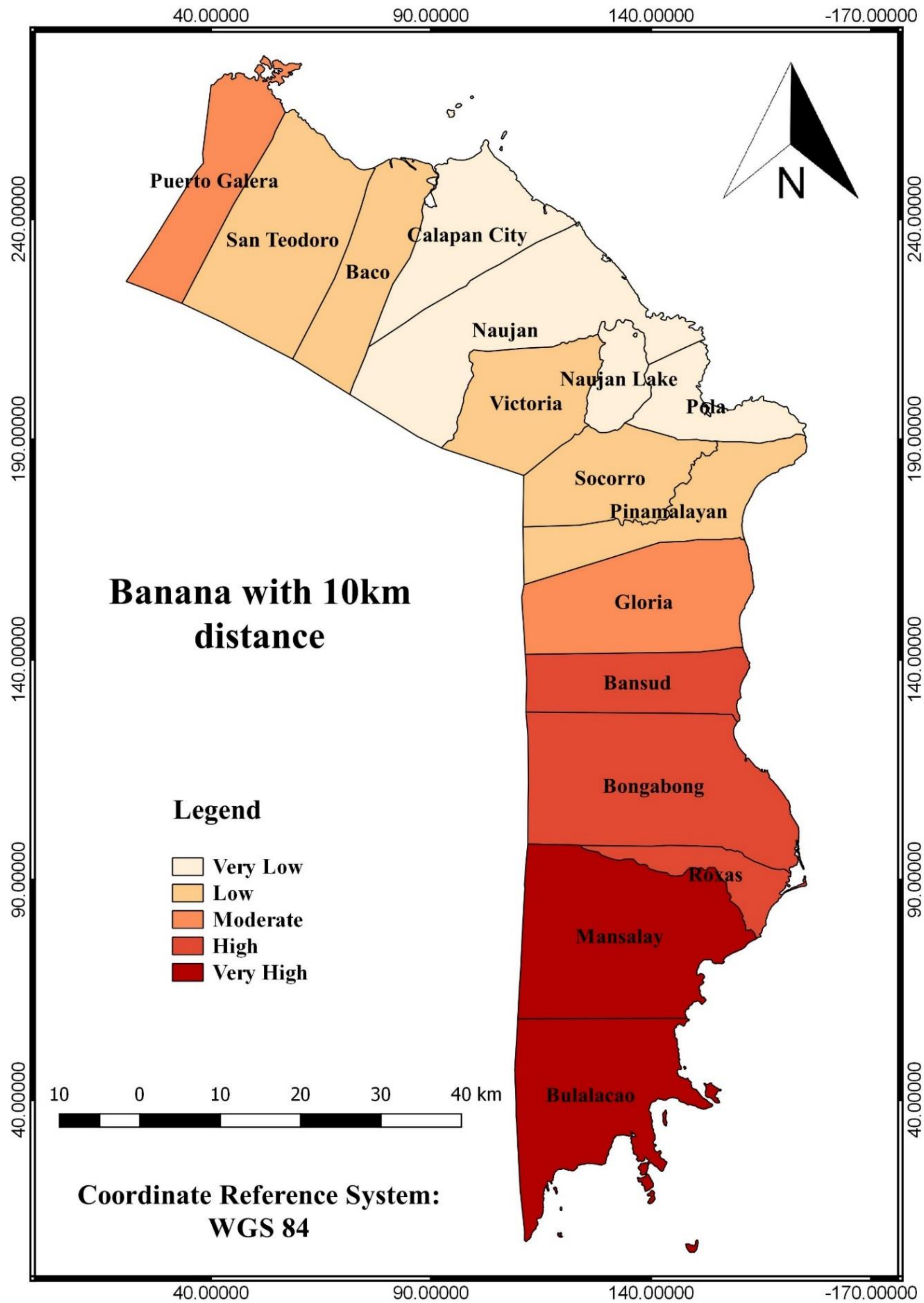


Figure 14. Sensitivity map of banana with 10km distance filtering.

Calamansi

Table 8. Sensitivity classification of calamansi with different scenarios.

Distance Filter Scenario	CLASSES IN SENSITIVITY				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
No Filter	Bulalacao			Puerto Galera Bansud Bongabong	San Teodoro Baco Calapan City Naujan Victoria Pola Socorro Pinamalayan Gloria Roxas Mansalay
2km distance	Bulalacao		Bansud	Puerto Galera San Teodoro Gloria Bongabong Mansalay	Baco Calapan City Naujan Victoria Pola Socorro Pinamalayan Roxas
5km distance	Bulalacao			Mansalay	Puerto Galera San Teodoro Baco Calapan City Naujan Victoria Pola Socorro Pinamalayan Gloria Bansud Bongabong Roxas
10km distance	Bulalacao	Mansalay	Gloria Bansud Bongabong Roxas	Puerto Galera San Teodoro Socorro Pinamalayan	Baco Calapan City Naujan Victoria Pola

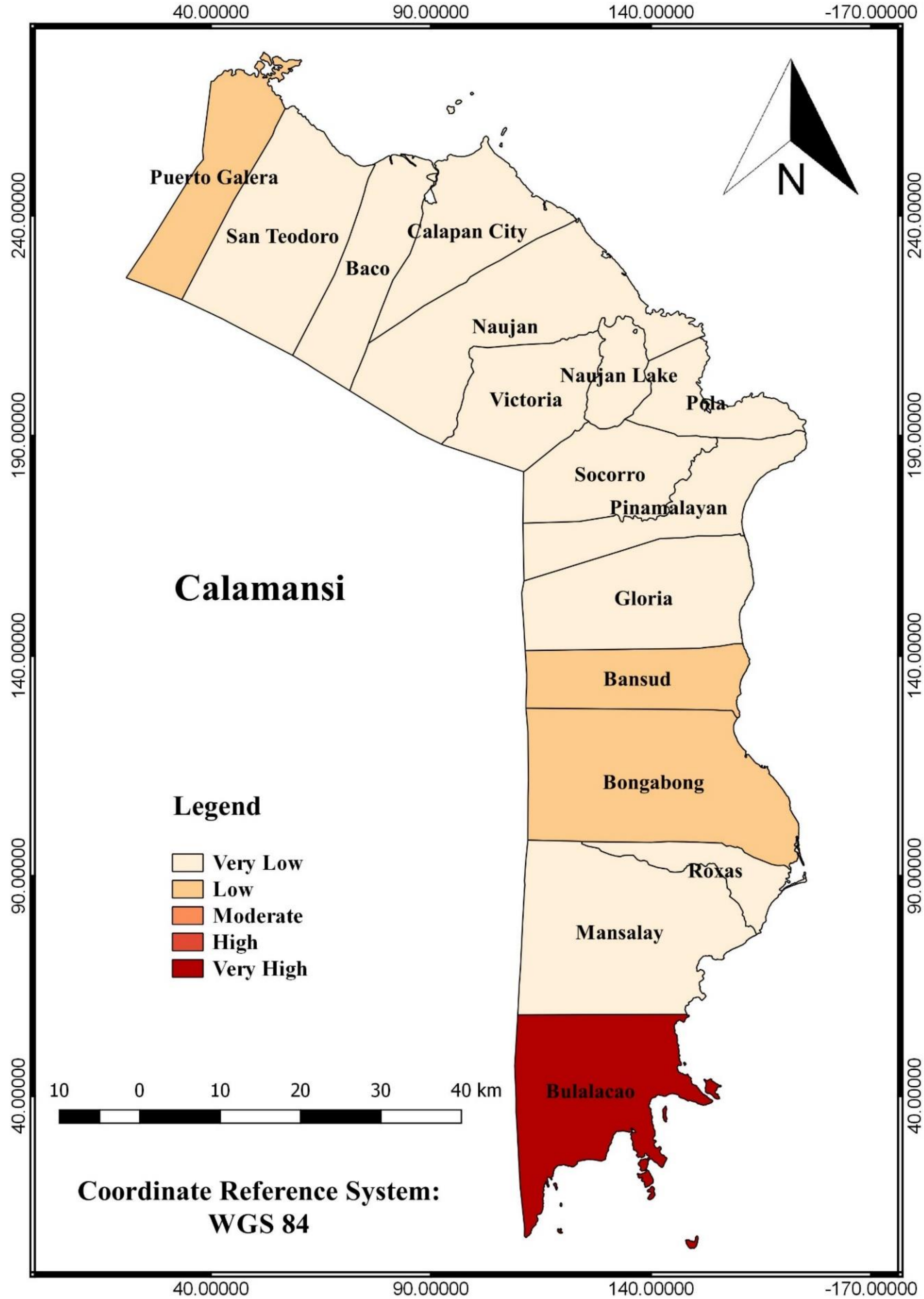


Figure 15. Sensitivity map of calamansi without filtering.

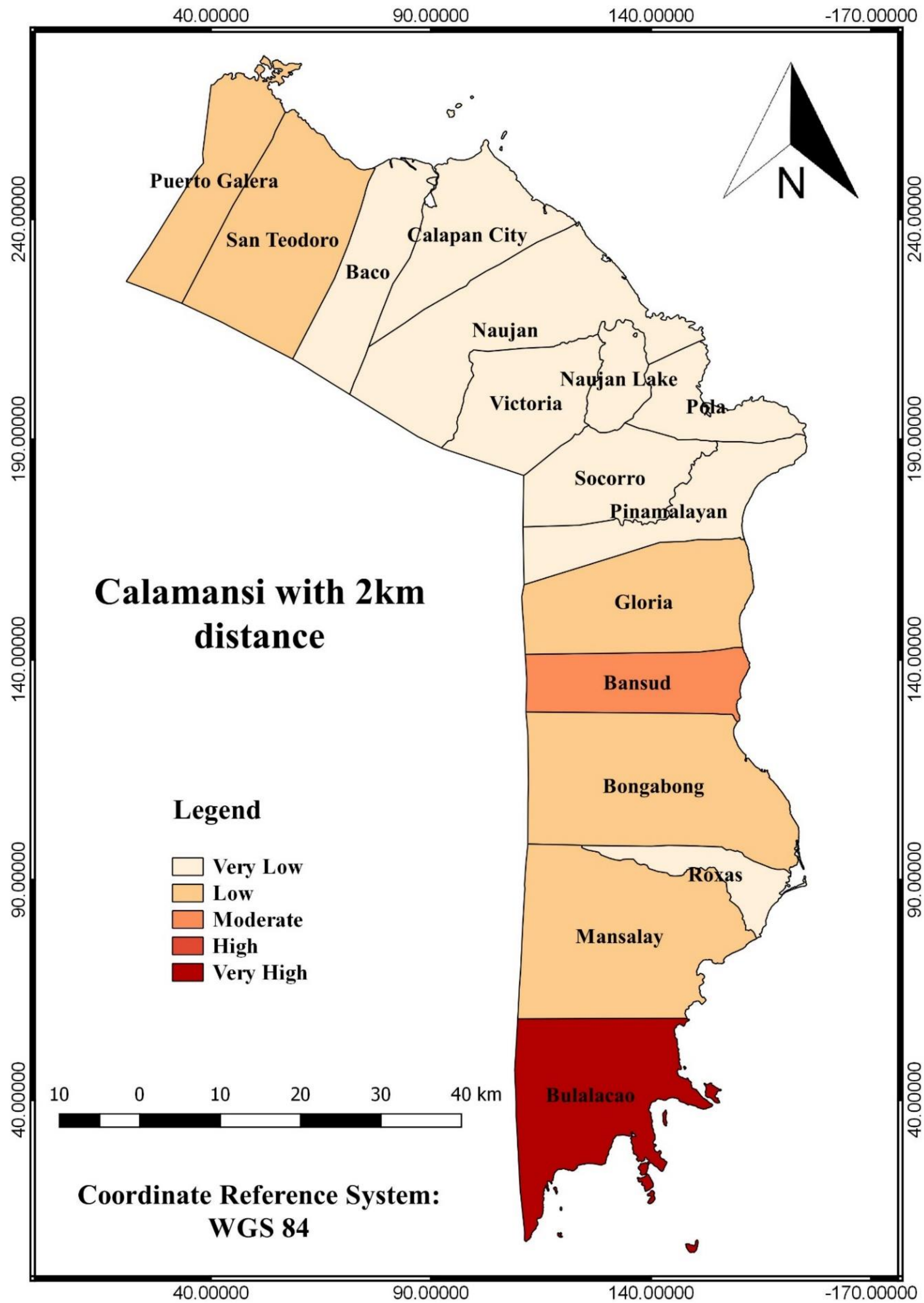


Figure 16. Sensitivity map of calamansi with 2km distance filtering.

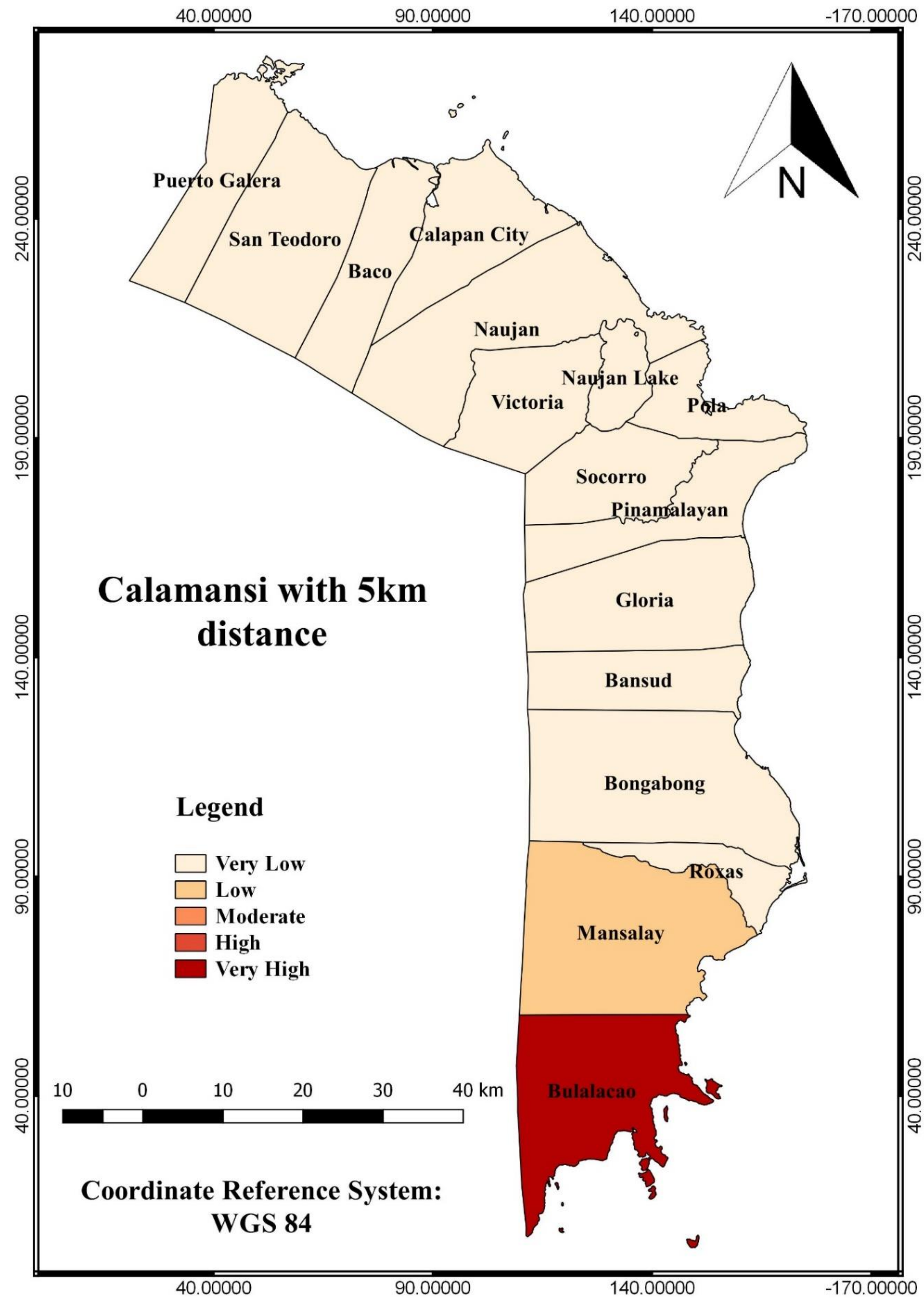


Figure 17. Sensitivity map of calamansi with 5km distance filtering.

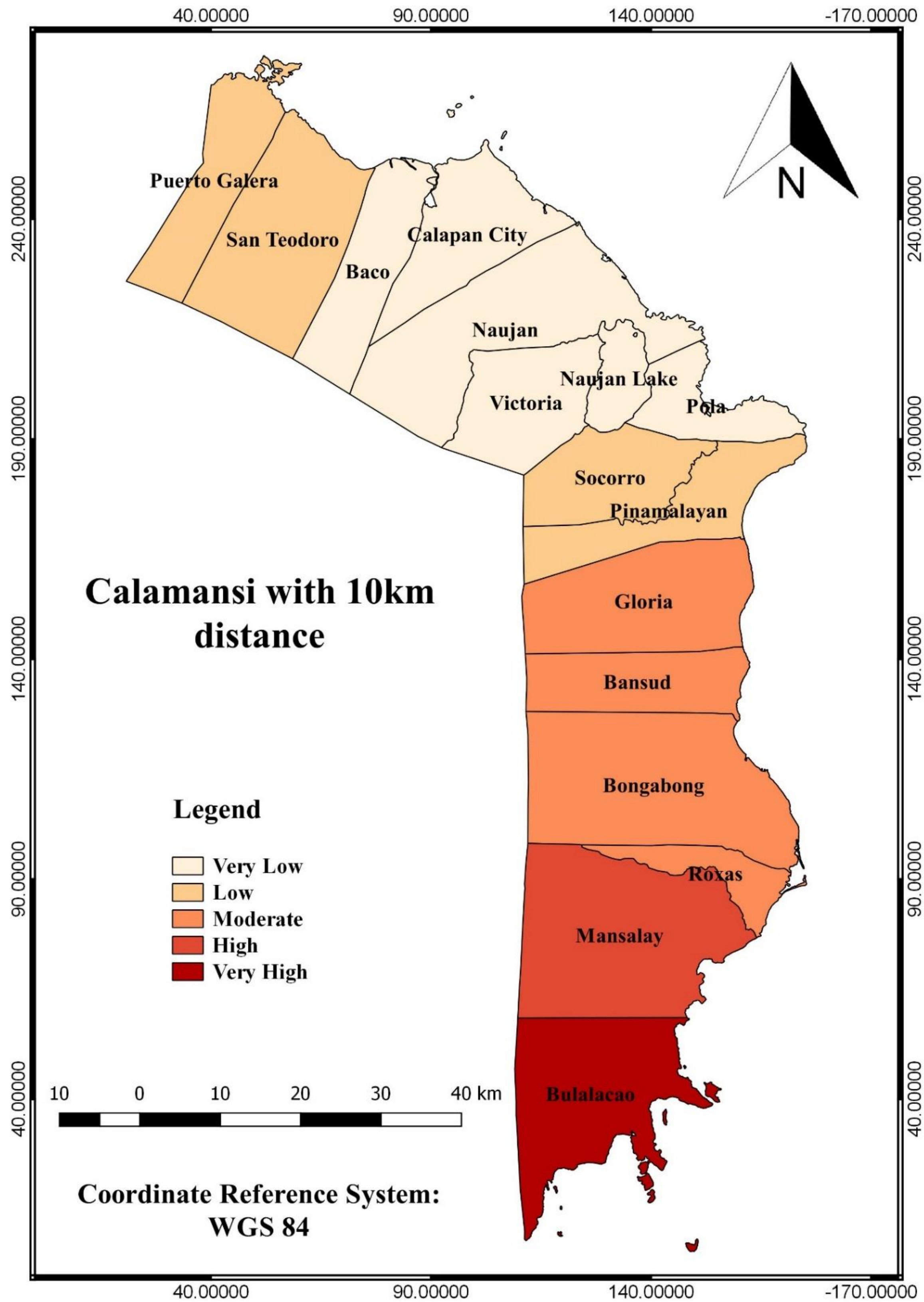


Figure 18. Sensitivity map of calamansi with 10km distance filtering.

Rice

Table 9. Sensitivity classification of rice with different scenarios.

Distance Filter Scenario	CLASSES IN SENSITIVITY				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
No Filter	Puerto Galera Bansud Mansalay	Bongabong	San Teodoro	Baco Gloria Bulalacao	Calapan City Naujan Victoria Pola Socorro Pinamalayan Roxas
2km distance	Puerto Galera Bansud Mansalay	Bongabong	San Teodoro Gloria Bulalacao	Baco	Calapan City Naujan Victoria Pola Socorro Pinamalayan Roxas
5km distance	Mansalay Bulalacao	Bongabong	Bansud Roxas	Puerto Galera San Teodoro Baco Pinamalayan Gloria	Calapan City Naujan Victoria Pola Socorro
10km distance	Bongabong Mansalay Bulalacao	Puerto Galera Gloria Bansud Roxas	San Teodoro Pinamalayan	Baco Naujan Victoria Socorro	Calapan City Pola

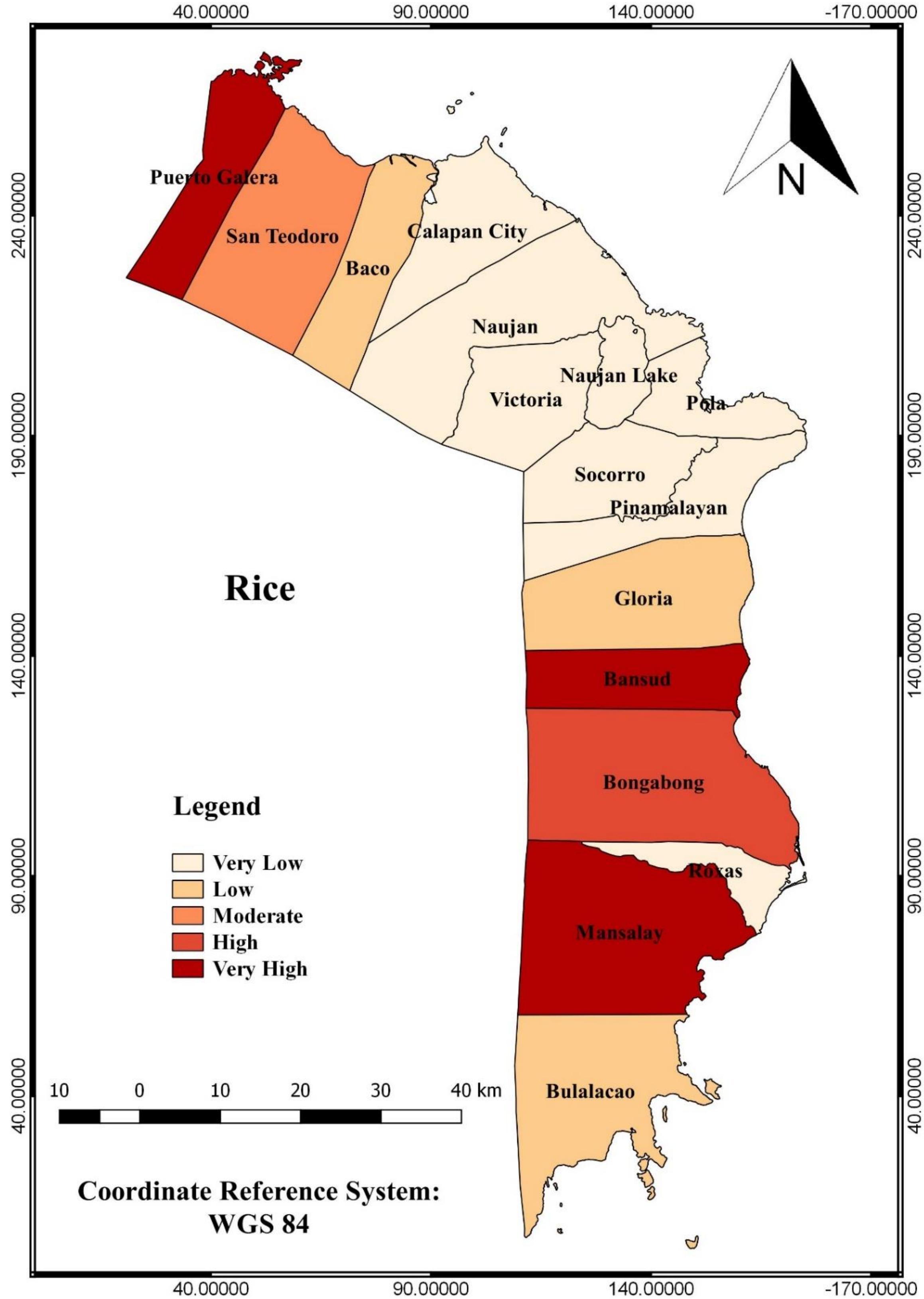


Figure 19. Sensitivity map of rice without distance filtering.

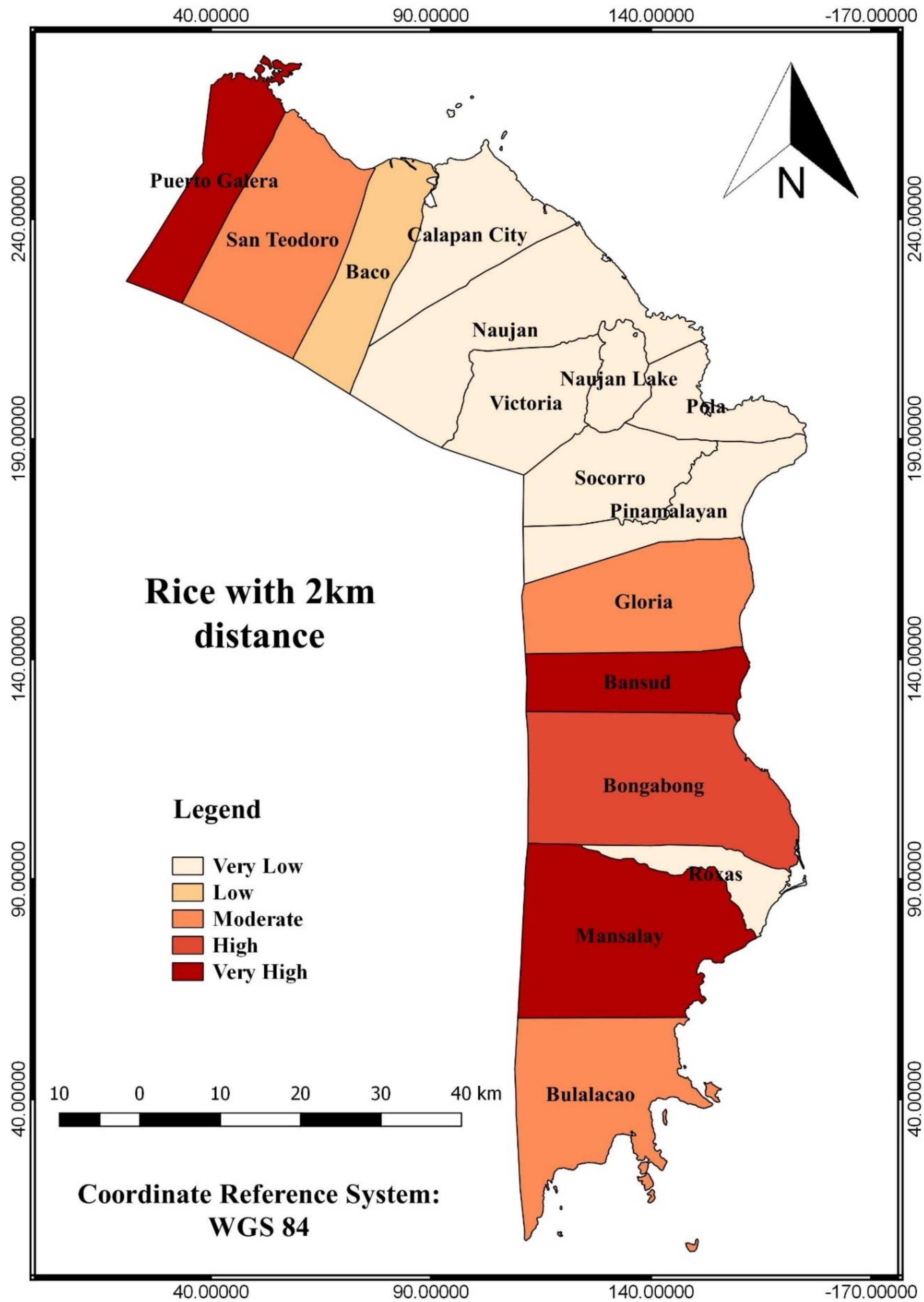


Figure 20. Sensitivity map of rice with 2km distance filtering.

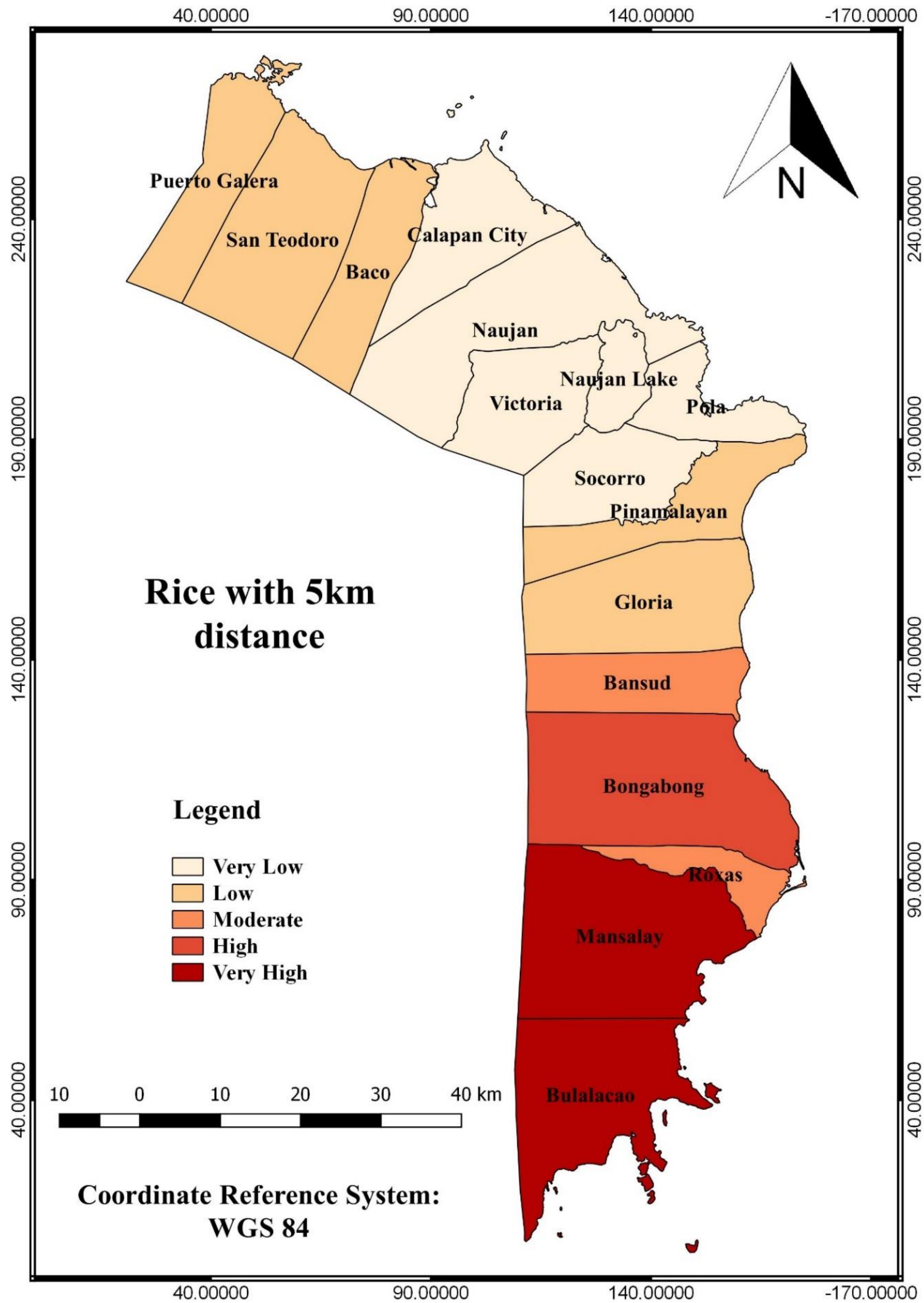


Figure 21. Sensitivity map of rice with 5km distance filtering.

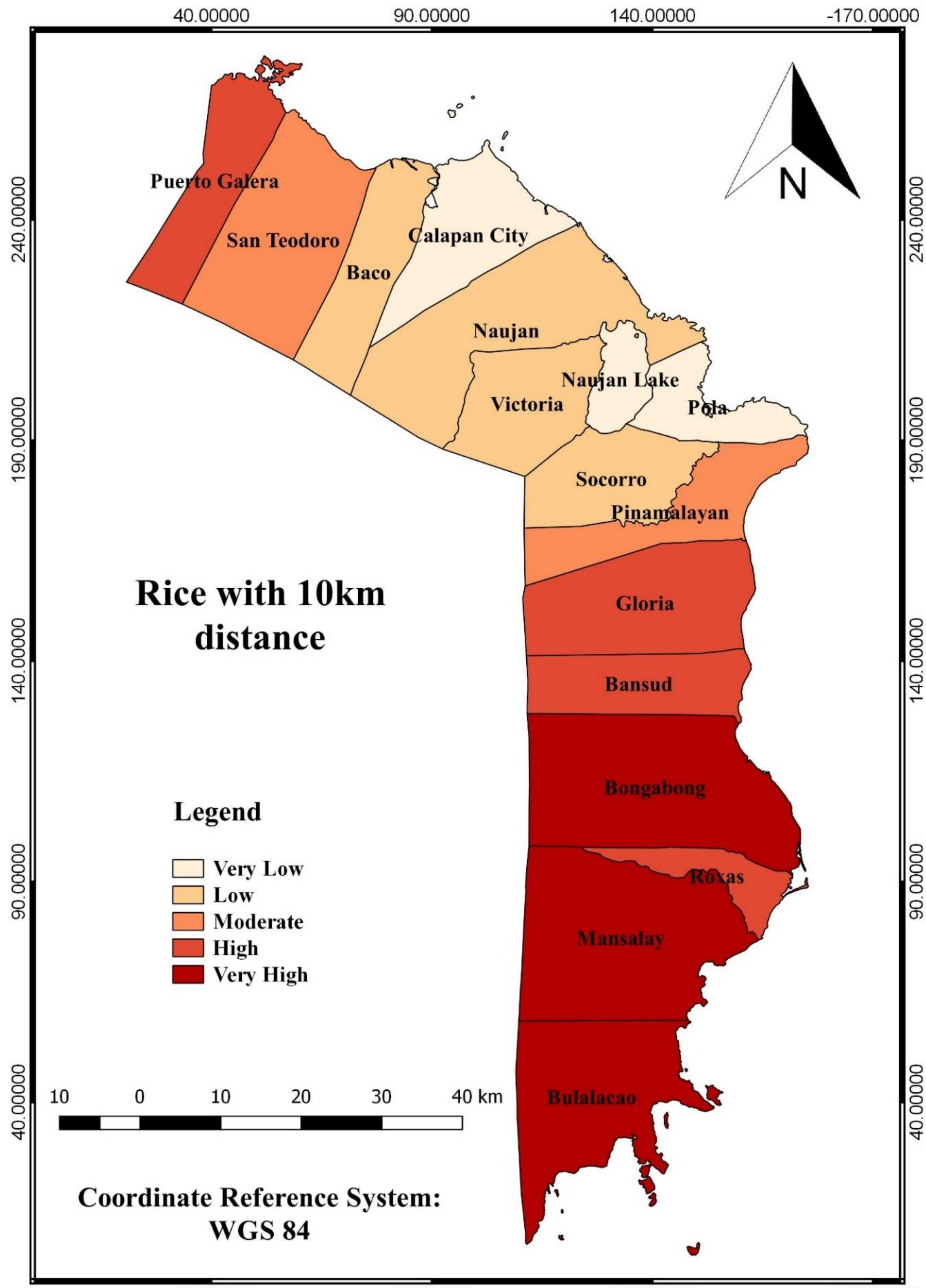


Figure 22. Sensitivity map of rice with 10km distance filtering.

