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COMPLETION REPORT

A. BASIC INFORMATION

1. Title of the Project: **Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 in Cebu Province (Central Visayas Region)**

2. Proponent/Project leader

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3. Implementing Agency

3.1 Lead Agency:	**Visayas State University**
3.2 Collaborating Agency(s):	**Department of Agriculture RFO VII**

4. Project Duration:

4.1. Approved Duration	**June 2017 – May 2018 (12 months)**
4.2. Actual Duration	July 1, 2017 – August 31, 2018
4.3. Start Date of Implementation	July 1, 2017

5. Project Site (s)

5.1. Province:	**Region VII, Province of Cebu**
5.2. City/Municipality:	**All cities and municipalities in Cebu**
5.3. Barangay	
5.4. Geocode	**0722**

6. Project Funding

6.1. Budget Requested:	**PHP 999,770.08**
6.2. Total Amount Released:	
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: **Climate-resilient agri-fisheries (CRA) technologies and practices in Central Visayas Region in support of AMIA2+**

9. Description of Technology/Information

10. Potential Impact: **Climate-resilient agriculture and fishing communities in Cebu Province – Central Visayas Region**

11. Target Beneficiaries/Users: **Agriculture and fishing communities in Central Visayas, Planners, Department of Agriculture**

12. Tags/Keywords: **Climate-resilient; agriculture; fishery; adaptation; mitigation; vulnerability; exposure**

B. TECHNICAL DESCRIPTION

1. PRELIMINARIES

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Abstract

The agriculture sector in today's time as the climate changes rapidly, the number of farmers dependent on it is increasingly getting more vulnerable to its associated effects. Thus, identification of the vulnerable areas has become an urgent issue that requires immediate policy need. The result of this study offers solution to this dilemma as this had examined the level of agriculture sector in Cebu. The study focused on the identification of vulnerability level of cities and municipalities in Cebu with emphasis on specific crop commodities such as corn, rice, banana, mango and cassava. In addition, this research also documented the climate-resilient practices in the province practiced by farmers as mitigation to the phenomenon. The results of the study were reflected into index maps using quantum geographic information systems (QGIS) technology to analyze the spatial vulnerability condition of Cebu.

2. Rationale

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 SWCCO), AMIA Phase 1 in 2015-16 to 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 9 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 results

The AMIA2+ framework provides overall guidance in the planning and design of research and development interventions in 7 target regions.

1. Cordillera Administrative Region
2. MIMAROPA Region
3. Region VII: Central Visayas
4. Region VIII: Eastern Visayas
5. Region IX: Zamboanga Peninsula
6. Region XIII: CARAGA
7. Autonomous Region in Muslim Mindanao

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).

SWOT Analysis

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 face limited availability of data, especially on crop occurrences and adaptive capacity.

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

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.

3. Narrative Summary

Potential Impact

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.

Outcome of General Objective/Purpose

The overall objective is to assess, target and prioritize climate-resilient agri-fisheries (CRA) research and development in Region VII in support of AMIA2.

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 modeling 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 by providing data in establishing AMIA baseline for outcome monitoring and evaluation (M&E) of CRA communities and livelihood.

Expected Output or Specific Objectives

At the end of the project, it is expected that

1. The project partners like DA staff and provincial staff will learn various tools used for climate-risk vulnerability assessment like climate sensitivity analysis, exposure from climate-related hazards and adaptive capacity;
2. The project will produce "Climate-risk vulnerability maps" at 2030 and 2050 predicted change in climate;
3. Documentation of farmer's knowledge and perceptions of various CRA practices tested by farmers.
4. Documentation of farmer's CRA practices and cost-benefit analysis of selected CRA practices;
5. Developed appropriate M&E tools for climate resilient livelihood and communities.

Scope and Limitations/Constraints

The project is being piloted in the province of Cebu covering all municipalities.

4. REVIEW OF LITERATURE

The Central Visayas (Region VII) is one of the fastest growing regions in the entire Visayas islands with Cebu City as the main hub of commerce and industry. Aside from the booming local industries, the relevance of foreign investors in the export-industries in Cebu City (and Mactan Island) is evident. The top relevant export products in this region are semiconductors, electronic watches, electrical equipment, cameras and furniture. The largest foreign markets are the USA and Japan. Total export sales in this region exceeded $2.0 Billion in 1998, representing close to 7% of the total Philippine exports. The exports are increasing with a average growth rate of more than 12% over the past five years" (DTI Cebu).

As of August 1, 2015, Central Visayas has a population of 6,041,903 comprising Cebu, Bohol and Negros Oriental (POPCEN 2015). While the total agricultural land area is 522,483 ha., comprising temporary crop land (346,719 ha), idle land (4,465 ha), permanent crop land (132,942 ha), meadows and pasture (1,453 ha), forest land (1,985 ha), and other land (35,562 ha.). The number of farms/holdings, area of farms/holdings, and average area per farm/holding is 427,464,000, 292,571.40 ha., and 0.684 ha., respectively (PSA, 2012). The top agricultural crop is palay and corn with production (in metric tons) of 347,697 and 173,225, respectively. However, in 2013, production in agriculture declined by 0.13 percent. The crops subsector, which accounted for 36.59 percent of the regions agricultural output recorded a 1.46 percent increment in output. On the other hand, the fisheries subsector posted a production cut by 2.35 percent (countrystat.psa.gov.ph). The major commodities of the region are hog, chicken, palay, chicken egg, sugarcane and mango. Hog and chicken production ranked fifth in the national production while, sugarcane and mango third.

Currently, with the creation of the Negros Island Region, Central Visayas is composed of two provinces only – Cebu and Bohol plus Siquijor Island. In a study conducted in 2011 by the WWF-Philippines and BPI Foundation Inc., on Business Risk Assessment and the Management of Climate Change Impacts, Cebu City scored 6.55 in vulnerability and will be exposed to all six climate scenarios listed in WWF study. It is ranked sixth out of 16 cities in terms of vulnerability to climate change impacts. Tan, 2015, said, “Cebu City, which is a resource-scarce area, must learn to produce more with less.”

Cebu City is generally characterized having narrow coastal plains with rugged mountains and limestone plateaus, barely 15% of the city’s total land area sits on flat terrain. With much of its land area on steep slopes, it is not an agricultural center and its uplands are also highly vulnerable to rain induced landslides. Further, one of the problems of metropolis Cebu is saltwater intrusion due to excessive groundwater extraction. Recent studies showed that saltwater intrusion has been reported 5 km inshore. It was reported that Cebu City will likely find itself caught in a “climate sandwich” as saltwater intrusion advances, sea level rise and more intense typhoons lash the coastline with storm surge.

The fisheries of Cebu have long exceeded maximum sustainable yields, which can be attributed to increase in sea surface temperature, ocean acidification coupled with increased population.

In the WWF-Philippines study they have identified that the key drivers to the development of the province are Governance and Water Resources Management. In response to the climate change adaptation several agencies and institutions including DA, ATI, DENR and even Metro Cebu Water District formulated strategies such as reforestation of watershed areas, planting of drought-tolerant crops, establishment of water catchments, capability building at the local level on DRRM-CCA (Blasco, 2014, Salvacion, 2008, Soliva, 2016).

Despite, the efforts of the Province of Bohol, Department of Agriculture-RFO VII there is need to develop a good risk and vulnerability assessment in order to incorporate Climate Change Adaptation (CCA)-DRR in updating the plans for agriculture in the area most especially that they have issues of water sufficiency.

5. Methodology Per Objective

The project seeks 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 are 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.

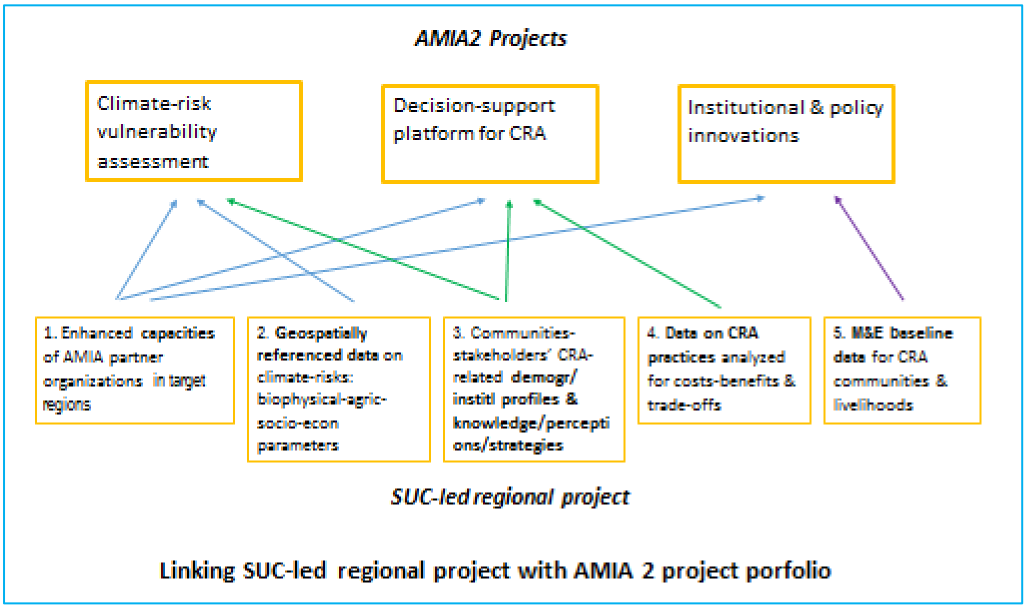

Figure 1. AMIA Project component framework

Component 1 - Capacity strengthening for CRA research & development

The regional project team participated in a series of trainings, workshops and learning events organized by AMIA2 projects. These events focuses on three key methodologies: 1) CRVA, 2) CRA prioritization, and 3) CRA M&E.

The project also provided training support to key research and development stakeholders in the region, by organizing an intra-regional training that covers key learning contents from the national-level trainings.

Component 2 - Geospatial assessment of climate risks

The regional project team collected and organized geo-referenced data on vulnerability to climate risks of the region's agri-fisheries sector. These datasets, from both primary and secondary sources, were based on the methodological guidelines provided by the AMIA2 CRVA project – covering climate-risk exposure, sensitivity and adaptive capacity.

Preliminary analysis – using GIS and climate modelling tools – was undertaken at the regional level. The project team also participated in a national-team level joint analysis of cross-regional data.

Component 3 - Stakeholders' participation in climate adaptation planning

The regional project team have organized a series of stakeholders' meetings and focus group discussions to collect supplementary data and validate preliminary results of CRVA, as well to undertake CRA prioritization and planning.

These activities were guided by process facilitation and data collection tools developed by the AMIA2 projects on CRVA and CRA decision-support platform.

Component 4 - Documenting & analyzing CRA practices

The regional project team have conducted a semi-structured survey with local stakeholders to identify and document CRA practices, as well as collect existing CRA-relevant statistical and other secondary data.

These data were systematized and analysed, using cost-benefit and trade-off analyses tools as input to AMIA2 CRA prioritization and investment planning. These will likewise contribute to developing knowledge products, such as searchable online portal, under the AMIA2 project on CRVA decision-support platform. A national working team, consisting of representatives from regional teams, will undertake this joint tasks.

Component 5 - AMIA baseline study for monitoring & evaluation

The regional project team have conducted a structured survey to collect baseline data on the target CRA communities and livelihoods as identified by AMIA2.
This was undertaken following the development of outcome-oriented M&E guidelines for CRA, under the AMIA2 project on institutional and policy innovations.

6. Results and Discussion Per Objective

In line with the programmed project methodologies and objectives, the project team attended a series of workshop and trainings led by the center of international tropical research (CIAT) aimed to capacitate the team with the knowledge and tools in conducting climate-risks vulnerability assessment (CRVA) research. In 2017, the project team participated the CRVA Workshop and Planning on July 24-25, CRA Decision Support Orientation and Planning Workshop on August 14-15 and AMIA-Wide Coordination Workshop last August 16-18 in the same year. The team have also conducted an inception and coordination meeting with its partners – the Department of Agriculture, Regional Office 7 (DA-RFO7) officials – to formally present the framework and scope of the project in Cebu.

Crop occurrence mapping

Right after the project team's inception meeting with DA-RFO7 officials, collection of data follows. The team conducted two Crop Occurrence Workshops and Focus Group Discussion (FGD) on September 21-22, and October 9-10, 2017 in Cebu Business Hotel, Cebu City. The participants of thess activities were the Municipal and City Agriculturists of Cebu Province. The purpose of the events were to collect crop occurrence data. During the workshop, the participants were asked to identify and locate which part in the municipality and city that crops such as corn, rice, banana, mango, cassava, sweet potato, pinakbet and chopsuey veggies, coffee and cacao were commercially grown. Municipalities that were not able to attend the workshops were personally visited by the project team. In total, out of the 53 municipalities and cities in Cebu the team were able to collect the crop occurrence data of 49 municipalities and cities except Mandaue City, Lapu-Lapu City and Cordova and Malabuyoc. This is because the land delineation of these places except Malabuyoc are all classified as built-up hence no crops were grown. However for the municipality of Malabuyoc, the team was not able to collect data because this municipality did not attend to any workshop nor responded to communications and invitations sent by the project team. Due to this absence of crop occurrence data, the four (4) aforesaid municipalities and cities of were excluded in the subsequent analysis.

Following the methodologies of intergovernmental panel on climate change (IPCC) in estimating climate change vulnerabilities, the team analyzed the project sites exposure and sensitivity to climate-induced hazards and their capacity to adapt to such changes in phenomenon. Climate-induced hazards such as typhoon, drought, soil erosion, landslide, storm surge and saltwater intrusion will account the exposure. Hazard maps from the Mines and Geosciences Bureau (MGB) were used as data for exposure which was re-validated through key informant interview (KII) (see attached questionnaire in Appendix 4). For sensitivity, 20 bio-climatic indicators from WorldClim and crop occurrence data were used. This bio-climatic indicators account for the changes in temperature and precipitation of baseline condition starting on year 1960-2000 to the future climate conditions from 2001 up to present. The extracted information were used as basis for future climate projections. Meanwhile, the adaptive capacity data were sourced out from primary sources through survey questionnaires, KII and secondary sources from the Philippine Statistics Authority (PSA), Department of Agriculture (DA), DA-RFO7 partner, CIAT and other government line agencies. Sample questionnaire used for primary data collection is attached in the Appendix 5.

Figure 2 is the output of participants from Naga City, Cebu during the conducted crop occurrence workshop. This activity co-facilitated by DA-RFO7 personnel was attended by 44 municipal and city agriculturists out of 53 LGUs in Cebu province. The markings on the map represent the identified priority crops present in municipality/city represented with letters. Each marking assumed that a certain crop inside the grids was produced for commercial purposes regardless of its production volume. Crop occurrence data gathered were then validated using satellite images from google earth and ridge-to-reef transect activities in selected municipalities.