C. *Adaptive Capacity maps*

The indicators used for adaptive capacity were categorized into six (6) capitals. By this, it can be seen the municipalities which has a high capacity to adapt and what are the municipalities need assistance. The following figure presents spatial analysis and table 10 summarizes the six capitals. It shows that Calapan City has the highest capacity to adapt. In this case, Calapan City is the center of economic activity and have higher access to basic services such as health and education.

Table 10. Adaptive capacity classification

CAPITALS	CLASSES IN ADAPTIVE CAPACITY				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
Economic Capital	Calapan City	Roxas	Naujan Pinamalayan	Victoria Socorro Gloria Bansud Bongabong	Puerto Galera San Teodoro Baco Pola Mansalay Bulalacao
Human Capital	Calapan City		Pinamalayan Roxas	Naujan Victoria Bongabong	Puerto Galera San Teodoro Baco Pola Socorro Gloria Bansud Mansalay Bulalacao
Institutional Capital	Puerto Galera Calapan City Naujan Victoria Pola Socorro Pinamalayan Gloria Bongabong	San Teodoro	Bansud		Baco Roxas Mansalay Bulalacao

Anticipatory Capital	Socorro	Puerto Galera Calapan City	Baco Naujan PInamalayan Bongabong Roxas		San Teodoro Victoria Pola Gloria Bansud Mansalay Bulalacao
Natural Capital	Puerto Galera Baco Naujan	Calapan City Pola Bulalacao	Victoria Pinamalayan Roxas	Bansud Mansalay	San Teodoro Socorro Gloria Bongabong
Physical Capital	Baco Calapan City Naujan Pola Socorro Pinamalayan Roxas	Puerto Galera Victoria Gloria	San Teodoro	Bansud Mansalay	Bongabong Bulalacao
Over-all Adaptive Capacity	Calapan City	Puerto Galera Naujan Pola Socorro Pinamalayan	Baco Victoria Gloria Bongabong Roxas	San Teodoro Bansud Mansalay Bulalacao	

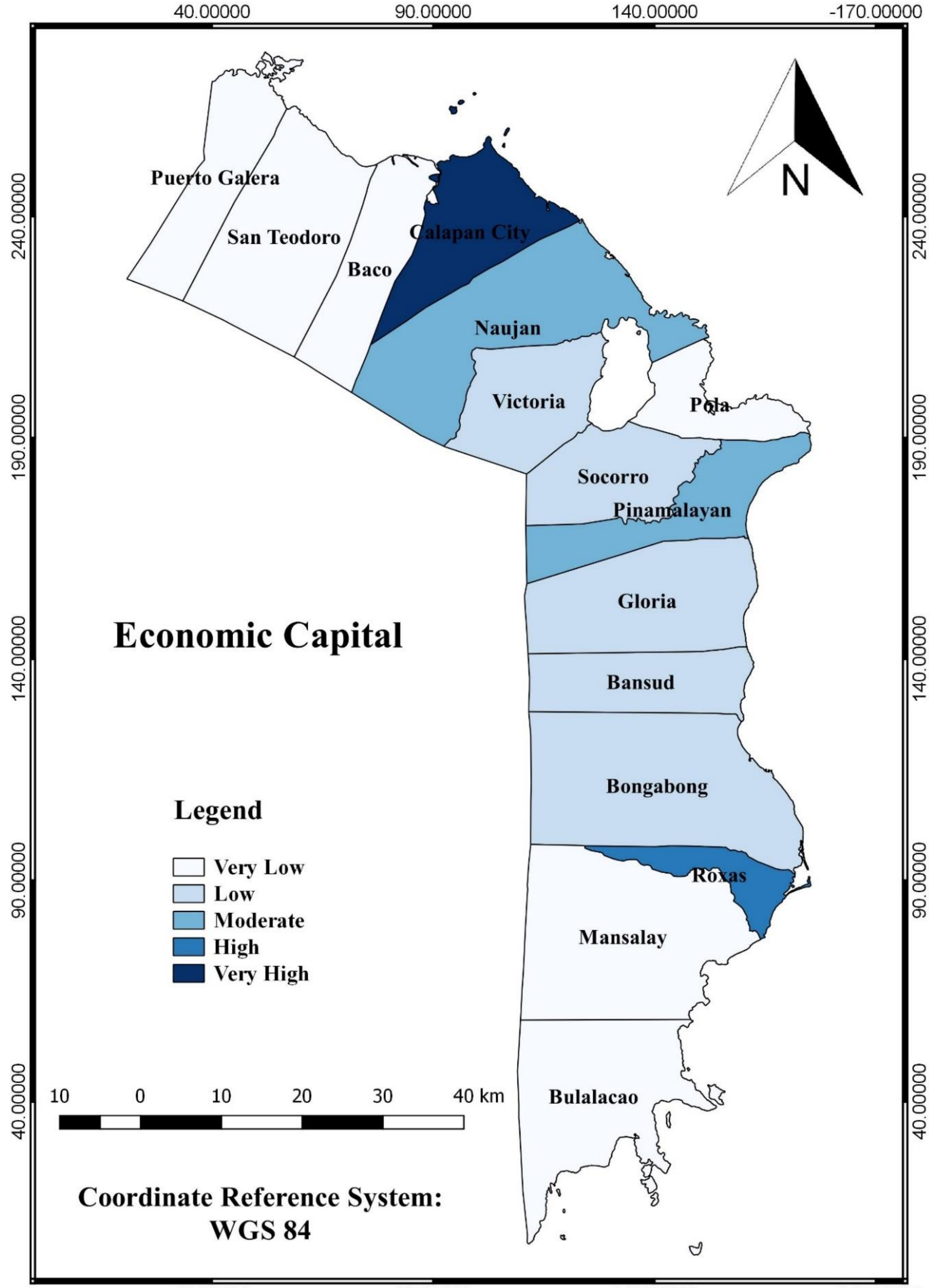


Figure 23. Economic capital map of Oriental Mindoro.

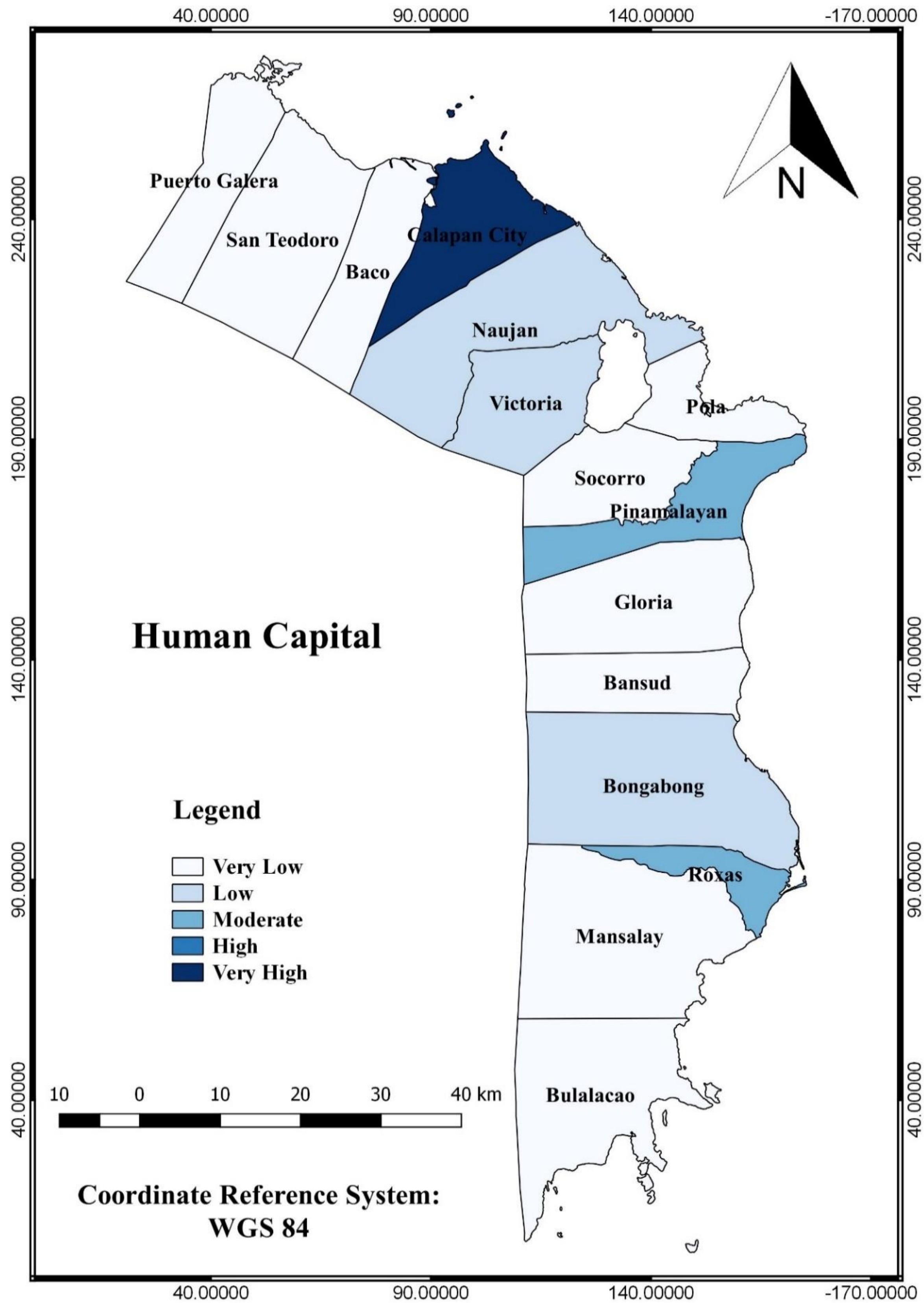


Figure 24. Human capital map of Oriental Mindoro.

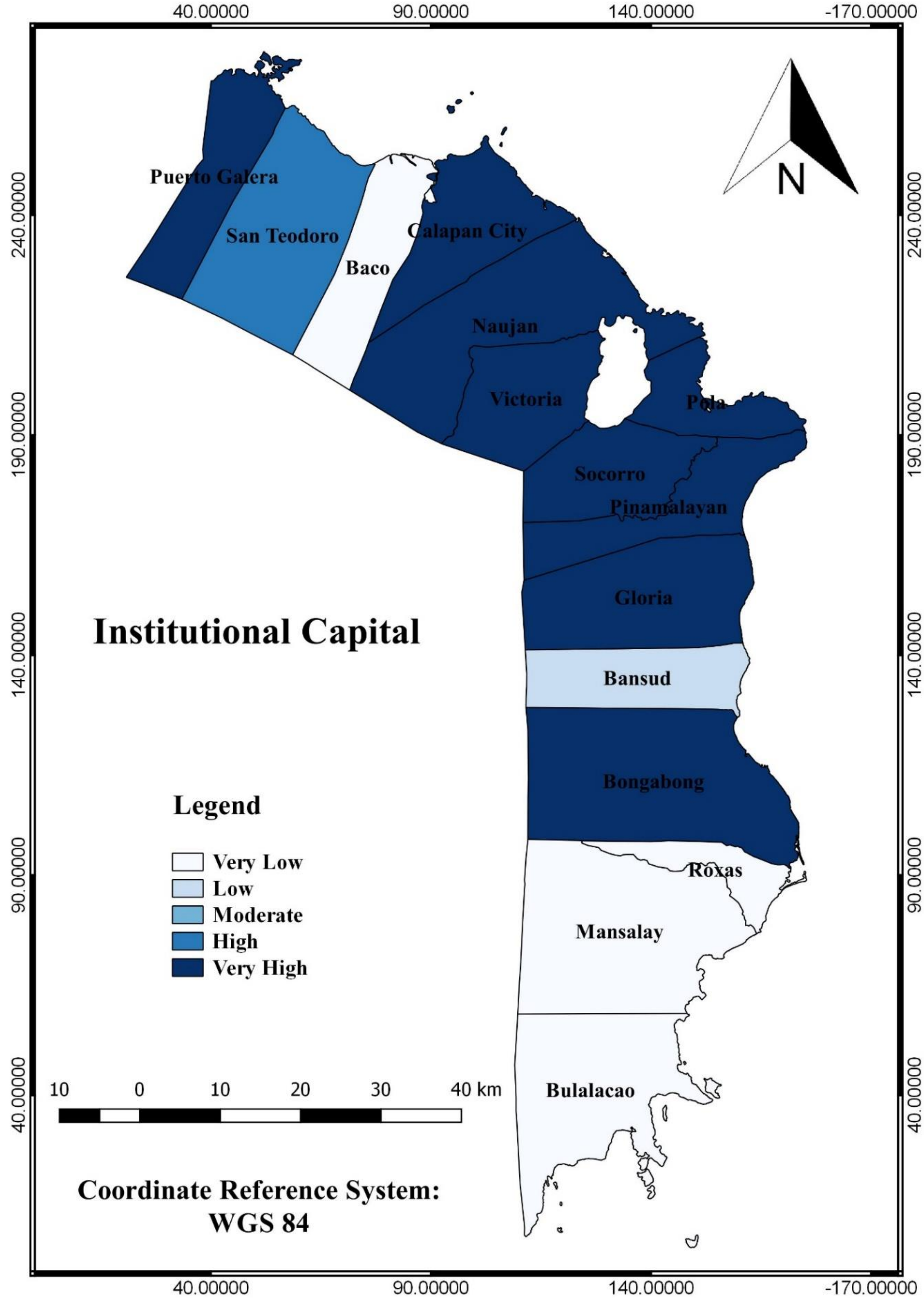


Figure 25. Institutional map of Oriental Mindoro.

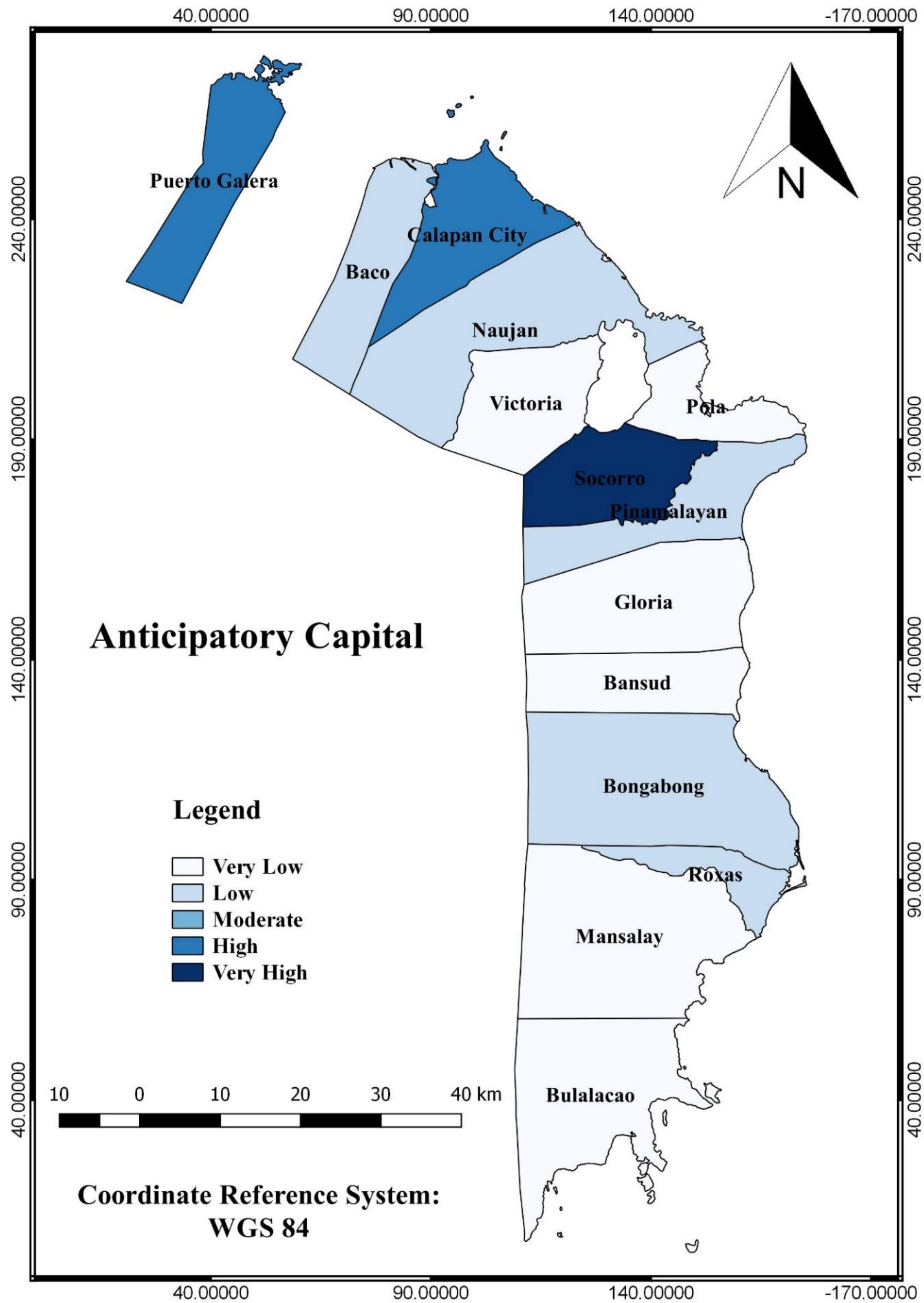


Figure 26. Anticipatory capital map of Oriental Mindoro.

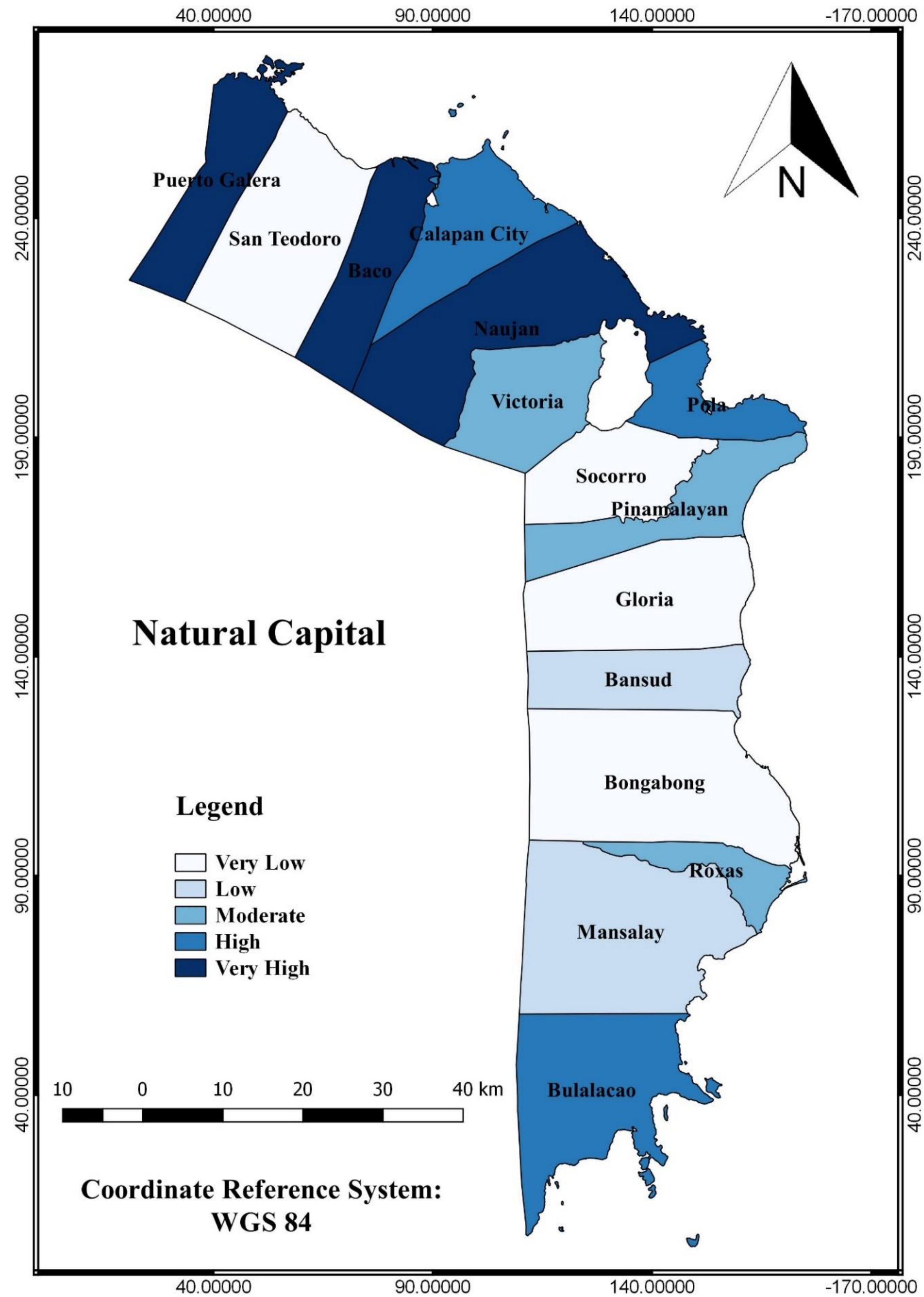


Figure 27. Natural capital map of Oriental Mindoro.

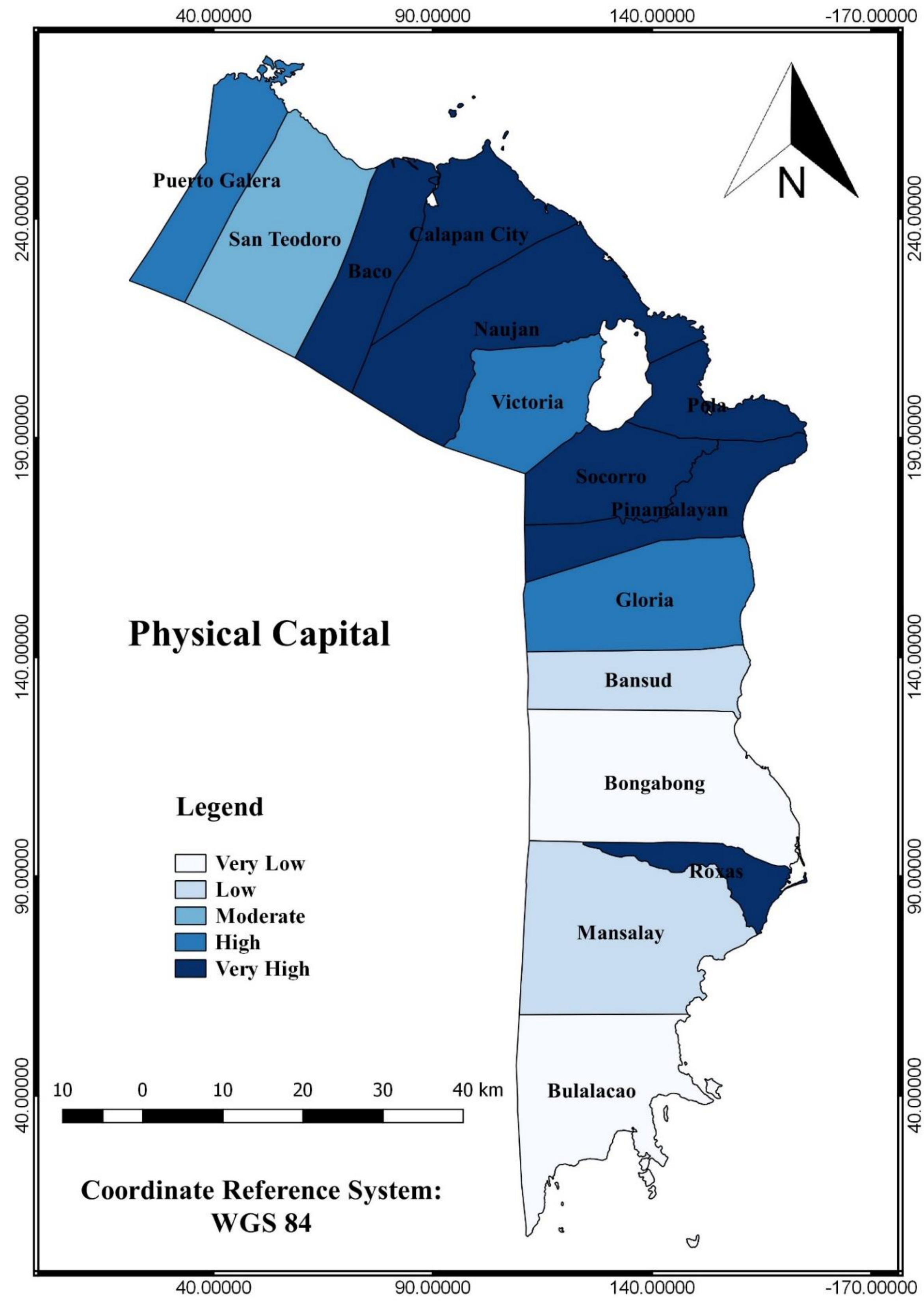


Figure 28. Physical capital map of Oriental Mindoro.

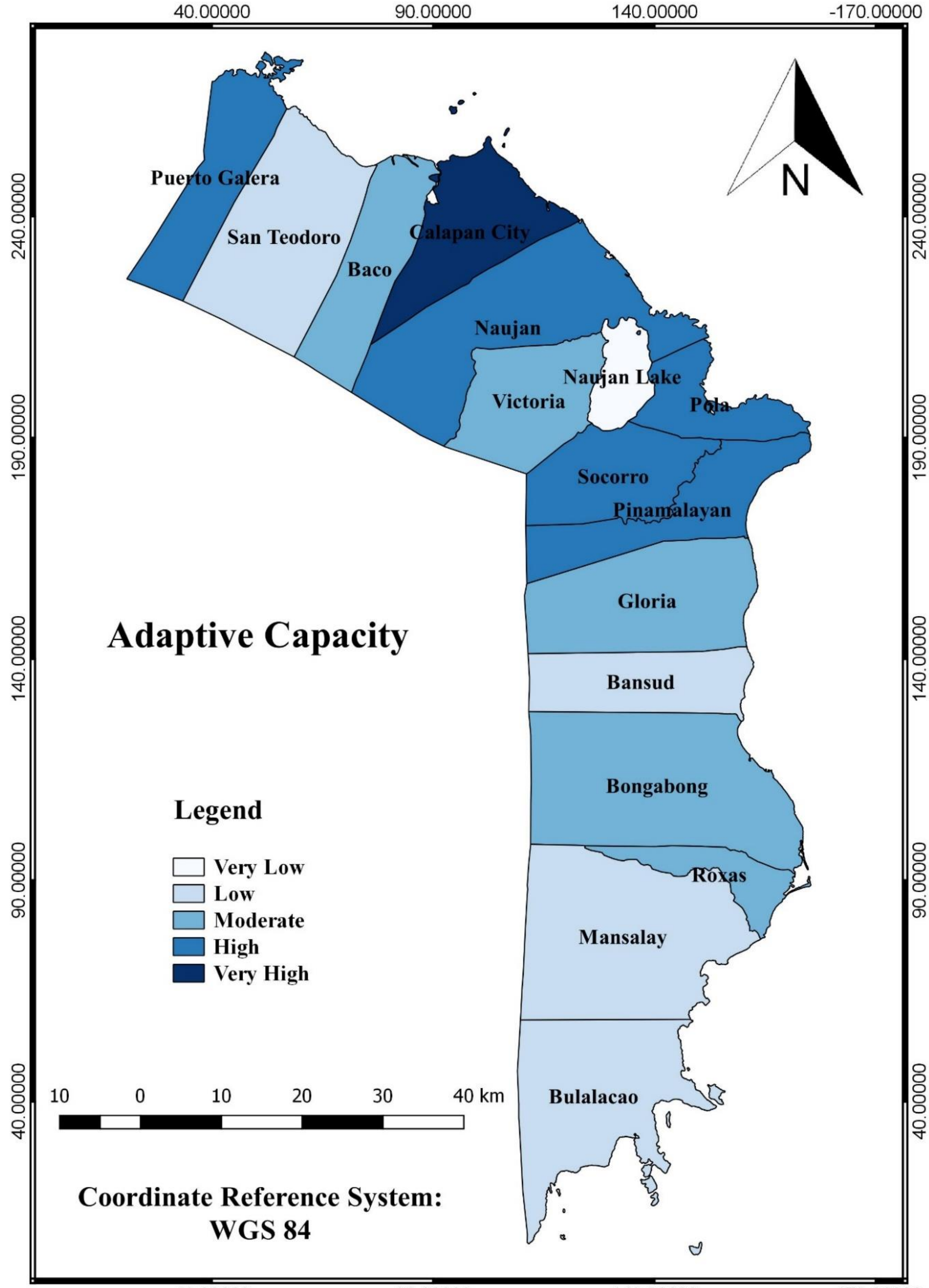


Figure 29. Adaptive capacity map of Oriental Mindoro.

D. Over-all Climate Risk Vulnerability Maps

The over-all climate risk vulnerability map was show in Figures 30-33. Each crop was assessed using the equation 1. Different classes of vulnerability (moderate to very high vulnerability) for different scenarios are shown in table 11 for banana, table 12 for calamansi, and table 13 for rice. The assessment focuses on the agricultural sector, hence, urban areas like Calapan City is considered to be less vulnerable than the other areas.

In addition, in the case of banana, the municipalities of Bansud and Bongabong that are the major producing of this crop tends to be classified in high and moderate vulnerable. While the municipalities of Socorro and Roxas which are known in citrus production are classified in low vulnerable section.

Table 11. Vulnerability classification of banana with different Scenarios.

Scenario	CLASSES				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
Scenario 1 (reference)		San Teodoro Bansud Mansalay Bulalacao	Baco Gloria Bongabong	Puerto Galera Naujan Victoria Pola Socorro Pinamalayan Roxas	Capalan City
Scenario 2		Gloria Bansud Mansalay	Puerto Galera San Teodoro Baco Bongabong Bulalacao	Naujan Victoria Socorro Pola Pinamalayan Roxas	Calapan City
Scenario 3		Bansud Mansalay	Puerto Galera San Teodoro Baco Gloria Bongabong Bulalacao	Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 4		San Teodoro Bansud Mansalay Bulalacao	Baco Gloria Bongabong	Puerto Galera Naujan Victoria Pola	Calapan City

				Socorro Pinamalayan Roxas	
Scenario 5		Gloria Bansud Mansalay	Puerto Galera San Teodoro Baco Bongabong Bulalacao	Naujan Victoria Socorro Pola Pinamalayan Roxas	Calapan City

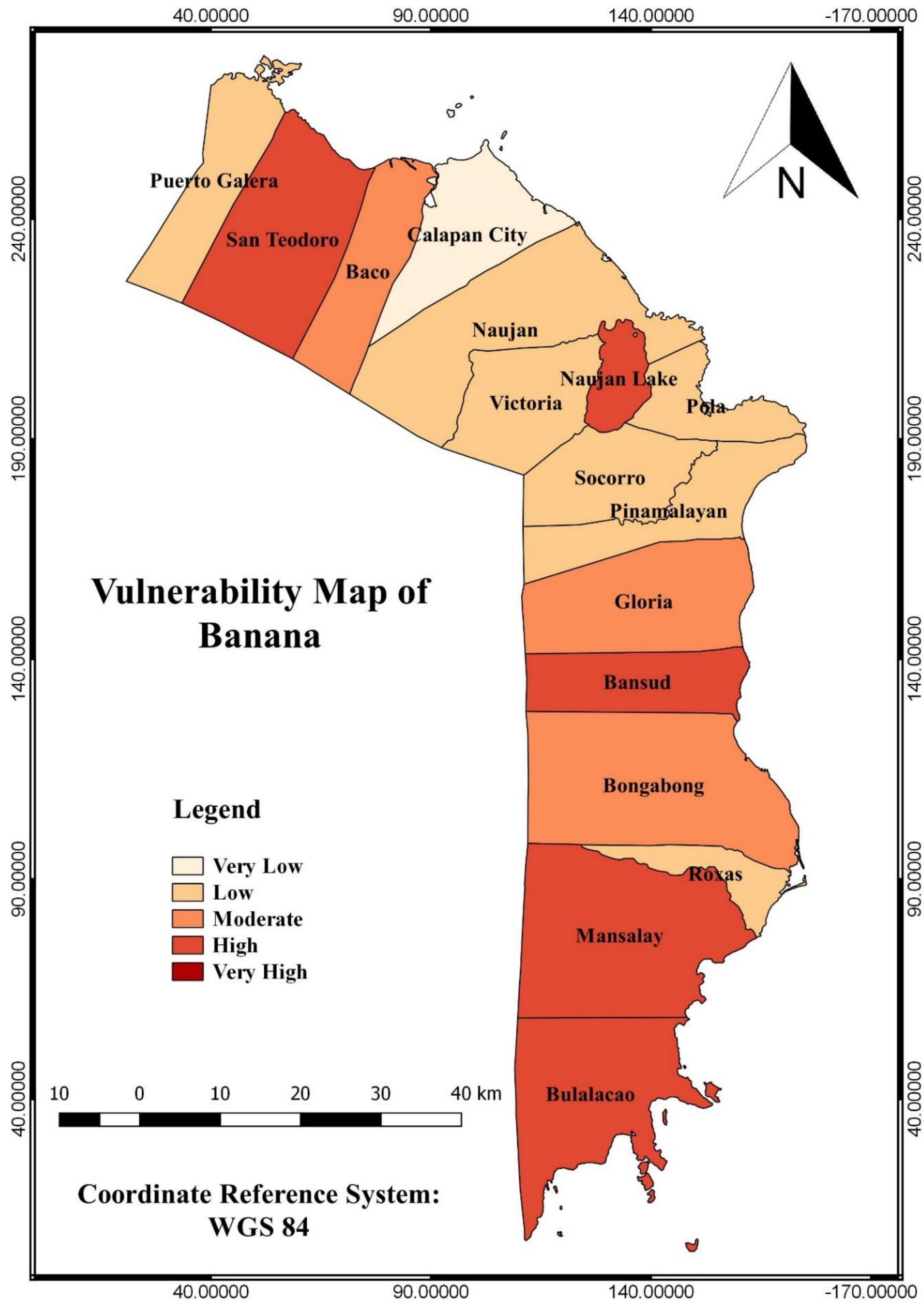


Figure 30. Vulnerability map of banana.

Table 12. Vulnerability classification of calamansi with different Scenarios.