Table 1. Production volume and physical area of prioritized commodities in Cebu Province

Commodity	Physical Area (ha)*	Average Yield (mt/ha)*	Annual Production (in metric tons)**		
			2015	2016	2017
Palay	2,549.90	3.10	14,291.00	13,546.00	14,514.00
Corn	61,998.84	1.03	84,300.00	84,346.00	78,209.00
Cassava	6,773.32	6.20	20,256.11	17,449.19	16,765.57
Banana	2,135.81	6.21	78,378.91	84,075.08	86,438.31
Mango	Bearing	342,034	53,269.89	40,831.39	42,018.98
	Non-Bearing	168,368	-	-	-

*Source: *DA-RFO7 Cebu provincial agricultural profile, 2014*
***PSA, CountryStat*

Figure 2. Crop occurrence output of Naga City, Cebu Province

Crop Climate Sensitivity Modelling Using MaxEnt

In looking at the sensitivity of the 5 prioritized crops in Cebu province, crop occurrence data together with the 20 bio-climatic factors from WorldClim were analyzed using Maximum Entropy (MAxEnt) modeling software. Through this analysis, the sensitivity of the prioritized crops to changes in temperature and precipitation projected in the year 2050 were determined.

Figures 3-7 show the results of the sensitivity analysis. It showed that in some parts of Cebu, rice (Figure 4) is very sensitive to changes in precipitation and temperature relative to corn (Figure 3) which shows moderate sensitivity that is evenly distributed throughout the Province. The classification of rice sensitivity of Cebu Province as reflected on Figure 4 is clustered rather than equally distributed. The mid-part of Cebu starting from cities of Cebu and Toledo going north up to Borbon have a very low sensitivity level. However, municipalities following to Cebu City going south up to Alcantara scored very high sensitivity while rest of the south except Samboan and Santander have very low. For fruitcrops, mango (Figure 6) appeared more sensitive than banana (Figure 5) with sensitivity values that fall within the category of very high to high except in the municipalities of Daanbantayan and San Remegio which only recorded moderate sensitivity level. For Banana, the southern part of Cebu shows higher sensitivity relative to the north. However in the municipalities of Camotes Island, all except Pilar have very high sensitivity level.

For cassava (Figure 7), the Municipalities of Tuburan and Sogod and the rest of the North have very low sensitivity level including Bantayan Island. In general, the same figure tells that the southern part of Cebu, cassava is relatively sensitive to climatic changes relative to the mid and northern part of Cebu except Cebu City, Lapu-Lapu City, Cordova, Catmon, Carmen, and in the municipalities in Camotes Island such as Tudela, Poro, Pilar.

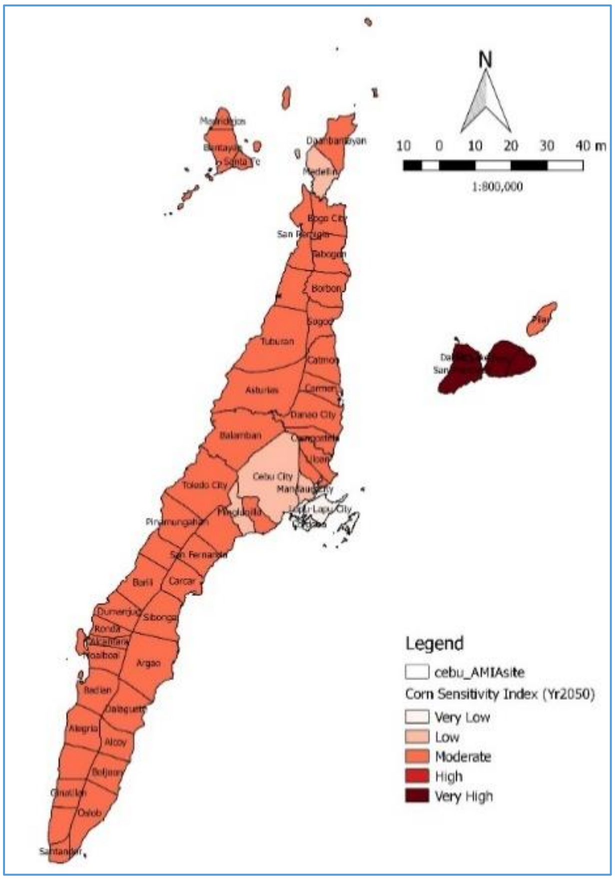

Figure 3. Sensitivity map of corn in Cebu Province for the year 2050

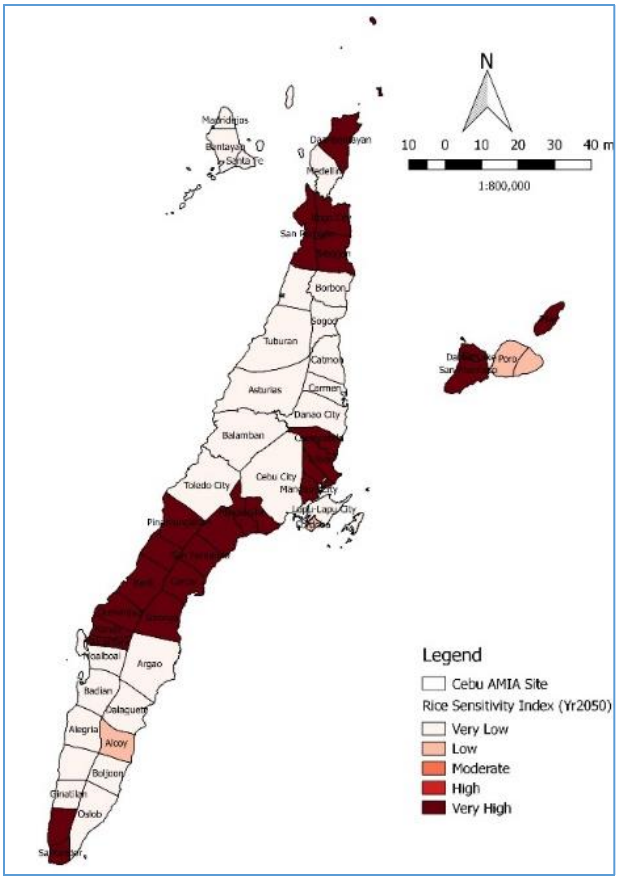

Figure 4. Sensitivity map of rice in Cebu Province for the year 2050

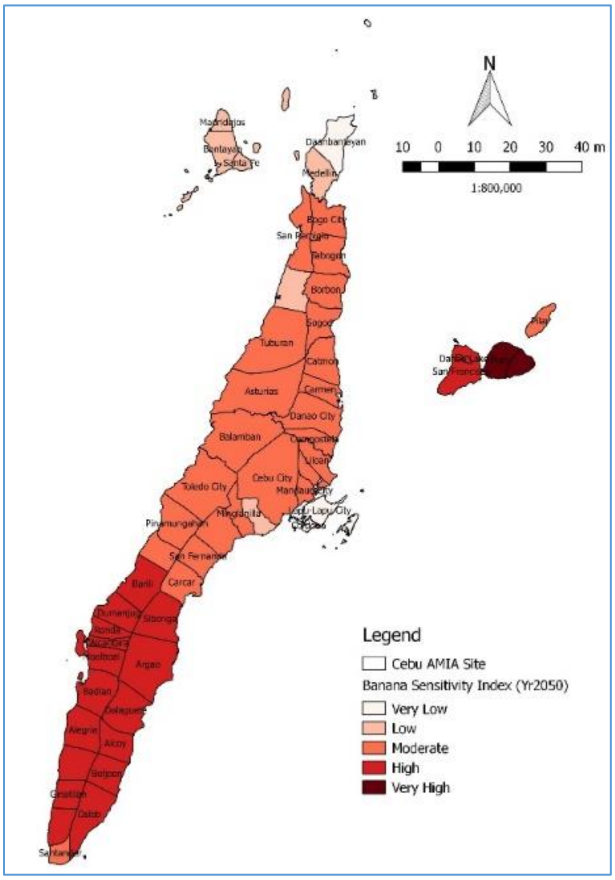

Figure 5. Sensitivity map of banana in Cebu Province for the year 2050

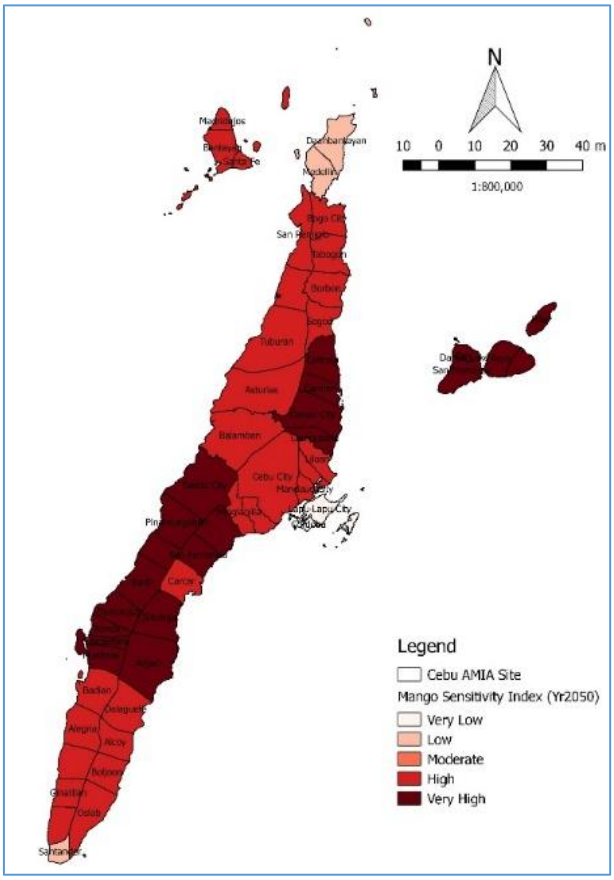

Figure 6. Sensitivity map of mango in Cebu Province for the year 2050

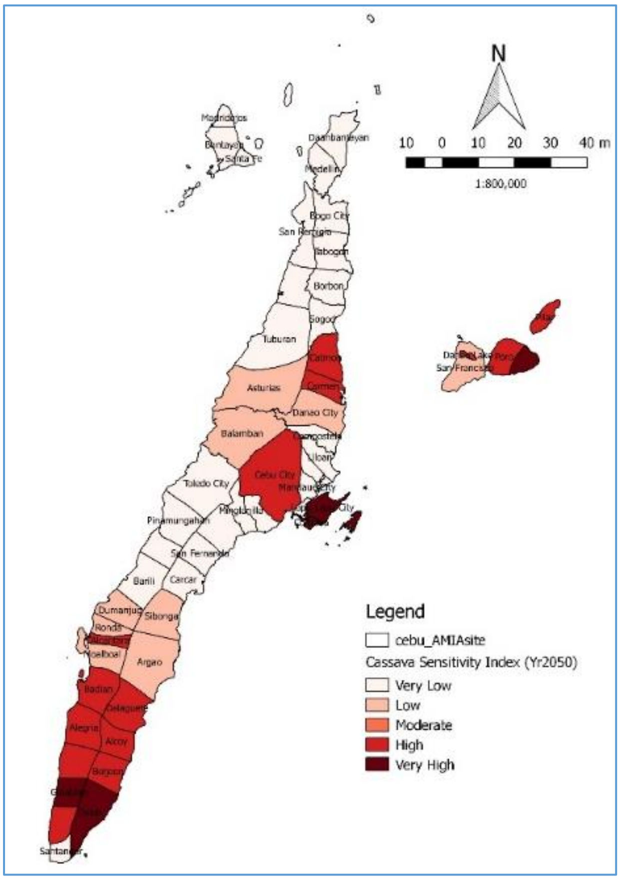

Figure 7. Sensitivity map of cassava in Cebu Province for the year 2050

Cebu Province Climate-Related Hazards

With regards to the province's exposure to hazard, Figure 8 presents the municipalities and cities in Cebu with high to very high exposure to typhoon, flooding, drought, landslide, soil erosion, sea-level rise and saltwater intrusion. As reflected in the same figure, all of the places included were situated in mid-part and northern part of the island province. However in terms of specific hazard exposure, places in the mid-part of Cebu such as Cebu City, Toledo City, Pinamungahan, Balamban, Asturias, Tuburan and Carmen were noted as the most exposed to landslide and soil erosion. One probable reason is the topography of the areas mentioned. Since these places have steep slope rolling mountains, landslide and soil erosion incidence is not a surprise which could also happen anytime. The very high exposure to flooding is noted in Mandaue City which is due to its low elevation and land delineation. The massive transformation of built-up areas in Mandaue transformed its natural landscape into a cemented jungle. Thus, the natural discharge of excess water through soil absorption is clogged which results to flooding. Aside from this, the city has also high exposure to saltwater-intrusion but lesser compared to Cebu which is reported to be very high.

In the northern part (Figure 9), the hazardous impact of typhoon is notably affecting the municipalities of Daanbantayan, San Remegio and Medellin along with Bogo City and Tudela in the island of Camotes. This high to very high exposure to hazard of the aforesaid places is attributed to their exposure to typhoons. Since these places are located within the typhoon lane, it is not surprising that they experienced more number of typhoons annually relative to the rest of Cebu. In fact during the onslaught of Typhoon "Yolanda", which is said to be the strongest Typhoon ever recorded that made its landfall, only the aforesaid municipalities and cities were gravely affected in Cebu. For drought, the same figure indicated the Municipality of Tudela in the island of Camotes being the most exposed (Figure 8). Although not as much with Tudela, drought appears to be affecting also the Municipalities of Pinamungahan, Borbon and Tabogon.

In terms of hazards ranking as to which is the most devastating, Table 2 presents the responses of municipal and city agriculturists in Cebu province. This information was collected during the conducted focus group discussion through questionnaire formulated by CIAT (Appendix 4). In the questionnaire, the ranking of hazards were categorized based on its individual impacts (a) disastrous, (b) significant), (c) moderate, (d) minor and (e) insignificant) as observed in the province. Relative to its intensity of impact, among the seven identified hazard, typhoon was reported to be the most devastating. The information presented in the same table showed that typhoon has the most negative bearing to income which is reported as disastrous (24%), significant (26%), and moderate (26%) by the participants. It was also described as the most-frequently occurring hazard affecting the province with 82% reported probability of occurrence of "once a year or more". Typhoon is followed by flooding (63%), soil erosion (47%), drought (50%), landslide (34%), sea-level rise (26%), salt-water intrusion (16%), and storm surge (5%) with reference to "once a year or more" probability of occurrence. However with respect to their impact to income, typhoon is followed by drought with 13% of the respondents reported the hazard as disastrous, 37% significant and 29% moderate. Relative to impacts to key natural resource and national economy, drought was reported to be the most disastrous while Typhoon for food security. The rest of the information are reflected in the same table.

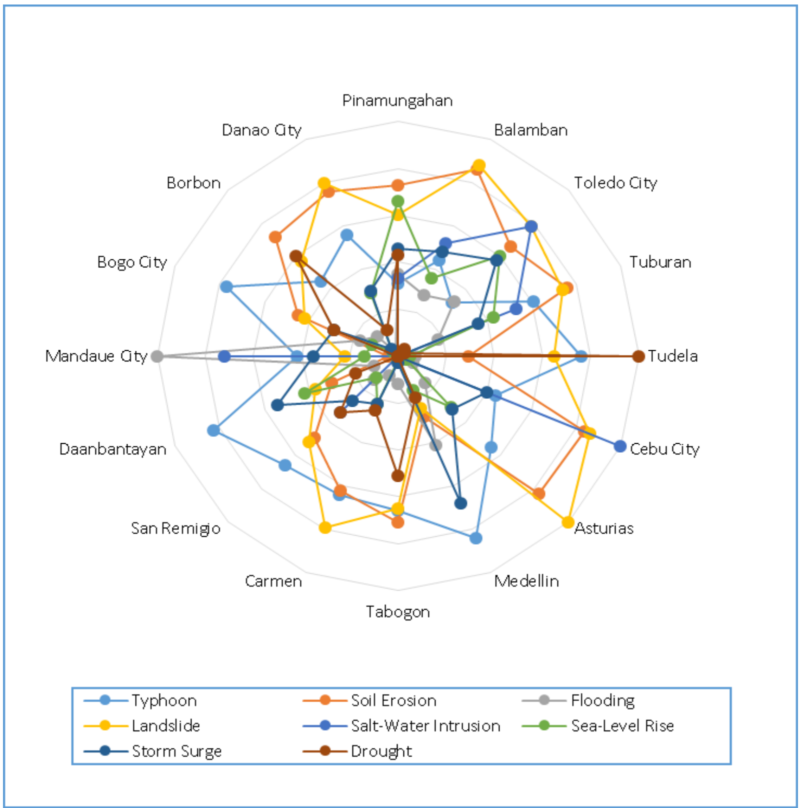

Figure 8. Radar plot of municipalities and cities in Cebu province with VERY HIGH and HIGH EXPOSURE indices to climate hazard.

Table 2. Climate-change related hazards occurrence and magnitude of its effects

Occurrence/Impacts	Typhoon	Flooding	Drought	Soil Erosion	Landslide	Storm Surge	Sea Level Rise	Saltwater Intrusion
Once a year or more	31 (82%)	24 (63%)	19 (50%)	18 (47%)	13 (34%)	2 (5%)	10 (26%)	6 (16%)
Once in 5 years	6 (16%)	6 (16%)	16 (42%)	9 (24%)	10 (26%)	4 (11%)	3 (8%)	4 (11%)
Once in 10 years or less	1 (3%)	5 (13%)	2 (5%)	5 (13%)	6 (16%)	13 (34%)	15 (40%)	12 (32%)
No response/NA	0(0%)	3 (8%)	1 (3%)	6 (16%)	9 (24)	19 (50%)	10 (26%)	16 (42%)
Impact to Local Household Income								
Disastrous	9 (24%)	8 (21%)	5 (13%)	3 (8%)	2 (5%)	2 (5%)	1 (3%)	2 (5%)
Significant	10 (26%)	5 (13%)	14 (37%)	4 (11%)	3 (8%)	4 (11%)	2 (6%)	1 (3%)
Moderate	10 (26%)	8 (21%)	11 (29%)	8 (21%)	6 (16%)	3 (8%)	7 (18%)	5 (13%)
Minor	7 (18%)	9 (24%)	6 (16%)	13 (34%)	13 (34%)	5 (13%)	8 (21%)	4 (11%)
Insignificant	1 (3%)	4 (11%)	0 (0%)	4 (11%)	5 (13%)	7 (18%)	9 (24%)	10 (26%)
No response/NA	1 (3%)	4 (11%)	2 (5%)	6 (16%)	9 (24%)	17 (45%)	11 (29%)	16 (42%)
Impact to Key Natural Resources								
Disastrous	2 (5%)	2 (5%)	6 (16%)	3 (8%)	2 (5%)	1 (3%)	2 (5%)	2 (5%)
Significant	15 (40%)	9 (24%)	11 (29%)	4 (11%)	2 (5%)	5 (13%)	1 (3%)	3 (8%)
Moderate	10 (26%)	12 (32%)	11 (29%)	7 (18%)	7 (18%)	3 (8%)	5 (13%)	1 (3%)
Minor	10 (26%)	8 (21%)	7 (18%)	13 (34%)	13 (34%)	5 (13%)	9 (24%)	9 (24%)
Insignificant	0 (0%)	3 (8%)	1 (3%)	5 (13%)	5 (13%)	7 (18%)	10 (26%)	9 (24%)
No response/NA	1 (3%)	4 (11%)	2 (5%)	6 (16%)	9 (24%)	17 (45%)	11 (29%)	14 (37%)
Impact to Food Security of the Country								
Disastrous	5 (13%)	4 (11%)	3 (8%)	3 (8%)	1 (3%)	1 (3%)	1 (3%)	1 (3%)
Significant	20 (53%)	7 (18%)	15 (40%)	3 (8%)	4 (11%)	3 (8%)	1 (3%)	2 (5%)
Moderate	6 (16%)	10 (26%)	7 (18%)	12 (32%)	9 (24%)	6 (16%)	9 (24%)	4 (11%)
Minor	5 (13%)	10 (26%)	9 (24%)	8 (21%)	8 (21%)	5 (13%)	5 (13%)	5 (13%)
Insignificant	1 (3%)	3 (8%)	2 (5%)	6 (16%)	7 (18%)	7 (18%)	10 (27%)	11 (29%)
No response/NA	1 (3%)	4 (11%)	2 (5%)	6 (16%)	9 (24%)	16 (42%)	12 (32%)	15 (40%)
Impact to the National Economy								
Disastrous	9 (24%)	4 (11%)	7 (18%)	3 (8%)	1 (3%)	1 (3%)	0 (0%)	1 (3%)
Significant	12 (32%)	7 (18%)	8 (21%)	4 (11%)	6 (16%)	7 (18%)	1 (3%)	2 (5%)
Moderate	7 (18%)	7 (18%)	7 (18%)	10 (26%)	6 (16%)	6 (16%)	10 (26%)	5 (13%)
Minor	3 (8%)	7 (18%)	7 (18%)	6 (16%)	6 (16%)	8 (21%)	4 (11%)	3 (8%)
Insignificant	5 (13%)	8 (21%)	6 (16%)	9 (24%)	10 (26%)	0 (0%)	12 (32%)	12 (32%)
No response/NA	2 (5%)	5 (13%)	3 (8%)	6 (16%)	9 (24%)	16 (42%)	11 (29%)	15 (40%)

Note: Percentage and total may not add up due to rounding; Number of Respondents - 38

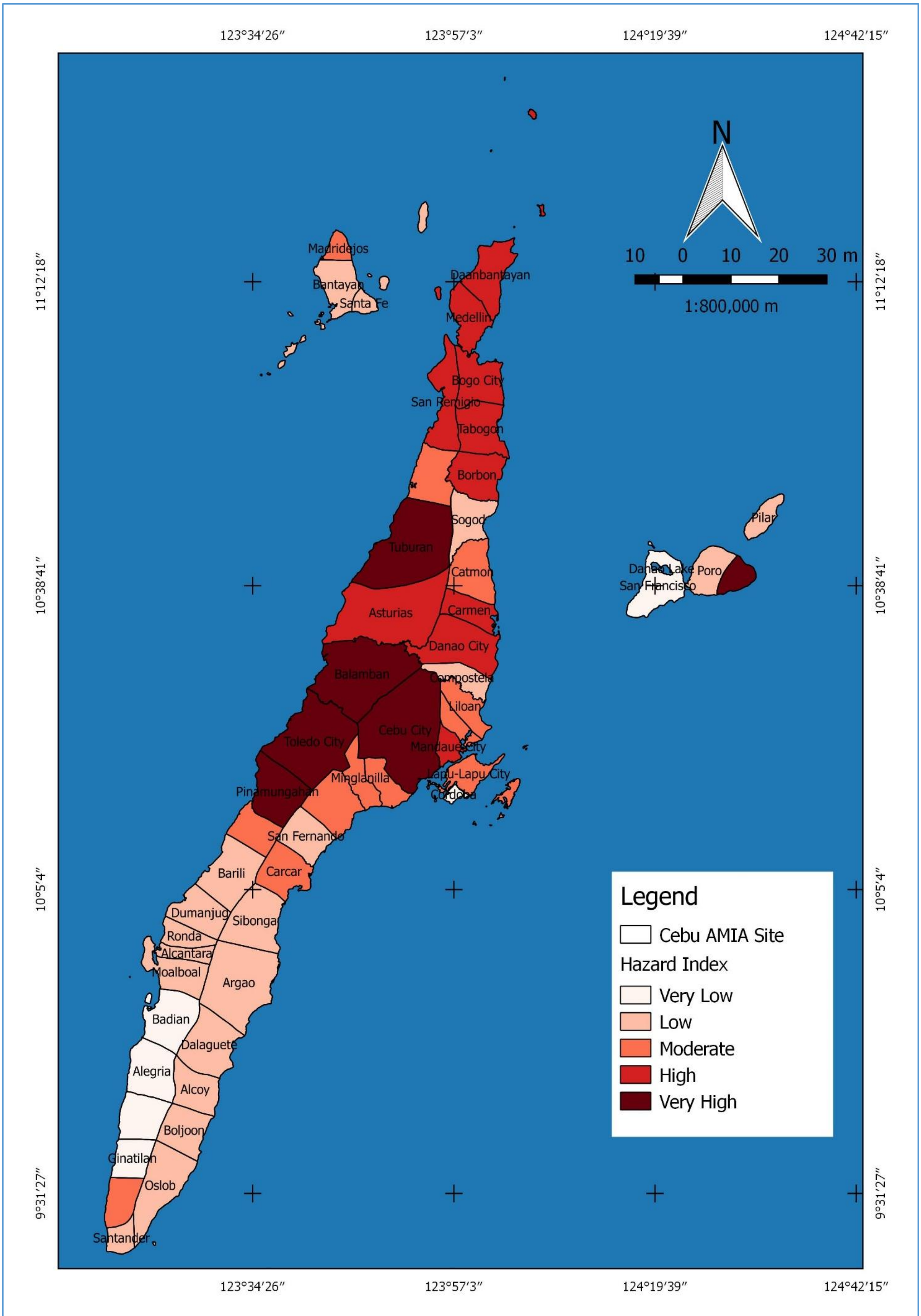

Figure 9. Hazard index map of Cebu province to climate-related hazards

Adaptive Capacity Data Collection

The calculation of adaptive capacity (AC) values was based on eight (8) capitals namely: economic, social, natural, human, health, physical, institutional, and anticipatory of which each has each own number of indicators. Each of the corresponding indicators of the AC capitals is attached in the Appendix 3. In the estimation, each capital was assumed to have an equal bearing on the AC level which implicates that regardless of their individual number of indicators, they're all equal.

The resulting adaptive capacity (AC) of municipalities and cities of Cebu province were illustrated in Figure 10. These values represent the data gathered on the internet and government line agencies, technical partners and KII of selected respondents. The inclusion of adaptive capacity in the calculation of vulnerability is that it measures how well a specific unit or entity adapt to different stressors. It is subtracted to the value of sensitivity and exposure hence high AC would mean less vulnerability and high resilience to climate-related hazards. Table 3 presents the municipalities and cities in Cebu with the highest and lowest adaptive capacity level, percentage of dependence to agriculture sector and income classification. Based on the results, Cebu City has the highest adaptive capacity to climate change while the municipality of Algeria has the lowest.

Table 3. Top Municipalities/Cities with Highest and Lowest Adaptive Capacity Level in Cebu Province by income class and level of dependence on agriculture

Municipality/City	Adaptive Capacity (AC)	AC Category	Dependence on Agriculture (%)	Income Class
Cebu City	1.00	Very High	18	Highly Urbanized City
Bantayan	0.79	High	75	1st Class
Madridejos	0.67	High	50	4th Class
Carcar City	0.65	High	10	5th Class City
Mandaue City	0.64	High	1	Highly Urbanized City
Cordoba	0.64	High	25	3rd Class
Asturias	0.62	High	70	3rd Class
Lapu-Lapu City	0.60	High	35	Highly Urbanized City
Daanbantayan	0.60	High	50	1st Class
Consolacion	0.56	Moderate	10	1st Class
Minglanilla	0.21	Low	5	1st Class
Tuburan	0.20	Low	16	2nd Class
San Fernando	0.19	Very Low	38	2nd Class
Barili	0.17	Very Low	40	2nd Class
Alcantara	0.17	Very Low	40	5th Class
Boljoon	0.16	Very Low	80	5th Class
Aloguinsan	0.16	Very Low	30	4th Class
Pinamungahan	0.15	Very Low	62	2nd Class
Catmon	0.05	Very Low	45	4th Class
Alegria	0.00	Very Low	90	4th Class

Note: Low figures indicate low level of adaptive capacity while high indicates the opposite

Looking at the other values reflected in Table 3, one implication that can be drawn is that adaptive capacity level is correlated negatively with the dependence of agriculture while positively to the income class. Resulting values reflected in the same table implies that municipalities and cities with high-income classification and low dependence on agriculture is more adaptable to changes in climate hence less vulnerable to its associated effects. This is because high income associates with high revenue collection which can be used for welfare programs such as health, education, and other institutional services. This in turn results to low poverty incidence and unemployment rate. Since some of these factors were included as indicators to capitals such as health, human and economic hence, the AC of high-income towns in Cebu are high.

Climate Change Vulnerability

Using the estimated values of sensitivity, exposure, and adaptive capacity, the vulnerability level of agriculture sector of Cebu was the computed. The vulnerability analysis was conducted using three different combination of weight assignments for sensitivity, exposure and adaptive capacity. Since the concept of vulnerability of is subjective and relative in nature, a numerous basis for estimation emerged from online literatures. However, the most common weight assignments for sensitivity, exposure and adaptive capacity were 15-15-70, 25-25-50, and 30-30-40. Due to this lack of concession to which weights assignments is best, the project team decided to use the three (3) to have broader perspective of the overall result. Figures 11, 12, and 13 illustrate the vulnerability of agriculture sector in Cebu province under three (3) different weight assignments. In Figure 11, the assigned weights were 15% for sensitivity, 15 for exposure and 70 for adaptive capacity. Meanwhile, in Figure 12 and 13 assigned weights were 25% and 30% for sensitivity, 25% and 30% for exposure and 50% and 40% for adaptive capacity, respectively.

Using the 15-15-70 weight assignment combination of sensitivity, exposure and adaptive capacity as reflected in Figure 11, the municipalities of Pinamungahan, Aloguinsan, Alcantara, Alegria, Boljoon, Tuburan and Catmon have a very high vulnerability index value while Cebu city and Bantayan have very low. Meanwhile in 25-25-50 combination reflected in Figure 12, the municipality of Tudela which in the previous version had a vulnerability index value falling into "high" category turned very high along with Pinamungahan, Tuburan, Catmon, and Tuburan while Aloguinsan, Alcantara, Alegria and Boljoon vulnerability level reduced to high. Finally using the 30-30-40 combination, the City of Toledo joined the group with very high level of vulnerability along with the previous. The consistent inclusion of Pinamungahan and Tuburan to the group having the very high vulnerability is due to their very high exposure to hazards coupled with low adaptive capacity. Such condition is also true to Catmon with a high exposure to hazard and a low adaptive capacity. The vulnerability of the Municipalities of Aloguinsan, Alcantara, Alegria, and Boljoon in succeeding combination of weights (25-25-50 and 30-30-40) downgraded since they are not very exposed to hazard and the weight assignment for adaptive capacity to which they scored low to very low reduced.

The resulting value of index category in the three weight assignment illustrated the different impacts of hazard exposure and adaptive capacity in estimating vulnerability. The result may have returned different results but the picture it portrays remained the same. That is – high exposure due to high agricultural dependence coupled with low adaptive translates to high vulnerability to climate change.