Scenario	CLASSES				
	Very High	High	Moderate	Low	Very Low
Scenario 1 (reference)		Mansalay Bulalacao	San Teodoro Baco Gloria Bansud Bongabong	Puerto Galera Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 2	Bulalacao		Gloria Bansud Bongabong Mansalay	Puerto Galera San Teodoro Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 3	Bulalacao		San Teodoro Gloria Bansud Bongabong Mansalay	Puerto Galera Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 4		Mansalay Bulalacao	San Teodoro Gloria Bansud Bongabong	Puerto Galera Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 5	Bulalacao		San Teodoro Gloria Bansud Bongabong Mansalay	Puerto Galera Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City

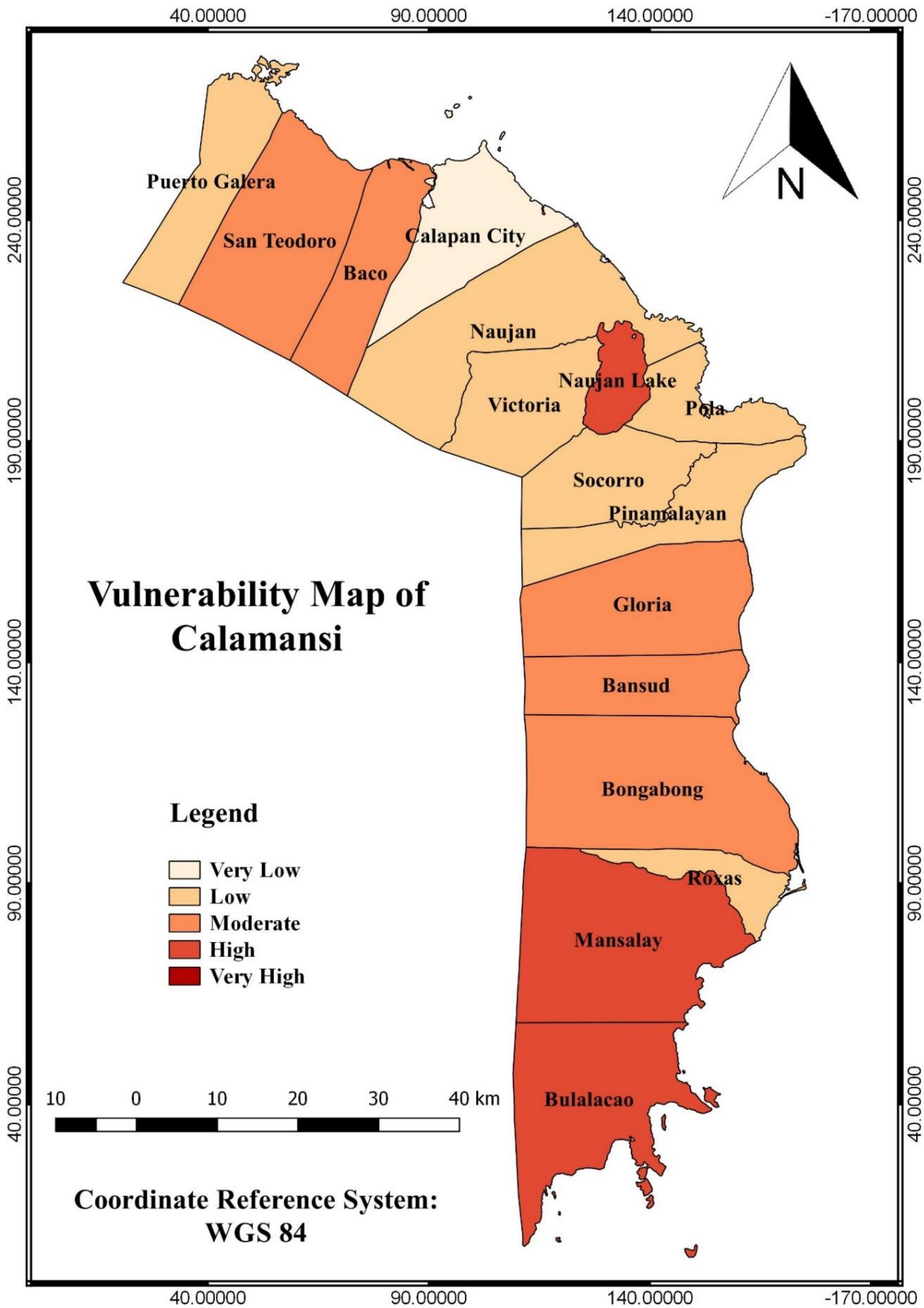


Figure 31. Vulnerability map of calamansi.

Table 13. Vulnerability classification of rice with different Scenarios.

Scenario	CLASSES IN SENSITIVITY				
	Very High	High	Moderate	Low	Very Low
Scenario 1 (reference)		Bansud Mansalay Bulalacao	San Teodoro Baco Gloria Bongabong	Puerto Galera Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 2		Gloria Bansud Bongabong Mansalay Bulalacao	Puerto Galera San Teodoro	Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 3		Gloria Mansalay Bulalacao	San Teodoro Baco Gloria Bongabong	Puerto Galera Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 4		Bansud Mansalay Bulalacao	San Teodoro Baco Gloria Bongabong	Puerto Galera Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City
Scenario 5		Gloria Bansud Bongabong Mansalay Bulalacao	San Teodoro	Puerto Galera Baco Naujan Victoria Pola Socorro Pinamalayan Roxas	Calapan City

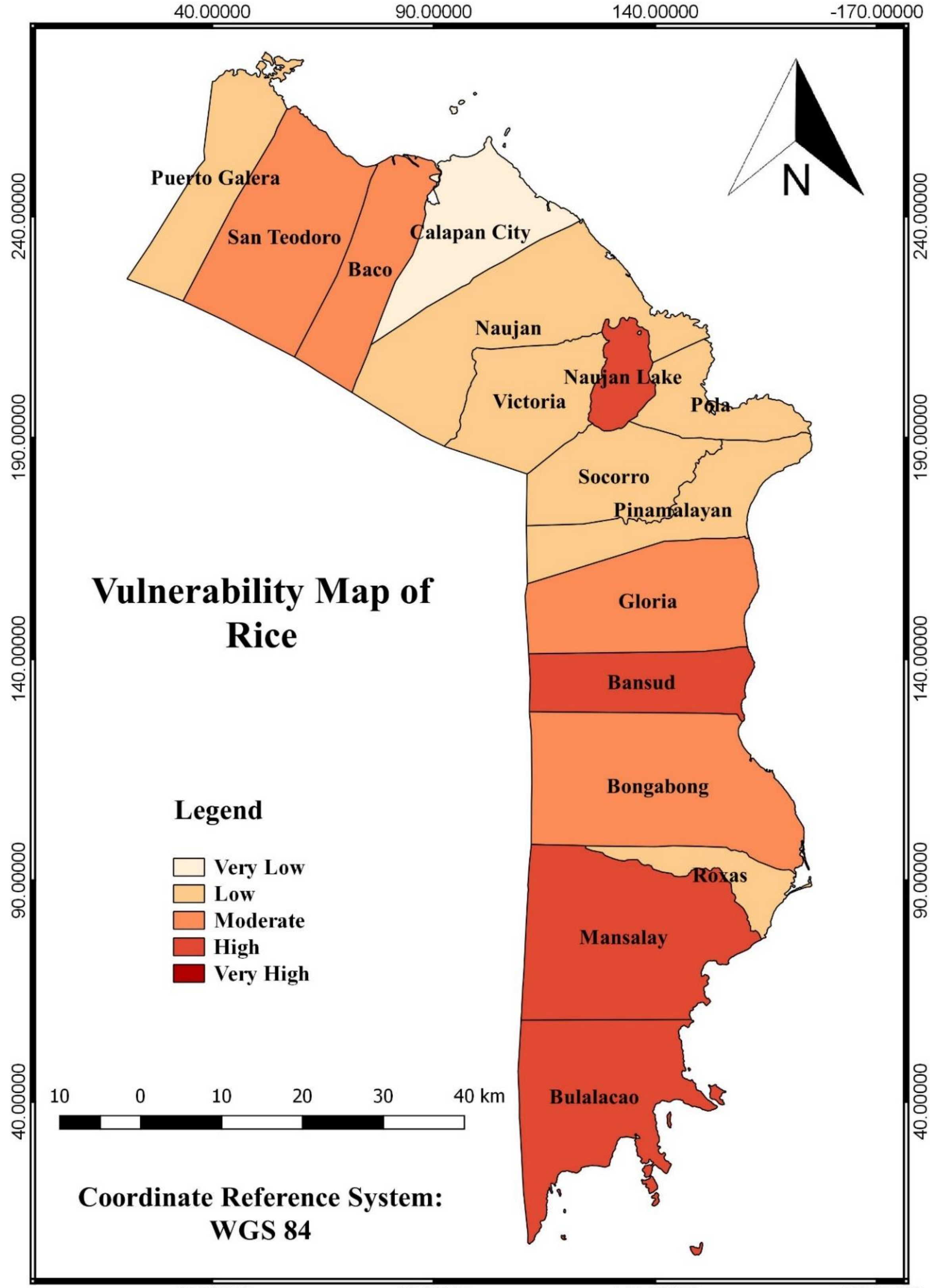


Figure 32. Vulnerability map of rice.

IV. *Conclusions*

Crop vulnerability to climate change was assessed and mapped in 14 municipalities and 1 city of Oriental Mindoro using modelling, climate variability, and socio-economic variables. The analyses focuses on the top three commodities of Oriental Mindoro, such as banana, calamansi, and rice. The analyses only focuses on these three because of the limited availability of time. It is important to understand that the assessment for this study is based on modelling, in which have uncertainties. There is also a limit in the variables used in the model. However, the assessment is based on a municipal resolution. This is where the planning takes place. Although the results of this project was presented in the provincial and some of the municipal agriculture officers, using the result of this research should be made consideration of the actual local conditions. The results was also complimented with some of the existing literatures.

V. *Recommendations*

Climate change affects the agricultural sector of the Philippines. One of the hazards that greatly affect the Philippines is the occurrence of typhoons and heavy rains. The Philippine government and other private institutions have already created and established facilities that provides near real-time weather information. One of these, is the project NOAH that is being established by the DOST. It is being used by some of the LGUs in the country and it is accessible in http://noah.up.edu.ph. In addition, there are also several researches that have done in the province of Oriental Mindoro, these can also be complimented with the result of this study for planning and development purposes. Reports of other offices within LGUs can also be used, this includes the Comprehensive Land Use Plans and Climate and Disaster Risk Assessment (CDRA) prepared by the planning office of each municipality.

On the other hand, this research has also the CRA component, on which identifies the practices by the farmers. This also answers the best recommendation on what to do per crop to sustain its productivity.

VI. *Challenges*

One of the challenges on the earlier part of the implementation of the project was the Identification/confirmation of site. The initial site that was given to the UPLB team was Marinduque. The team already did some coordination with the local government and with the provincial offices when we got the notice that the final site will be Oriental Mindoro. Another challenge was the weather condition. The team have difficulty in gathering the data because of the weather condition. Also, the availability of the Municipal Agricultural Officer and agricultural technicians was a challenged during the time of crop occurrence gathering. A number of scheduled workshops were cancelled because of their availability. On the other note, the team decided that the municipalities that were not present during the scheduled workshop will be visited on their office to do the mapping.

VII. *References*

1. CIAT (International Center for Tropical Agriculture) and Future Earth. Spatial Downscaling Methods: CCAFS-Climate Data Portal. Available online: https://ccafs.cgiar.org/spatial-downscaling-methods Accessed: 22 November 2017.

2. Intergovernmental Panel on Climate Change (IPCC) (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 582 pp.

3. Intergovernmental Panel on Climate Change (IPCC) (2014). Synthesis Report of Working Groups I, II and III to the Fifth Assessment Report. Geneva, Switzerland. Available online: https://www.ipcc.ch/report/ar5/syr/

4. Intergovernmental Panel on Climate Change (IPCC) (2015). Scenario Processes for AR5. Available online: http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

5. NASA Global Climate Change. Available online: https://climate.nasa.gov/vital-signs/sea-level/

6. O'Donnell, M and Ignizio, D., 2012. USGS Data Series 691: Bioclimatic Predictors for Supporting Ecological Applications in the Conterminous United States. Available online: https://pubs.usgs.gov/ds/691/ds691.pdf

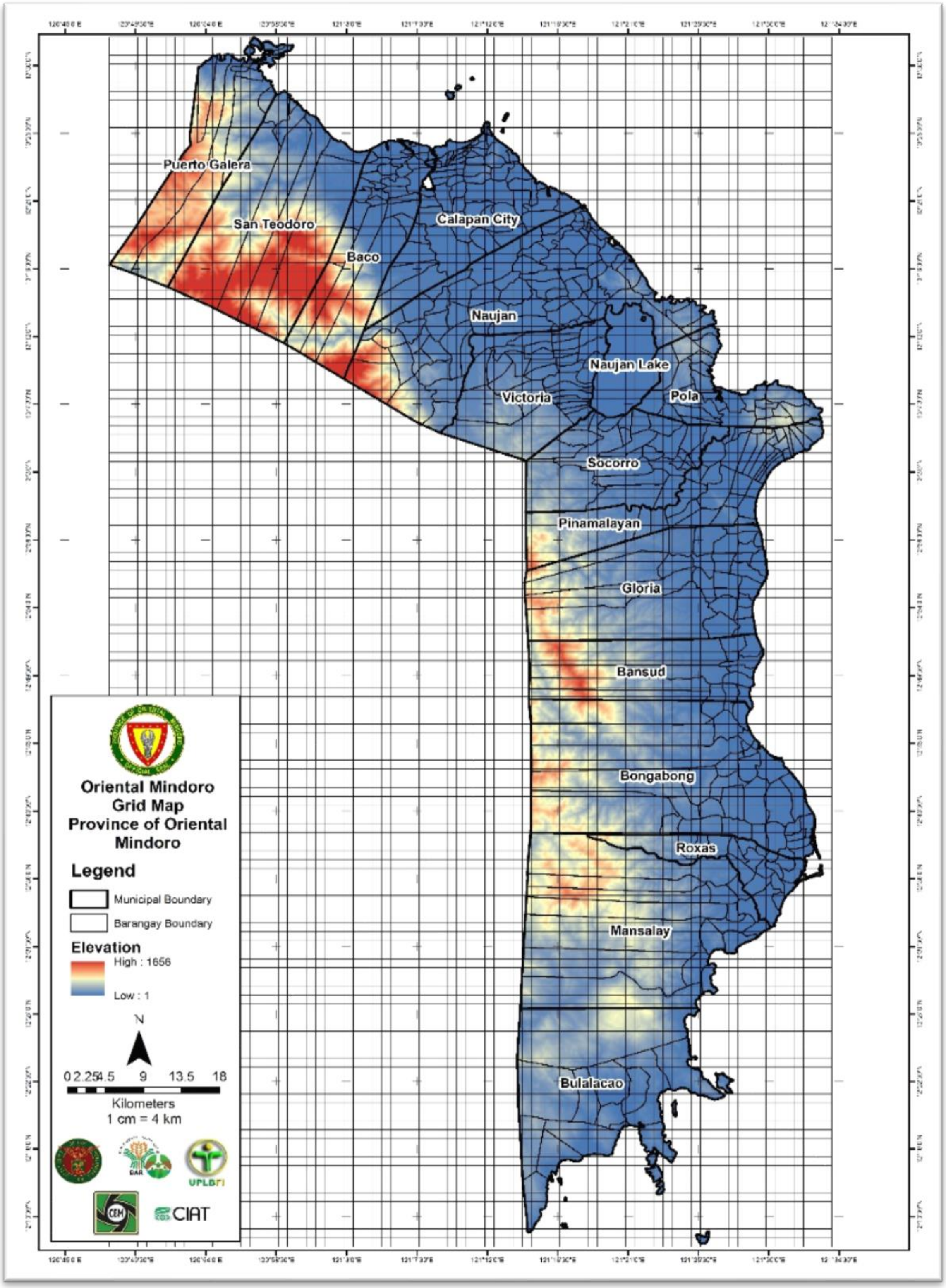
7. Ontario Minisitry of Agriculture, Food, and Rural Affairs. Soil Erosion:Causes and Effects. Available online: http://www.omafra.gov.on.ca/english/engineer/facts/12-053.htm

8. Philippine Information Agency. MIMAROPA. Available online: http://pia.gov.ph/news/regions/mimaropa?p=2

9. Second National Communication on Climate Change: Philippine SCN Project. 2009. Vulnerability and Assessment Component. United Nations Development Programme.

10. USGS. 2018. USGS Groundwater Information. Available online: https://water.usgs.gov/ogw/gwrp/saltwater/salt.html

VIII. Appendix



Appendix 1. Sample of the Oriental Mindoro grid map with municipal and barangay boundaries and elevation.

Climate Risk Vulnerability Assessment Report for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR

Climate Risk Vulnerability Assessment of the Five Major Agricultural Crops in Benguet

Project Leader: Elizabeth Supangco-Dela Paz
Geographic Information System Specialist: Roscinto Ian C. Lumbres
Research Assistant: Ralphael Gonzales

I. Introduction

A. Description of the study site

Climate change and variability continue to exert increasing pressure upon the agricultural sector of the Philippines. The three sectors that record the highest economic damage resulting from geophysical hazards in the Asia Pacific region are transport, housing and agriculture; whereas the agricultural sector is recognized as the most vulnerable of all sectors (UNESCAP 2015). A better understanding of major agricultural vulnerabilities to climate risks is important in achieving more resilient farming systems, especially among poor rural households. Therefore, it is necessary to identify and prioritize municipalities and relevant crops that are most vulnerable to climate risks. One of the tool that can be used is the Climate Risk Vulnerability Assessment (CRVA).

Benguet province was the province selected for the Cordillera Administrative Region as one of the study site for the Adaptation and Mitigation Initiative in Agriculture (AMIA) 2++ project. Specifically, this study covers the 13 municipalities of Benguet (Figure 1). It lies southernmost in the Cordillera Administrative Region (CAR) and is geographically located between 16°33'' N and 120°34'' to 120°52'' E and has a total land area of 2,833.0 km^2. On the north, it is bounded by Mountain Province, on the south by Pangasinan, on the east by Ifugao and Nueva Vizcaya, and on the west by La Union and Ilocos Sur. Among the six provinces in CAR, Benguet has the highest population with 446,224. Baguio City, on the other hand, has a total population of 345,366. In terms of number of households, Benguet has 106,838 while Baguio City has 89,987 (Philippine Statistics Authority, 2015).

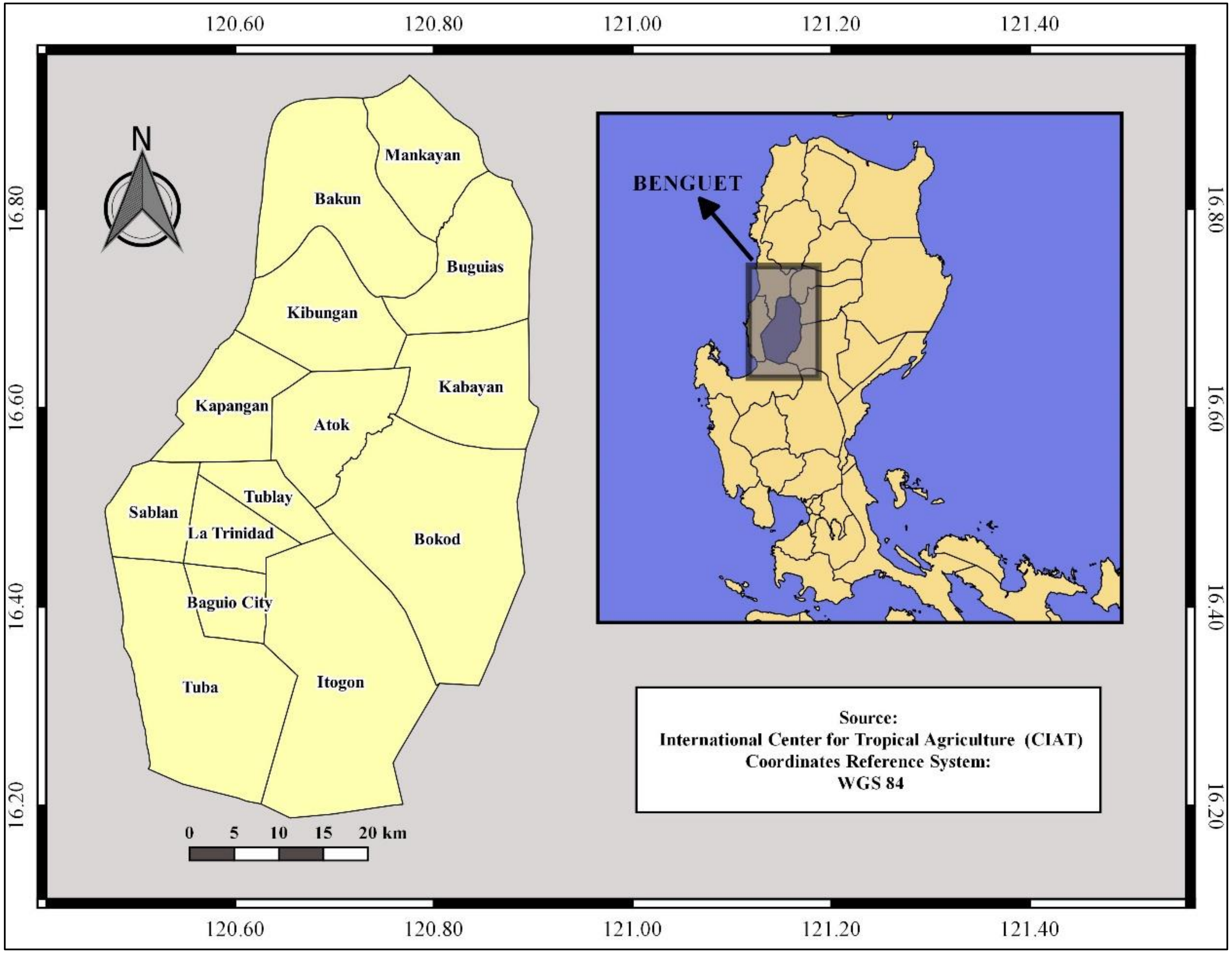


Figure 1. Geographical Location Map of Benguet.

B. Framework of CRVA (based on CIAT's framework)

The International Center for Tropical Agriculture (CIAT) created a framework in conducting CRVA for different crops in the various provinces of the Philippines as Figure 2. In this framework, 3 key dimensions are needed to assess the overall vulnerability of a specific crop for the different municipalities and these are: sensitivity, exposure and adaptive capacity. Sensitivity is the increase or decrease of climatic suitability of selected crops to changes in temperature and precipitation. According to IPCC (2014), exposure is the nature and degree to which a system is exposed to significant climate variations. Lastly, adaptive capacity is defined as the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2014).

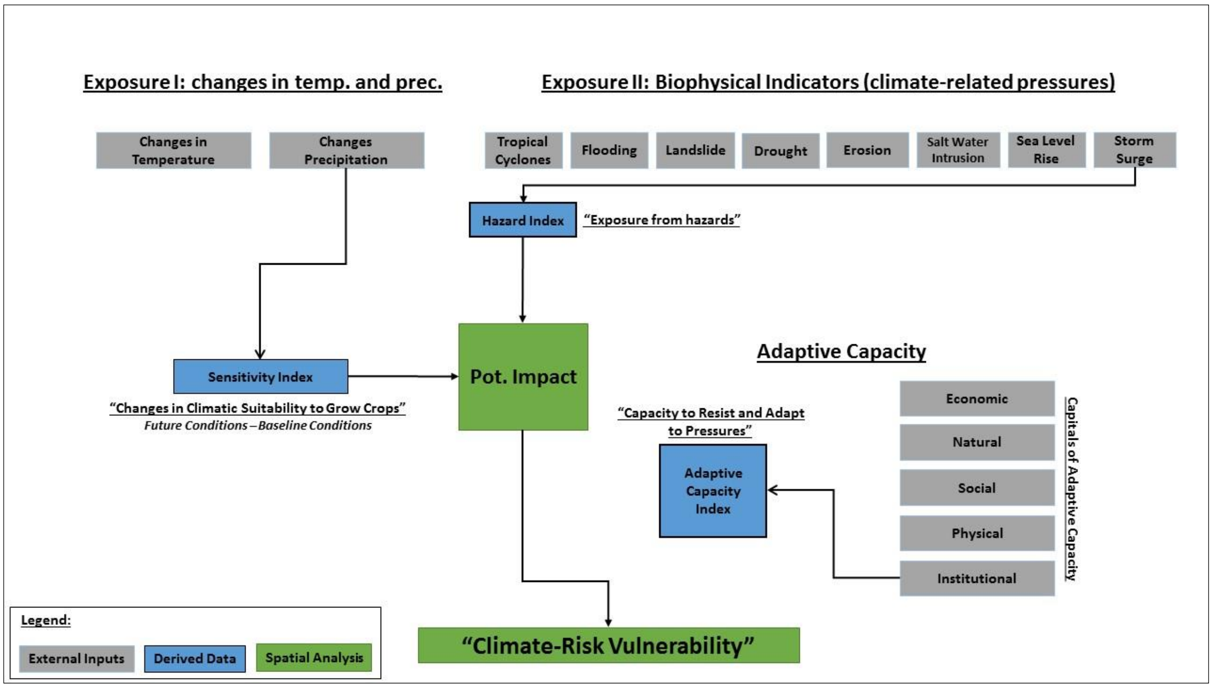


Figure 2. Climate Risk Vulnerability Assessment Framework.

II. Methodology

A. Hazard

Eight (8) climate hazards that affect crop production were identified for the Philippines and these are tropical cyclone, flood, drought, erosion, landslide, storm surge, saltwater intrusion and sea level rise (Palao et al., 2017). The selection of hazards was based on consultation with the CRVA project partners, such as SUCs and the DA-System Wide Climate Change Office in the Philippines (Palao et al., 2017). However, the Regional Field Office of the Department of Agriculture requested that frost must be included as one of the hazards. Since each hazard has different degree, intensity and frequency, the potential damage also varies, especially across the three main islands of the Philippines, (Luzon, Visayas, and Mindanao) hence, each hazard was weighed in each island group based on occurrence and impact.

New hazard weights for Benguet were developed with the inclusion of frost based from the weights of Luzon used for the overall hazard index as shown on Table 1. The hazard maps in raster format (Figure 3) were provided by CIAT and the hazard for each municipality was summarized using the zonal statistics of QGIS (Figure 4). These values were normalized for each hazard. Normalization was done using the equation shown below:

$$hazidx\_norm = \frac{x - x_{min}}{x_{max} - x_{min}}$$ (Source: Palao et al., 2017)

where: hazidx_norm is the normalized values of the hazard index and x is the value of a particular hazard, min is minimum value and max is maximum value.

To determine the overall hazard index for each municipality, normalized value of each hazard for each municipality was multiplied to the corresponding hazard weight and were summed up.

Table 1. Hazard scores in the island groups and in Benguet province based on consultation with experts.

Hazards	Benguet	Island Group		
		Luzon (%)	Visayas (%)	Mindanao (%)
Typhoon	19.38	20.00	18.21	16.95
Flood	16.00	19.05	16.40	15.25

Drought	12.92	14.25	16.17	16.95
Erosion	12.92	11.43	12.57	12.71
Landslide	13.37	8.57	10.72	14.41
Storm Surge	4.46	9.52	10.39	8.47
Sea Level Rise	4.46	5.71	8.33	5.08
Salt Water Intrusion	4.46	11.43	7.21	10.17
Frost	12.03	-	-	-

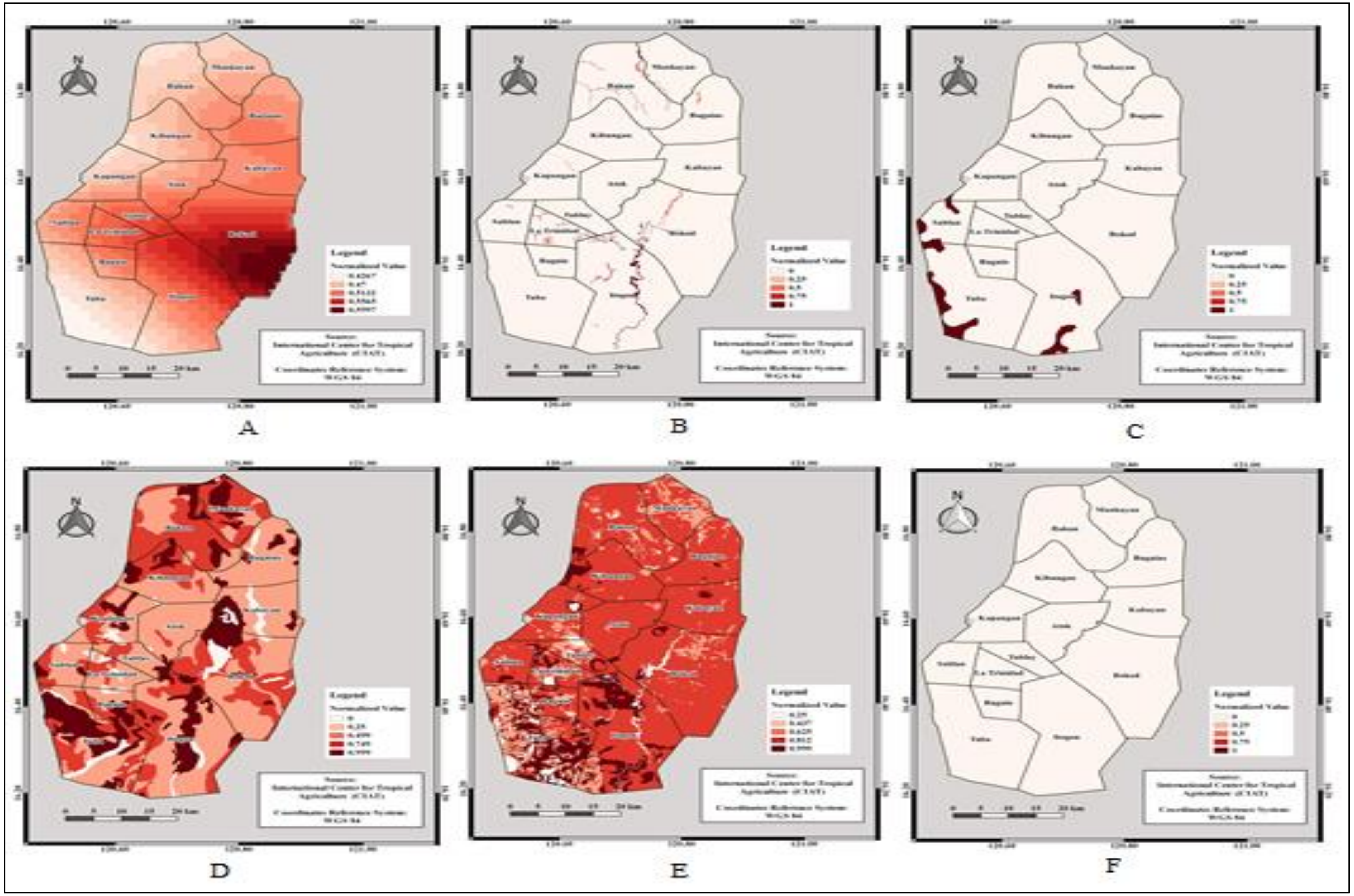


Figure 3. Raw data of the 8 hazards provided by CIAT. A) Tropical Cyclone B) Flood C) Drought D) Erosion E) Landslides F) Storm Surge, Saltwater Intrusion, and Sea Level Rise.

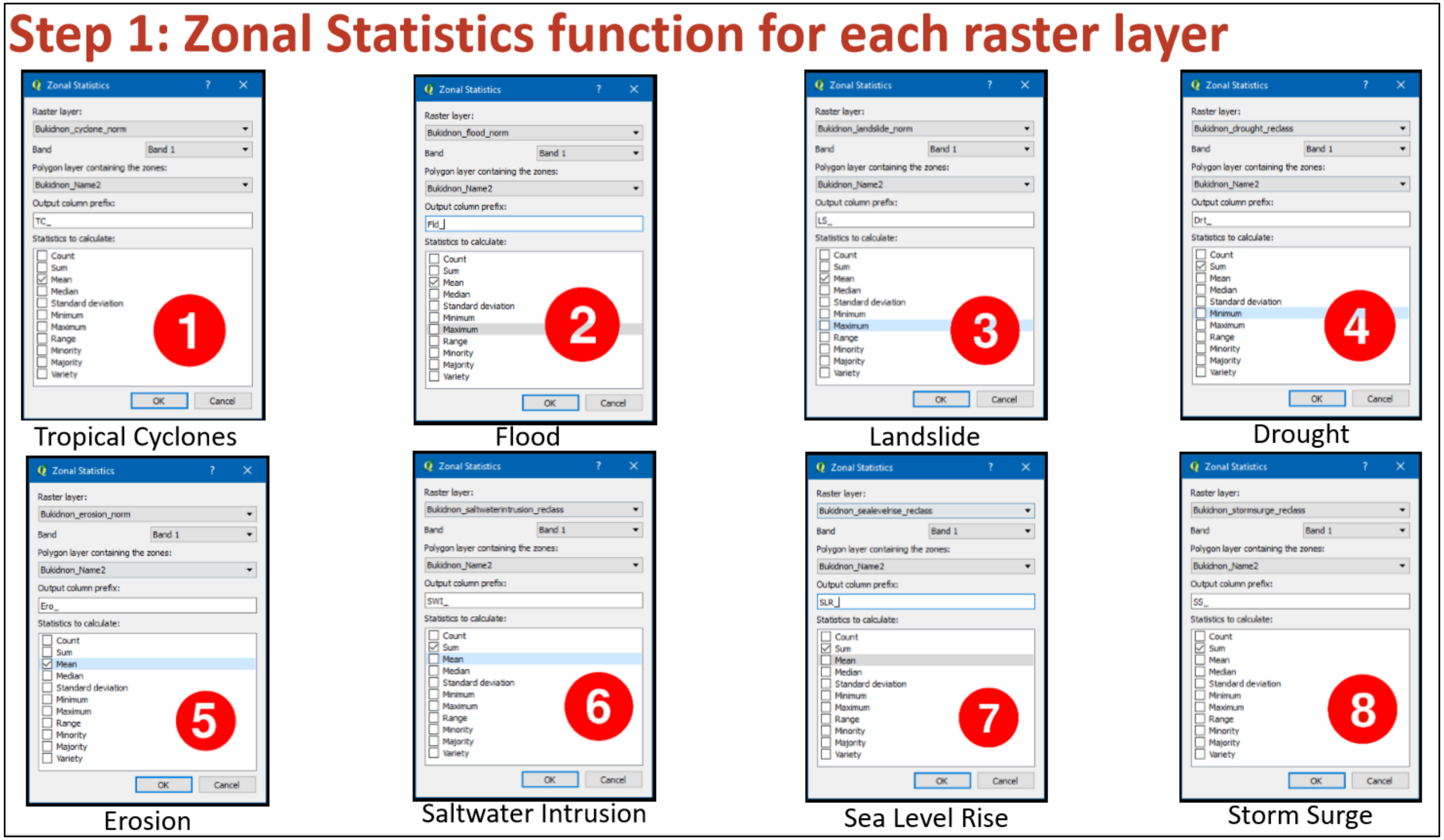


Figure 4. Zonal statistics for the different hazards

B. Adaptive capacity

The adaptive capacity was based on the different capitals identified and developed by experts from Department of Agriculture (DA) agencies, National Economic Development Authority (NEDA), United Nations Food and Agriculture Organization (UN-FAO), Non-Government Organizations (NGOs), and the academe who were invited to a workshop by CIAT. These capitals include economic, natural, social, human, physical, anticipatory, and institutional. Each capital has indicators that were used as basis for each municipality's adaptive capacity. These data (Table 2) were also collected from the different agencies such as LGUs, Philippine Statistics Authority (PSA), and others.

Table 2. List of capitals with their indicators.

Capital	Indicator	Source
Economic	Income level - Municipality class	Benguet-LGU
	Access to credit - Total number of financial institutions - Number of finance cooperatives	National Competitive Council (NCC), 2015
	Commodity price fluctuation - Average inflation rate	NCC, 2015
	Agriculture minimum wage (plantation / non plantation)	NCC, 2015
	Agriculture minimum wage (finance institutions)	Benguet-LGU
	Number of Micro Finance Institutions	NCC, 2015
	Total Number of Banks and Finance Institutions	NCC, 2015
	Average Diesel Price	NCC, 2015

Natural	Supporting ecosystems and their health (e.g. mangroves, forests, lakes, coral reefs)	NCC, 2015
	- Forest cover	
Social	Number of Public Transport Vehicles	Benguet LGU
Human	Education	
	- Ratio of school teachers to students	NCC, 2015
	- Number of private secondary schools	NCC, 2015
	- Number of secondary schools	NCC, 2015
	- Number of public tertiary schools	NCC, 2015
	- Number of public technical vocational schools	NCC, 2015
	Health	
	- Public health services	NCC, 2015
	- Private doctors	NCC, 2015
	- Private health service	NCC, 2015
	- Health services manpower	NCC, 2015
	- Public doctors	NCC, 2015
	- Local citizen with Phil Health	NCC, 2015
	- Total Public Health Facilities	NCC, 2015
Physical	Access to irrigation infrastructure (total irrigated area in hectares)	NCC, 2015
	- % of crops irrigated	
	Percent of Households (HH) with water services	NCC, 2015
	Percent of HH with electricity services	NCC, 2015
	Electricity Firms and customers (average)	NCC, 2015
	Total Road Network	NCC, 2015
	Road Density	NCC, 2015
	Infra investment	NCC, 2015

	Percent Infra to LGU Budget	NCC, 2015
Anticipatory	Telephone companies and mobile services	NCC, 2015
	Presence of DRRMO	NCC, 2015
	Presence of Early Warning Systems	NCC, 2015
	DRRM Budget Allocation	NCC, 2015
Institutional	Presence of Office Implementing CLUP	NCC, 2015
	Presence of Executive Order and Ordinance	NCC, 2015
	Presence of DRRMP	NCC, 2015

Each indicator was normalized and was summed up for each capital. Furthermore, normalized values for each capital of the different municipalities were integrated in the Benguet shapefile that contains municipal boundaries. Five equal breaks were used to classify the adaptive capacity of each municipality: 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High), and 0.80-1.00 (Very High).