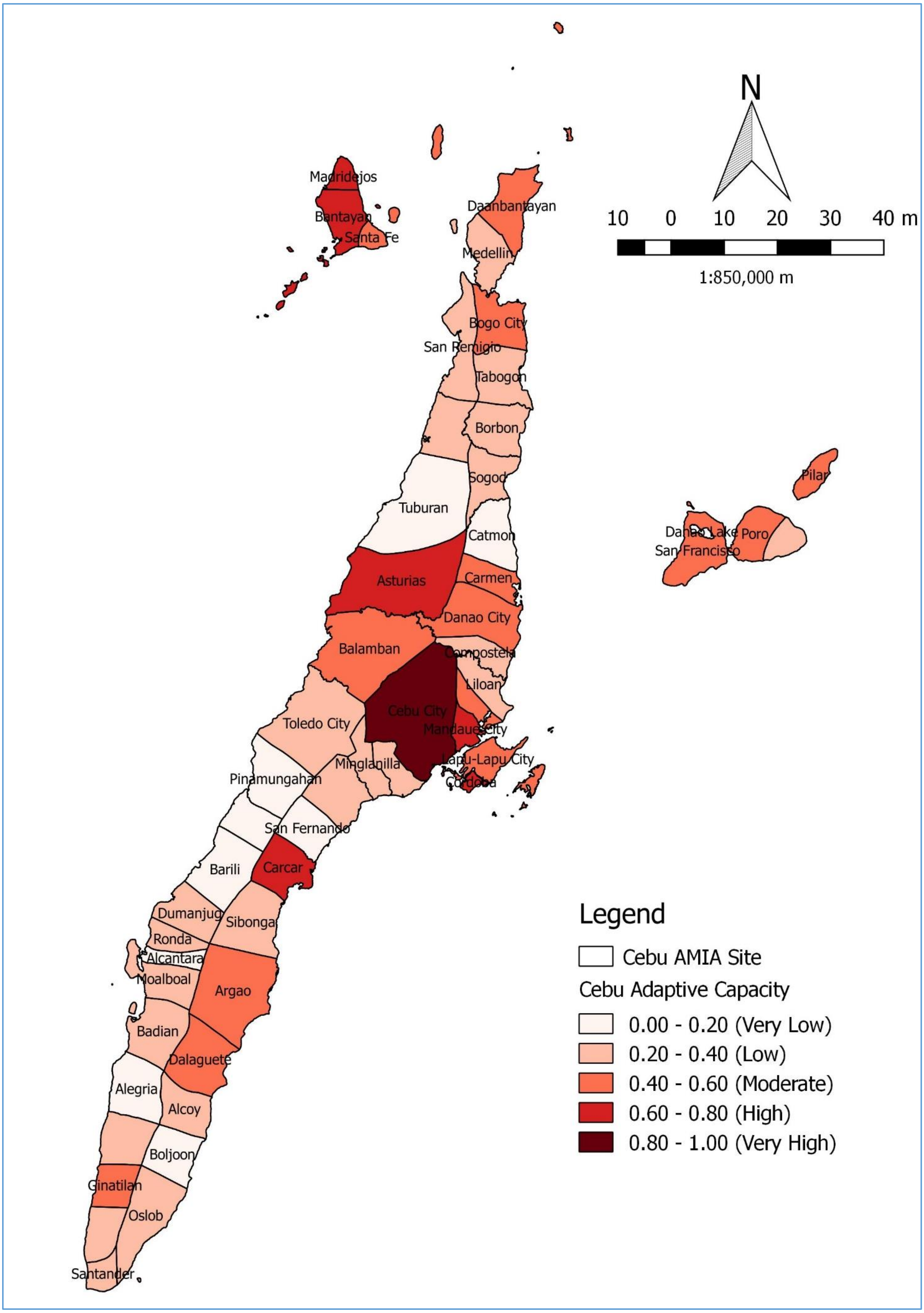

Figure 10. Adaptive capacity map of Cebu province

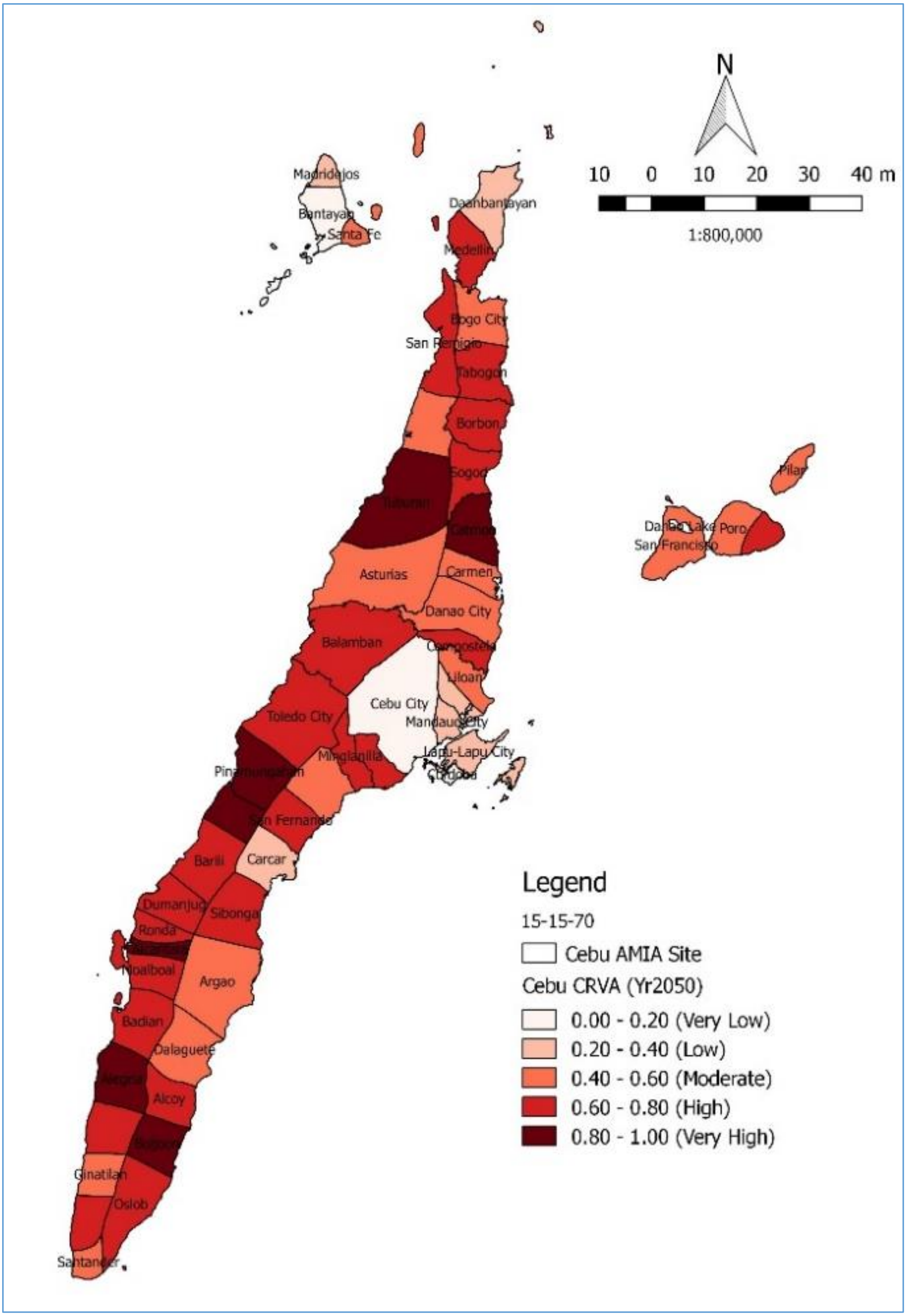

Figure 11. Vulnerability indices of Cebu province to climate-related hazards in the year 2050 under 15-15-70 weight assignments of sensitivity, exposure and adaptive capacity

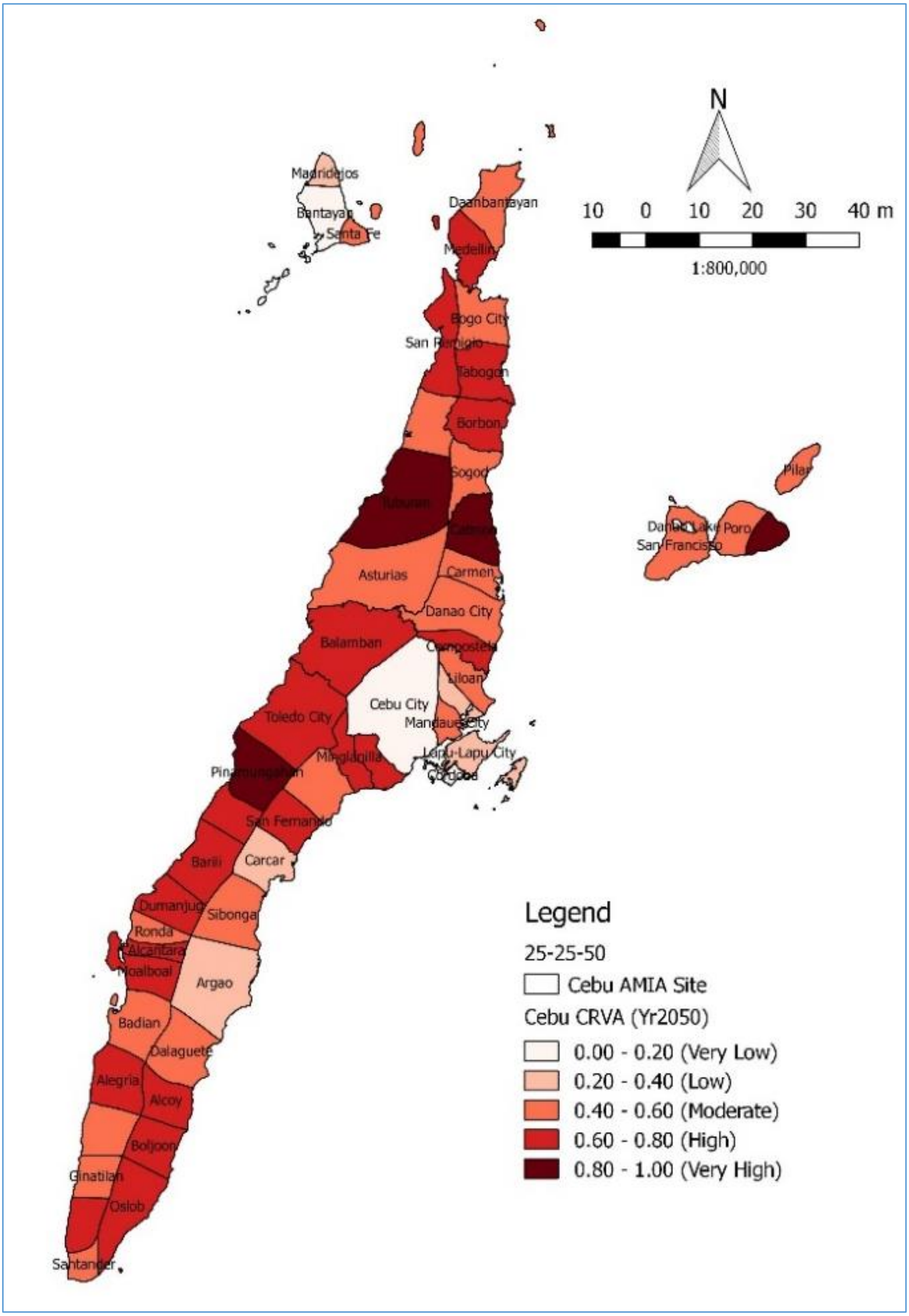

Figure 12. Vulnerability indices of Cebu province to climate-related hazards in the year 2050 under 25-25-50 weight assignments of sensitivity, exposure and adaptive capacity

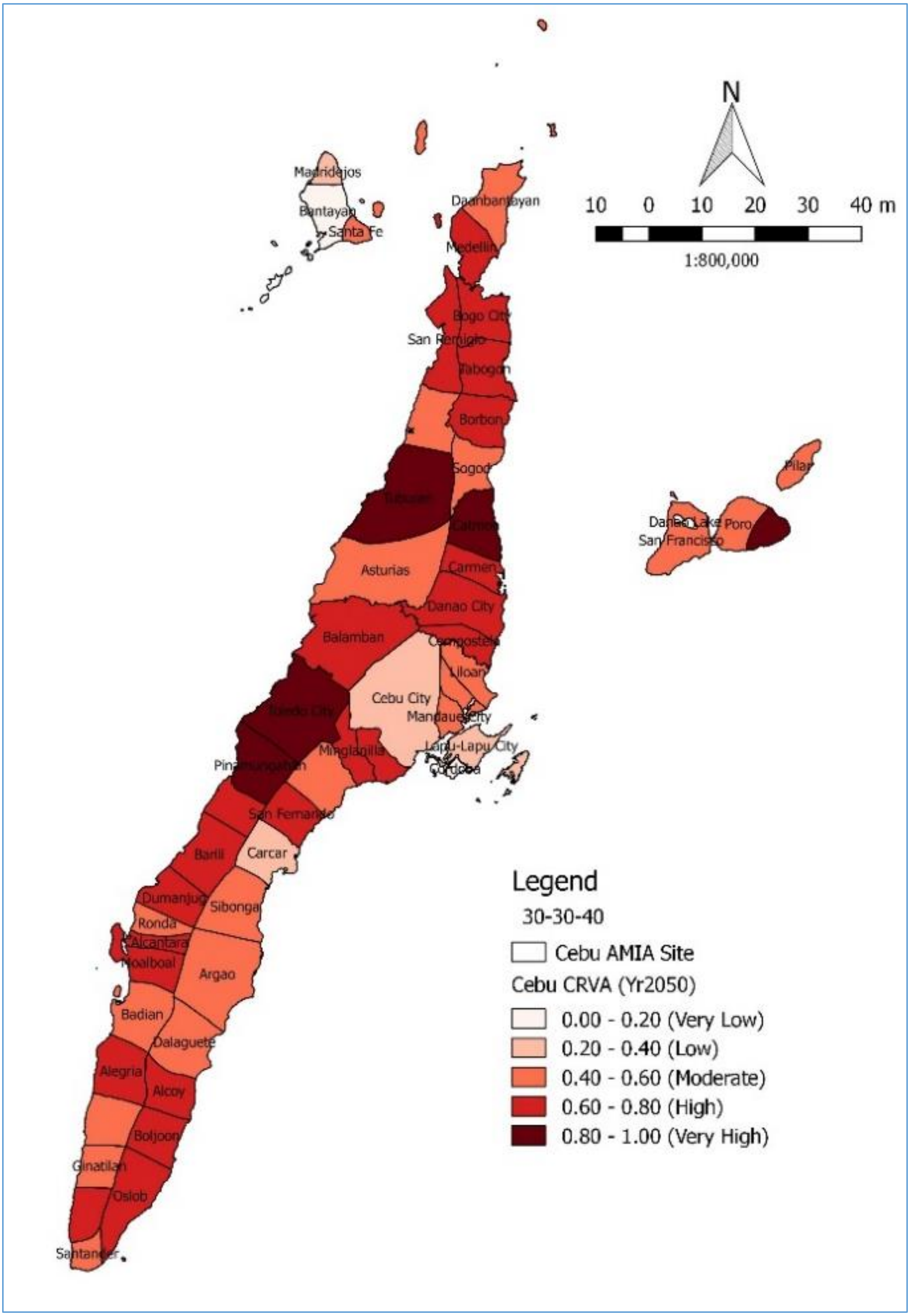

Figure 13. Vulnerability indices of Cebu province to climate-related hazards in the year 2050 under 30-30-40 weight assignments of sensitivity, exposure and adaptive capacity

CRA practice documentation

A CRA basically refers to an agricultural practices that is considered climate resilient. In order for a practice to be considered as CRA, it has to qualify within the three pillars or condition of the concept. These pillars are productivity, mitigation and adaptation. Such conditions necessitates a particular practice to be more productive, adaptable to changes in temperature while at the same time reduces agricultural carbon emission.