C. Sensitivity

The Regional Field Office of the Department of Agriculture in CAR identifies five major crops in Benguet province and these were cabbage, carrot, snap bean, sweet potato and white potato. Locations of the five major crops production areas in Benguet were collected using a participatory mapping approach. Representatives from the Municipal Agriculture Office of the 13 municipalities of Benguet province were invited. The mapping workshop was designed to rapidly locate the five major crops in Benguet. A 1 km by 1 km grip map, barangay boundary map, Google earth satellite image and digital elevation model map were provided for each participant. The participants identified if a particular crop occurs in a specific grid (Figure 5).

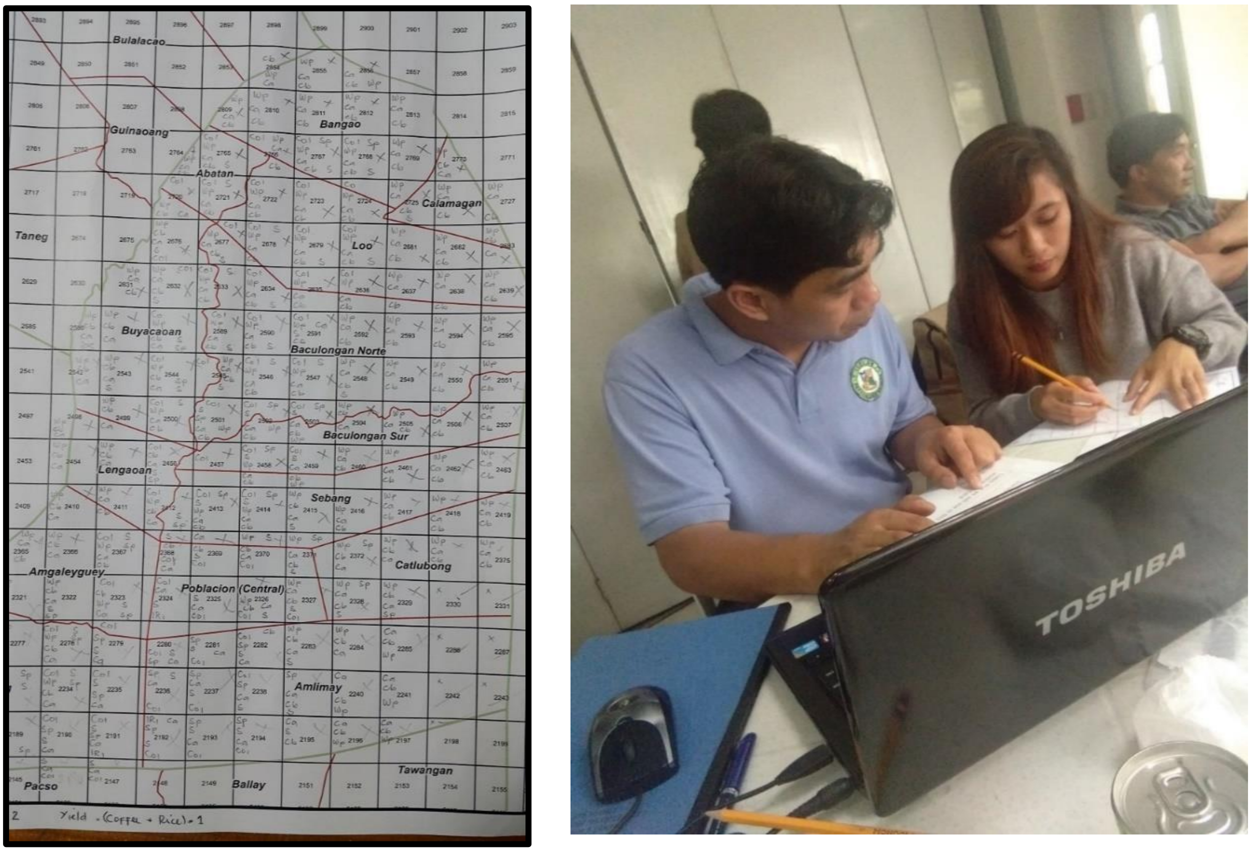


Figure 5. Participatory mapping was conducted to determine the location of the five majors crops in Benguet

In order to determine the sensitivity of a crop to climate change, Maximum entropy (MaxEnt) were used. MaxEnt model is a crop distribution model commonly used to estimate most suitable areas for a species or crop based on probability in geographic areas where the distribution of crops is scarce (Burgman, 2002). This model makes use of the climatic conditions that meet the crop's environmental requirements and predicts the relative suitability of location (Davis et al., 2012). These requirements are represented by bioclimatic variables which are combined to determine areas most suitable for the crop. Moreover, MaxEnt program determined the best location for the five major crops based on the present climatic condition. Furthermore, this program also determined the best location of the five major crops based on future climatic projections.

A total of 19 bioclimatic variables (Table 3) were used to assess the crop suitability of the selected crops in Benguet province. For current conditions, datasets (available at WorldClim.org) were used. The described bioclimatic factors are relevant to understand species responses to climate change (O'Donnell and Ignizio, 2012). Eleven of the bioclimatic variables are temperature related and the nine are precipitation related.

Representative concentration pathway (RCP) 8.5 scenario (Figure 6) was used to project future climatic variables in the year 2050. RCP 8.5 is the worst-case scenario among the four scenarios (RCP 2.6, RCP4.5, RCP 6, and RCP 8.5) developed by the IPCC. These scenarios are based on the projected amount of carbon dioxide (CO_2) emission.

Table 3. Bioclimatic variables used in sensitivity modeling.

Parameters	Description
Bio 1. Annual mean temperature	Annual mean temperature derived from the average monthly temperature.
Bio 2. Mean diurnal range	The mean of the monthly temperature ranges (monthly maximum minus monthly minimum).
Bio 3 - Isothermality	Oscillation in day-to-night temperatures.
Bio 4 - Temperature seasonality	The amount of temperature variation over a given year based on standard deviation of monthly temperature averages
Bio 5 - Maximum temperature of warmest month	The maximum monthly temperature occurrence over a given year (time-series) or averaged span of years (normal).
Bio 6 - Minimum temperature of coldest month	The minimum monthly temperature occurrence over a given year (time-series) or averaged span of years (normal). Variation over a given period.

Bio 7 - Temperature annual range	A measure of temperature
Bio 8 - Mean temperature of wettest quarter	This quarterly index approximates mean temperatures that prevail during the wettest season.
Bio 9 - Mean temperature of driest quarter	This quarterly index approximates mean temperatures that prevail during the driest quarter.
Bio 10 - Mean temperature of warmest quarter	This quarterly index approximates mean temperatures that prevail during the warmest quarter.
Bio 11 - Mean temperature of coldest quarter	This quarterly index approximates mean temperatures that prevail during the coldest quarter.
Bio 12 - Annual precipitation	This is the sum of all total monthly precipitation values.
Bio 13 - Precipitation of wettest month	This index identifies the total precipitation that prevails during the wettest month.
Bio 14 - Precipitation of driest month	This index identifies the total precipitation that prevails during the driest month.
Bio 15 - Precipitation seasonality	This is a measure of the variation in monthly precipitation totals over the course of the year. This index is the ratio of the standard deviation of the monthly total precipitation to the mean monthly total precipitation and is expressed as percentage.

Bio 16 - Precipitation of the wettest quarter.	This quarterly index approximates total precipitation that prevails during the wettest quarter
Bio 17 - Precipitation of driest quarter	This quarterly index approximates total precipitation that prevails during the driest quarter.
Parameters	Description
Bio 18 - Precipitation of warmest quarter	This quarterly index approximates total precipitation that prevails during the warmest quarter.
Bio 19 - Precipitation of coldest quarter	This quarterly index approximates total precipitation that prevails during the coldest quarter.

Source: http//:www.WorldClim.org

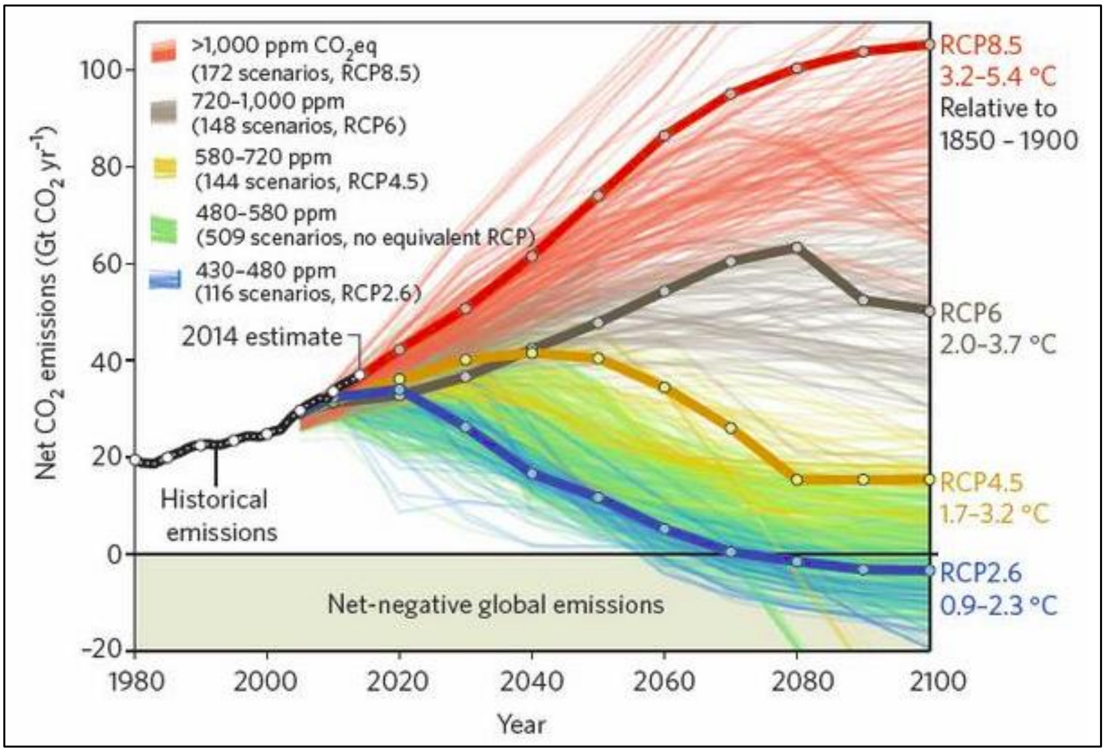


Figure 6. Different scenarios (RCP 2.6, RCP4.5, RCP 6, and RCP 8.5) developed by IPPC based on the projected amount of CO_2 emitted. (Source: Leo Kris M. Palao, "Impacts of Climate Variability and Change: Towards Resilience using Decision Support Tools in Agriculture. 2018.)

To determine the sensitivity of each crop for the different municipalities, the equation suggested by CIAT was used in this study and this was shown below:

$$\frac{Projected\ Conditions - \ Current\ Conditions}{Current\ conditions}\ X\ 100$$

(Source: Palao et al., 2017)

An index was developed from -1.0 to 1.0 for the CRVA where the range from 0.25 to 1.0 indicates a loss in suitability, while -0.25 to -1.0 indicates a gain in suitability to climate change (Table 4).

Table 4. Sensitivity index based on percent change in crop suitability from baseline to future condition.

Percent Change in Suitability (Range in %)	Index	Description
<= -50 (Very high loss)	1.0	
>-50 & <= -25 (High loss)	0.5	Loss
> -25 & <= -5 (Moderate loss)	0.25	
> -5 & <= 5 (No change)	0	No Change
> 5 & <= 25 (Moderate gain)	-0.25	
> 25 & <= 50 (High gain)	-0.5	Gain
> 50 (Very high gain)	-1.0	

Source: Palao et al., 2017

D. Climate Risk Vulnerability Assessment

To determine the vulnerability of each crop for the different municipalities, hazard, sensitivity and adaptive capacity were summed up based on their weights. For the Adaptive capacity, it was 70% while it 15% for hazard and sensitivity. Different scenarios were also created using different weights for adaptive capacity, hazard and sensitivity (Table 5).

The equation used was shown below:

$$f(Haz, Sens, AC) = \sum_{n=i}^{n} \left(\left(Haz_{(w_h)} + Sens_{(w_s)} \right) + 1 - AC_{Wa} \right)$$

where: Haz=hazard index, Sens=sensitivity index ($_i$=crop), and AC=adaptive capacity index. W_h=weight given for hazard, W_s=weight given for sensitivity, and W_a=weight given for adaptive capacity.

Table 5. Scenarios with different weights for adaptive capacity, sensitivity and hazard

Scenario	Adaptive capacity (%)	Sensitivity (%)	Hazards (%)
1 (reference)	70	15	15
2	33	33	33
3	50	25	25
4	60	20	20
5	40	30	30

III. Results and Discussion

A. Hazard

Nine hazards were used to come up with the hazard index. These include tropical cyclone, flood, drought, erosion, landslide, storm surge, saltwater intrusion, sea level rise and frost. Each hazard map was provided by CIAT. The values for each hazard were normalized to give uniform weights and classifications.

Tropical cyclone

As reported by the Typhoon Committee of the Philippine Atmospheric Geophysical Astronomical Services Administration (PAGASA, 2009), an average of 20 tropical cyclones enter the Philippine Area of Responsibility (PAR) from January to November. Tropical cyclones are classified as tropical depressions, tropical storms, and typhoons. Typically, within a year, there are about four (4) to six (6) tropical depressions, three (3) to five (5) tropical storms, and six (6) to nine (9) typhoons that develop within the PAR. It has the highest weight among all hazards and it is most prominent in Northern Luzon (Palao et al., 2017).

Results (Figure 7) show that the municipalities of Tuba, Bakun, Kapangan, Mankayan, Kibungan, Sablan, and Atok have the least exposure to tropical cyclone with normalized values of 0, 0.12, 0.14, 0.15, 0.16, 0.38, and 0.4, respectively. Buguias, Kabayan, and Itogon have moderate exposures with values of 0.41, 0.46, and 0.59, respectively. On the other hand, the municipalities of La Trinidad, Tublay, and Bokod have the highest exposures with values of 0.65, 0.67, and 1, respectively. Figure 7 shows the level of hazard of each municipality to tropical cyclone.

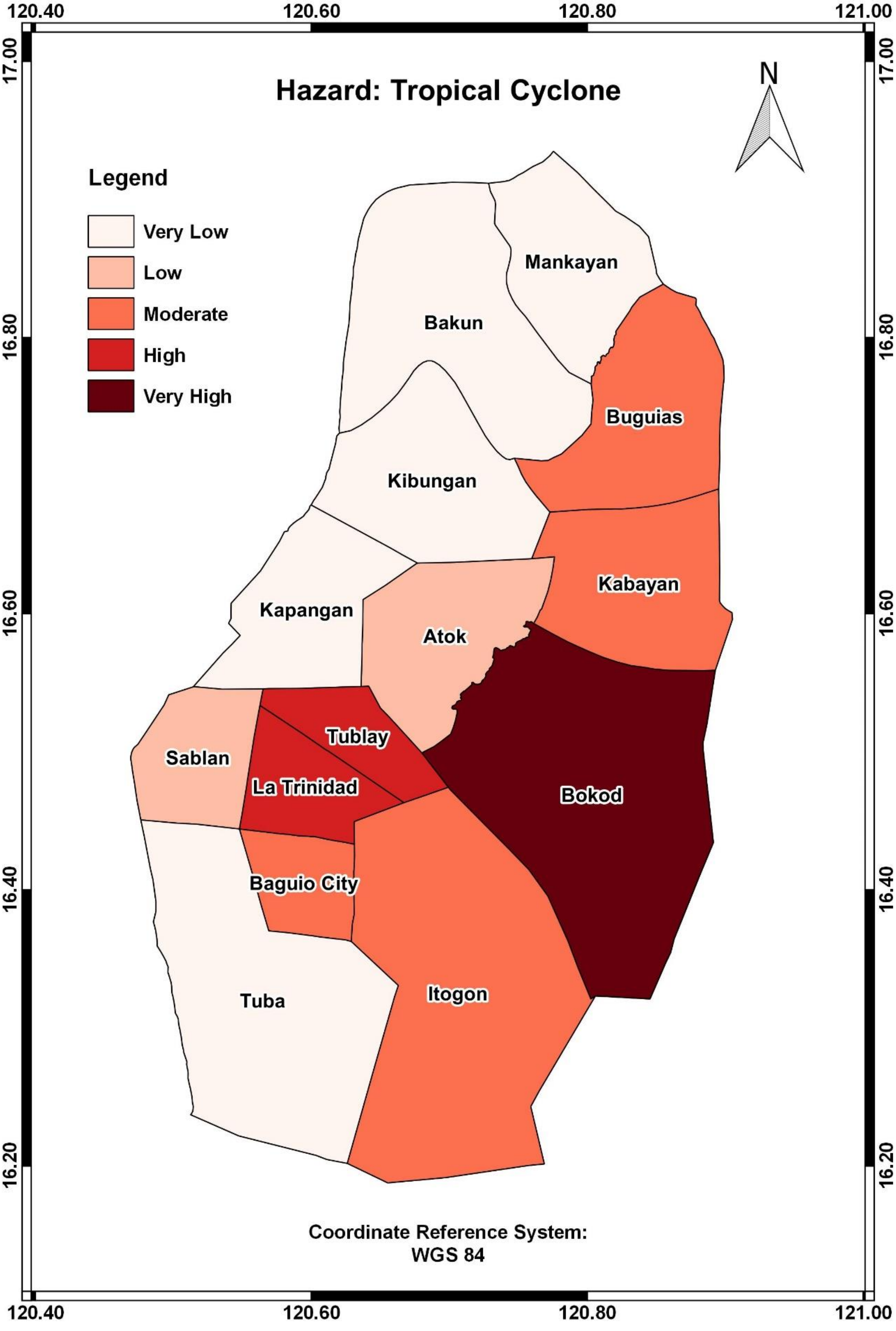


Figure 7. Normalized tropical cyclone index of the different municipalities in Benguet.

Flood

Flood is one of the major problems in the country, primarily during the monsoon season, and it is caused by either typhoon or enhanced southwest monsoon. An enhanced southwest monsoon is a weather system where a typhoon or low pressure area located outside the PAR enhances the southwest monsoon winds that brings heavy rainfall in Luzon and parts of the Visayas. Flood dataset was acquired from the multihazard AMIA dataset in raster format (Palao et al. 2017). Figure 8 shows that La Trinidad and Itogon are the municipalities that are most prone to flooding with normalized values of 1 and 0.81, respectively. The municipalities of Bakun with a value of 0.35, and Bokod, 0.28, have low exposure, and Mankayan, 0.15, Buguias, 0.08, Sablan and Kapangan, both with 0.05, Tublay, 0.03, Kabayan and Atok, both with 0.01, Kibungan and Tuba both with values of 0, have very low exposure to flooding.

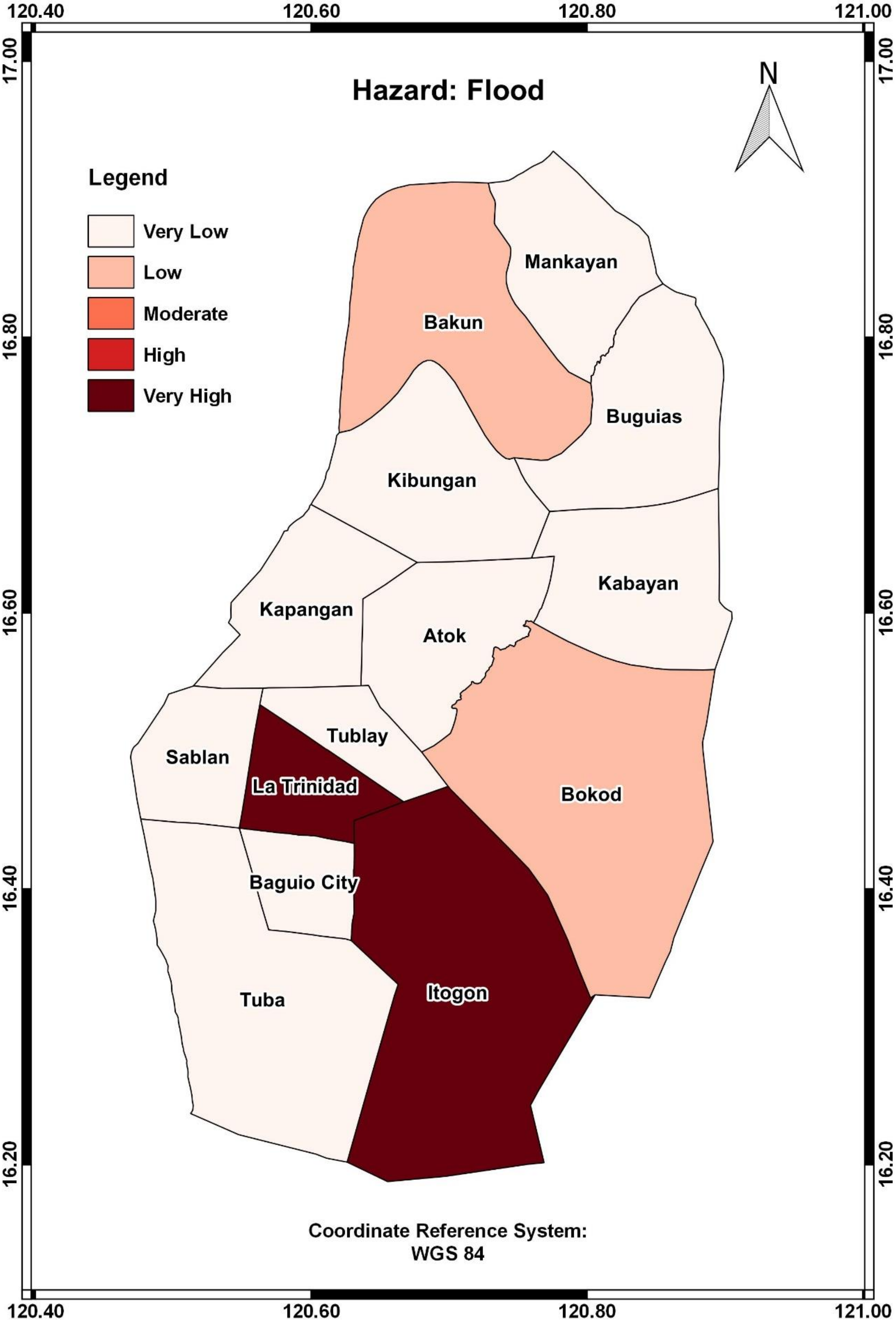


Figure 8. Normalized flood index of the different municipalities in Benguet.

Drought

Drought has always an impact on agricultural, ecological and socio-economic spheres and causes serious environmental, social, and economic consequences worldwide. Drought is one of the most challenging hazards to monitor since it always has a slow onset and it is difficult to observe and forecast quite well. Based on the results, the municipality of Tuba has the highest exposure to drought with a value of 1, followed by the municipality of Itogon (moderate), with a value of 0.53, and Kapangan (low), with a value of 0.03. All other municipalities, having a value of 0 (very low), have the least exposure to drought as shown in Figure 9.

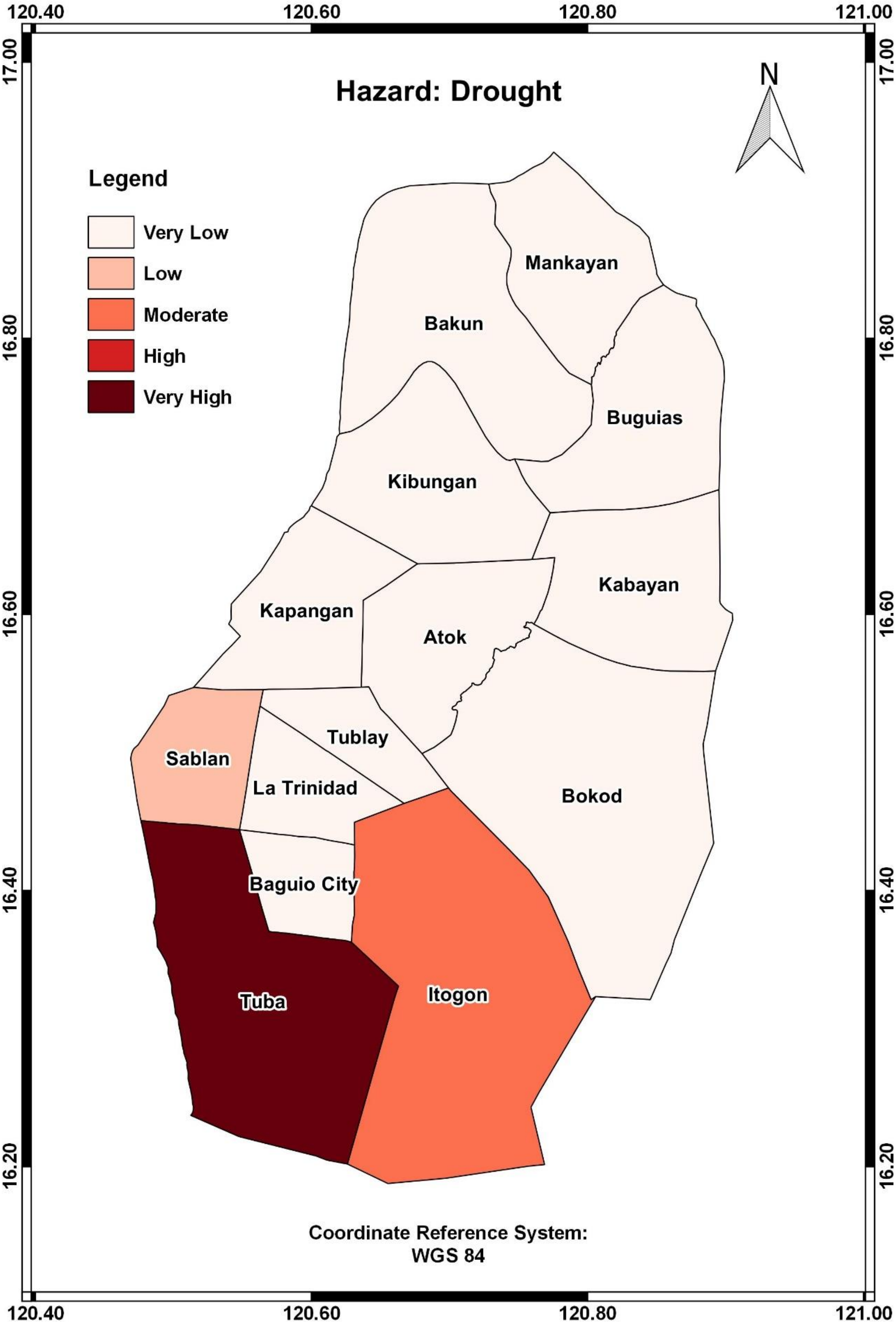


Figure 9. Normalized drought index of the different municipalities in Benguet.

Erosion

Erosion is a natural occurring process attributed to different factors such as soil properties, ground slope, vegetation/land cover, and the amount and intensity of rainfall (Montgomery, 2007). It is usually a slow and gradual process which involves movement of rocks and loosened soil on the Earth's surface from one place to another. In the coming years, the soil erosion rate is expected to increase due to higher amount of rainfall and more frequent extreme events brought by climate change. An increase in erosion rate may lead to poor soil productivity and accelerated siltation of waterways and reservoirs (Lal, 2010). Based on the results (Figure 10), Mankayan and Tuba are the municipalities that are most prone to soil erosion with values of 1 and 0.81, respectively. These were followed by the municipality of Bakun with 0.73. Kibungan, Itogon, and Bokod which are considered moderate with values 0.57, 0.48, and 0.49, respectively. With a value of 0, La Trinidad has the least exposure to soil erosion along with all other municipalities.

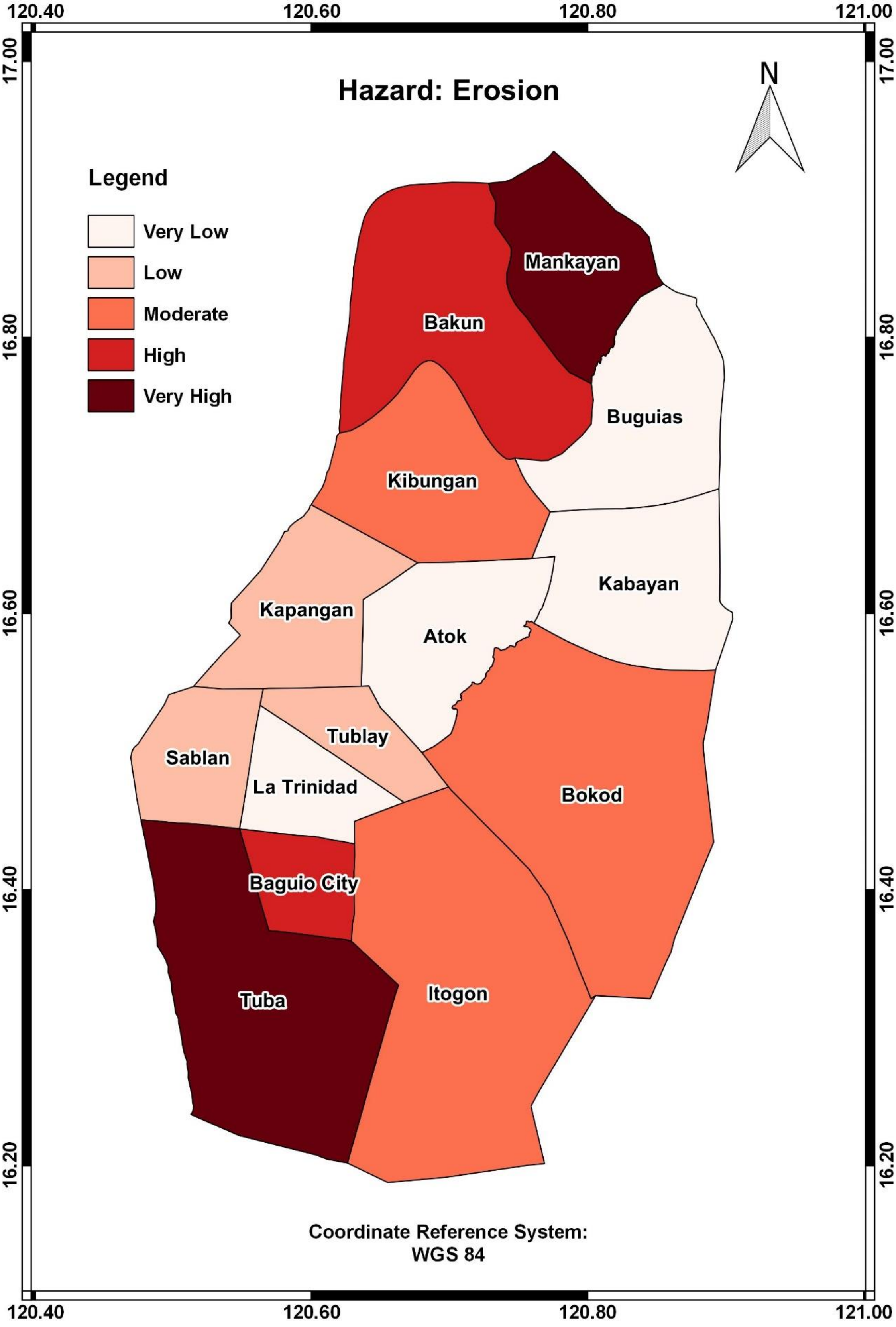


Figure 10. Normalized erosion index of the different municipalities in Benguet.

Landslides

Landslides, also known as landslip, is a geological phenomenon which includes a wide range of ground movements, such as rockfalls, deep failure of slopes and shallow debris flows, which can occur in offshore, coastal and onshore environments. Landslides are caused when the force of gravity pulls rocks, debris or soil down a slope. Fundamentally, they are one of the forms of erosion called mass wasting, defined as erosion involving gravity as the agent causing movement. Gravity constantly acts on a slope. Consequently, landslides only occur when the downslope weight or considered as the driving force of the slide mass exceeds the strength of the soil or the resisting force along a slip surface. This happens when the water from rain sinks through the earth on top of a slope, seeps through cracks and pore spaces in underlying sandstone, and encounters a layer of slippery material, such as shale or clay, inclined toward the valley (Cruden et al., 1996).

In Benguet, the municipalities of Itogon, Kibungan, and Sablan are most exposed to landslides with values of 1, 0.94, and 0.83, respectively (Figure 11). Kabayan, Atok, and Buguias are also highly exposed to landslides with values of 0.78, 0.76, and 0.63, respectively. Furthermore, the municipalities of Bokod, Bakun, and Tuba, are moderately exposed and the municipalities of Kapangan, La Trinidad, Tublay, and Mankayan have the least exposure to landslides with values of 0.55, 0.46, 0.44, 0.39, 0.28, 0.05, and 0, respectively.

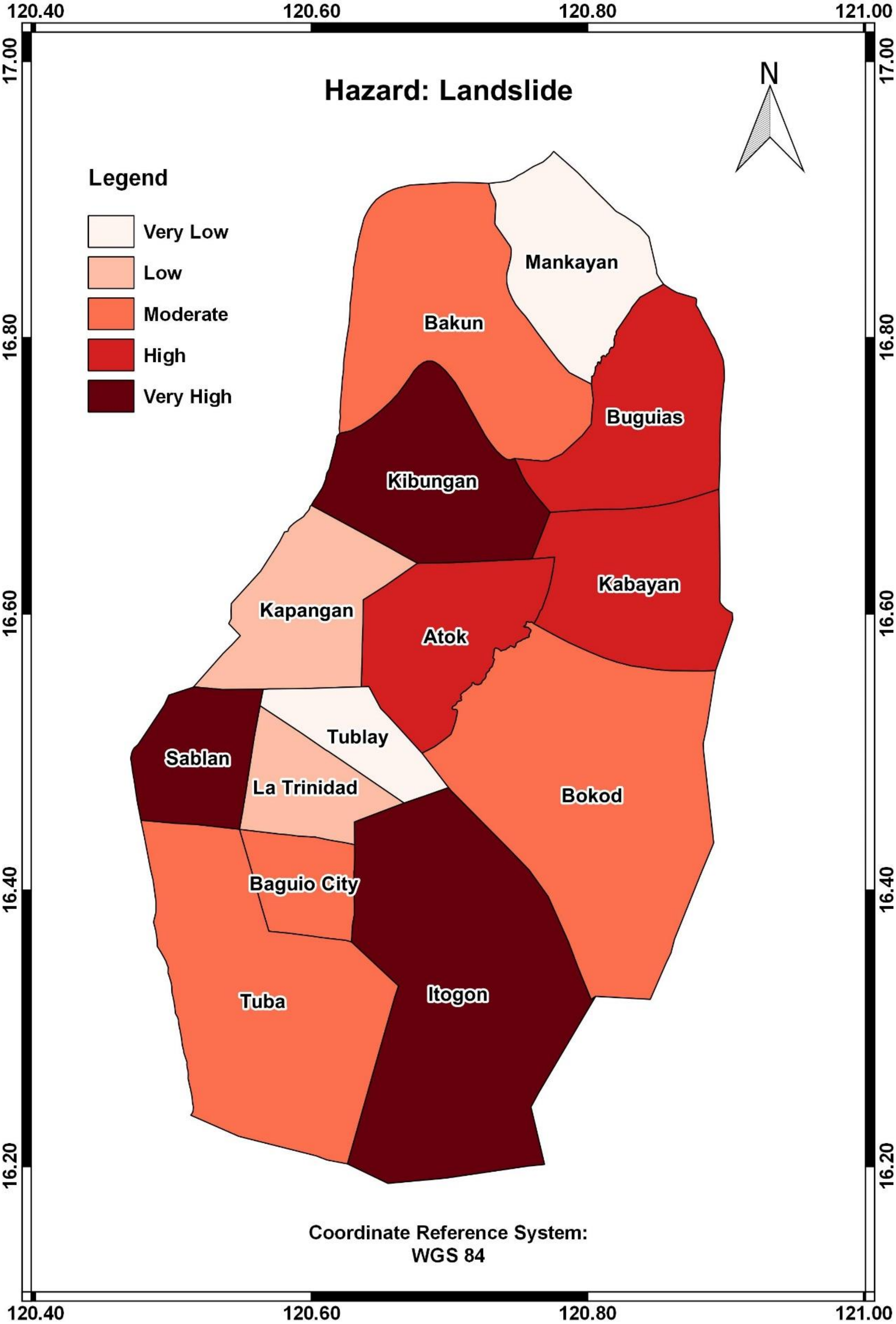


Figure 11. Normalized landslide index of the different municipalities in Benguet.