Table 4 presents the 10 most-common climate-resilient agriculture (CRA) practices in Cebu provinces. These practices were considered a climate-resilient since it is believed to have the fitting qualities of CRA. The CRAs were identified during the crop occurrence workshop organized by the project team mentioned previously. In the course of this event, a questionnaire was given to each of the participants as the project bio-agricultural systems specialist discussed what agricultural practices are considered climate-resilient. In the questionnaire, each respondent has to indicate what barangays in their respective municipality a CRA is being practiced. A sample of their response on the questionnaire is attached in Appendix 5 and below is the tabulated summary of the most prevalent CRA practice in Cebu province.

Investment brief

The identification of the CRA practices of Cebu province is crucial since this will used as basis for selecting the CRA for the investment brief. Using this result, the project team consulted with its DA-RFO7 counterparts in Cebu to select two (2) CRA practice. Upon the consultation and meeting held in DA-RF07 office and project workshop in the SEARCA Dorm in UPLB with CIAT, the team decided to choose corn-peanut rotation and the use of protected cultivation for vegetable production. The corn-peanut rotation was chosen because (1) in Cebu, corn is the most prevalent crops being cultivated and (2) crop rotation cropping system is the most practiced CRA. For vegetable, Lettuce and French Beans were selected since these are the vegetable produced under protected structures and is among of the high-value commodities produced in the province.

Corn-Peanut rotation was considered a CRA because rotating corn with peanut improves soil condition through the N-Fixing properties of peanut. Unlike the conventional corn-corn cropping scheme that depletes soil nutrients, the CRA naturally restore soil fertility that improves productivity. Consequently, this reduces fertilizer application that emits carbon. Also, crop rotation scheme is widely noted as effective solution in breaking the cycle of pest and disease incidence in crops. The adaptability of corn-peanut rotation traces back to the cycle of seasons. Since rainy days is not whole-year-round, planting of corn in summer will cause wilting of corn plants. Thus, rotating with peanut and planting it during dry season is perfect since this crops thrives best under warm conditions. On the other hand, protected cultivation is considered a CRA because planting crops under protected structure improves productivity of crops due to reduction of loses associated with climate, pest and diseases. Due to the nature planting plants under protected structure, application of pesticides is reduced.

For the data collection, a farmer interview was conducted. The data collection for corn-peanut rotation was conducted in the Municipality of Daanbantayan while data for the vegetable protected cultivation were gathered in Brgy. Mantalungon, Dalaguete, and Sudlon 2, Cebu City, Cebu Province. Other details of the data gathering are presented in Table 5.

Table 4. Top 10 climate-resilient agriculture (CRA) practices in Cebu province

Rank	CRA Practices in Cebu	Number of Barangay Practicing
1	Cropping Systems (i.e., intercropping, multiple cropping, strip cropping and multi storey cropping etc.)	365
2	Agroforestry	256
3	Climate resilient or Tolerant Varieties	201
4	Crop Rotation	200
5	Zero Grazing	178
6	Index-based Insurance Schemes	171
7	Crop-Livestock Farming	165
8	Organic Farming	158
9	Conservation Agriculture	142
10	Traditional Cultivars/ Varieties	123

Table 5. Number of respondents interviewed for the two CRA practices per municipality

Municipality	Date of data collection	CLIMATE RESILIENT AGRICULTURE PRACTICES				
		Corn-Peanut Rotation		Vegetable Protective Cultivation		TOTAL
		Rotation	Mono cropping	Protective cultivation	Open field	
Daanbantayan	Feb. 20-23	7	11	-	-	18
Dalaguete	Mar. 20-23	-	-	4	10	14
Cebu city	Mar. 20-23	-	-	-	2	2

Cost-Benefit analysis

The collected data through interview for the two (2) chosen CRA were summarized then analyzed using an online tool provided by CIAT. This tool was used for cost-benefit analysis to determine the profitability of the CRA practice compared to that of conventional method of corn farming and vegetables. Table 6 presents some highlights of the analysis. The results of the analysis can be used as indicator of profitability for corn-peanut rotation and vegetable protected cultivation.

Based on the results, the CRA practice is a profitable venture for farmers planting corn and vegetable. Both CRA practice has a payback period of three years which suggests the length of time to which farmers can recover investment costs should he choose to adopt the CRAs. In terms of internal rate of return (IRR), values for corn (51.32%) and vegetable (60.42%) suggest that investing in both would generate more income than putting the capital on banks at 10% market interest rates compounded annually.

Table 6. Cost-benefit result highlights of the CRA practices

Financial Indicators	CLIMATE-RESILIENT AGRICULTURE (CRA) PRACTICES	
	Corn-Peanut Rotation	Vegetable protected Cultivation
Initial investment requirement per hectare	PhP 30,000.00	PhP 40,000.00
Net Present Value (NPV)	PhP 81,128.20	PhP 63,526.98
Internal Rate of Return (IRR)	51.32%	60.42%
Payback Period (PP)	3 years	3 years

Assumptions: Interest rate – 10%; Investment Period – 10 years

7. Other activities: Ridge-to-Reef transect activities of existing agricultural systems

Importance of transect in identifying AMIA through assessment of suitable crops, livestock and other components in the different ecosystems in Cebu province

Transect is an option in gathering spatial data in the identified AMIA municipalities by identifying important resources; i.e., crops, livestock, fishes, weeds and soil conditions; cropping systems, farming systems, cropping pattern including climate or weather; topography and other important resources especially related to agriculture and energy in the different ecosystems.

For this undertaking, observations of specific indicators vital for the AMIA project and responses of the populace based on both qualitative and quantitative data are collected on actual observations. The route is identified based on existing resource maps of the entire area. The route selected across municipalities is a representative in the project site. The conduct of transect in collecting relevant data relative to the edaphic factors, cropping systems and identification of most adaptable and/or resilient crops, livestock and other agri-products is important in the final selection of AMIA strategies in enhancing the productivity of crops, livestock, fishery and other resources in the identified AMIA municipalities as reflected in Tables 7 & 8.

Transect Result

During transect activity, Cebu province was subdivided into 3 component parts; northern, mid and southern part which was vital in the final identification of crops, livestock, and fishery resource most suitable in the abovementioned areas. The province of Cebu has varied agro-ecosystems comprising of mangrove or coastal areas, lowlands, uplands, hillylands and rocky to mountainous areas. Based on transect, the soil type and the dominant crop species, animals and/or livestock, weeds, forest and timber trees and other resources found in the aforesaid component areas are reflected in Table 7.

The dominant soil type in irrigated ecosystem were clay, clay loam, and sandy loam. Clay soil was found mostly in the uplands and hillyland ecosystems with low top soil in the northern part of Cebu while clay loam was generally found in the uplands most particularly located at low elevation or under hillylands but found in side slopes of the aforesaid ecosystem in the mid-part of the province. However, sandy loam and calcareous soil were found under the low lying or near coastal areas where siltation is dominant in the said areas (Table 7).

For the specific crop components in the province, the most dominant crops grown in all parts; northern, mid and southern parts were coconut, banana, corn, legumes and fruit crops. Vegetables and ornamental plants were dominantly raised in the mid-part and southern part of the island while sugarcane was abundantly grown in commercial basis in the northern part of the island. However, rice is grown mostly in the lowlands in the southern part of the province particularly Argao but nothing under the upland and hillyland ecosystems. Root/tuber crops and bamboos are sparsely planted in almost all ecosystems covering northern, mid and southern parts of the province. However, mangrove trees, coconut and nipa are mostly grown mostly in the coastal areas of northern municipalities of Carmen, Consolacion and other nearby municipalities, and in the southern parts particularly Santander, Samboan, Alegria and other municipalities in the southernmost part particularly in the 7th district of the province. The promising crop component that demand high production and income for the elite growers is sugarcane. This crop is grown abundantly under open field conditions in both the uplands and hillylands.

For animal and livestock components, cattle and goats are the dominant animals and/or livestock raised by most populace in the northern and southern part municipalities of the province while poultry was a dominant animal component in the mid-part of the island (Table 7). Carabao is raised only in limited number in the uplands and hillylands in all component parts; northern, mid and southern even if this animal is a lifelong partner of farmers in doing tillage, cultivation, transport and/or hauling of agri-products and/or goods.

The dominant weed species in the transect areas are grasses, sedges and broadleaves, and these are dominant weed types in all ecosystems in the northern, mid and southern parts. Grasses, sedges and limited broadleaves are dominantly grown in the sloping uplands and hillylands while most sedges, ferns and broadleaves are dominating in fertile soils in the lowlands and upland plain particularly those flood-prone areas. However, creeping legumes and ferns are sparsely grown in some farms in uplands and hillylands. This implies that the aforesaid farms are still abundant in nutrients thereby intercropping, relay, strip and sequential cropping with planting of corn and leguminous intercrops i.e., peanut and mungbean are the best strategy for enhancing family's livelihood and income.

The cropping systems dominantly adopted by most farmers in the transect municipalities are mostly intercropping, sole cropping, sequential, alley cropping and strip cropping in the northern parts of the province while multi-storey cropping and mixed cropping in the mid and southern parts of Cebu province.. Although multiple cropping system is sparsely observed in the boundaries of each farm parcel in all ecosystems in almost all municipalities in the province. However, a patches of farms also adopting agroforestry particularly in between boundaries of each farm in both upland and hillyland ecosystems are observed in the northern part while this practice was dominant in the mountainous areas in the mid-part and southern part of the province.

Farming system is the main approach adopted by most farmers in all ecosystems and in all component areas wherein planting of coconut, banana, fruitcrops, rootcrops and raising of cattle and/or goats are generally observed regardless of component areas. However, both farming and fishing are the dominant livelihoods of the populace in the coastal barangays mostly in the northern part where most of the populace focused more on farming than that of fishing during the wet cropping season while fishing is mainly focused during the dry season for their existence.

In terms of production constraints, soil erosion is observed most prevalent in the rolling to sloping uplands and hillylands in the northern part but not so much in the southern part because of contour hedgerows used i.e., horse radish tree, leguminous trees etc. However, flooding and drought are noted in the lowlands most particularly in low lying lowlands and upland plains in the northern part of the province. Although low lying uplands in northern municipalities are severely affected by flooding during the wet season while sloping uplands and hillylands are extremely affected by limitation of soil moisture during the dry season.

Based on the result of transect, some CRA strategies are identified to cope with the upcoming environmental problems. Integrated Farming Systems (IFS) is the most applicable farming endeavour that can be adopted in all ecosystems in all municipalities in the northern, mid-part and southern part of the province.

In lowland ecosystems however, the most recommended farming practice is palayamanan, with the integration of animals and/or livestock in the system especially in the rainfed lowland ecosystem. In sloping uplands and hillylands areas however, Sloping Agricultural Land Technology (SALT) is strongly recommended. While for boundaries of each farm parcel, the adoption of alley cropping is highly encouraged in all areas, namely; northern, mid and southern portion in order for the family to avail of timber or forest trees for their own utilization and additional income.

About cropping systems, the most dominant cropping systems practiced by farmers are sole cropping, alley cropping, strip cropping and intercropping followed by multi-storey cropping system. However, sole cropping, alley cropping and intercropping are mostly adopted under the uplands and hillylands while multi-storey cropping was commonly practiced under the steep slope hillylands and mountainous areas. Banana, fruitcrops, corn and other annual crops are mostly interspaced under coconut while rice was only adopting a monocropping scheme under lowland irrigated ecosystem. For multi-storey cropping system under uplands and hillylands, coconut was the maincrop while it was interspaced with banana, fruitcrops, plantation crops and other annual and perennial crops in order to enhance farmers' crop productivity and apparently income.

For the livelihood of the populace, Farming, Fishing and Business are the common livelihood of the Cebuanos. However, working abroad is the dominant livelihood in the northern and mid-part of the people in the province while vending is mostly participated endeavor by the majority of southern and mid-part Cebuanos comparing the northern part populace in the province.

Relative to production constraints, drought and flooding are the common problems faced by most farmers during the rainy and dry seasons, respectively inflicting damage to their grown crops mostly in the lowlands and upland plains. However, drought was the primary crop production constraint in the uplands, and this was more severe in the northern municipalities than that of the mid-part and southern part of the province.

Based on transect, Integrated Farming System (IFS) is the most recommended production strategies in the lowlands covering all component areas, namely northern, mid and southern part. Intercropping, strip, and relay cropping systems are applicable cropping strategies for the uplands and hillylands. While SALT technologies, multi-storey cropping and adopting the zero/ minimum tillage are the recommended options in minimizing adverse effects on soil erosion, landslides and soil degradation that caused reduction of soil fertility in the hillyland ecosystem for the entire province, thereby reducing crop productivity and income to highlanders.

With this present scenario on climate change nowadays, Climate Resilient Agriculture (CRA), Sustainable Agriculture (SA), Agri-tourism are the most appropriate approaches and strategies in alleviating crop productivity and augmenting their income on paving the way for improving the quality of life of rural and fisherfolks under the different component areas. Crop-animal integration is the most common farming systems in all areas. However, cattle is the dominant animal for raising in the northern part, hogs and poultry in the mid-part while mixture of cattle, goats and poultry are the animal components feasible in the southern part of the province.