Storm surges, Salt water rise, and Sea level rise

The province of Benguet is located in mountainous areas, thus, there are no cases of storm surges, salt water rise, and sea level rise. Based on the results, the values of each municipality for these three hazards are all 0.

Frost

Frost is a hazard that is unique in Benguet province. The municipalities of Buguias and Bakun were classified as very high in terms of exposure to frost. Kabayan and Bokod were classified as high while Kibungan had a moderate classification in frost hazard (Figure 12).

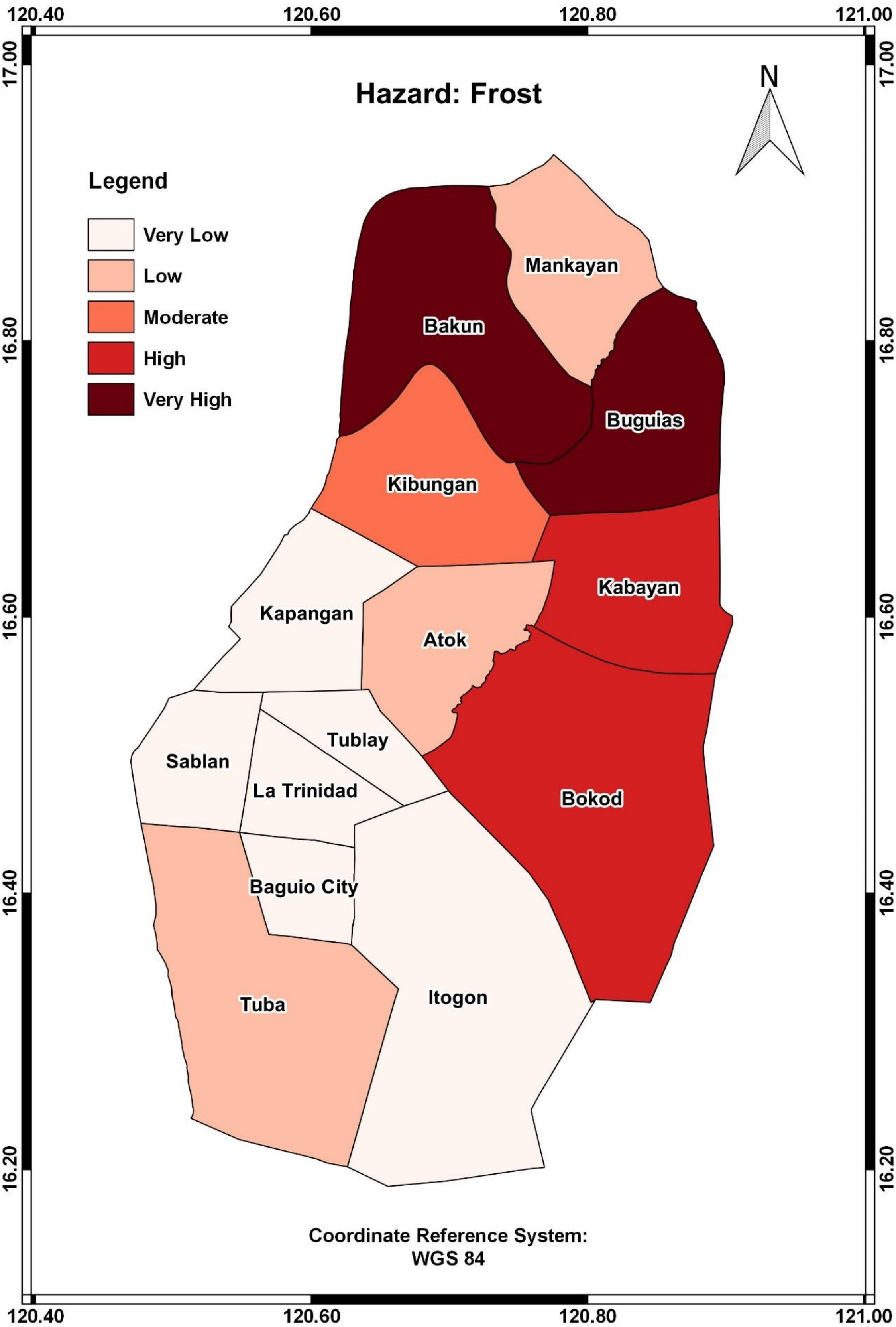


Figure 12. Normalized frost index of the different municipalities in Benguet.

Hazard Index

The nine hazards were combined for the different municipalities using the assigned weights and was shown in Figure 13. In Benguet, tropical cyclone, soil erosion, and landslide are consistently rated high across the 13 municipalities and are considered the major driving factors of high hazard exposure at the same time high hazard index. Based on the results, the municipality of Itogon has a very high exposure to hazards and it was followed by the Bokod municipalty. While the muniipalites of La Trinidad, Tuba, Buguias and Bakun were classified as moderately hazardous. On the other hand, Mankayan, Kapangan and Tublay municipalities are considered very low in hazard exposure as compared to other municipalites in Benguet province.

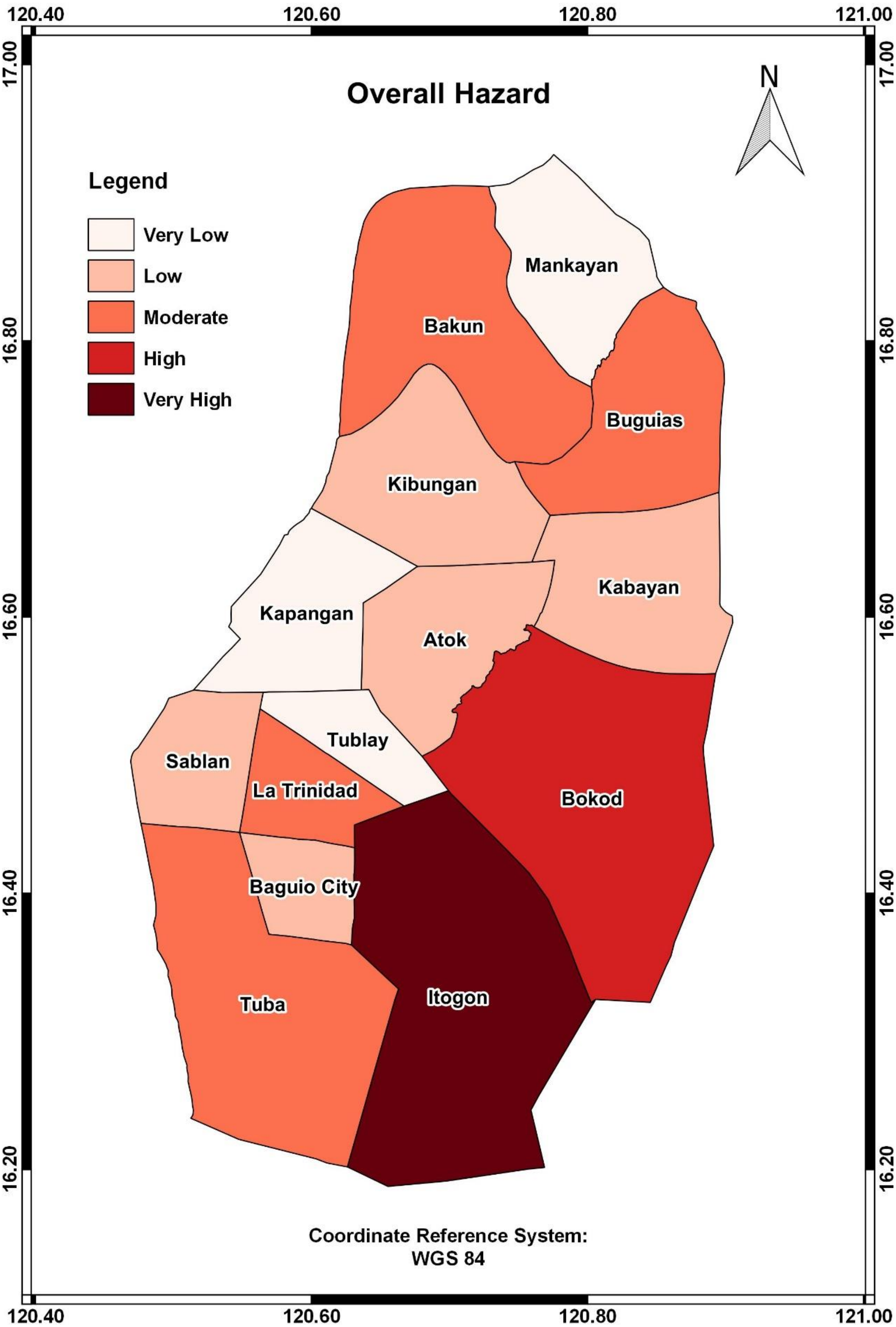


Figure 13. Overall hazard Index map of Benguet.

B. Adaptive Capacity

The adaptive capacity was based on a set of capitals including economic, natural, social, human, physical, anticipatory, and institutional. Each capital has indicators that were used as basis for each municipality's adaptive capacity.

Anticipatory

There are four (4) indicators used for the anticipatory capital: presence of Disaster Risk Reduction Management Office (DRRMO), presence of early warning systems, number of telephone companies and mobile service providers, and DRRM budget. Based on the results (Figure 14), the municipality of La Trinidad has the highest adaptive capacity (very high) in terms of the anticipatory capital with a value of 1, followed by Tuba (moderate) with a value of 0.60. The municipalities of Tublay and Sablan, both with values of 0.40, have low adaptive capacity. All other municipalities including Kibungan, Kapangan, Kabayan, Itogon, Buguias, Bokod, and Atok, have low adaptive capacity with values of 0.20 and the municipalities of Mankayan and Bakun as well, both with values of 0.

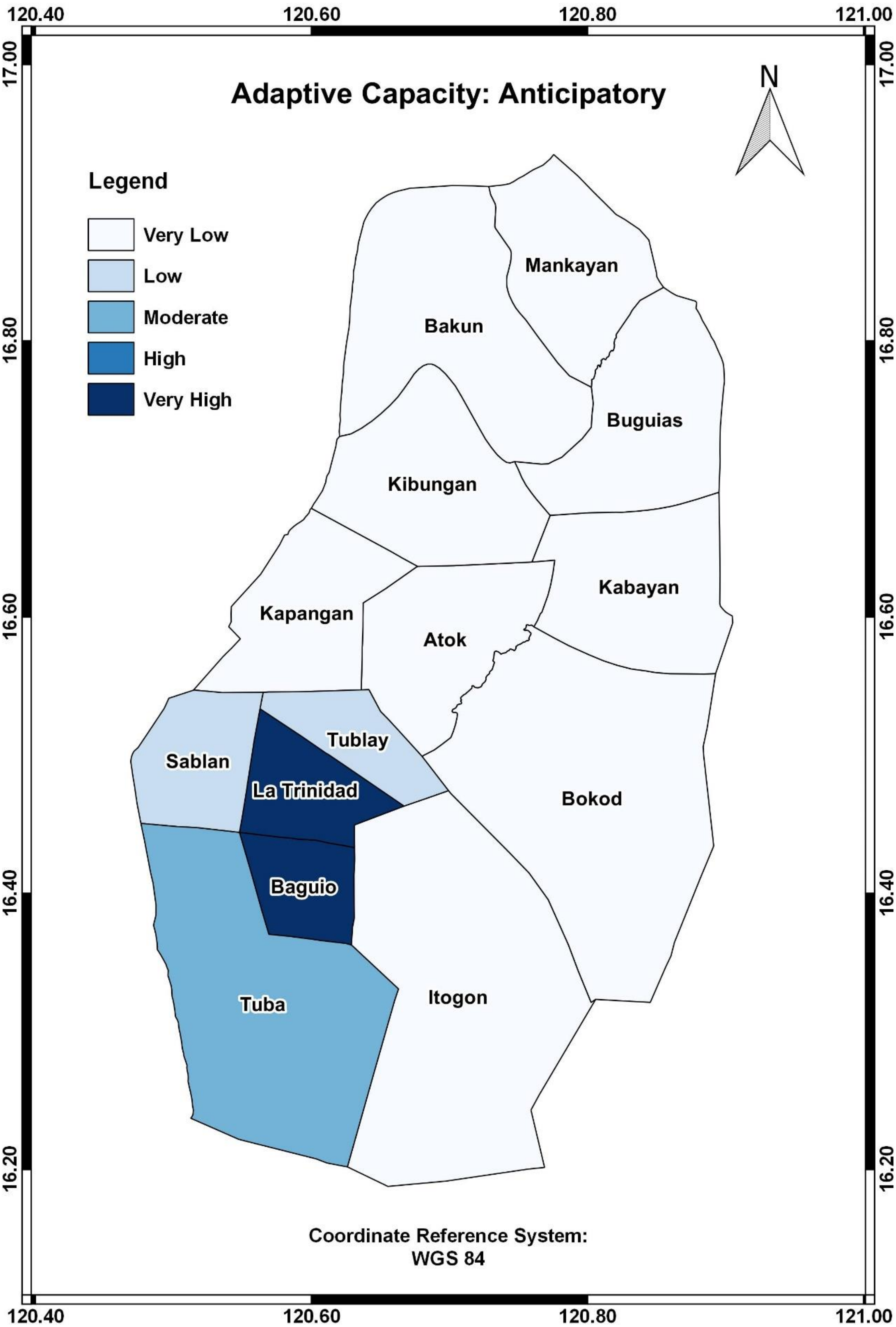


Figure 14. Normalized anticipatory capital map of Benguet.

Economic

The economic capital includes municipality class, total number of finance institution, number of finance cooperatives, average inflation rate, agriculture minimum wage, number of micro finance institutions, and average diesel price. For this capital, the municipality of La Trinidad has the highest adaptive capacity (moderate) with a value of 0.43 as compared to all other municipalities (Figure 15). The municipality of Itogon, Tuba, and Tublay have low economical adaptive capacity with values of 0.39, 0.33, and 0.21, respectively. On the other hand, all other municipalities have very low economical adaptive capacity where the municipalities of Sablan and Mankayan have values of 0.19, the municipalities of Buguias, Bokod, and Atok have values of 0.16, 0.15, and 0.05, respectively, the municipalities of Bakun and Kabayan with values of 0.03, and the municipalities of Kapangan and Kibungan with a value of 0.02 and 0, respectively.

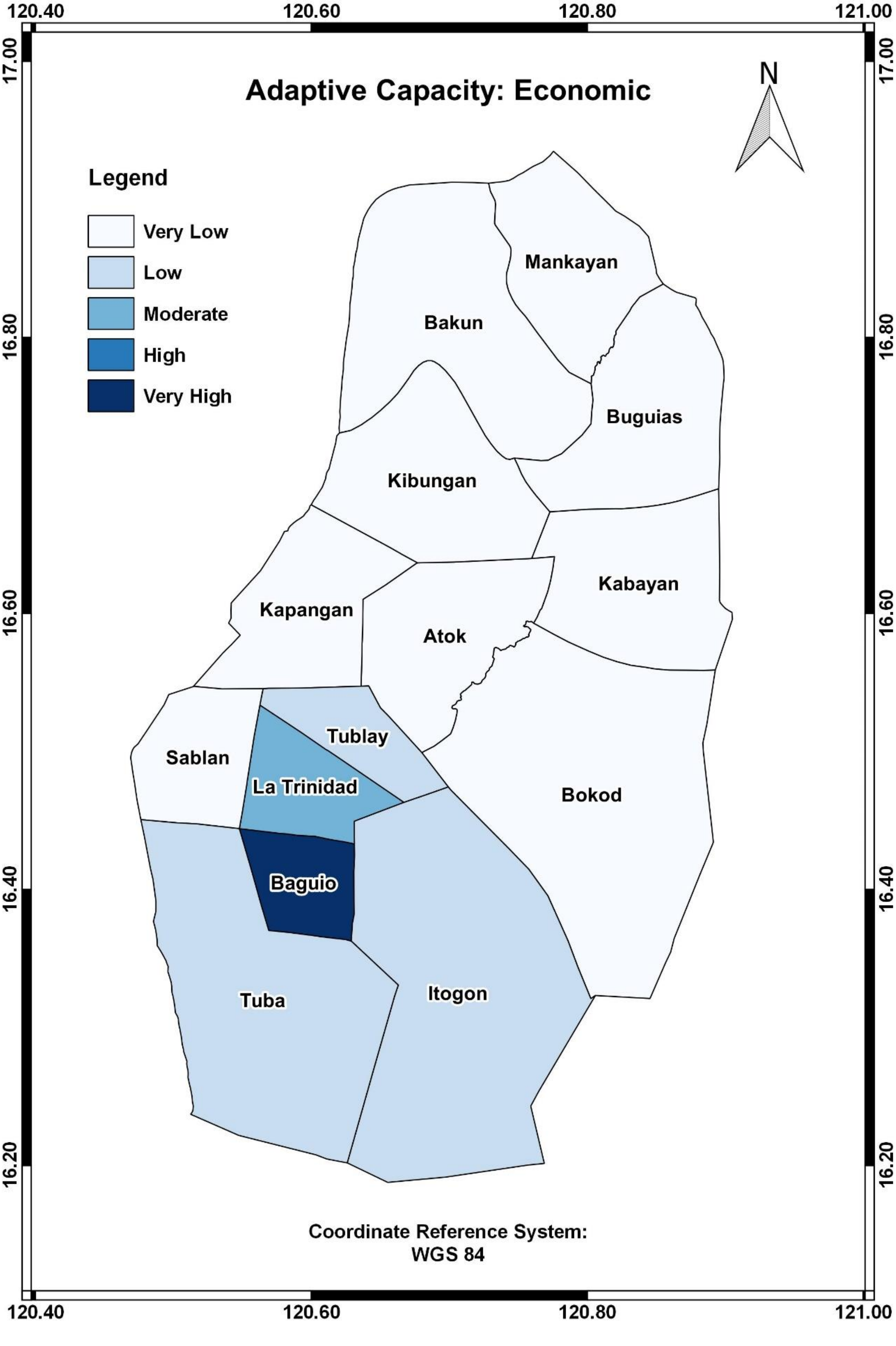


Figure 15. Normalized economic capital of Benguet.

Human

Human capital has the highest number of indicators including the ratio of school teachers to students, number of private secondary schools, number of secondary schools, number of public tertiary schools, number of public technical vocational schools, public health services, private doctors, private health service, health services manpower, public doctors, local citizen with Phil Health, total public health facilities, and total private health facilities. For the human capital, all municipalities have low to very low adaptive capacity in terms of human capital including the municipality of La Trinidad (low) which has a value of 0.27. The municipality of Buguias has a value of 0.12, Tuba and Itogon, both with values of 0.10, Kapangan, Bokod, and Kabayan, have values of 0.09, 0.07, and 0.06, respectively, Tublay, Sablan, and Bakun, all with values of 0.04, Atok and Mankayan, both with 0.02 values, and the municipality of Kibungan with a value of 0, are all considered to have very low adaptive capacity in terms of human capital (Figure 16).

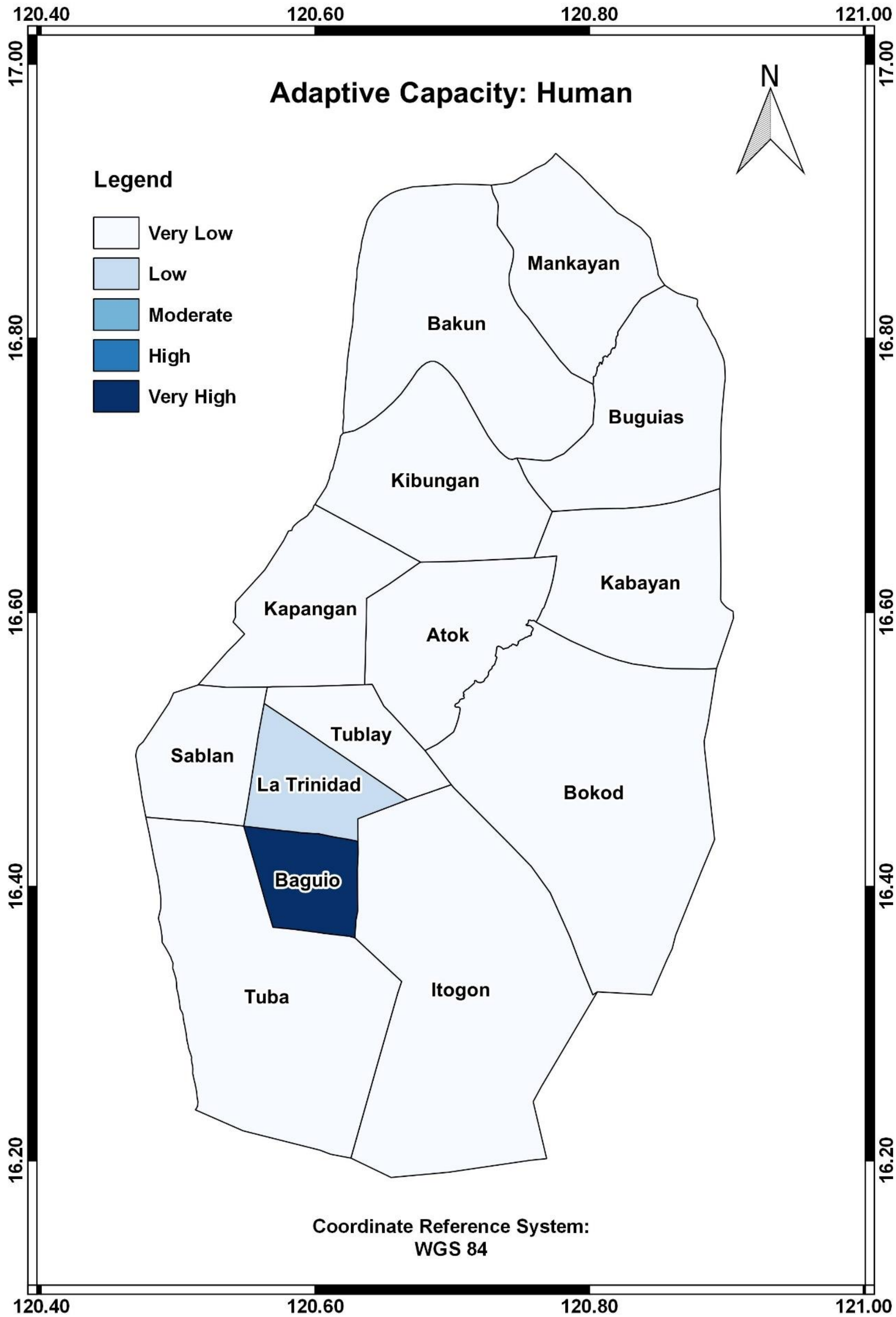


Figure 16. Normalized human capital map of Benguet.

Institutional

There are three (3) indicators for the institutional capital: presence of offices implementing Comprehensive Land Use Plan (CLUP), Presence of Executive Orders and Ordinances, and presence of Disaster Risk Reduction Management Plan (DRRMP). The results (Figure 17) show that almost all municipalities have high adaptive capacity in terms of this capital except for the municipalities of Kibungan and Mankayan, both with values of 0. The municipality of Bakun with a value of 0.67 has high institutional adaptive capacity and all other municipalities including Tublay, Tuba, Sablan, La Trinidad, Kapangan, Kabayan, Itogon, Buguias, Bokod, and Atok have very high institutional adaptive capacity, all with values of 1.

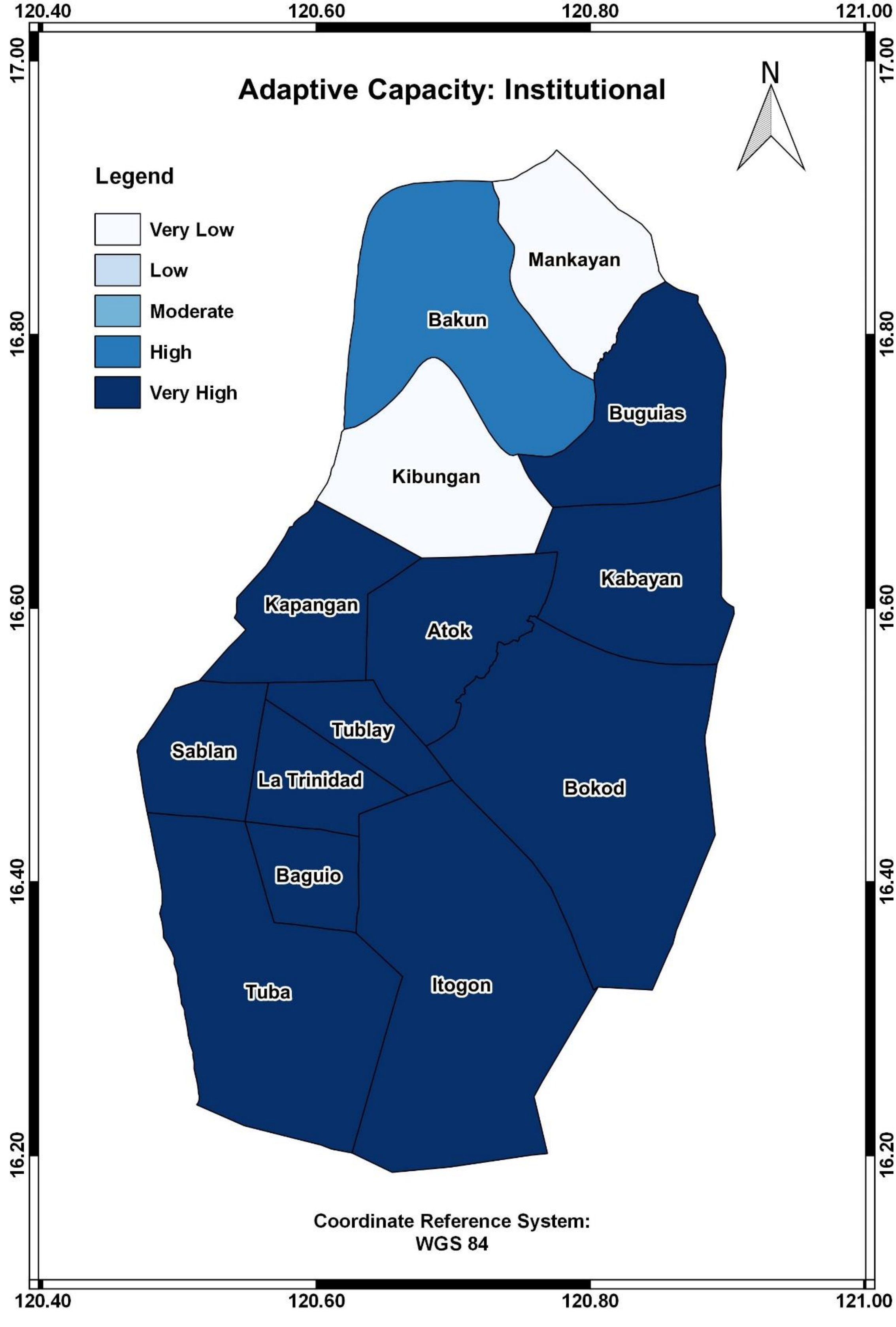


Figure 17. Normalized institutional capital map of Benguet.

Natural

Forest cover is the only indicator for the natural capital. Among all other municipalities, Kibungan, with a value of 1, has the highest (very high) natural adaptive capacity in terms of this capital followed by Bokod (moderate) with a value of 0.49. The municipality of Itogon, with a value of 0.05, and all other municipalities, have very low adaptive capacity with values of 0. Figure 18 shows the adaptive capacity map of Benguet in terms of natural capital.

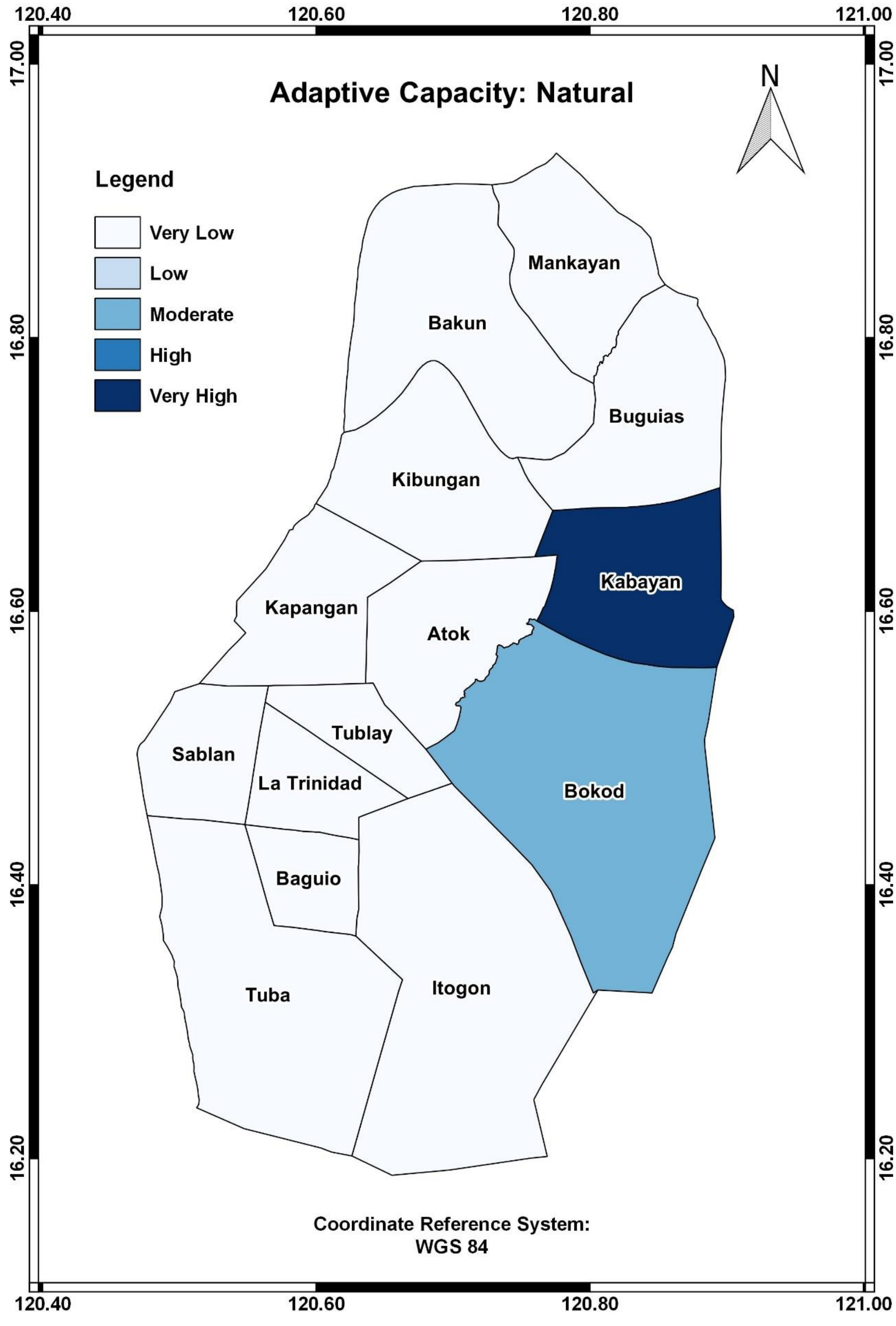


Figure 18. Normalized natural capital map of Benguet.

Physical

For the physical capital, the indicators include percent of crops irrigated, percent of households (HH) with water services, percent of HH with electricity services, average number of electricity firms and customers, total road network, road density, infrastructure investment, and percent infrastructure to LGU Budget. Based on the map (Figure 19), the municipalities of Kibungan (low) and Kabayan (very low), with values of 0.27 and 0, respectively, have the least physical adaptive capacity. The municipalities of Bokod, Kapangan, Itogon, and Atok, all with values from 0.40 to 0.60, have moderate physical adaptive capacity. On the other hand, the municipalities having values from 0.60 to 0.80, including Bakun, Tuba, Mankayan, La Trinidad, Sablan, and Buguias, have high physical adaptive capacity.

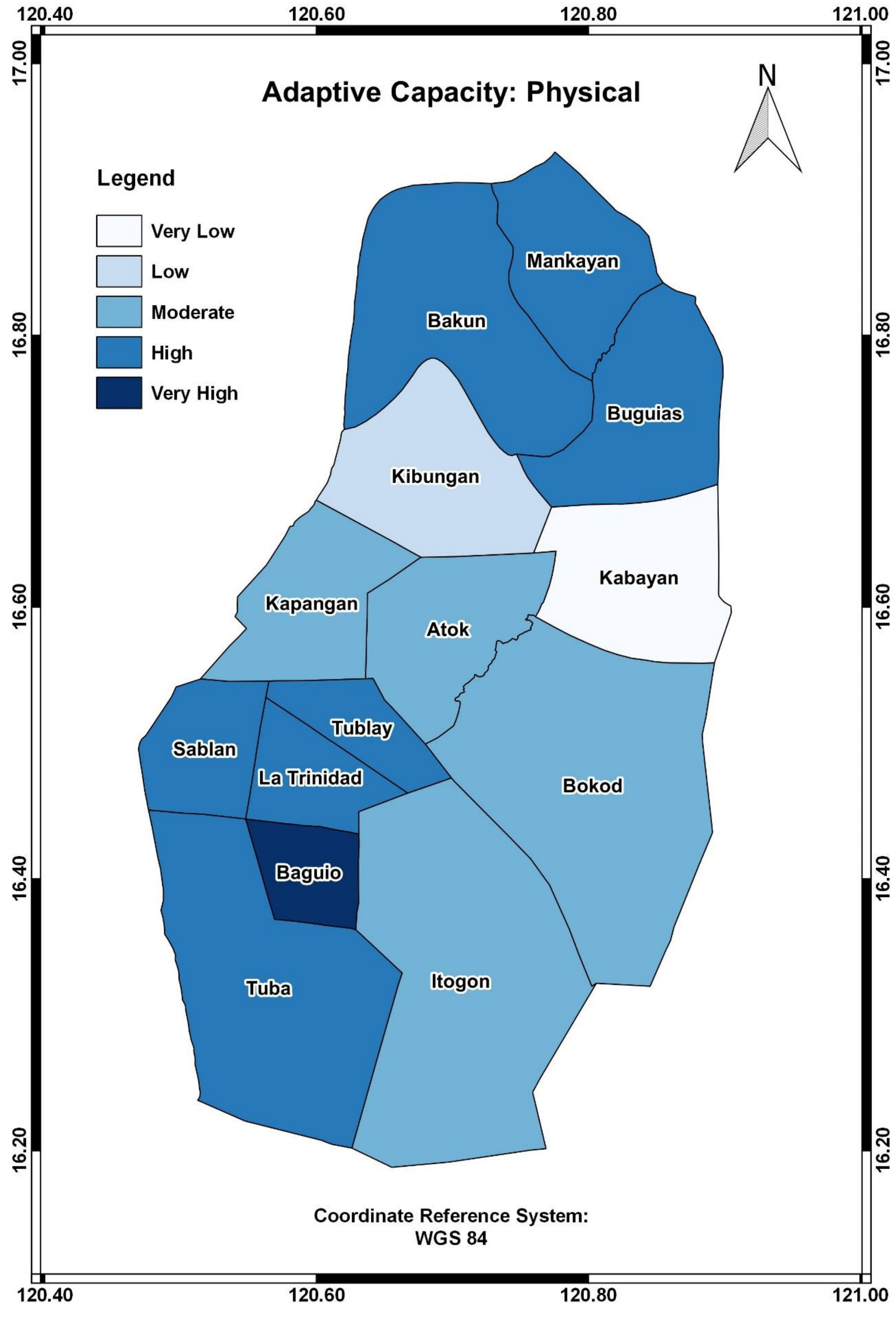


Figure 19. Normalized physical capital map of Benguet.