Table 7. Result of transect conducted in the different component parts in Cebu province

Indicator	Component Areas in Cebu Province		
	Northern part	**Mid-part**	**Southern part**
Cities/municipalities in Cebu province	Consolacion until Daanbantayan including Bantayan Island	Cebu City including Mandaue, Lapu-lapu, Toledo and Asturias	Talisay City, Naga City, Barili until the southernmost municipalities of Santander and Samboan
Soil Texture (dominant)	Clay, Clay loam & Silty clay loam	Clay, Clay loam & Silty clay loam	Clay, Clay loam, Sandy clay loam
Soil Color (dominant)	Black, Light brown, Reddish brown, Black with porous white stones	Black, Reddish brown, Light brown	Black, Light brown with with porous white stones
Existing Major Crops (dominant)	Coconut, Banana, Corn, Legumes, Rootcrops, Sugarcane, Bamboo	Vegetables, Corn, Banana, Rootcrops, Ornamental, Legumes, Coconut, Fruitcrops	Vegetables, Coconut, Banana, Corn, Rootcrops, Fruitcrops, Legumes
Existing Animal Components (dominant)	Cattle, Goats, Hogs	Poultry, Hogs, Goats, Cattle	Goats, Cattle, Hogs, Poultry
Existing Weeds	Grasses, Sedges & Broadleaves	Grasses, Sedges & Broadleaves	Broadleaves, Grasses & Sedges
Existing Cropping Systems (dominant)	Alley cropping, Sole cropping, Intercropping, Relay, Strip cropping	Intercropping, Mixed cropping, Sole cropping, Strip cropping, Multi-storey cropping	Agroforestry, Multi-storey, Intercropping, Sole cropping, Strip cropping
Present Livelihood (dominant)	Farming, Fishing, Business & OFWs	Business, OFWs, Farming, Fishing	Farming, Business, Fishing, Vending
Production constraints	Typhoons, Flooding and Drought	Drought, Flooding, Soil Erosion, Landslide	Drought, Landslide, Soil Erosion
Recommended Farming Systems	IFS, Crop-livestock integration (cattle), Fishery+Poultry, SALT	IFS, Crop-animal integration (hogs, poultry), SALT	IFS, Crop-mixed animal integration (cattle+goats+poultry), SALT
Recommended Production and Business Strategies	Climate Resilient Agriculture (CRA), Sustainable Agriculture (SA), Agri-tourism, Poultry, fastcraft making, Tourism	CRA, SA, Agri-enterprise, Agri-Tourism, Furniture making, Business processing services, Handicraft, Heavy industries	CRA, SA, Agri-fishery-tourism, ship building, Tourism

Table 8. The identified crops, fishery and animal/livestock suitable and most suitable in the different component areas in Cebu province

Indicator	Component Areas in Cebu Province		
	Northern part	Mid-part	Southern part
Suitable crops	Sweet potato, Yautia, Peanut, Mungbean, Fruitcrops & Bamboo	Peanut , Mungbean, Banana, Rootcrops & Lanzones	Peanut, Mungbean, Rootcrops, Corn, Rice, Ornamental, Mango, Rambutan & Bamboo
Most suitable crops	Sugarcane, Coconut, Banana, Corn, Cassava	Vegetables (leafy and fruit), Ornamentals, Corn, Fruitcrops (Mango, Rambutan)	Vegetables, Coconut, Banana, Lanzones
Suitable fishery undertaking	Fishing and dried fish making	Fish canning, Aquaculture	Aquaculture, Fishing
Most suitable animal/livestock	Poultry, Cattle	Hogs, Poultry	Goats, Hogs, Poultry

Table 9. Result of soil analysis in the different sampling locations in Cebu province

Location	Physical and Chemical Analyses				
	Soil Texture	pH	% OM	Phosphorus (mg kg-1)	Potassium (ppm)
Saksak, Dalaguete, Cebu	Clay Loam	7.76	7.76	50.50	203.00
Langkas, Dalaguete, Cebu	Clay Loam	7.92	8.54	129.60	427.00
Mantalongon # 1, Dalaguete, Cebu	Clay	4.68	2.21	9.30	243.00
Mantalongon # 2, Dalaguete, Cebu	Clay	5.24	2.95	75.20	247.00
Ablayan, Dalaguete, Sebu	Clay	6.87	3.66	104.00	292.00
Dumalan, Dalaguete, Cebu	Clay	6.60	4.73	16.50	103.00
Tabon, Dalaguete, Cebu	Clay	6.72	7.58	82.40	377.00
Obo, Dalaguete, Cebu	Clay	8.36	5.77	12.40	48.00
Sudlon 1, Cebu City	Sandy Loam	6.78	3.44	106.40	58.00
Babag, Cebu City	Sandy Loam	5.81	1.97	29.70	233.00

8. Summary of Significant Findings

This study determined the vulnerability of agriculture sector in Cebu Province's to climate-related stressors such as typhoon, flooding, drought, soil erosion, landslide, salt-water intrusion, sea-level rise and storm surge. The assessment of vulnerability to aforesaid stressors focuses on farmers planting prioritized crop commodities in the province such as rice, corn, mango, cassava, and banana. Other important crops in the province were also included in the analysis are sweet potato, coffee, cacao, pinakbet, and chopsuey vegetables. In the estimation process, the study used data such as bio-climatic factors, hazard maps, natural and socio-economic indicators to determine the level sensitivity, exposure and adaptive capacity which translates to vulnerability of farmers in the Province. The estimated vulnerability indices were transformed into maps using quantum geographic information (QGIS) which represents the level of vulnerability of each city and municipality in the province of Cebu.

Results showed that municipalities with high exposure to hazards and have a low adaptive capacity such as Pinamungahan, Tuburan and Catmon were among the most vulnerable in the province. Meanwhile, the cities of Lapu-Lapu, Mandaue, Cebu and the municipality of Bantayan which have high adaptive capacity were the least vulnerable. One noticeable factor observed was the high negative correlation between income class and vulnerability level. The municipalities and cities with the high-income class were less vulnerable compared to low-income class municipalities.

In the context of hazard ranking relative to its effect to agriculture sector in the province, the typhoon was ranked first. This hazard affects mainly the mid and northern part of island province including the islands of Camotes and Bantayan. However, in terms of prevalence, soil erosion and landslide were the most common as hazard data shows. This is primarily due to the landscape of the central part of Cebu which is characterized by rolling mountains and steep slopes stretching from north to the south. The incidence of salt-water intrusion was noted the most in Cebu City, flooding in Mandaue City, storm surge and sea-level rise in Lapu-Lapu City and Cordoba, and drought in the municipality of Tudela.

Meanwhile, observations from ridge-to-reef transect activities revealed that coconut, banana, corn, legume, rootcrops, were cultivated throughout the province but sugarcane was observed mostly in the northern part. Rice was grown sparsely in mid and northern part while corn was observed in all parts of the province. Chopsuey veggies are cultivated in higher elevation areas in Dalaguete, Argao, and Cebu City while Pinakbet veggies were planted in low-lying areas in Cebu. For animal components, cattle, hogs, goats, and poultry are the most common. With regards to cropping practices, alley cropping, sole cropping, intercropping relay, strip cropping and agroforestry, especially in the southern part, were common. However, in terms of suitability, the most recommended farming practice is "palayamanan" with the integration of animal and livestock, especially in the rainfed lowland ecosystems. Sloping agricultural systems (SALT), on the other hand, is the most suitable in sloping uplands and hilly land.

9. Project Management

The regional project team will comprise of members from the VSU and the DA-RFO VII - Cebu. The core team expertise from VSU will cover: a) geo-spatial analysis, b) socio-economics, and c) agriculture/fisheries systems. This arrangement is so designed in order to mentor and capacitate the project team members coming from DA RFO VII - Cebu. Such arrangement is without prejudice to involving more expertise from the collaborating institution or other SUC in the province. One of the team members would serve as project leader, or an additional person designated to serve in this overall coordination role.

In addition, 1-2 members from the DA-RFO will join the project team. The member/s key role, besides general CRA/AMIA expertise, will be to facilitate institutional linkage and coordination for successful implementation of project activities.

Team Position	Name/Institution
Project leader	Alan B. Loreto (Ag. Engg – GIS & Prec. Agri.)
Socio-economist	Moises Neil V. Seriño (Development Economics)
Agriculture/fisheries specialist	Dionesio M. Bañoc (Bio-Agricultural Science)
Science Research Assistant	Jade P. GA
DA-RFO collaborating staff	Maria Chona Maleza

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11. APPENDICES

Appendix 1. Adaptive capacity (AC) indices of municipalities and cities in Cebu province

Municipality/City	Adaptive Capacity Index	AC Classification
Alegria	1.00	Very Low
Catmon	0.95	Very Low
Pinamungahan	0.85	Very Low
Aloguinsan	0.84	Very Low
Boljoon	0.84	Very Low
Alcantara	0.83	Very Low
Barili	0.83	Very Low
San Fernando	0.81	Very Low
Tuburan	0.8	Low
Minglanilla	0.79	Low
Alcoy	0.77	Low
Malabuyoc	0.77	Low
Moalboal	0.77	Low
Dumanjug	0.73	Low
Oslob	0.71	Low
Samboan	0.71	Low
Badian	0.70	Low
Talisay City	0.70	Low
Sibonga	0.69	Low
Borbon	0.68	Low
Compostela	0.68	Low
Ronda	0.67	Low
Sogod	0.66	Low
Toledo City	0.66	Low
Medellin	0.65	Low
Tudela	0.63	Low
San Remigio	0.62	Low
Tabogon	0.62	Low
Liloan	0.61	Low
Naga City	0.60	Moderate
Santander	0.60	Moderate
Tabuelan	0.60	Moderate
Dalaguete	0.59	Moderate
Ginatilan	0.59	Moderate
San Francisco	0.57	Moderate
Santa Fe	0.57	Moderate

Municipality/City	Adaptive Capacity Index	AC Classification
Pilar	0.56	Moderate
Balamban	0.54	Moderate
Poro	0.54	Moderate
Danao City	0.52	Moderate
Argao	0.48	Moderate
Carmen	0.47	Moderate
Bogo City	0.44	Moderate
Consolacion	0.44	Moderate
Daanbantayan	0.40	High
Lapu-Lapu City	0.40	High
Asturias	0.38	High
Cordoba	0.36	High
Mandaue City	0.36	High
Carcar	0.35	High
Madridejos	0.33	High
Bantayan	0.21	High
Cebu City	0.00	Very High

Appendix 2. Hazard indices of the municipalities and cities of Cebu province

Municipality	Hazard Index	Hazard Classification
Pinamungahan	1.00	Very High
Balamban	0.94	Very High
Toledo City	0.94	Very High
Tuburan	0.87	Very High
Tudela	0.84	Very High
Cebu City	0.81	Very High
Asturias	0.77	High
Medellin	0.77	High
Tabogon	0.74	High
Carmen	0.71	High
San Remigio	0.71	High
Daanbantayan	0.68	High
Mandaue City	0.68	High
Bogo City	0.65	High
Borbon	0.65	High
Danao City	0.65	High
Lapu-Lapu City	0.58	Moderate
Madridejos	0.58	Moderate
Talisay City	0.58	Moderate

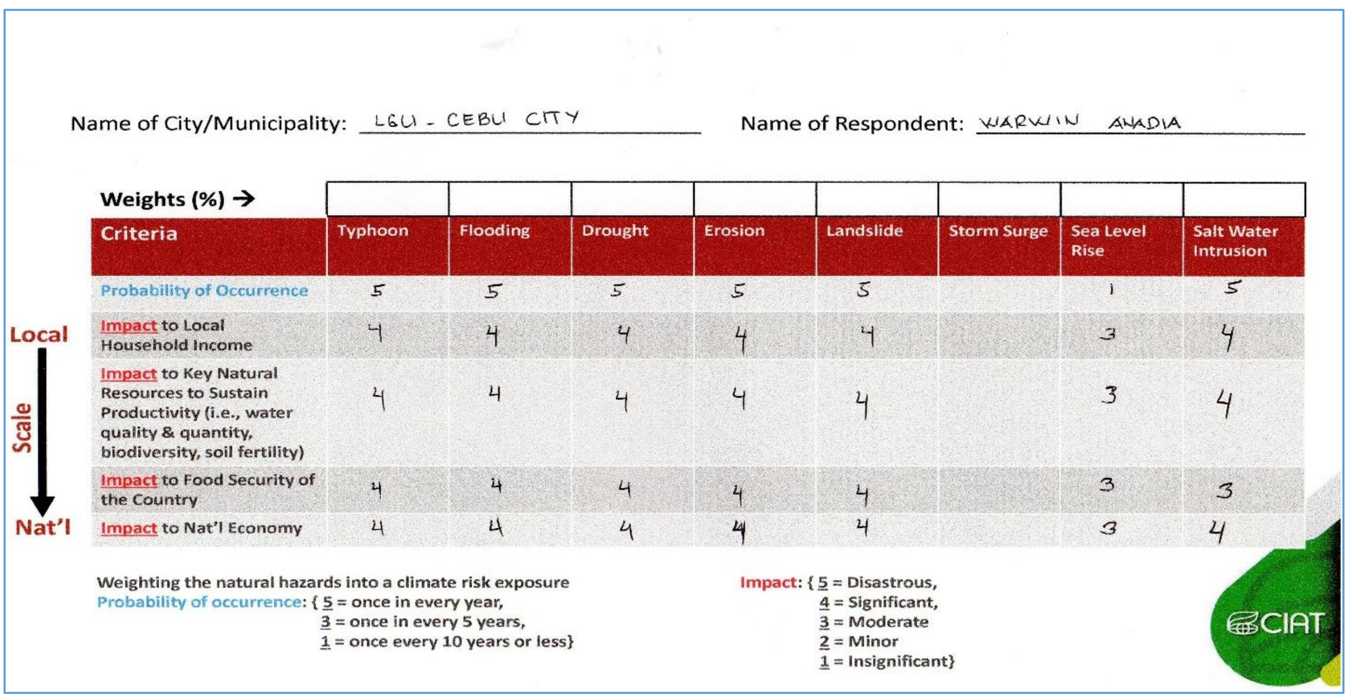
Municipality	Hazard Index	Hazard Classification
Catmon	0.55	Moderate
Samboan	0.55	Moderate
Liloan	0.52	Moderate
Aloguinsan	0.48	Moderate
Carcar	0.45	Moderate
Consolacion	0.45	Moderate
Minglanilla	0.45	Moderate
Naga City	0.45	Moderate
Tabuelan	0.45	Moderate
Moalboal	0.39	Low
Oslob	0.39	Low
Santander	0.39	Low
Bantayan	0.35	Low
Compostela	0.35	Low
San Fernando	0.35	Low
Santa Fe	0.35	Low
Sogod	0.35	Low
Alcoy	0.32	Low
Boljoon	0.32	Low
Poro	0.32	Low
Ronda	0.32	Low
Barili	0.29	Low
Dalaguete	0.29	Low
Dumanjug	0.29	Low
Pilar	0.29	Low
Alcantara	0.26	Low
Argao	0.26	Low
Sibonga	0.23	Low
Badian	0.19	Very Low
San Francisco	0.16	Very Low
Alegria	0.10	Very Low
Ginatilan	0.10	Very Low
Malabuyoc	0.10	Very Low
Cordoba	0.00	Very Low

Appendix 3. Adaptive capacity capital indicators used and source

INDICATORS	DATA SOURCE
ECONOMIC	
Crop production (rice, corn, cassava, camote, pakbet and chopsuey) (In MT)	Cebu Agricultural Profile, DA-RFO7, 2014
Revenue (In Pesos)	Cities and Municipalities Competitive Index CMCI, 2015
Number of financial institutions (count)	
Number of finance cooperatives (count)	
Percentage of farmers with access to crop insurance (%)	Philippine Crop Insurance Corp. PCIC, 2017
Dependence in agriculture (%)	City and Municipal Agriculturists' estimates, 2017
Poverty incidence (%)	Philippine Statistics Authority PSA, 2012
Agriculture minimum wage in agriculture sector (Non-Plantation)	City and Municipal Agriculturists' estimates, 2017
Agriculture minimum wage in agriculture sector (Plantation)	
NATURAL	
Soil organic matter (%)	DA-RFO7 Soil's Laboratory
Forest cover	Centre for International Tropical Agriculture (CIAT)
Total area of marine protected area(s) (In ha)	City and Municipal Agriculturists' estimates, 2017
Percentage of farmers with access to STW (In %)	
Access to reliable water for irrigation	Centre for International Tropical Agriculture (CIAT)
SOCIAL	
Number of registered farmer groups or unions (count)	City and Municipal Agriculturists' estimates, 2017
Percentage of farmers with access to farmer groups or unions (%)	
Percentage of women elected in local government position (%)	Commission on Election (COMELEC)
HUMAN	
Literacy rate	PSA, 2015
Ratio of School Teachers to Students (ratio)	Cities and Municipalities Competitive Index CMCI, 2015
Number of Public Secondary School (count)	
Number of Tertiary School (count)	
Number of Public Technical Vocational School (count)	
Health	
Percentage of Malnourished Children Aged 7 years and Below (%)	National Nutrition Council NNC, 2016
Number of Public Health Services (count)	Cities and Municipalities Competitive Index CMCI, 2015
Number of Health Services Manpower (count)	

INDICATORS	DATA SOURCE
Number of Public Doctors (count)	
Philhealth Membership (Count)	
Age-Dependency Ratio (count)	PSA, 2015
PHYSICAL	
Percentage of farmers owning their agricultural land	City and Municipal Agriculturists' estimates, 2017
Average farm size (ha)	
Distance of farthest barangay to the nearest market (km)	
Number of livestock raised (count)	DA-RFO7, 2017
Percentage of crops irrigated (%)	Centre for International Tropical Agriculture (CIAT)
Road density	
ANTICIPATORY	
Number of climate change related trainings conducted (count)	City and Municipal Agriculturists' estimates through survey questionnaire, 2017
Percentage of the population with access to communication technology	
INSTITUTIONAL	
Percentage of farmers consulted/visited by agricultural extension officers (%)	City and Municipal Agriculturists' estimates through survey questionnaire, 2017
Number of municipal or city agricultural staff/officers (count)	

Appendix 4. Sample questionnaire of the hazard validation through key informant interview



Name of City/Municipality: LGU - CEBU CITY Name of Respondent: WARWIN ANADIA

Weights (%) →								
Criteria	Typhoon	Flooding	Drought	Erosion	Landslide	Storm Surge	Sea Level Rise	Salt Water Intrusion
Probability of Occurrence	5	5	5	5	5		1	5
Impact to Local Household Income	4	4	4	4	4		3	4
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity, biodiversity, soil fertility)	4	4	4	4	4		3	4
Impact to Food Security of the Country	4	4	4	4	4		3	3
Impact to Nat'l Economy	4	4	4	4	4		3	4

Local → Scale → Nat'l

Weighting the natural hazards into a climate risk exposure
Probability of occurrence: { 5 = once in every year,
3 = once in every 5 years,
1 = once every 10 years or less}

Impact: { 5 = Disastrous,
4 = Significant,
3 = Moderate
2 = Minor
1 = Insignificant}

CIAT

Appendix 5. CRA Practice identification questionnaire

Name of Respondent: ROMMEL PINATIL Municipality: SAN FERNANDO

IDENTIFICATION OF CLIMATE-RESILIENT AGRICULTURE (CRA) PRACTICES IN CEBU PROVINCE

CRA Practices/Technologies		**Check if Yes**	**Barangay(s) where it is located**
Forestry	Agroforestry		
	Use of Living Fences		
Crop Production System	Intercropping	✓	TUBOD, BALUNGAG, BUGHO MAGSICO, LIBURON
	Conservation Agriculture		
	Crop switching	✓	BUGHO, TUBOD, MAGSICO
	Adaptive Crop Calendar	✓	MOUNTAIN BARANGAYS
	Organic Agriculture Practices		
Soil Management	Mulching	✓	TONGGO, TUBOD, BALUNGAG
	Improved Fallow	✓	BUGHO, TUBOD - BALUNGAG LIBURON
Water Management	Terracing	X	~~CABATBATAN~~,
	Drip Irrigation		
	Water Harvesting	✓	MAGSICO, BALUNGAG BUGHO (SWIPS)
Pest and Disease Management	Use of Bio-pesticides		
	Use of Beneficial Organisms		
	RATOONING	✓	TUBOD, BALUNGAG, BUGHO
	STONEWALLING	✓	CABATBATAN

CRA Practices/Technologies		Check if Yes	Barangay(s) where it is located
Genetic Resource Management	Use of tolerant varieties	✓	BUGHO (BANANA) LIBURON
Livestock	Zero Grazing	✓	LIBURON, TUBOD MAGSICO TONGGO CABATBATAN, BALUNGAG BUGHO
	Silvopastoral system		
Value Chains	On-farm Value added products		
Fish and Aquaculture	Aquasilviculture	✓	ILAYA, BALUNGAG, BUGHO, CABATBATAN, NORTH POBLACION
Energy	Use of biogas digesters	✓	SANGAT
Climate Risk Management	Meteorological advisories, Early Warning Systems		
Policies and Institutions	Index-based Insurance schemes	✓	MOUNTAIN BARANGAYS LIVESTOCK AND CROPS
	~~Crop~~ Animal Integration farming	✓	BUGHO, BALUNGAG TUBOD, MAGSICO, TABIONAN, LIBURON

Appendix 6. Sample questionnaire for adaptive capacity data for sources other than the internet

MUNICIPALITY	**OSLOB**	
Additional Adaptive Capacity Data		
Institutional	***Measure***	***Response***
Effective government and/or CSO programs for climate change	Yes/No	Yes
Adequate government response to previous shocks	Yes/No	No
Number of DA officers*	Count	5
Access to communication technology: cell phone, internet	% of the population	75%
Percentage of the population employed in the agriculture sector	Percent of the total labor force	55%
Lacking Data	***Measure***	***Response***
Area of marine protected area(s)	In hectares	5 MPA's -81.17 hectares
Number of farmers with access to shallow tube well (STW)	Count	None
Number of registered farmer groups or unions/coops and their respective number of members*(use another sheet if necessary)*	Count	
(DOLE Registered 2 groups farmers)		55 members
(DOLE Registered 6 groups fishermen)		318 members
Number of technical vocational school(s)	Count	None
Number of trainings held relating to climate change in the municipality	Count	3
Estimated percentage of household with water services	Percent	60%
Estimated percentage of household with access to electricity	Percent	65%
Number of elementary and secondary schools in the municipality	Count	12 Elementary 3 Primary 5 Secondary

Prepared by:

JACQUELINE L. VILLAGANTOL
A.T.

Noted by:

PROCESO R. BOMEDIANO
MAO

*Appendix 7. Documentation picture of the activities conducted and trainings attende*d

Courtesy call of VSU AMIA Team and DA-RFO7 officers with the Municipal Agriculturist of Daanbatayan during the conduct of farmer interview for the CRA corn-peanut intercropping.

Interview of farmers practicing protected cultivation in Mantalungon, Dalaguete, Cebu for the CRA Vegetable Protected Cultivation.

AMIA Project Team together with the vegetable farmer in the showcasing his farm in Sudlon 2, Cebu City.

Interview of farmers open field cultivation in Mantalungon, Dalaguete, Cebu for the CRA Vegetable Protected Cultivation.

Cost-Benefit Workshop using the tools provided by CIAT at SEARCA-Guest House in University of the Philippines Los Baños, Laguna.

Farmer in Sudlon 2, Cebu City, watering her lettuce under open field cultivation.

Interview of farmers open field cultivation in Mantalungon, Dalaguete, Cebu for the CRA Vegetable Protected Cultivation.

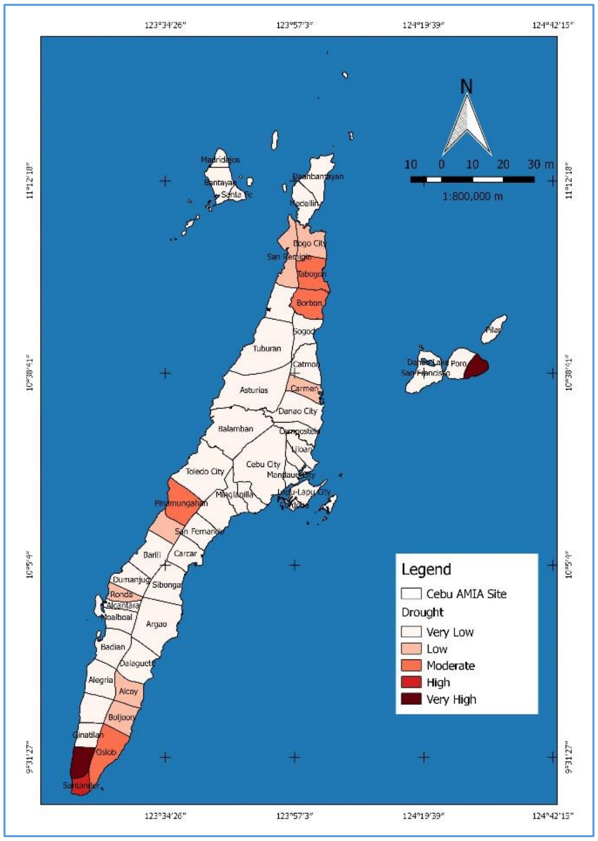
Courtesy call of VSU AMIA Team and DA-RFO7 officers with the Municipal Mayor of Daanbatayan Hon. Vicente M. Loot during the conduct of farmer interview for the CRA corn-peanut intercropping.

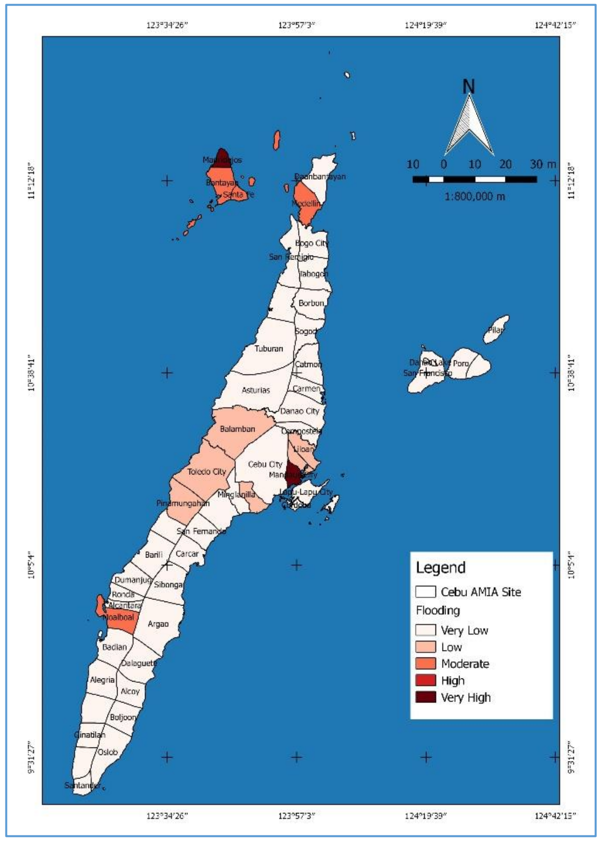
VSU AMIA Team and DA-RFO7 official together with the municipal agricultural and city agriculturist during the crop occurrence workshop held at the Cebu Business Hotel.

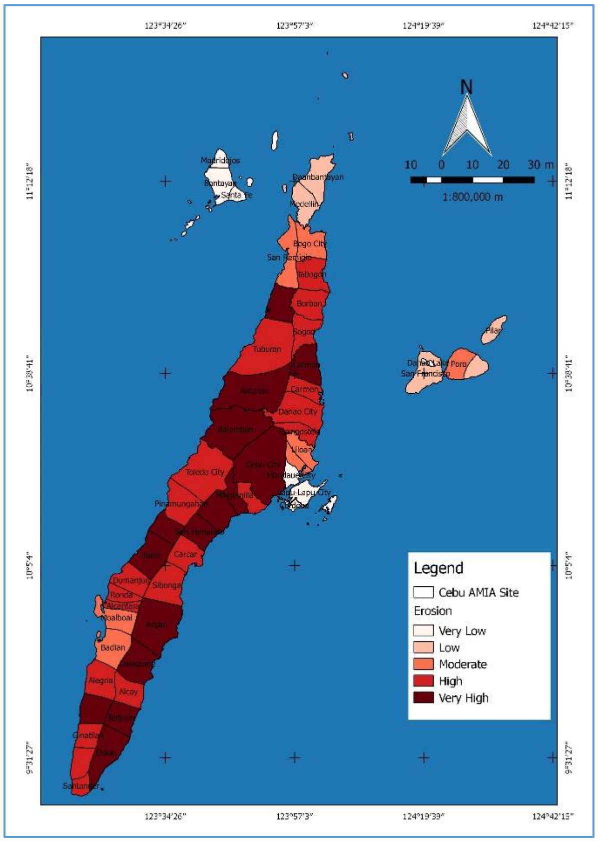
Municipal and city agriculturist locating the crops on the maps during crop occurrence workshop held at the Cebu Business Hotel.

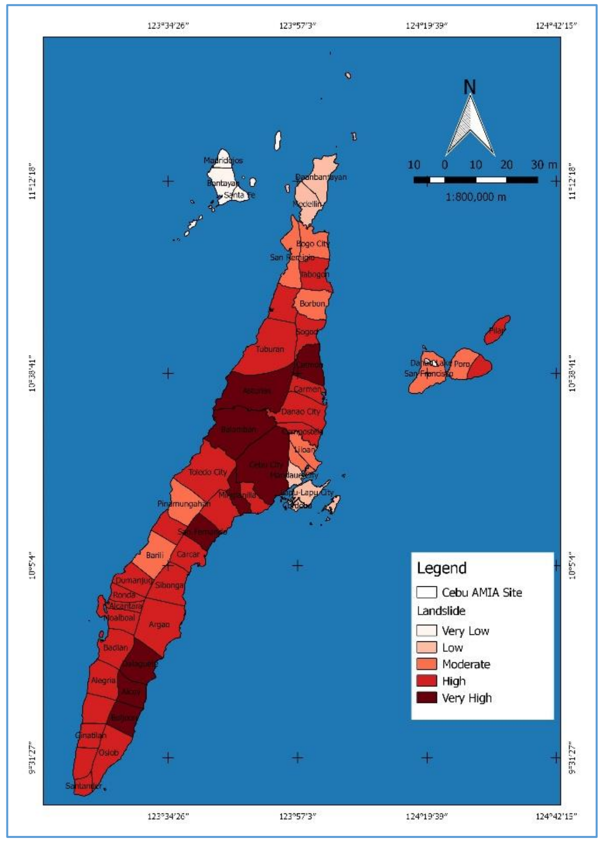
Municipal Mayor of Alegria, Cebu (center) together with the project team headed by Prof. Alan B. Loreto and DA-RFO7 partner represented by Ms. Maria Chona Maleza during the field validation in Cebu.