Social

The number of public transport vehicles is the only indicator that contributes for the social capital. The result (Figure 20) shows that all of the 13 municipalities have low to very low adaptive capacity in terms of public transportation. With values ranging from 0 to 0.20, the municipalities of Bokod, Kibungan, Bakun, Atok, Kabayan, Tuba, Kapangan, Tublay, Sablan, Mankayan, Buguias, and Itogon, have very low social adaptive capacity. On the other hand, the municipality of La Triniadad, with a value of 0.22, has low social adaptive capacity.

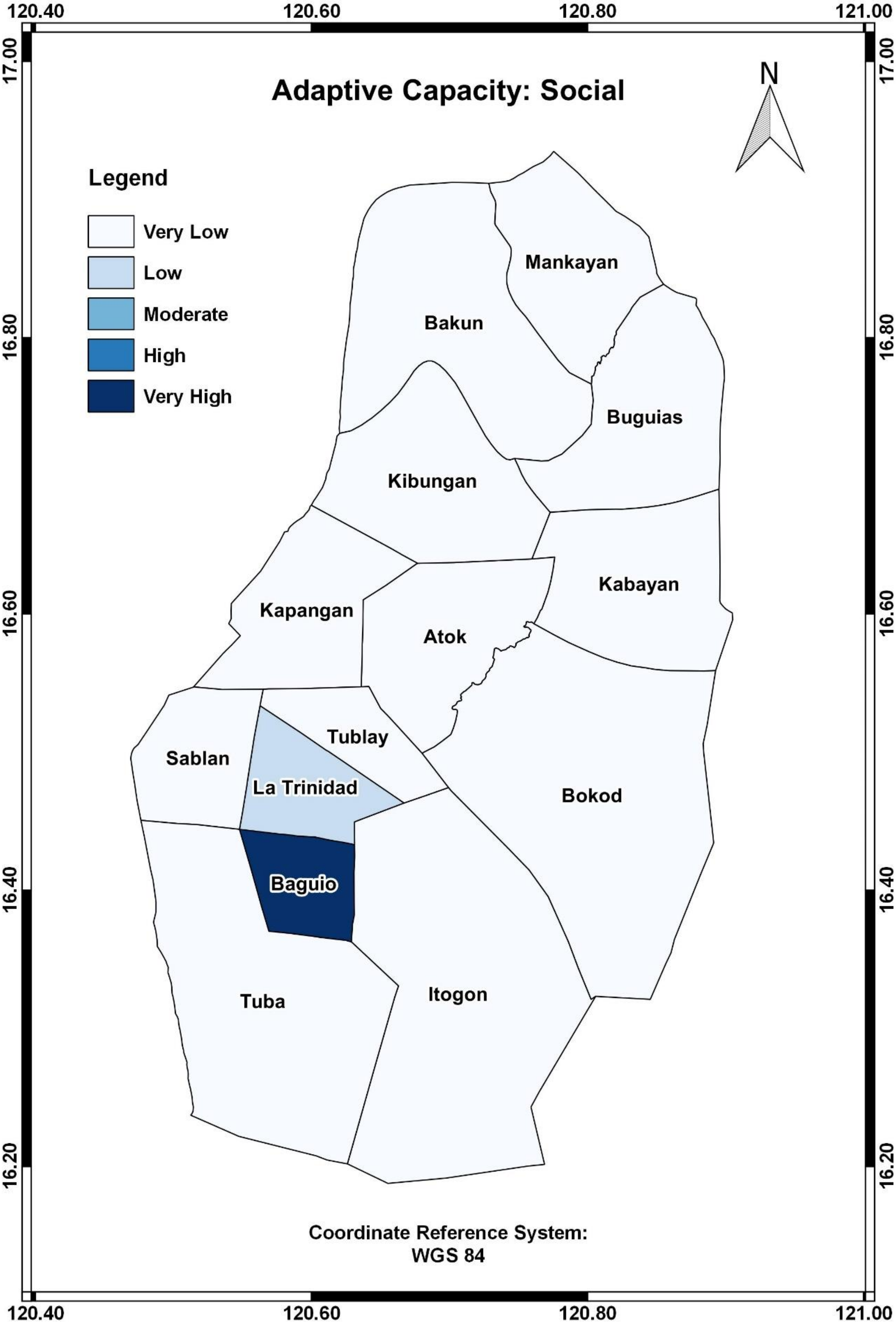


Figure 20. Normalized social capital map of Benguet.

Adaptive Capacity Index

The adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation. Such resources may be natural, financial, institutional or human, and might include access to ecosystems, information, expertise, and social networks. There are many indicators that could form a strong adaptive capacity index, but data availability was a driving factor in establishing the final index for the province of Benguet. The following presents the spatial analysis of all 7 capitals as well as the aggregated overall adaptive capacity index (Figure 21). It can be seen that almost all of the municialities have low adaptive capacity with La Trinidad having moderate adaptive capacity.

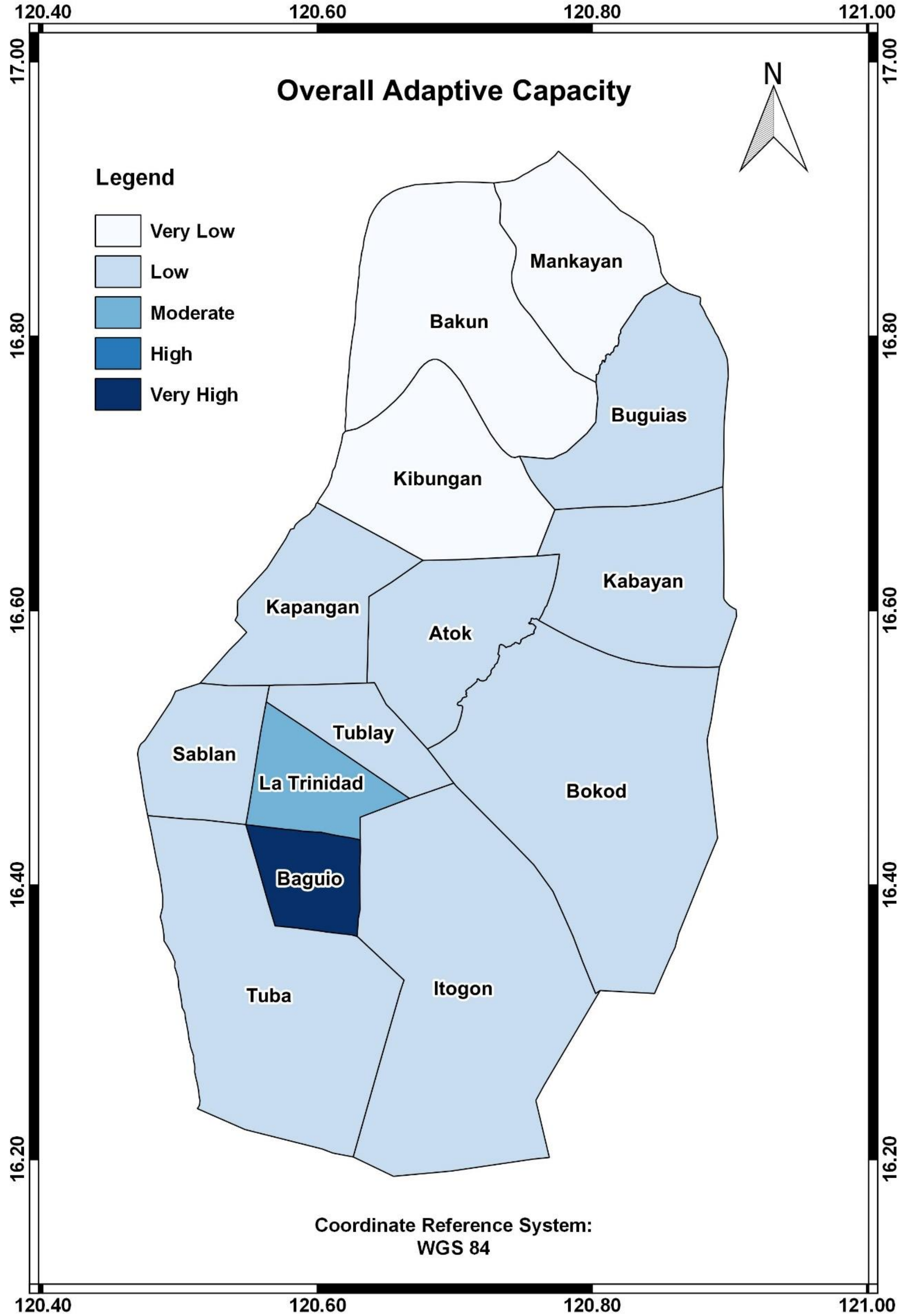


Figure 21. Normalized adaptive capacity map of the different municipalities of Benguet province

C. Sensitivity

The municipalities of Buguias, Kabayan and Tuba are expected to be the most sensitive for cabbage, carrot and white potato production using the Maxent program and based on the different bioclimatic variables used in this study. Results also showed that snap bean production will be more sensitive in La Trinidad and Tuba. For the sweet potato, it is projected that the municipality of Tuba will have the highest loss as compared to other municipalities (Table 6). On the other hand, Bokod, Kibungan and Kapangan are expected to gain production for the cabbage (Figure 22). For the carrot production, Atok, Bokod, Itogon, Kibungan and Kapangan are expected to have gains in the future as shown in Figure 23. For snap bean, municipalities of Atok, Bakun, Bokod, Kibungan, Kapangan and Sablan are projected to have gains in the production based on the bioclimatic variables (Figure 24). The municipalities of Atok, Bakun, Bokod, Itogon, Kibungan, Tublay are projected to gains for sweet potato (Figure 25) while the municipalities of Atok, Bokod, Itogon, Kibungan, Kapangan for the white potato production (Figure 26).

Table 6. Sensitivity of the major crops in the different municipalities in Benguet province.

Crop	Loss	No change	Gain
Cabbage	Buguias, Kabayan, Tuba	Atok, Bakun, Itogon, La Trinidad, Mankayan, Sablan, Tublay	Bokod, Kibungan, Kapangan
Carrot	Buguias, Kabayan, Sablan, Tuba	Bakun, La Trinidad, Mankayan, Tublay	Atok, Bokod, Itogon, Kibungan, Kapangan
Snap bean	La Trinidad, Tuba	Buguias, Itogon, Kabayan, Mankayan, Tublay	Atok, Bakun, Bokod, Kibungan, Kapangan, Sablan
Sweet potato	Tuba	Buguias, Kabayan, Kapangan, La Trinidad, Mankayan, Sablan	Atok, Bakun, Bokod, Itogon, Kibungan, Tublay
White potato	Buguias, Kabayan, Tuba	Bakun, La Trinidad, Mankayan, Sablan, Tublay	Atok, Bokod, Itogon, Kibungan, Kapangan

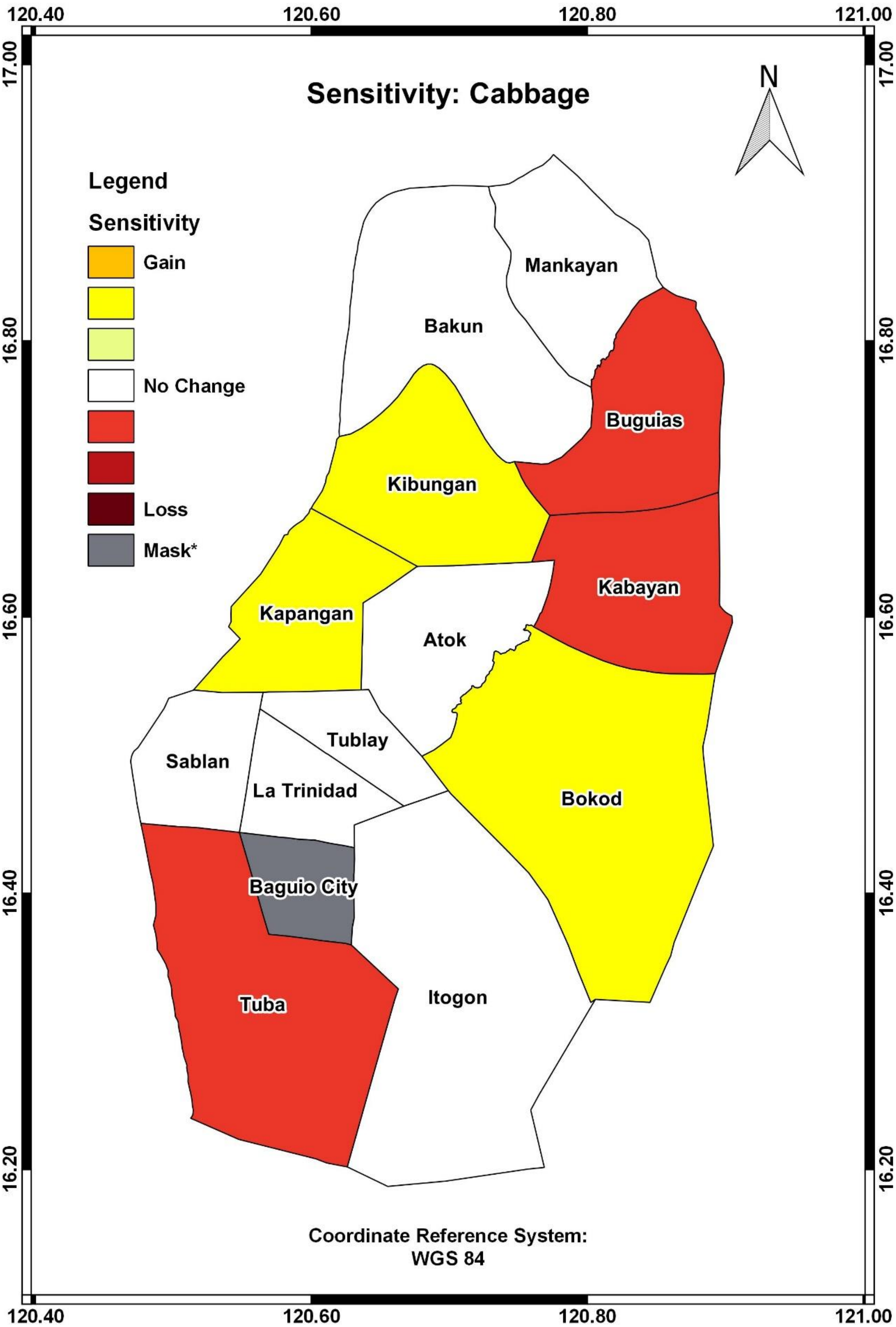


Figure 22. Sensitivity map of cabbage in the different municipalities of Benguet province.

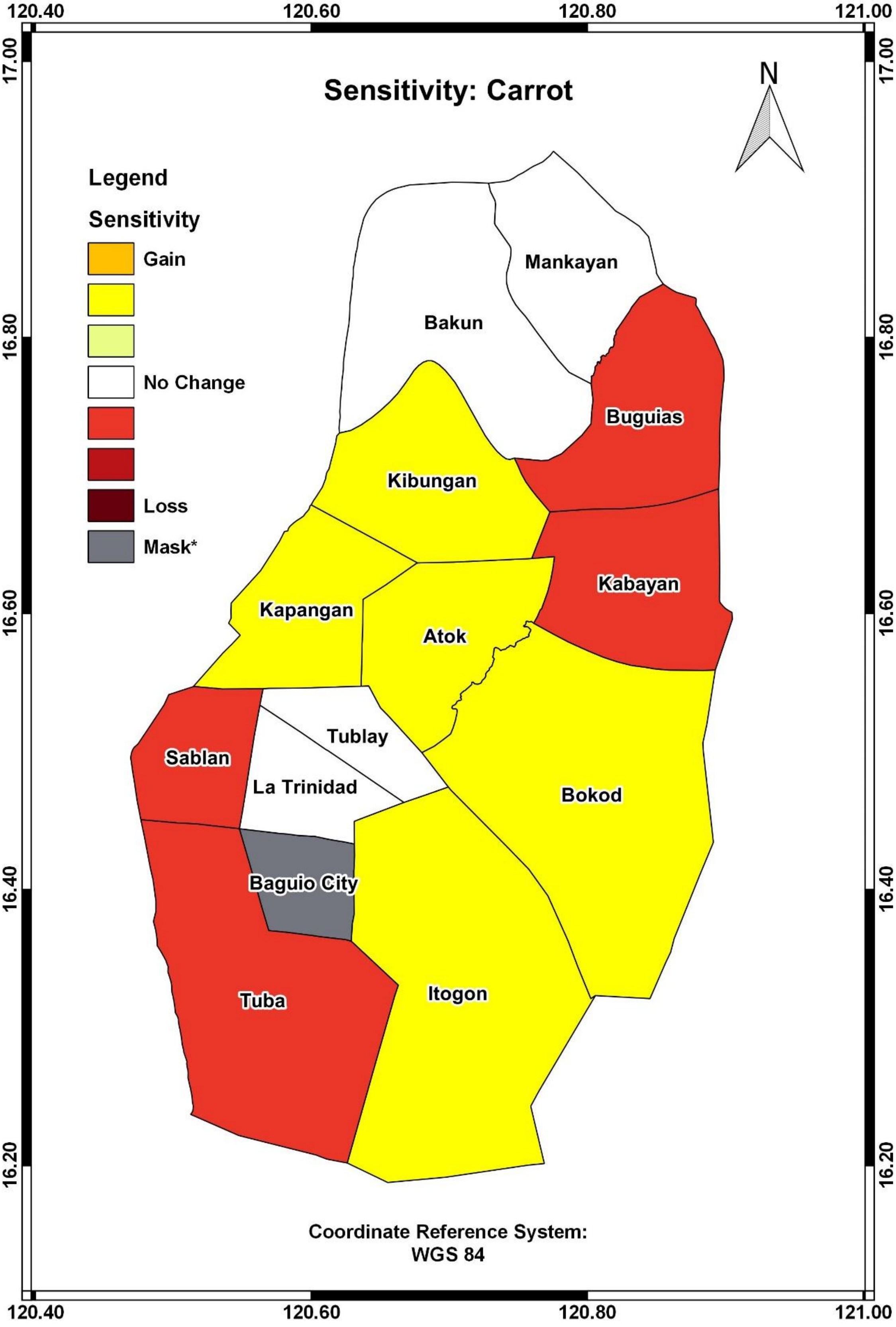


Figure 23. Sensitivity map of carrot in the different municipalities of Benguet province.

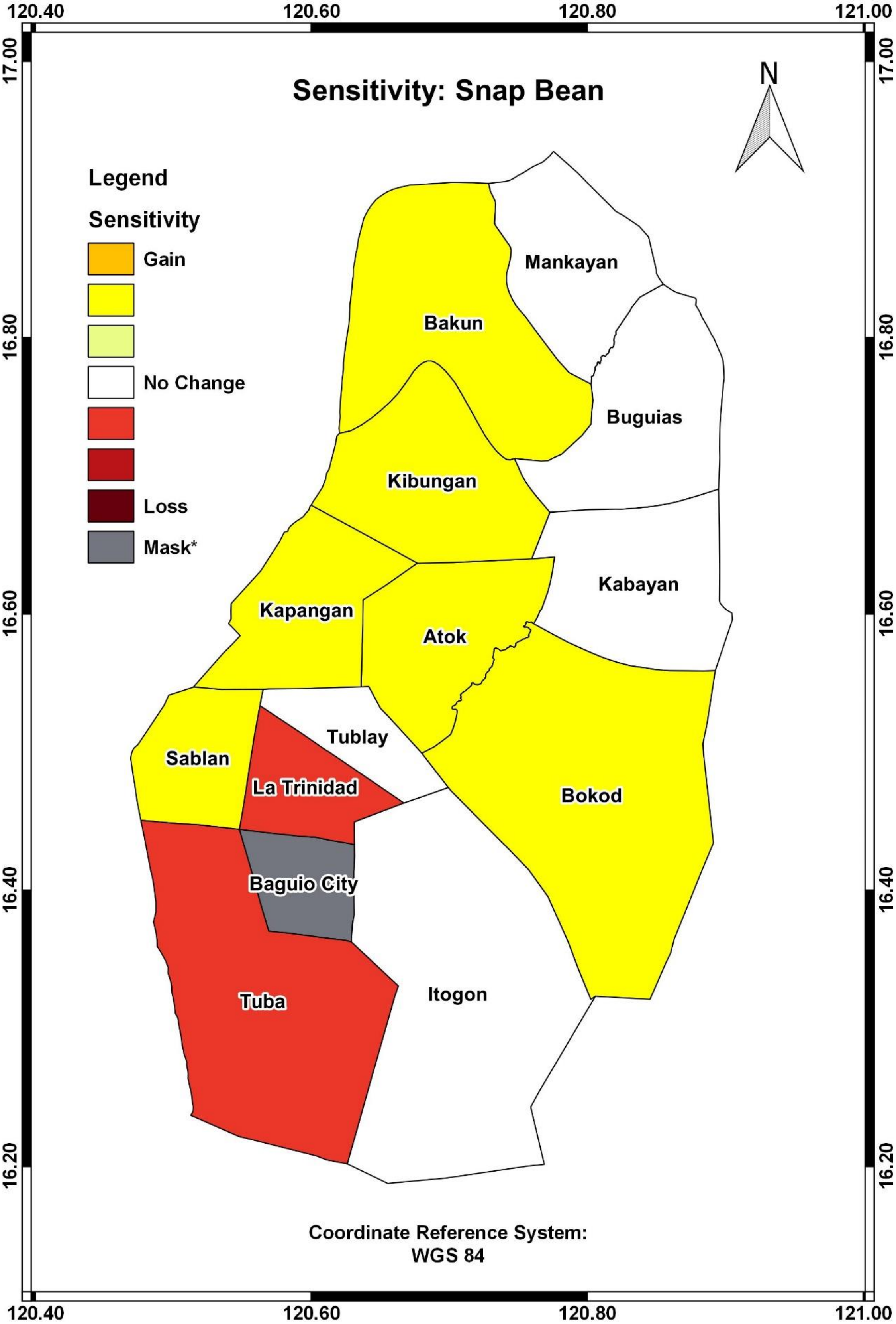


Figure 24. Sensitivity map of snap bean in the different municipalities of Benguet province.

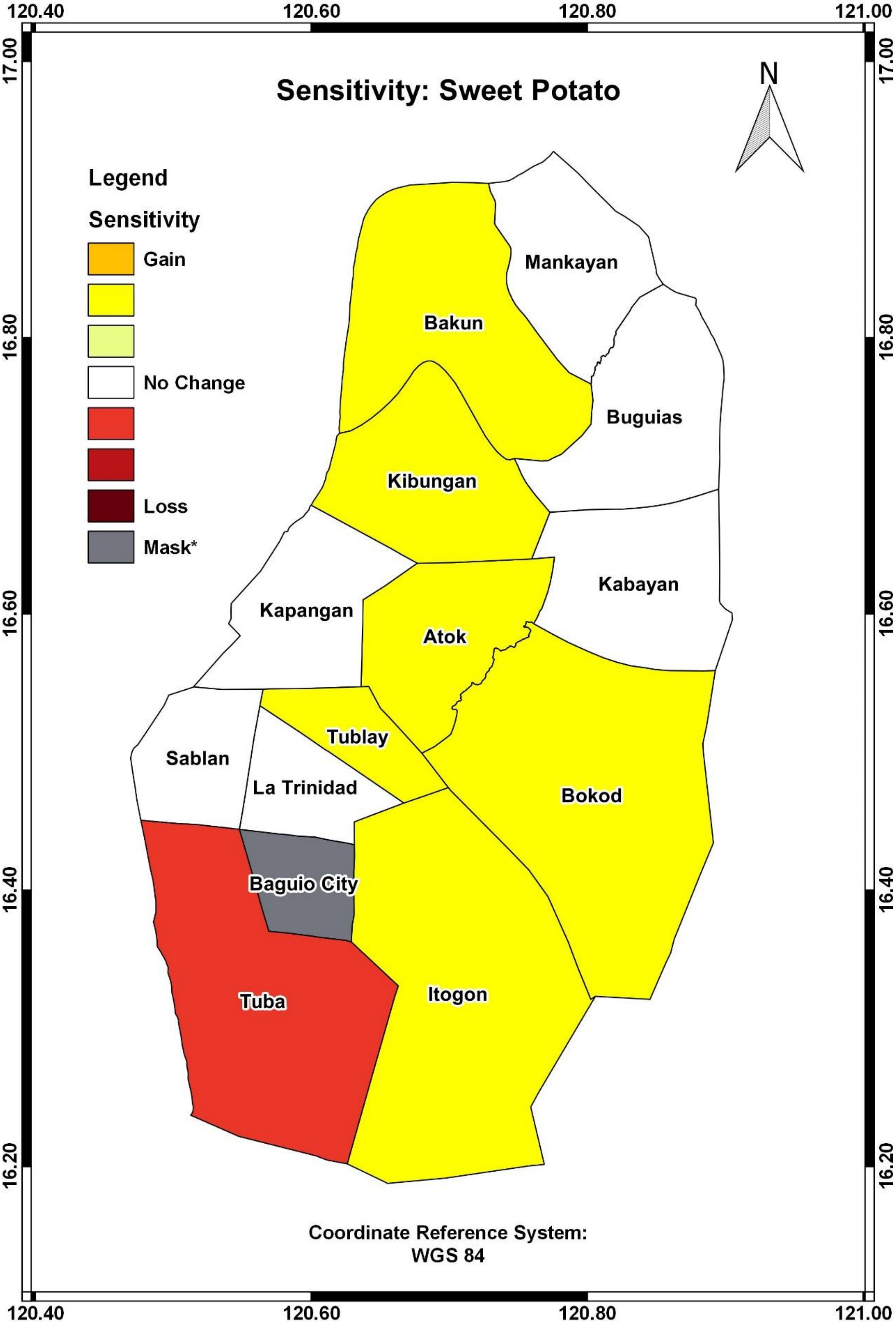


Figure 25. Sensitivity map of sweet potato in the different municipalities of Benguet province.

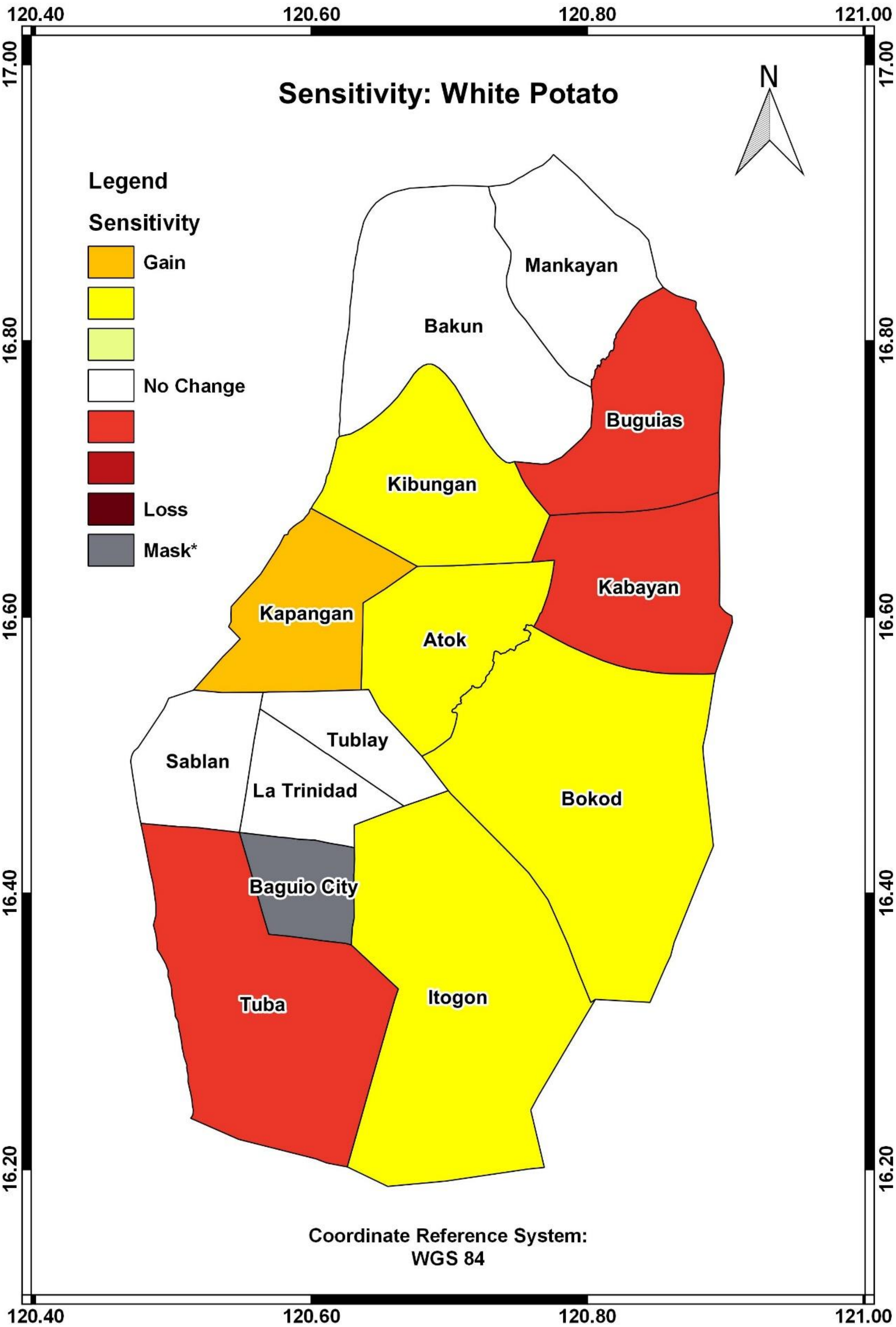


Figure 26. Sensitivity map of white potato in the different municipalities of Benguet province.

D. Overall CRVA

The three key dimensions which are hazard (15%), adaptive capacity (70%) and sensitivity (15%) were combined together with different weights to determine the overall vulnerability of the different municipalities in Benguet province for the various major crops. Furthermore, this assessment focuses on the agricultural sector and therefore Baguio city was excluded from the CRVA. For cabbage (Figure 27), snap bean (Figure 29) and white potato (Figure 31), the municipalities of Bakun, Itogon, Kibungan and Mankayan have the highest vulnerability. Bakun, Kibungan and Mankayan are classified as very high vulnerable for carrot (Figure 28) and sweet potato production (Figure 30). Different weights for hazard, adaptive capacity and sensitivity were also used to provided different scenarios.

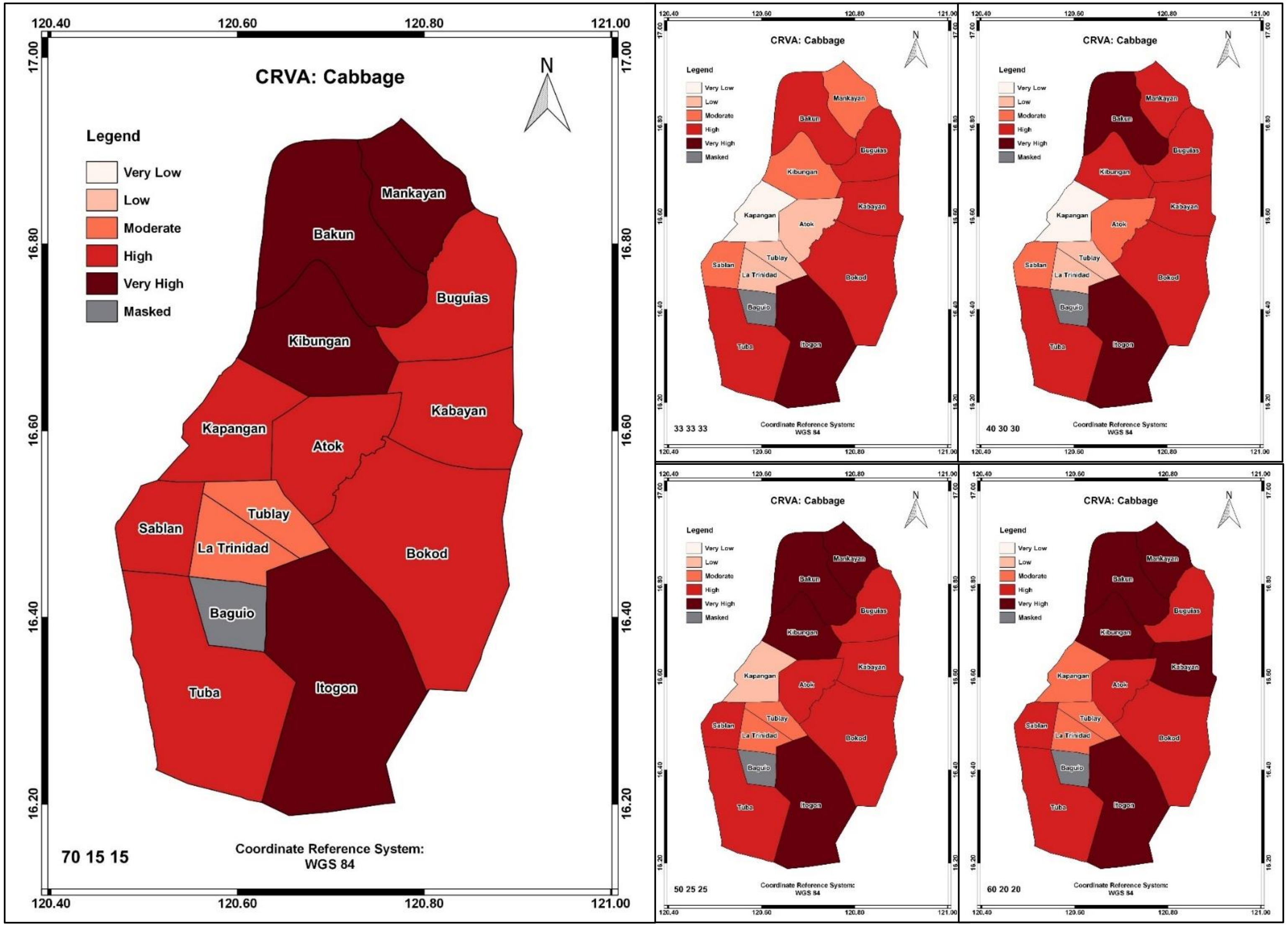


Figure 27. Climate risk vulnerability map of cabbage in the different municipalities of Benguet province

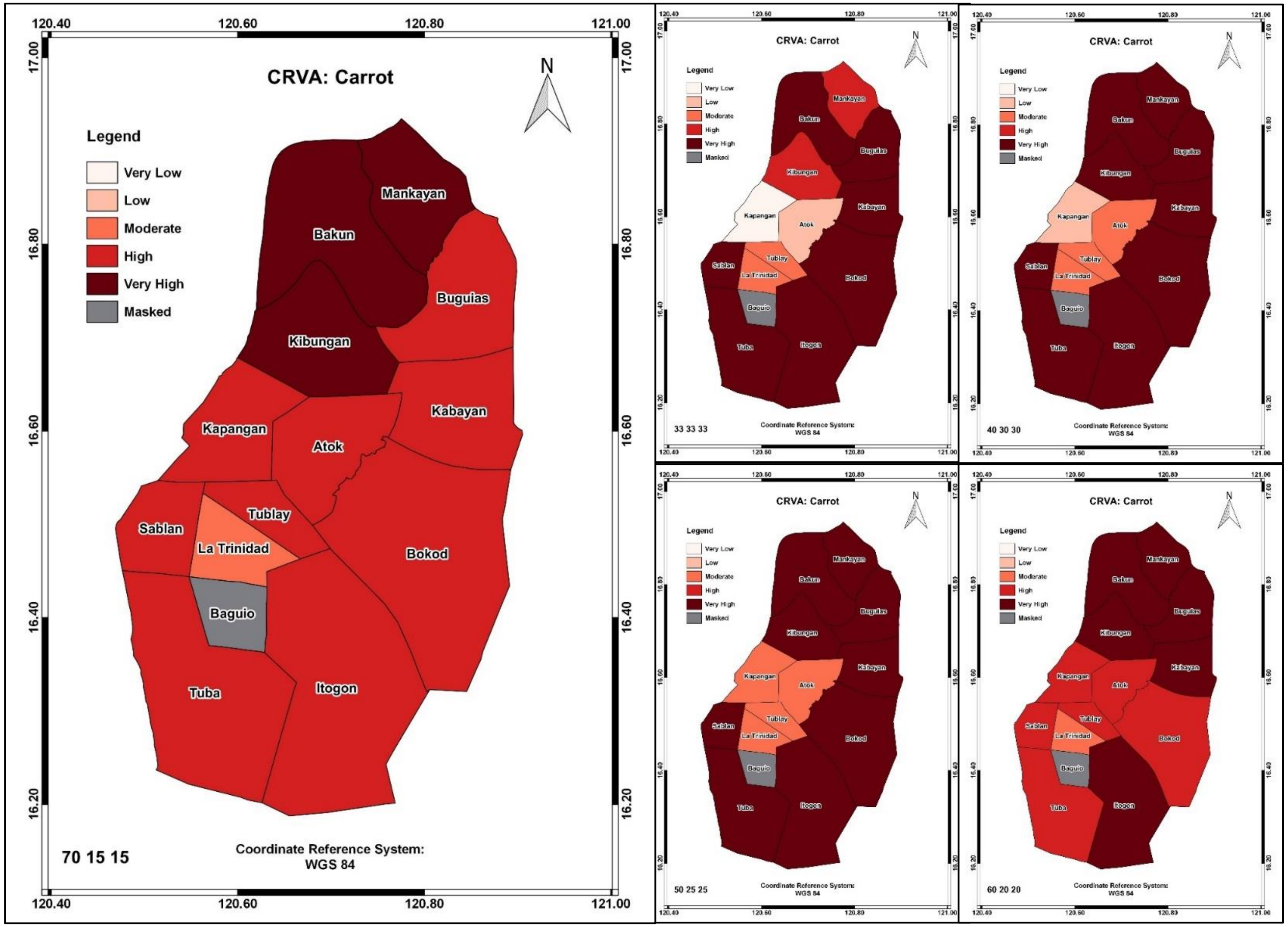


Figure 28. Climate risk vulnerability map of carrot in the different municipalities of Benguet province

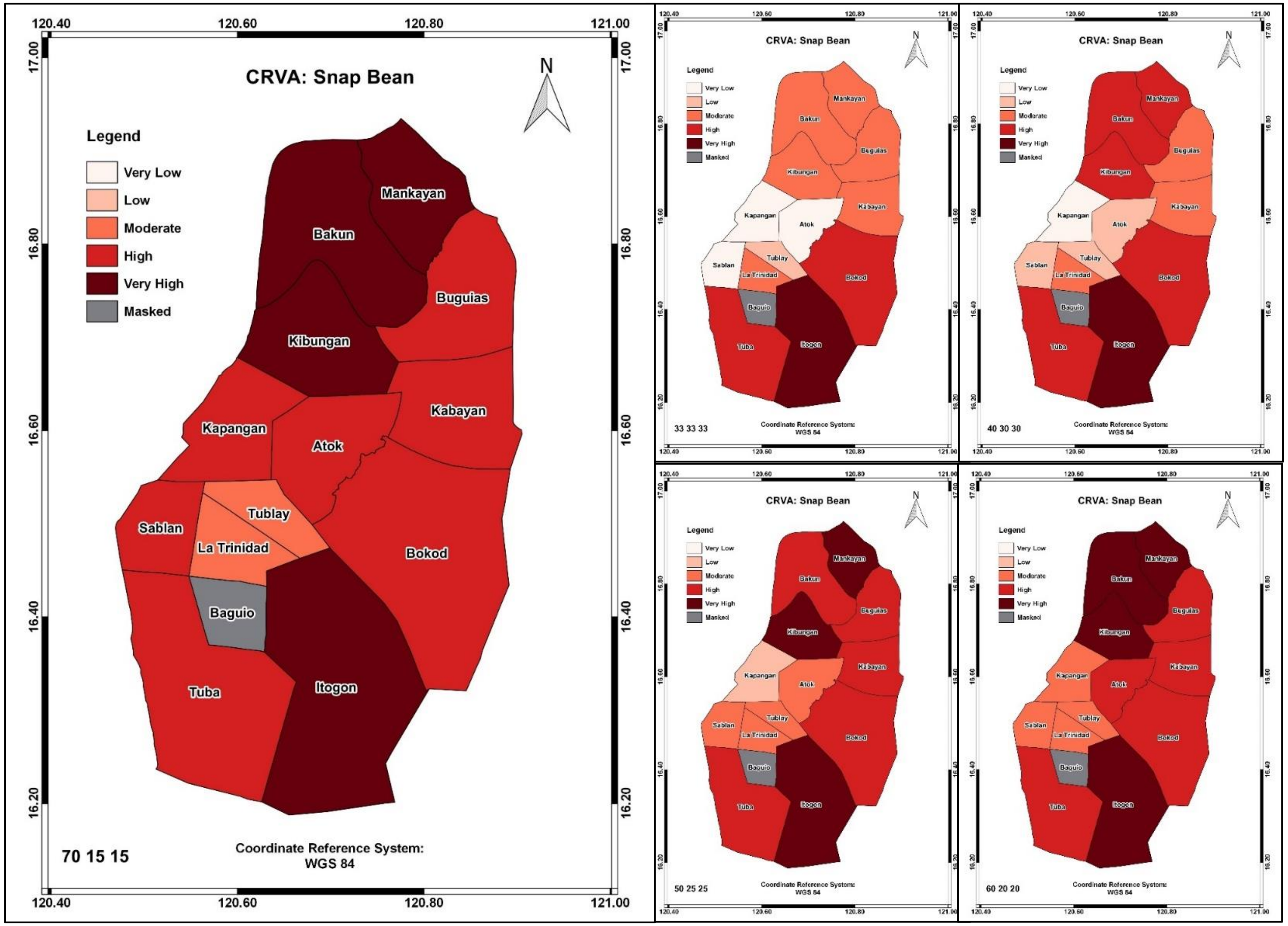


Figure 29. Climate risk vulnerability map of snap bean in the different municipalities of Benguet province

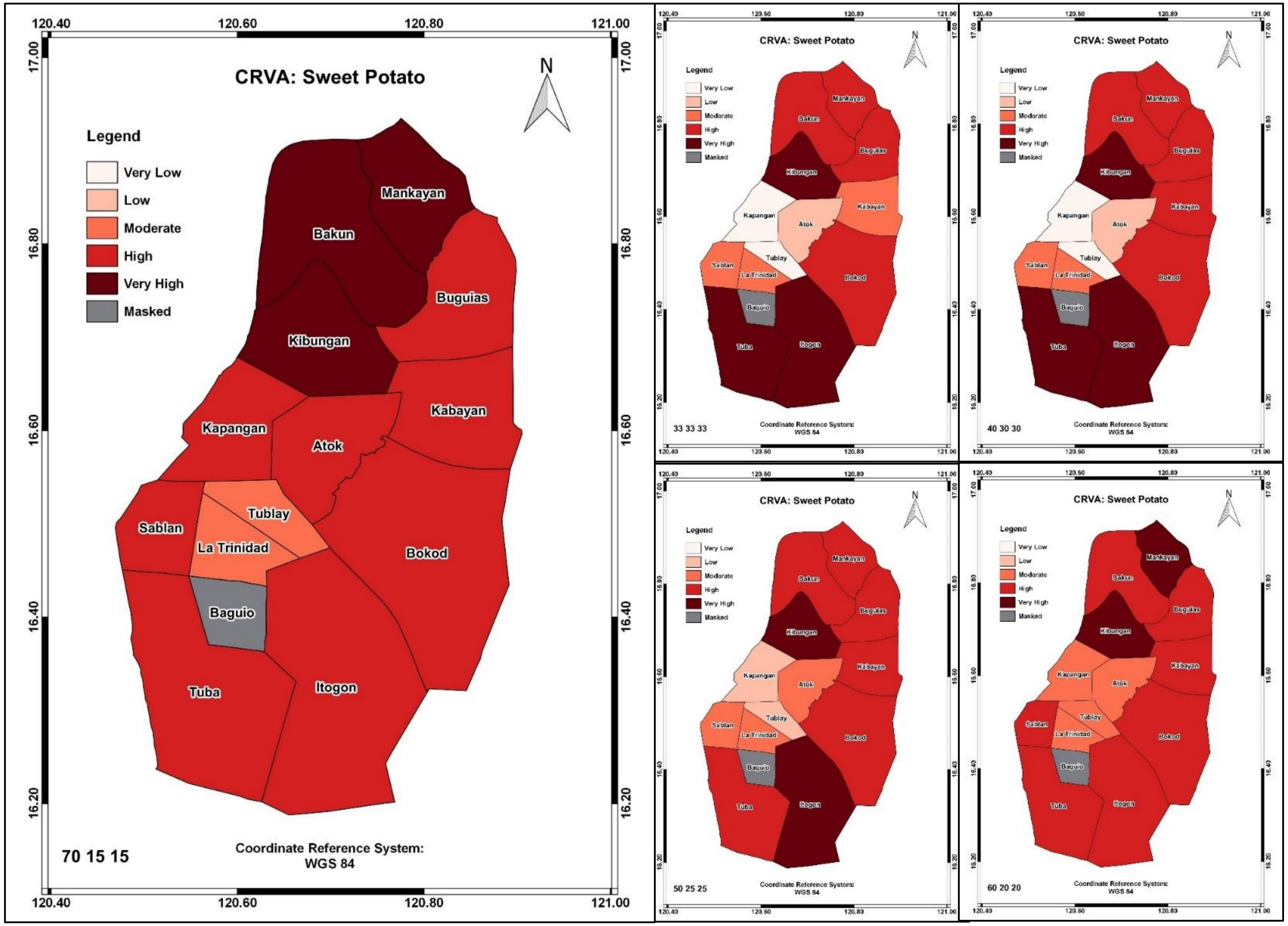


Figure 30. Climate risk vulnerability map of sweet potato in the different municipalities of Benguet province

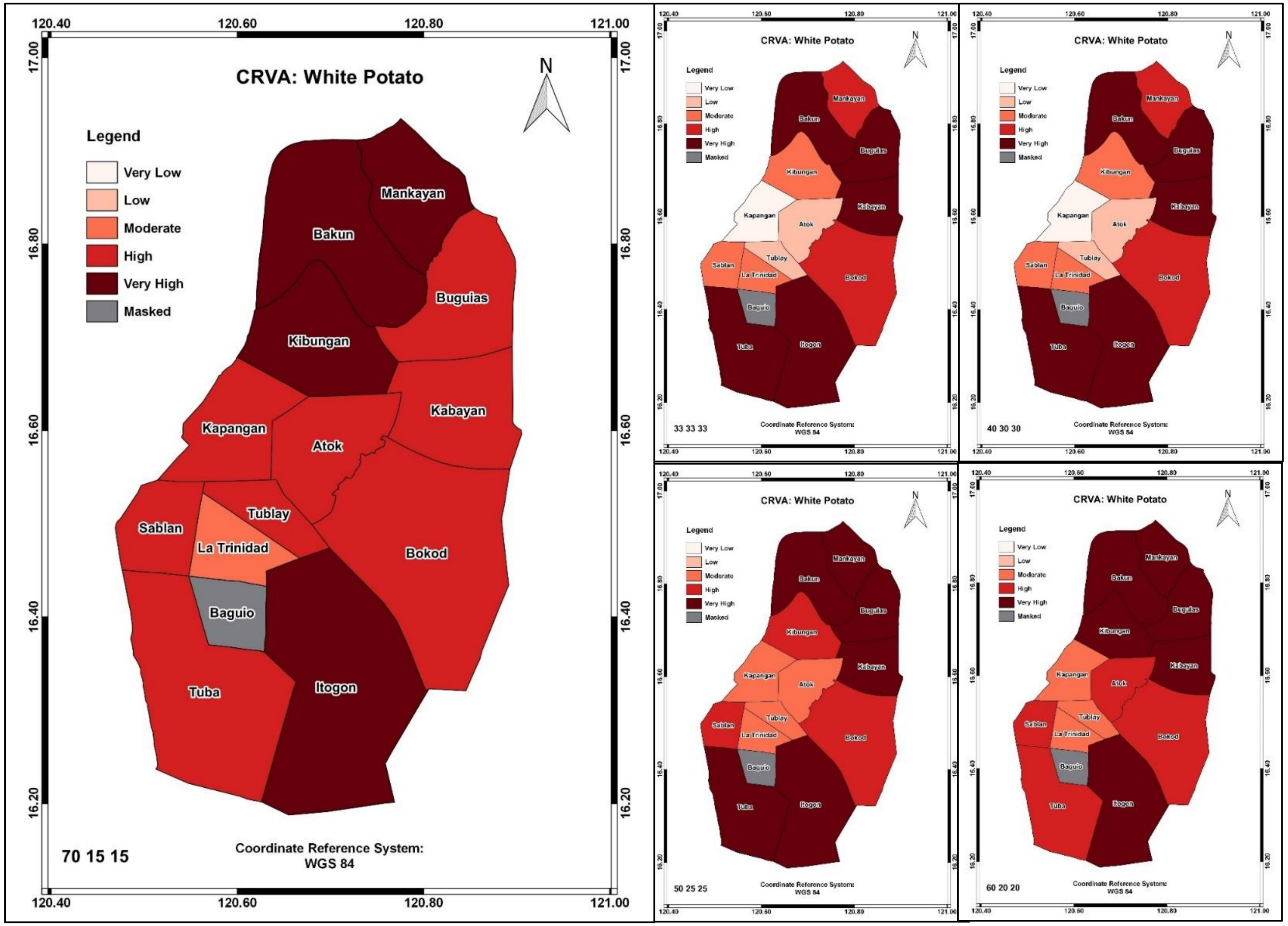


Figure 31. Climate risk vulnerability map of white potato in the different municipalities of Benguet province

CONCLUSIONS

Benguet province is very important in the food security of the Philippines. This province is one of the highest producers of temperate and high valued crops. However, threats of climate change are occurring and must be addressed. The vulnerability of the five major crops (cabbage, carrots, snap bean, sweet potato and white potato) to climate change in Benguet province was assessed using the CRVA tool. This tool is essential for the prioritization of the various municipalities of Benguet province for future climate change and agriculture related projects such as the "AMIA village". Overall, most of the municipalities in Benguet were classified as very high and high in terms of vulnerability to climate change based on their adaptive capacity, sensitivity of crops to the different climatic variables (temperature and precipitation) and hazard. Benguet province is prone to various hazards due to its geographic location and unique topography. Furthermore, some of the crops in some municipalities were sensitive to climate change due to the projected change in precipitation and temperature. For the adaptive capacity, other municipalities were classified as high specifically the 1st class municipalities, however most had low adaptive capacity which is essential to climate change resiliency.

RECOMMENDATIONS

Five major crops in Benguet province were selected for the CRVA that has 3 key dimensions which are adaptive capacity, sensitivity and hazard. For cabbage and carrots, the municipalities of Atok and Buguias must be prioritized in terms of improving their resiliency in cabbage and carrots production. Although Atok and Buguias were classified as highly vulnerable as compared to other municipalities with very high classification, these two municipalities have the highest production (yield per ha) of cabbage and carrots in the province of Benguet, thus these two were recommended. For snap beans, Tuba and Buguias municipalities were recommended for prioritization as they have high production (yield per ha) of snap bean and were classified as highly vulnerable. Furthermore, Tuba was also selected for the sweet potato while Atok, Buguias, and Kibungan for white potato due to their vulnerability to climate change and high production for these crops.

Overall, Atok and Buguias were recommended based on their vulnerability, crop productions and discussions during the consultation meeting with the Regional Field Office of the Department of Agriculture- Cordillera Administrative Region. Another recommendation is that the "AMIA village" must be conducted in the Benguet province to improve its resiliency to climate change.

For the improvement of future CRVA studies, it is recommended that different agencies from the national government and local government units must develop an enhanced database related to adaptive capacity of each municipalities that can be easily viewed and accessed. Mapping of the different high valued crops for the various municipalities must be also done.

CHALLENGES

Data availability is one of the major challenges in this study. The researcher had difficulties in collecting secondary data for the different municipalities in Benguet province. Some data can be accessed easily but some were not available or not collected. The availability of the other Agricultural technologist for the participatory mapping due to their busy schedule was one of the challenges encountered, thus some workshops were cancelled. But in the end, they were all hospitable to accommodate our request and they did their best in mapping the five major crops in Benguet province.

REFERENCES

ASIAN DEVELOPMENT BANK. 2009. Building Climate Resilience in the Agriculture Sector in Asia and the Pacific.

BÉNÉ, C., FRANKENBERGER, T., AND NELSON, S. 2015. Design, Monitoring and Evaluation of Resilience Interventions

BIOCLIM: WorldClim Bioclimatic variables (2000, 20, 50. ,80). Bioclimatic Variables Definition. https://www.edenextdata.com/?q=content/bioclim-worldclim-bioclimatic-variables-2000-20-50-80

BROOKS, N. AND ADGER, W., 2004. Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures. Assessing and Enhancing Adaptive Capacity.

BUNN, C., LÄDERACH, P., RIVERA, O., AND KIRSCHKE, D. (2015) Climatic Change. A bitter cup: climate change profile of global production of Arabica and Robusta coffee.

CRUDEN, D. M. and D. J.VARNES. 1996. Landslide types and processes; in, Landslides Investigation and Mitigation, A. K. Turner and R. L. Schuster, eds.

EHRHART, C., A. THOW, M. DE BLOIS, AND A. WARHUST 2008. Humanitarian Implications of Climate Change: Mapping Emerging Trends and Risk Hotspots. Chatelaine, Geneva: CARE International.

FOOD AND AGRICULTURE ORGANIZATION (FAO) OF THE UNITED NATIONS. 1994. Land Degradation in South Asia: Its Severity Causes, and Effects upon the People. Rome: FAO.

FOOD AND AGRICULTURE ORGANIZATION. 2006. The State of Food Insecurity in the World. Rome: FAO.

FOOD AND AGRICULTURE ORGANIZATION. Agroforestry definition. http://www.fao.org/forestry/agroforestry/80338/en. Accessed on May 8, 2018.

HIJMANS, R. J., S. E. CAMERON, J. L. PARRA, P. G. JONES, AND A. JARVIS. 2005. Very High Resolution Interpolated Climate Surfaces for Global Land Areas. International Journal of Climatology. 25: pp. 1965-1978.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). 2001. Climate Change 2001: Mitigation. Contribution of the Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC.

IPCC. 2014 Jha S, Bacon CM, Philpott SM, Ernesto Mendez V, Läderach P, Rice RA (2014) Shade coffee: update on a disappearing refuge for biodiversity. Bioscience 64:416–428.

IIZUMI, T. AND RAMANKUTTY, N. (2015). How Do Weather and Climate Influence Cropping Area and Intensity? Global Food Security.

KAHN, M. E. 2005. The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions. Review of Economics and Statistics. 87 (2). Pp. 271-284.

KLEIN, R.J.T., AND TOL, R.S.J. (1997). Adaptation to Climate Change: Options and Technologies. An Overview Paper.

MOSS, R., BRENKERT, A., AND MALONE, E. 2001. Vulnerability to Climate Change: A Quantitative Approach. Springfield, Virginia: National Technical Information Service.

KURUKULASURIYA, P. AND M. I. AJWAD. 2007. Application of Ricardian technique to estimate the impact of climate change on smallholder farming in Sri Lanka. Climatic Change. 81 (1). pp. 39-59.

LAL, R. (2010). Soil Erosion Impact on Agronomic Productivity and Environment Quality [Abstract]. Critical Reviews in Plant Sciences,17(4), 319-464.

MENDELSOHN, R. AND WILLIAMS. 2004. Comparing forecasts of the global impacts of climate Chang. Mitigation and Adaptation Strategies for Global Change. 9 (4). pp. 315-333.

NATIONAL COMPETITIVENESS COUNCIL PHILIPPINES (NCC) (2016): Cities and Municipalities Competitiveness Index.

NOY, I. 2009. The macroeconomic consequences of disasters. Journal of Development Economics. 88 (2). pp. 221-231.

DOST-PAGASA (Department of Science and Technology – Philippine Atmospheric Geophysical Astronomical Services Administration). Typhoon Incidence Map

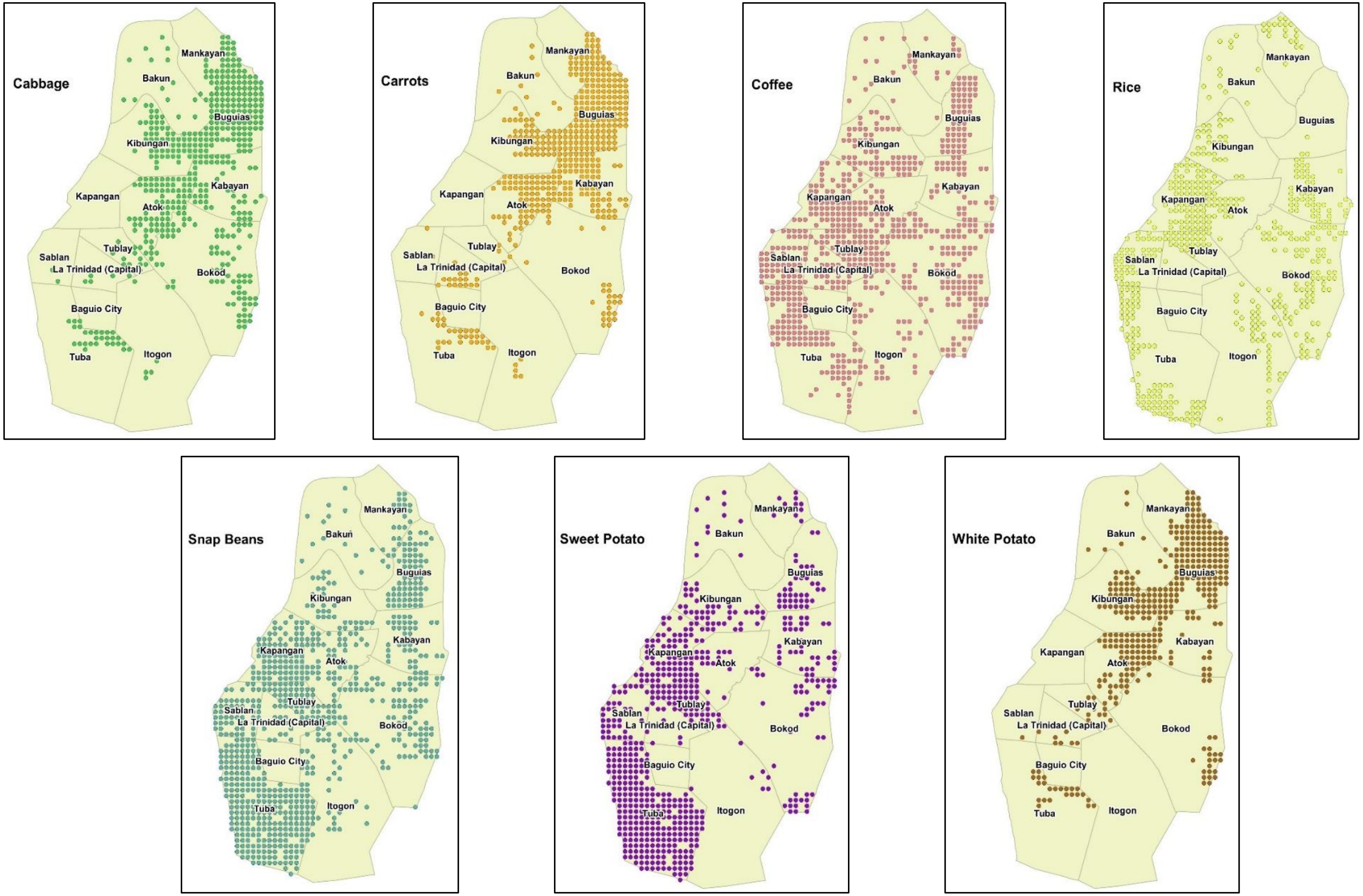
PALAO, L. K., N. GUERTEN, A. MARTINEZ, L. PARKER, J. G. BALANZA, J. LEYTE, R. DIKITAN, D., AND BURRA, D.. 2017. A Climate Risk Vulnerability Assessment for the Adaptation and Mitigation Initiative in Agriculture Program in the Philippines.

PENG, S., HUANG, J., SHEEHY, J. E., LAZA, R. C., VISPERAS, R. M., ZHONG, X., AND CASSMAN, K. G. (2004). Rice Yields Decline with Higher Night Temperature from Global Warming. Proceedings of the National Academy of Sciences.

SMIT, B., PILIFOSOVA, O., BURTON, I., CHALLENGER, B., HUQ, S., KLEIN, R.J.T., AND YOHE, G. (2001). Adaptation to Climate Change in the Context of Sustainable Development and Equity.

STROMBERG, D. 2007. Natural disasters, economic development, and humanitarian aid. Journal of Economic Perspectives.

TUBIELLO, F. AND C. ROSENZWEIG. 2008. Developing climate change impact metrics for agriculture. Integrated Assessment Journal.



Appendix 4. Results of the participatory mapping of the various municipal and provincial Agricultural technologist for the five major crops in Benguet. The FGD included Rice and Coffee for the crops.

ANNEX 3

Qualifier:
Practices vegetable production under greenhouse or tunnel: _______ 01 – Yes 02 – No
Does Not vegetable production under greenhouse or tunnel: _______ 01 – Yes 02 – No

COST AND BENEFIT OF CLIMATE-SMART AGRICULTURE PRACTICES IN ATOK, BENGUET PROVINCE, 2017

Name of Data Collector: ______________________ Date of Interview: ______________
Contact. No.: ______________________

I. Site Information

1.1 Barangay: _____________________________
1.2 Municipality: ___________________________
1.3 Province: ______________________________

II. Farmer Profile

2.1 Name: ________________________ 2.5 Contact No.: ________________________
2.2 Age: _________ 2.6 Farming Experience (Years): _______
2.3 Sex: ____ 01 – Male 02 – Female 2.7 Educational Attainment: _______________
2.4 Household Size: ________ 2.8 No. of HH Members working in the farm: ______
2.9 Membership in Organization: _______

01 – Irrigator's Association 02 – Farmer's Association 03 - Cooperatives
04 – None 05 – Others, please specify ____

2.10 Trainings/Seminars attended in the last 3 years: ____

Title of Training	**Sponsor**	**Year**

III. Farm profile and cropping system

3.1 Total area of agriculture land (ha) owned? _________
3.2 Total cultivated area (ha) last cropping season? ________

No.	Parcel (Name of Crop) 3.31	Ownership 3.32	Area (ha) 3.33	Water source 3.34	Water availability 3.35	Distance of parcel to water source 3.36		Distance of parcel to house 3.37		Distance of parcel to market 3.38	
						(km) 3.36a	(mins) 3.36b	Mode of transport 3.37a	(mins) 3.37b	Mode of transport 3.38a	(mins) 3.38b
1											
2											
3											

4											
5											

Ownership: 01 – Owner 02 – Amortizing Owner 03 – Mortgage Owner 04 – Share tenant 05 – Others, please specify ___________________
Water source: 01 – NIS/CIS 02 – SFR/SWIP/STW/Pump 03 - Rainfall
Water availability: 01 – Sufficient 02 – Insufficient 03 – Excessive
Mode of transport – 01– Walk 02–Animal-drawn 03–Tractor 04–Tricycle 05–Public conveyance 06–Private vehicl 07–Others, specify ________________

3.4. Cropping system

No.	Crop 3.41	Area (ha) 3.42	Cultivation method (01 - Monocropping; 02 - Crop rotation; 03 - Intercropping) 3.43	Which crop did you rotate/intercrop 3.44	Area of intercrop/ rotation (ha) 3.45	No. of season 3.46	Output/ season 3.47	Total output/ year 3.48	Unit 3.49	Volume/ unit 3.410	Total sold/ year 3.411	Price/ unit 3.412
1												
2												
3												
4												
5												

3.5 Cropping calendar

No.	Cropping Pattern 3.51	Crop	Month Planted 3.53	Month Harvested 3.54
Ex.	Potato-Cabbage-Carrots	a) Potato		
		b) Cabbage		
		c) Carrot		
1		a)		
		b)		
		c)		
2		a)		
		b)		
		c)		
3		a)		
		b)		
		c)		

3.6. Annual crop yield and price change

Crop	Season/Cropping Time	Yield					
		Current			2016		
		Amount	Unit	Price/unit	Amount	Unit	Price/unit

III. Cost and Benefit of crops

Item			Crop1: ___________	Crop2: _____________	Crop3: ____________
Amount and expenses on input use		**Unit**			
What was the ***total cultivated*** area in one season?		Ha			
How many crop seasons did you grow?		Number			
Input					
a) Seeds					
What kind of seed did you use?		Variety of seed1			
What type of seed did you use? 01 – Hybrid Seeds 02 – Certified Seeds 03 –Registered Seeds 04 – Good Seeds 05 – Farmer's Seeds		Type of Seed			
What is the quantity used?		Kg			
Amount you bought?		Kg			
What is the price? (if buying)		PhP/kg			
What kind of seed did you use?		Name of seed 2			
What is the quantity you used?		Kg			
Amount you bought?		Kg			
What is the price? (if buying)		Php/kg			
b) Fertilizer and Pesticide					
1. Urea (46-0-0)	Quantity				
	Unit				
	Weight/ Volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
2. Complete	Quantity				
	Unit				
	Weight/volume				

	per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
3. Ammonium phosphate	Quantity				
	Unit				
	Weight/volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
4. Ammonium sulfate	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
5. Muriate of potash	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
6. Others, please specify ____________ ____________ ____________ ________	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
7. Organic Fertilizers: Farm Residues	Quantity				
	Unit				
	Weight/ volume per unit				
8. Organic Fertilizers: Commercial Organic	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				

	When did you pay?	01 -Immediately 02 - After harvest			
Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
9. Pesticide 1: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
10. Pesticide 2: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
11. Pesticide 3: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
c) Labor (notice that man-day=number of days * number of people)					
1. Land preparation	Did you use machine	01 – Yes 02 – No			
	Non-hired labor	Man-day			
	Hired labor	Man-day			
		Man-animal day			
		Man-machine day			
	Prev. Wage Rate	Php/man-day			
		Man-animal day			
		Man-machine day			
2. Seedbed preparation	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
3. Seed sowing	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
4. Seedling Care and Maintenance (Fertilizer and Chemical Application)	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
5. Transplanting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
6. Direct Seeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
7. Irrigation	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
8. Fertilizer Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
9. Pesticide Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
10. Weeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
11. Field Monitoring	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
12. Harvesting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
13. Hauling	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
d) Other Costs	Land Rental	Terms 01 – per season 02 – per year			
		Php/ season or year			
	Hired Machinery (if different from man-machine day in labor costs)	Php/season			
	Irrigation Fee	Php/season			
	Interest paid for loan	Php			
	Food Cost	Php			
	Fuel Cost	Php			
	Transportation Cost	Php			
	Others, specify ____________	Php			
Output					
What is the total quantity of crop did you harvest in one season?		Quantity			
		Unit			
		Weight/ per unit			
Quantity used for home consumption		Quantity			
		Unit			
Quantity given away		Quantity			
		Unit			
Reserved for seeds		Quantity			
		Unit			
Quantity sold		Kg			
Average selling price		Php/kg			
What was the total quantity of <u>by-products</u> did you harvest in one season?		Quantity			
		Unit			
Quantity used for home consumption		Quantity			
		Unit			
Quantity given away		Quantity			
		Unit			
Quantity sold		Unit			
		Quantity			
Average selling price		Php/kg			

IV. Agricultural practices including material and labor input. (Place a check mark or details of the practice if the activity is still the current or past practice. Indicate the reason if the practice was done in the past.)

Activities and Inputs	Current practice	Past practice	Reasons for adopting the practice	When did the farmer start to adopt the practice?
Organic Farming				
Clearing of field				
Land preparation				
Planting material preparation and sowing				
Transplanting				
Direct Seeding				
Hand weeding				
Harvesting				
Hauling				
Mulching				
Trellising				
Others ___________________________				
B. Inputs				
Kind of seed				
Pesticide				
Organic fertilizer				
Inorganic fertilizer				
Irrigation				
Hired Labor				
Animal use				
Machineries				
Others______________________________				
C. Local agricultural practices				
Intercropping				
Crop Rotation				
Greenhouse				
Tunneling				
Others_______________________________				

Qualifier:
Practices organic farming: _______ 01 – Yes 02 – No Does Not practice organic farming: _______ 01– Yes 02 – No

COST AND BENEFIT OF CLIMATE-SMART AGRICULTURE PRACTICES IN BUGUIAS, BENGUET PROVINCE, 2017

Name of Data Collector: ______________________ Date of Interview: ______________
Contact. No.: ______________________

I. Site Information
1.1 Barangay: ____________________________
1.2 Municipality: __________________________
1.3 Province: _____________________________

II. Farmer Profile
2.1 Name: ________________________ 2.5 Contact No.: ________________________
2.2 Age: _________ 2.6 Farming Experience (Years): _______
2.3 Sex: ____ 01 – Male 02 – Female 2.7 Educational Attainment: _______________
2.4 Household Size: ________ 2.8 No. of HH Members working in the farm: ______
2.9 Membership in Organization: _______
01 – Irrigator's Association 02 – Farmer's Association 03 - Cooperatives
04 – None 05 – Others, please specify _______________________________________
2.10 Trainings/Seminars attended in the last 3 years: ____

Title of Training	**Sponsor**	**Year**

III. Farm profile and cropping system
3.1 Total area of agriculture land (ha) owned? _________
3.2 Total cultivated area (ha) last cropping season? ________

No.	Parcel (Name of Crop) 3.31	Ownership 3.32	Area (ha) 3.33	Water source 3.34	Water availability 3.35	Distance of parcel to water source 3.36		Distance of parcel to house 3.37		Distance of parcel to market 3.38	
						(km) 3.36a	(mins) 3.36b	Mode of transport 3.37a	(mins) 3.37b	Mode of transport 3.38a	(mins) 3.38b
1											

2											
3											
4											
5											

Ownership: 01 – Owner 02 – Amortizing Owner 03 – Mortgage Owner 04 – Share tenant 05 – Others, please specify ___________________
Water source: 01 – NIS/CIS 02 – SFR/SWIP/STW/Pump 03 - Rainfall
Water availability: 01 – Sufficient 02 – Insufficient 03 – Excessive
Mode of transport – 01– Walk 02–Animal-drawn 03–Tractor 04–Tricycle 05–Public conveyance 06–Private vehicl 07–Others, specify ________________

3.4. Cropping system

No.	Crop 3.41	Area (ha) 3.42	Cultivation method (01 - Monocropping; 02 - Crop rotation; 03 - Intercropping) 3.43	Which crop did you rotate/inter crop 3.44	Area of intercrop/ rotation (ha) 3.45	No. of season 3.46	Output/ season 3.47	Total output/ year 3.48	Unit 3.49	Volume/ unit 3.410	Total sold/ year 3.411	Price/ unit 3.412
1												
2												
3												
4												
5												

3.5 Cropping calendar

No.	Cropping Pattern 3.51	Crop	Month Planted 3.53	Month Harvested 3.54
Ex.	Potato-Cabbage-Carrots	a) Potato		
		b) Cabbage		
		c) Carrot		
1		d)		
		e)		
		f)		
2		d)		
		e)		
		f)		
3		d)		
		e)		
		f)		

3.6. Annual crop yield and price change

Crop	Season/Cropping Time	Yield					
		Current			2016		
		Amount	Unit	Price/unit	Amount	Unit	Price/unit

III. Cost and Benefit of crops

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
Amount and expenses on input use		**Unit**			
What was the ***total cultivated*** area in one season?		Ha			
How many crop seasons did you grow?		Number			
Input					
a) Seeds					
What kind of seed did you use?		Variety of seed1			
What type of seed did you use? 01 – Hybrid Seeds 02 – Certified Seeds 03 –Registered Seeds 04 – Good Seeds 05 – Farmer's Seeds		Type of Seed			
What is the quantity used?		Kg			
Amount you bought?		Kg			
What is the price? (if buying)		PhP/kg			
What kind of seed did you use?		Name of seed 2			
What is the quantity you used?		Kg			
Amount you bought?		Kg			
What is the price? (if buying)		Php/kg			
b) Fertilizer and Pesticide					
12. Urea (46-0-0)	Quantity				
	Unit				
	Weight/ Volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
13. Complete	Quantity				
	Unit				
	Weight/volume per unit				

	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
14. Ammonium phosphate	Quantity				
	Unit				
	Weight/volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
15. Ammonium sulfate	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
16. Muriate of potash	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
17. Others, please specify ____________ ____________ ____________ ________	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 -Immediately 02 - After harvest			
18. Organic Fertilizers: Farm Residues	Quantity				
	Unit				
	Weight/ volume per unit				
19. Organic Fertilizers: Commercial Organic	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you	01 -Immediately			

	pay?	02 - After harvest			
Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
20. Pesticide 1: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
21. Pesticide 2: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
22. Pesticide 3: ____________ __________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
c) Labor (notice that man-day=number of days * number of people)					
14. Land preparation	Did you use machine	01 – Yes 02 – No			
	Non-hired labor	Man-day			
	Hired labor	Man-day			
		Man-animal day			
		Man-machine day			
	Prev. Wage Rate	Php/man-day			
		Man-animal day			
		Man-machine day			
15. Seedbed preparation	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
16. Seed sowing	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
17. Seedling Care and Maintenance (Fertilizer and Chemical Application)	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
18. Transplanting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
19. Direct Seeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
20. Irrigation	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
21. Fertilizer Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
22. Pesticide Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
23. Weeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
24. Field Monitoring	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
25. Harvesting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
26. Hauling	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Item			Crop1: ____________	Crop2: ______________	Crop3: _____________

d) Other Costs	Land Rental	Terms 01 – per season 02 – per year			
		Php/ season or year			
	Hired Machinery (if different from man-machine day in labor costs)	Php/season			
	Irrigation Fee	Php/season			
	Interest paid for loan	Php			
	Food Cost	Php			
	Fuel Cost	Php			
	Transportation Cost	Php			
	Others, specify ___________	Php			
Output					
What is the total quantity of crop did you harvest in one season?		Quantity			
		Unit			
		Weight/ per unit			
Quantity used for home consumption		Quantity			
		Unit			
Quantity given away		Quantity			
		Unit			
Reserved for seeds		Quantity			
		Unit			
Quantity sold		Kg			
Average selling price		Php/kg			
What was the total quantity of by-products did you harvest in one season?		Quantity			
		Unit			
Quantity used for home consumption		Quantity			
		Unit			
Quantity given away		Quantity			
		Unit			
Quantity sold		Unit			
		Quantity			
Average selling price		Php/kg			

IV. Agricultural practices including material and labor input. (Place a check mark or details of the practice if the activity is still the current or past practice. Indicate the reason if the practice was done in the past.)

Activities and Inputs	**Current practice**	**Past practice**	**Reasons for adopting the practice**	**When did the farmer start to adopt the practice?**
Organic Farming				
Clearing of field				
Land preparation				
Planting material preparation and sowing				
Transplanting				
Direct Seeding				
Hand weeding				
Harvesting				
Hauling				
Mulching				
Trellising				
Others ____________________________				
B. Inputs				
Kind of seed				
Pesticide				
Organic fertilizer				
Inorganic fertilizer				
Irrigation				
Hired Labor				
Animal use				
Machineries				
Others_______________________________				
C. Local agricultural practices				
Intercropping				
Crop Rotation				
Greenhouse				
Tunneling				
Others________________________________				

COST AND BENEFIT OF CLIMATE-SMART AGRICULTURE PRACTICES IN ORIENTAL MINDORO, 2016

Qualifier: Practices Organic Farming: _______ 01 – Yes 02 – No	Practices Crop Rotation: ________ 01 – Yes 02 - No
Does Not Practice Organic Farming: _______ 01 – Yes 02 – No	Does Not Practice Crop Rotation: _______ 01 – Yes 02 - No

Name of Data Collector: _______________________ Date of Interview: _______________

Contact. No.: _______________________

I. Site Information

1.1 Barangay: ________________________

1.2 Municipality: ______________________

1.3 Province: ________________________

II. Farmer Profile

2.1 Name: _________________________

2.2 Age: _________

2.3 Sex: ____ 01 – Male 02 – Female

2.4 Household Size: ________

2.5 Contact No.: _________________________

2.6 Farming Experience (Years): _______

2.7 Educational Attainment: ________________

2.8 No. of HH Members working in the farm: ______

2.9 Membership in Organization: _______

01 – Irrigator's Association 02 – Farmer's Association 03 - Cooperatives

04 – None 05 – Others, please specify ____

2.10 Trainings/Seminars attended in the last 3 years: ____

III. Farm profile and cropping system

3.1 Total area of agriculture land (ha) owned? _________

3.2 Total cultivated area (ha) last cropping season? ________

No.	Parcel (Name of Crop) 3.31	Ownership 3.32	Area (ha) 3.33	Water source 3.34	Water availability 3.35	Distance of parcel to water source 3.36		Distance of parcel to house 3.37		Distance of parcel to market 3.38	
						(km) 3.36a	(mins) 3.36b	Mode of transport 3.37a	(mins) 3.37b	Mode of transport 3.38a	(mins) 3.38b
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Ownership: 01 – Owner 02 – Amortizing Owner 03 – Mortgage Owner
04 – Sharetenant 05 – Others, please specify ______________________
Water source: 01 – NIS/CIS 02 – SFR/SWIP/STW/Pump 03 - Rainfall
Water availability: 01 – Suffiicient 02 – Insufficient 03 – Excessive
Mode of transport – 01 – Walk 02 – Animal-drawn 03 – Tractor 04 – Tricycle
05 – Public conveyance 06 – Private vehicle 07 – Others, please specify _______________________

3.4. Cropping system

No.	Crop 3.41	Area (ha) 3.42	Cultivation method (01 - Monocropping; 02 - Crop rotation; 03 - Intercropping) 3.43	Which crop did you rotate/intercrop 3.44	Area of intercrop/ rotation (ha) 3.45	No. of season 3.46	Output/ season 3.47	Total output / year 3.48	Unit 3.49	Volume / unit 3.410	Total sold/ year 3.411	Price/ unit 3.412
1												
2												
3												
4												
5												

3.5 Cropping calendar

No.	Cropping Pattern 3.51	Crop	Month Planted 3.53	Month Harvested 3.54
Ex.	Rice-Vegetables-Rice	a) Rice		
		b) Vegetables		
		c) Rice		
1		a)		
		b)		
		c)		
2		a)		
		b)		
		c)		
3		a)		
		b)		
		c)		

3.6. Annual crop yield and price change

Crop	Season	Yield					
		Current			2016		
Rice	Wet	Amount	Unit	Price/unit	Amount	Unit	Price/unit
	Dry						
Other crop	1						
	2						

III. Cost and Benefit of crops

Item		Crop1: ____________	Crop2: ______________	Crop3: _____________
Amount and expenses on input use	**Unit**			
What was the ***total cultivated*** area in one season?	Ha			
How many crop seasons did you grow?	Number			
Input				
a) Seeds				
What kind of seed did you use?	Variety of seed1			
What type of seed did you use? 01 – Hybrid Seeds 02 – Certified Seeds 03 – Registered Seeds 04 – Good Seeds 05 – Farmer's Seeds	Type of Seed			
What is the quantity used?	Kg			
Amount you bought?	Kg			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
What is the price? (if buying)		PhP/kg			
What kind of seed did you use?		Name of seed 2			
What is the quantity you used?		Kg			
Amount you bought?		Kg			
What is the price? (if buying)		Php/kg			
b) Fertilizer and Pesticide					
1. Urea (46-0-0)	Quantity				
	Unit				
	Weight/ Volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
2. Complete	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
3. Ammonium phosphate	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
4. Ammonium sulfate	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
5. Muriate of potash	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
6. Others, please specify ___________ ___________ ___________ ___________	Quantity				
	Unit				
	Weight/ volume per unit				
	Price per unit				
	When did you pay?	01 - Immediately 02 - After harvest			
7. Organic Fertilizers: Farm Residues	Quantity				
	Unit				
	Weight/ volume per unit				
8. Organic Fertilizers: Commercial Organic	Quantity				
	Unit				
	Weight/ volume per unit				

			Crop1: ____________	Crop2: ______________	Crop3: _____________
	When did you pay?	01 - Immediately 02 - After harvest			
9. Pesticide 1: ___________ ___________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
10. Pesticide 2: ___________ ___________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
11. Pesticide 3: ___________ ___________	Quantity				
	Unit				
	Weight/Volume per unit				
	Price per unit				
c) Labor (notice that man-day=number of days * number of people)					
1. Land preparation	Did you use machine	01 – Yes 02 – No			
	Non-hired labor	Man-day			
	Hired labor	Man-day			
		Man-animal day			
		Man-machine day			
	Prev. Wage Rate	Php/man-day			
		Man-animal day			
		Man-machine day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
2. Seedbed preparation	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
3. Seed sowing	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
4. Seedling Care and Maintenance (Fertilizer and Chemical Application)	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
5. Cleaning and repair of dikes	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
6. Transplanting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
7. Direct Seeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
8. Irrigation and drainage	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
9. Fertilizer Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
10. Pesticide Application	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
11. Weeding	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
12. Field Monitoring	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
13. Harvesting	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
14. Threshing and Cleaning	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Hired labor	Man-machine day			
	Prev. Wage Rate	Php/man-day			
15. Hauling	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			

Item			Crop1: ____________	Crop2: ______________	Crop3: _____________
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
Other activities, please specify _____________	Non-hired labor	Man-day			
	Hired labor	Man-day			
	Prev. Wage Rate	Php/man-day			
d) Other Costs	Land Rental	Terms 01 – per season 02 – per year			
		Php/ season or year			
	Hired Machinery (if different from man-machine day in labor costs)	Php/season			
	Irrigation Fee	Php/season			
	Interest paid for loan	Php			
	Food Cost	Php			
	Fuel Cost	Php			
	Transportation Cost	Php			
	Others, please specify ____________	Php			
Output					

Item		Crop1: ____________	Crop2: ______________	Crop3: _____________
What is the total quantity of crop did you harvest in one season?	Quantity			
	Unit			
	Weight/ per unit			
Quantity used for home consumption	Quantity			
	Unit			
Quantity given away	Quantity			
	Unit			
Reserved for seeds	Quantity			
	Unit			
Quantity sold	Kg			
Average selling price	Php/kg			
What was the total quantity of by-products did you harvest in one season?	Quantity			
	Unit			
Quantity used for home consumption	Quantity			
	Unit			
Quantity given away	Quantity			
	Unit			
Quantity sold	Unit			
	Quantity			
Average selling price	Php/kg			

IV. Agricultural practices including material and labor input. (Place a check mark or details of the practice if the activity is still the current or past practice. Indicate the reason if the practice was done in the past.)

Activities and Inputs	**Current practice**	**Past practice**	**Reasons for adopting the practice**	**When did the farmer start to adopt the practice?**
Organic Farming				
Clearing of field & burning of straw				
Seedbed preparation				

Activities and Inputs	Current practice	Past practice	Reasons for adopting the practice	When did the farmer start to adopt the practice?
Rotavating/Tractor/Kubota				
Plowing				
Harrowing				
Pulling & bundling of seeds				
Transplanting				
Direct Seeding				
Hand weeding				
Harvesting				
Threshing				
Drying				
Mulching				
Trellising				
Bagging				
Others				
B. Inputs				
Kind of seed				
Pesticide				
Organic fertilizer				

Activities and Inputs	Current practice	Past practice	Reasons for adopting the practice	When did the farmer start to adopt the practice?
Inorganic fertilizer				
Irrigation				
Hired Labor				
Animal use				
Machineries				
Others				
C. Local agricultural practices				
Intercropping				
Crop Rotation				
Rice-fish farming				
Rice-duck farming				
Others				

ANNEX 4

November 17, 2017

FGD conducted for the municipality of Naujan

1. Anong tingin sa climate change
    a. Mahabang tag-init at mahabang tag-ulan
    b. Wala nang panahon ng tag-ulan at tag-araw (seasonality)
2. Hazards in Naujan
    a. Pagbaha (minsan inaabot ng hanggang 3 buwan)
        i. November to February
        ii. Brgy. Laguna
        iii. Delay sa pagtatanim
        iv. Positive ang pagbaha sa mga mangingisda
        v. Maraming river system nan age-end up sa Naujan lake
    b. Wind (brought about by typhoon)
        i. 75% ang di nakakapagtanim ng rice
        ii. Brgy. Laguna is only affected
    c. Drought
        i. Hindi na naalis ang bagyo sa Brgy. Laguna
3. RC 218 – bakla na dinorado; libre from DNA (?); nakaka-cause ng neck rat
4. RC10 – pwedeng late nang itanim para makahabol sa harvesting season
5. Source of water – bukal at flowing water
6. Kapag bagyo, madalas walang kuryente
7. Planting season - December and January (no distinct dry season)
8. Practices para masolusyonan ang effect ng climate change
    a. Nakikiramdam sa panahaon (adjusted planting)
    b. Gumagamit ng hybrid rice/nag iiba iba ng variety
        i. Dinorado and RC 218 (matibay sa sakit, mataas ang stand; madaling makarecover sa sakit)
        ii. Problem: malayo sa market
        iii. Hindi tinataniman ng ibang crop
    c. Organic farming
        i. Pag iwas sa mga chemicals
        ii. Para maiwasan ang pag-acidify ng lupa
        iii. Where do you learn first-hand about organic farming – DA
        iv. Reason for practicing organic farming according to DA: para mapanatili ang lusog ng lupa
    d. Use of RC 10 seed variety
        i. Para makahabol sa harvesting season kahit late na sa planting season
        ii. Malapit sa tubig
        iii. Reason for not planting RC10: no supply available
9. **Practice identified: use of RC10 and RC18 rice variety.**

November 20, 2017

FGD conducted for the municipality of Bulalacao

1. What is climate change?
    a. Pabago-bagong panahon
2. Hazard
    a. Tagtuyot
        i. Taon na naranasan – 2013
        ii. Buwan na naranasan – October to June
    b. Pagbaha/flooding
        i. La Niña
        ii. 2015
        iii. November to December
    c. Tagtuyot/walang ulan
        i. October 2016
        ii. Walang naani; alternate cropping practice
3. Palay
    a. Direct seeding
    b. Madaling palay ang binibinhi
    c. Wet season – transplanting
    d. Dry season – direct seeding; may iba na bakanteng lupa
4. Tag araw – 5% na lang ang nagtanim ng palay
5. Tag ulan – 95% ang nagtatanim ng palay
6. Practices to cope with the dry season:
    a. Direct seeding
    b. Naghahanap ng panibagong binhi
    c. Early plantation
    d. Alternate cropping (palay – onion and palay – palay)
7. **Practice identified: palay – onion and palay - palay**

Guide Questions for the FGD/Community Meeting with Atok and Buguias Municipalities of Benguet

1. What are the climate-related hazards that the community experienced for the past 10 years and how frequent is the occurrence within the last 10 years?
2. What are the effects of the climate-related hazards to the crops and the estimate of damage or loss?
3. What are the adaptations done to protect the crops or cope up with the hazards?
4. How effective are the adaptations?
5. How many in the community is adapting the technology? What are the reasons of the farmers for not adapting the technology?
6. If you are to rank the most effective adaptation, what would that be?

<u>Summary of FGD in Atok</u>

Climate Hazard	Occurrence (Time)	Places Affected	Crops Affected / Stages	Magnitude of Damage	Adaptation and Description
1.Landslide (due to continuous monsoon rain, heavy rain and typhoon)	Anytime of the year			1.Decrease of planting area 2.Closure of farm to market road (increase prices, shortage of supply,harvest becomes second class, 50% reduction in volume for leafy vegetables) 3.No income for farmers	1.Proper drainage canals 2.Greenhouse (but GH are used only as nursery beds) *GH provided by DA are destroyed but not yet repaired. *Existing GH's are private-owned (about 1% only) are used for flowers.
2. Drought	Before: October – April Now: October *changing summer time or dry months				1.Reduce planting area depending on available water supply.

					2.Plant crops that require less water or crops that are tolerable to drought like camote, gabi, and raddish.
3. Hailstorm (last 2 years)	Before: Feb. – March (expected) Now: anytime even September (start of rain)	Paoay Abiang Cattubo	1.Cabbage – not heading a)initial heading stage – heading don't continue b)heading time – harvests become 2nd class 2.Potato a)vegetative stage b)tuber initiation stage c)leaf fall	90% 100% 100% 100%	No adaptation yet but farmers say they can use black net during nursery time
4. Strong winds	October – December (Amihan) and those months without rain,duration: 2 weeks	Paoay Abiang Cattubo	1.Cabbage a)leaf breakage/ leaf fall b)uprooting of plants c)plants are " whirlwind" 2.Potato a) disturbed roots and tuberization b) tubers become ginger-like (will not grow) 3.Sayote - flower fall	Heading – 20% Vegetative – 95% Vegetative – 70% Tuber stage – 100% 100%	No adaptation yet

5. Frost	December – January February *depends on duration and thickness of frost - 3 days duration – 100% -thickness of 1 mm covers leaves	Paoay Abiang Cattubo	1.Cabbage – harvest becomes 2nd class a) thick frost b)sugar-like frost "mismisimis" 2.Potato – plants don't continue to grow *potatoes are more susceptible to frost 3.Carrots	10% 5% 30% Vegetative – 100% (after hill – up) Tuberization – 100% (36 DAP) Seedling stage – 100% Vegetative stage – 100% stunted at 0 degrees Celcius	1.Irrigation are done before the sun is up 2.Spray with water

FGD Result in Buguias

Climate Hazard	Occurrence (Time)	Places Affected	Crops Affected/ Stages	Magnitude of Damage	Adaptation and Description
1.Strong typhoon/Rain	*In the past,strong typhoon was usually in the months of November(3 yrs. or more not experienced now) *Anytime of the year		.Potato -After a month of planting(usually 75 days) when it rain then suddenly stops, potato will experience stunted growth, yellowing of leaves and small size of harvest. -susceptible also to bacterial wilt.	*If all the potatoes have bacterial wilt then there is 90% loss.	
2.Drought	Summer start on February	*Upland Buguias	Potato	*no yield	*Farmers will use PO3 variety of potato because of its harder stem, late blight resistance and drought tolerance for Highland Buguias). *For Lowland -PO3 is unfavorable in lowlands because it produces scab and during rainy season they are robust but it has no tubers.
3.High Temperature *Organic Agriculture			Different crops -pest from conventional farm will migrate to the organic farms		-Mulching -Drip Irrigation -Multicropping to prevent pest(crop combination: 5 crops that has

					different family like crucifers with tomato) -Organic Farming is mitigation
4.Strong winds	November to March *Dabadab-unpredictable	Upland Buguias -Bayoyo -Buyacaoan -Lengaon -Sinipsip -Natubleng -Parts of Abatan -Amgaley-gey	Potato (*Dabadab) -The plant will be disturbed/stress resulting in not producing tubers. -Faster dispersion of water in the leaf area. -In other cases, if the plant were hilled up and there is dabadab, there will be no yield.	*In sloppy areas, there is more loss in yield. *75% loss or worse, no yield produce.	*They use sack and net/screen as a wind breaker. *The hole of the net should be fine and the height should be higher to save more plants/crops. *If prevented, 65% out of 75% loss will be saved. *Frequent watering of crops
5.Pest and Disease occurrence due to high temperature	Summer starts in February	Lowland Buguias	Cabbage -DBM -Clubroot Potato -Leaf Miner -Thrips -Aphids (abnormal temperature) -Scab	*Frequent pesticide usage Past: 5-7 days interval Now: Every other day *Less yield *Increase in ROI	

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, … Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
BATINGAL, ANGELICA B.	BSU	09466365278	angelica.batingal@gmail.com	[signature]
AIPAN, LEVI EZEKIEL O.	BSU	09123201165	levidaipan@gmail.com	[signature]
ODIO, QUINERLYN A.	BSU	09101410695	quinerlyngodio@gmail.com	[signature]
INGALING, MYRA NIEVES T.	BSU	09123812882	lingalingmyra@gmail.com	[signature]

UPLBFI AMIA

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR (September 21, 2017)

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
1. NIDA L. FELICITAS	ITOGON / AT	09202190502		
2. Norma B. Amos	ITOGON /AT	09449443509		
3. Geofrey B. Binalio	Kabayan / MA	09996641370		
4. Roger P. Catayao	LGU-ITOGON/ENGR. II	09304506297		
5. SAMUEL L. GEKING	LGU-KABAYAN	09072554014		
6. Delima D. Juan	OPAG-Benguet	422-2306		
7. Marlyn N. Cabanua	OMAG-TUBA	09195884627		
8. Derman B. Dalmo	OPAG - Benguet	422-2306		
9. Felicia P. Fiatacag	Itogon	0907-336-1899		
10. Janet P. Pablo	BSU	0927 487 6605	daopiapablo@gmail.com	
11. Leandel Punzalan	UPLB FI	09165724201	leandelpunzalan@gmail.com	
12. Roscinto Ian C. Lumbres	BSU - Faculty	0939-5808368	rasslumbres@yahoo.com	
13. Gillian L Inciong	UPLB FI	09054412750	gklinciong@gmail.com	GKInciong

UPLBFI

AMIA

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR (September 22, 2017)

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
Valentina A. Camsol	AT - Buguias	09194639437	camsolvalentina@yahoo.com	[signature]
Denialyn A. Pis-et	AT - Kibungan	09184546017	denialyn.83@g.mail.com.	[signature]
Marina A. Segundo	MA - Kibungan	09301507935	omagkibungan@mail.com	[signature]
Enrique D. Ateraa	MA. Bakun	09955369171		[signature]
Victoria M. Antonio	A.T. - Atok, Beng.	09480769993		[signature]
Grace L. Calama	AT - LGU Bakun	0909-419-2363		[signature]
Rudy S. Dacuhan	MAO - Mankayan	09205632867		[signature]
Lolita C. Beganio	A.T. - Atok	09486555524		[signature]
Nida D. Organy	BA - LTD	09396025749	family4dans88@yahoo.com	[signature]
Jeffrey D. Sotero	MA - Tublay	(0919) 09202834842	tublay_omag@yahoo.com	[signature]
Robert T. Begnaen	MA - Kapangan	09496067741	mao_kapangan@yahoo.com.ph	[signature]
Jun Ann C. Esteban	A.T - Kapangan	09300755048	shen09@yahoo.com	[signature]
Janet P. Pablo	BSU	09274876605	daopiapablo@gmail.com	[signature]
Felicia P. Fiatacao	BSU	09073361899		[signature]
Gillian Katherine L. Inciong	UPLB FI	09054612750	gklinciong@gmail.com	[signature]
Kendel Jane D. Punzalan	UPLB FI	09165724701	kendelpunzalan@gmail.com	[signature]

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA (October 6, 2017)

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
LOURDES C. VAMILLA	LGU-GLORIA/AT	0950-266-5327		
MARIA PAUTA L. MAUSKI	LGU- GLORIA/AT	0907697325		
John Leonard F. Fetalver	LGU- ROXAS/AT	09202111748		
Domingo F. Galindo	LGU- ROXAS/AT	09508974824		
JENNY C. LANOT	LGU- POLA / Admin Aide	0909056 1243	lanot.jenny@yahoo.com	
Dimawala, Darrios	LGU - POLA	09057301357		
Nerissa C. Gutierrez	LGU- Roxas	09074101879		
DANNY S. VILLACRUSIS	LGU-Pinamalayan	09293352481	danny.villacrusis@yahoo.com	

UPLBFI

AMIA

BENGUET STATE UNIVERSITY 1916

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA (October 6, 2017)

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
ROMNEL SALAZAR	DA 4B SrSMS	09204043122		
MARY JOY DELFIN	SOCORRO	0907 057 7308		
MARIDEL F. DEMORA	LGU - BULALACAO	0916-181-4084		
DELMAR B CANUBAS	LGU - SAN TEODORO	09357076308		
GRACE T. MANTE	LGU - CALAPAN	09196530024	gracez_03 @yahoo.com	
EDILBERTO B. DE CASTRO	LGU - Socorro	09399151532	edeldecastro1961@gmail.com	
RENE D. DATINGUINOO	CASD - CALAPAN CITY	09353292202	datinguinoor@yahoo.com	
Chavito J. Manongsong	PAgO - Cal. City	09052553108	opagoomindoro@gmail.com	
Philip Andrew L. Fontanoza	LGU VICTORIA	09557184831		
Elowena M. Perez	LGU - BULALACAO	09478232296	elowenamperez@yahoo.com.ph	
Monalisa J. Laqueta	LGU Baco	09208280493	dababcomo15@gmail.com	
Gracita G. Poliño	LGU - Puerto Galera	09175351769	grape_naf@yahoo.com	
Rodel L. Pompa	LGU - Pinamalayan	09335799739	rodelp_25@yahoo.com	
Bernaliza M. Liwanagan	LGU - Bongabong	09756787083	recyclemind_23@yahoo.com	
NORIEL G. BAYETA	LGU - BONGABONG	0935-779-6466	noriel.bayeta@y.com	

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA (October 12, 2017)

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
DEMETRIO H. ALINIO	BANSUD/MUN. AGRIC	09219634625	da.bansud@gmail.com	[signature]
LILY M. ALAGAO	NAUJAN / AGRI. I	09279118988	agriculturem@yahoo.com	[signature]
Alma G. Arguelles	Naujan / AT	09192555445	agriculturem@yahoo.com	[signature]
DOMINEL B. SALAZAR	Sr. Science Research Specialist DA-MIMAROPA, Research Div	09204043122	damimaropa.researchdiv@gmail.com	[signature]
Leandel Jane D. Punzalan	RA/UPLBFI	09166724701	leandelpunzalan@gmail.com	[signature]
Gillian Katherine L. Inciong	GIS specialist	09054412750	gklinciong@gmail.com	GKInciong

UPLBFI

AMIA

BENGUET STATE UNIVERSITY 1916

Focus Group Discussion for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR (December 4, 2017)

Attendance Sheet

Name	Contact number	Signature
Haidea P. Dalisgen	09078575805	
RAFAELA SUMAKEY	09083987682	
MARIVIC O. DUCLISIN	09480765772	
Rowela T. Egsan	09091071358	
Norelyn L. Deneng	09079908548	
Zandro C. Ago	09480757244	
SALEM B. BIDANG	09301230034	
BERTON Q. IGNACIO	09467490481	
JEROME C. TOMAS	09289406640	

UPLBFI

AMIA

Farmer Surveys for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigatio Initiative in Agriculture (AMIA) in CAR (December__, 2017)

Attendance Sheet

Name	Contact number	Signature
SALPY T. LEPAGO	09208231064	[signature]
Mateo D. Miguel	09084984398	[signature]
BELINDA D. TEJAKEN	09098677497	[signature]
Elsie B. Legaspi	0	[signature]
Jenne C. manafiwo	09129635399	[signature]
Alfredo D. Pataras	09305768850	[signature]
WINNIE D TAYNAN	09195122100	[signature]
MARCIANO A. DONGGA-AS	09204064117	[signature]
Oscar H. Kimbongan	09301887029	[signature]
Lily S Telcogan	09463771064	[signature]
Martin L Baca	09197634304	[signature]
Nora L. Barkion	09098505889	[signature]
Lorna L. Tiden	09126700967	[signature]
Mena F. Sukitap	09075421878	[signature]
FEDERICO B. LANG-AY		[signature]
Ursula M. Kesim	09070888612	[signature]

UPLBFI

Focus Group Discussion for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR (December__, 2017)

Attendance Sheet

Name	Contact number	Signature
Conrado O. Baldino	09102671506	[signature]
Wilian P. Teofilo	09485648772	[signature]
Hilario Dicos	09074028483	[signature]
GORDON P. ATIWAG	09395636287	[signature]
SYLVIA S. BALAD	09483763159	[signature]
LINA Q. BENITO		[signature]
Teresita L. Colte	09487369588	T. Colte
Dora T. Guinoran	09128053686	[signature]
OLIVA E. CAPSULA	09502795938	[signature]
Romeo Bayating	09185268119	[signature]
SATUR S. PONASEN	09207200908	[signature]
BENIR D. BACUD	09095334046	[signature]
ARSENIA O. FUASEN	09284722782	[signature]
TONY O JUAN	09127326614	[signature]
Ponciano P. Dicos	09901246680	[signature]
APOLINARIO B. CELO		[signature]

Workshop for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA (June 13, 2018)

Attendance Sheet

Name	Contact number	Signature
LARRACAS, REYNALDO R.	09359367628	[signature]
RAMOS, EDRALYN R.	09501723714	[signature]
[illegible]	09293185278	[signature]
Sarah Alma A. Relox	0927-6974479	[signature]
VENERANDO M. SANCHEZ, JR.	09184386582	[signature]
CHRISTINE N. PINO	09176793714	[signature]
Jeff DC. Bay-angan	09486804259	[signature]
LILY VM KLAGAO	09279118988	[signature]

UPLBFI

Workshop for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in MIMAROPA (June 18, 2018)

Attendance Sheet

Name	Contact number	Signature
Ralphael P. Gonzales		
Gillian Katherine L. Inciong		
Angelee Fame B. Ramal		
ROMNEL B. SALAZAR	09204043122	

UPLBFI

Workshop on Exposure database for the Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in CAR

Attendance Sheet

Name	Municipality/Position	Contact number	Email address	Signature
Cornelio M. Benigno Jr.	BUGUIAS	09204976835	cmb_jr.@yahoo.com	
Ricardo D Aquiso	Buguias	09168516531		
Miguel M Toyaoan	"	09095889631		
Joaquin M. Depalog Jr	Buguias	0947 7304 619	jaged3863@yahoo.com	
SABADO B. DOROTEO	BUGUIAS	09215486439		
DAGUIO ATOPEN	BUGUIAS	09488401537		
Roselily Atopen	Buguias	09107865459		
Amado W. William	Buguias	09297176658	amadowilliam16@gmail.com	
JOSE M. MANGEG	Buguias	09102148157		
Elizabeth Buyangco	UPLB			
LITO D. LUCAY	DA-HUCDP/Sr. Agric	09273449616	dacar.drrm@gmail.com	
Camian, Frances Ann	BSU - Field Assistant			

ANNEX 5

Photo 1. Courtesy call to the Provincial Agriculturist of Oriental, Mindoro.

Photo 2. Project team meeting for the identification of priority crops for Benguet.

Photo 3. Discussion of CRA in Mindoro.

Photo 4. GIS Specialist in Benguet spearheading FGD in Benguet.

Photo 5. Data collection for crop occurrences in Benguet.

Photo 6. Data collection for crop occurrences in Benguet.

Photo 7. GIS Specialist of AMIA 2++ spearheading FGD in Mindoro.

Photo 8. Participants on data collection for crop occurrence in Mindoro

Photo 9. Focus group discussion in Mindoro

Photo 10. Farmer's interview in Mindoro

Photo 11. Rice field in Mindoro that practices CRA

Photo 12. Farmer's interview in Mindoro

Photo 13. Onion field in Mindoro (part of CRA practice)

Photo 14. Focus group discussion on farmers in Mindoro

Photo 15. Dr. Janet Pablo conducting FGD for the CRA practice in Benguet.

Photo 16. Dr. Janet Pablo conducting workshop on climate hazards in Benguet.

Photo 17. Re-echoing workshop for CRA and CRVA in MIMAROPA

Photo 18. Re-echoing meeting with RFO of MIMAROPA

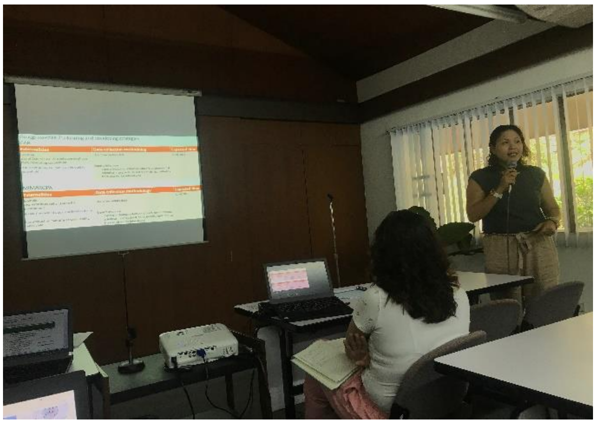


Photo 19. Prof. Supangco (Project leader) delivering updates of the project to SUCs and CIAT (photo taken on January 9, 2018 at UPLB)

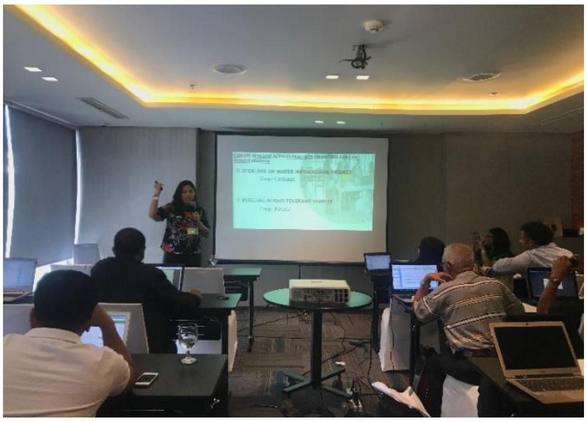


Photo 20. Prof. Supangco (Project leader) delivering the results of CBA to SUCs and CIAT (photo taken on June 7, 2018 at Quezon City Manila)

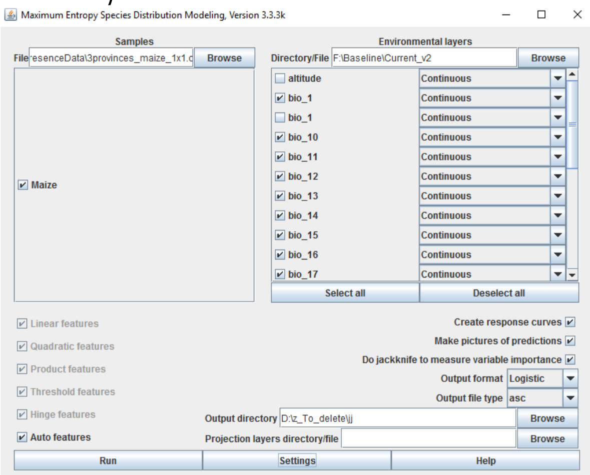


Photo 21. Sample of application (MaxEnt) used for sensitivity, vulnerability and adaptive capacity of the study sites.

Photo 22. Crop occurrence workshop and FGD being conducted in Benguet.

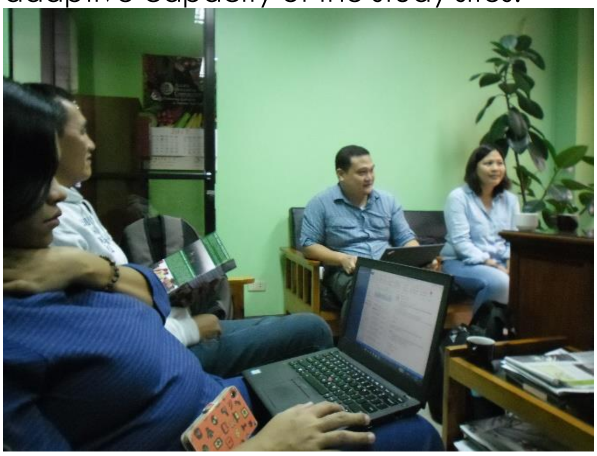


Photo 23. Prof Supangco together with GIS Specialists from CIAT Philippines.

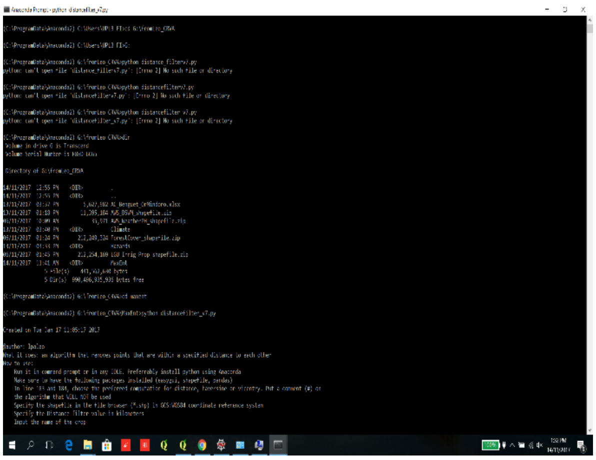


Photo 24. Anaconda application used for the computation of sensitivity analysis of the study sites.

Photo 25. Workshop on participatory mapping conducted at the college of Forestry, Benguet State University.

Photo 26. CRVA training held at University of the Philippines, Los Baños, Laguna with RFO-CAR.

Photo 27. Presentation of CRVA and CRA report of Benguet province.

Photo 28. Presentation of CRVA and CRA report of Benguet province.

Photo 29. Presentation of CRVA and CRA report of Benguet province.