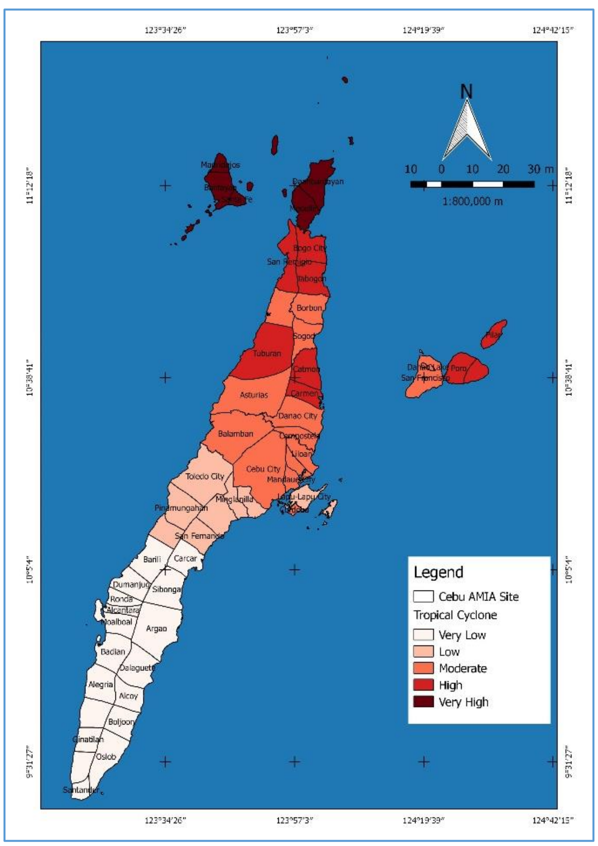
Appendix 8. Hazard maps

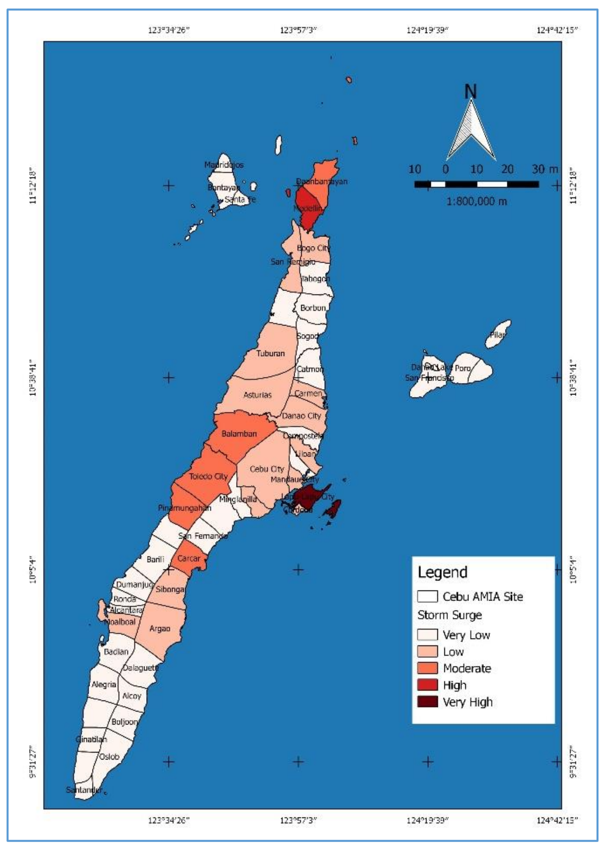


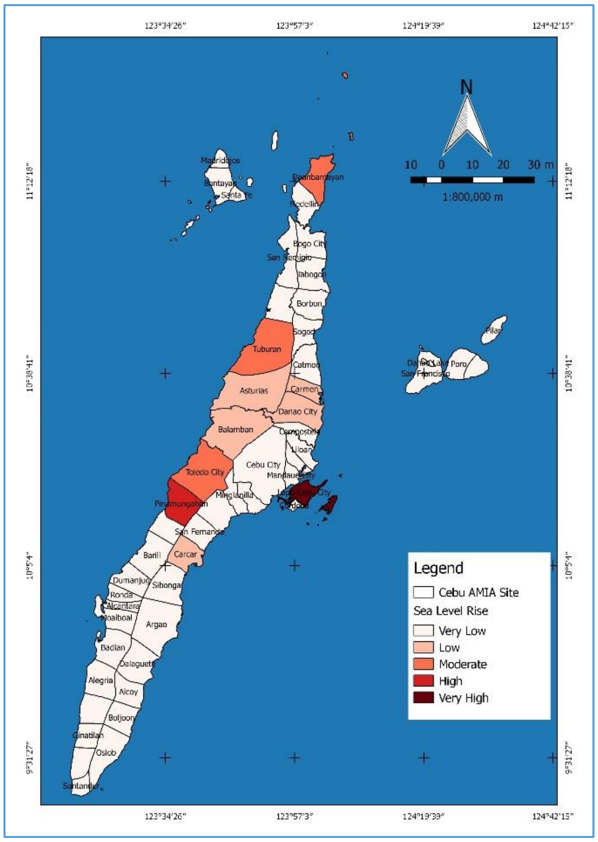


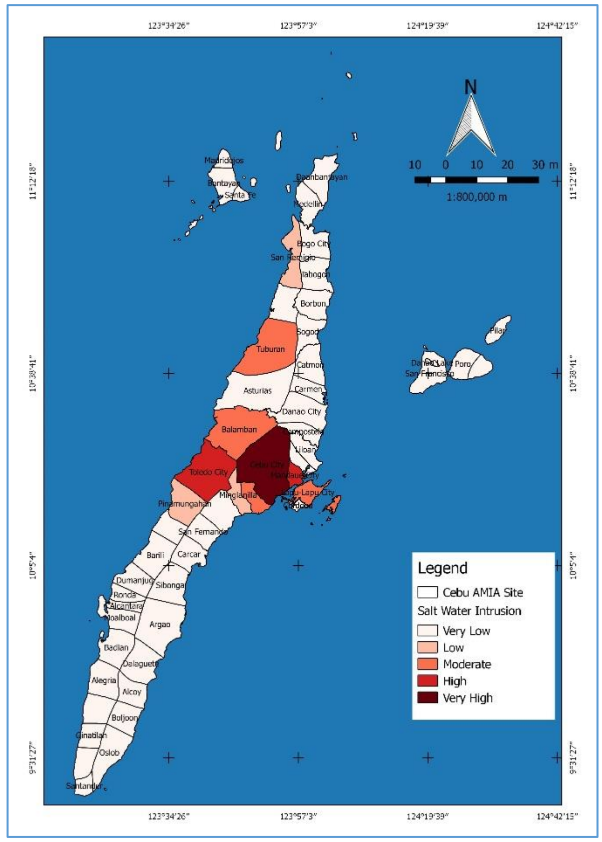

Legend
Cebu AMIA Site
Erosion
Very Low
Low
Moderate
High
Very High
1:800,000 m


Legend
Cebu AMIA Site
Landslide
Very Low
Low
Moderate
High
Very High
1:800,000 m

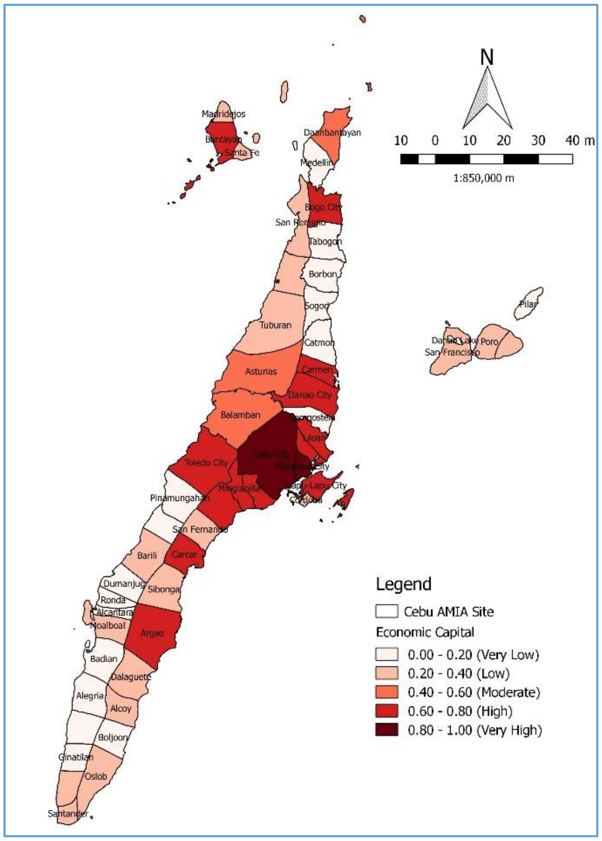

Legend
Cebu AMIA Site
Tropical Cyclone
Very Low
Low
Moderate
High
Very High
1:800,000 m

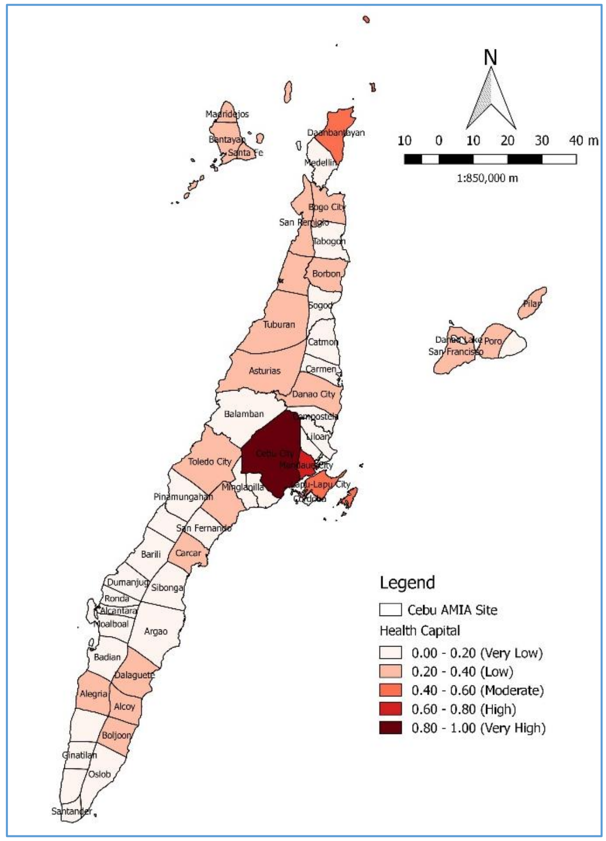

Legend
Cebu AMIA Site
Storm Surge
Very Low
Low
Moderate
High
Very High
1:800,000 m

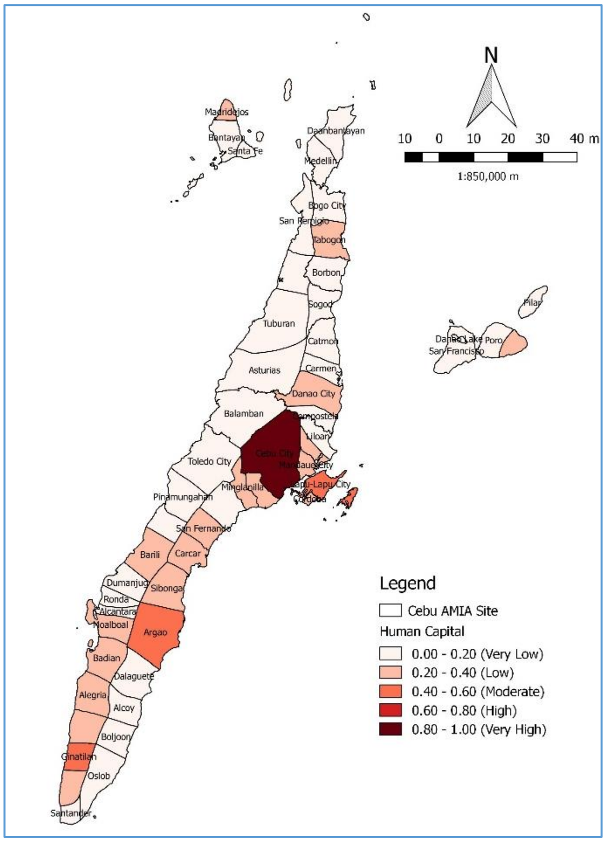

N
1:800,000 m
Legend
Cebu AMIA Site
Sea Level Rise
Very Low
Low
Moderate
High
Very High

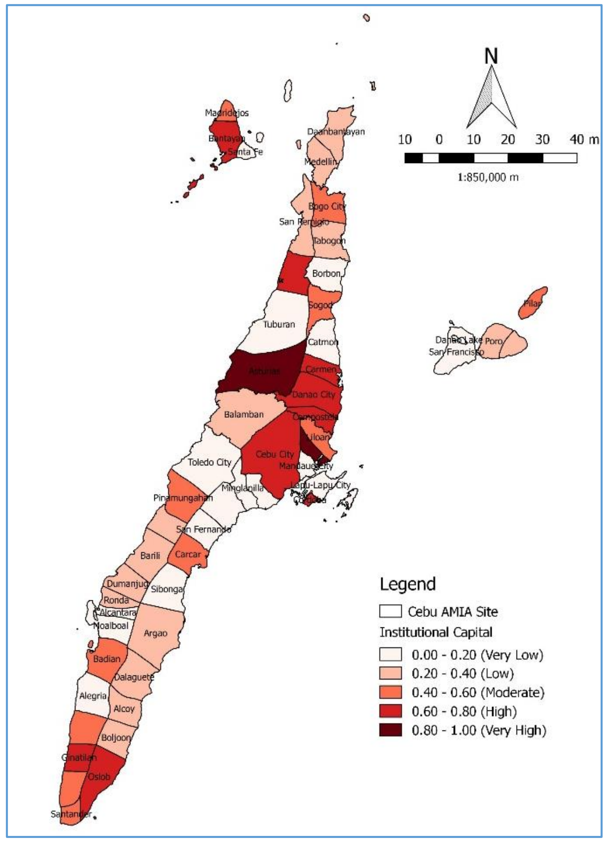

N
1:800,000 m
Legend
Cebu AMIA Site
Salt Water Intrusion
Very Low
Low
Moderate
High
Very High

Appendix 9. Adaptive capacity capitals maps






N
10 0 10 20 30 40 m
1:850,000 m
Legend
Cebu AMIA Site
Human Capital
0.00 - 0.20 (Very Low)
0.20 - 0.40 (Low)
0.40 - 0.60 (Moderate)
0.60 - 0.80 (High)
0.80 - 1.00 (Very High)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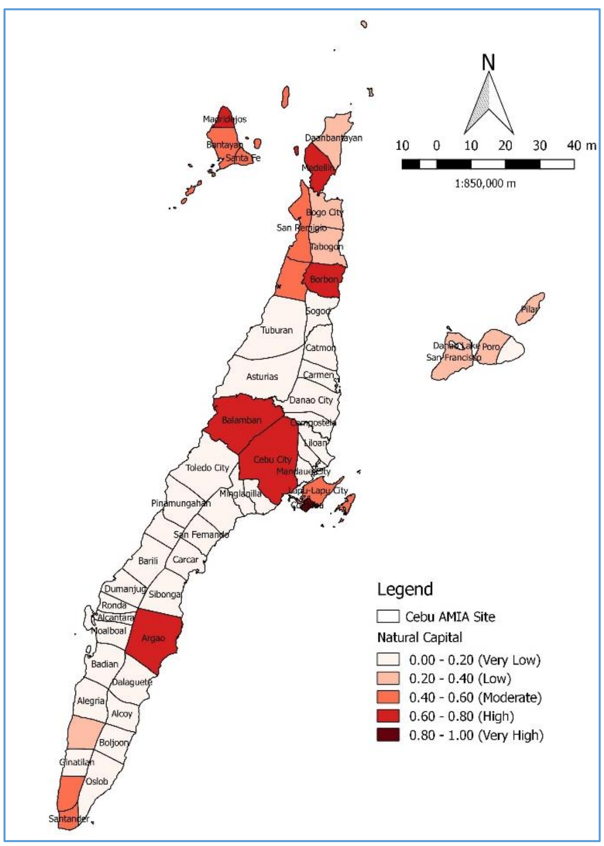
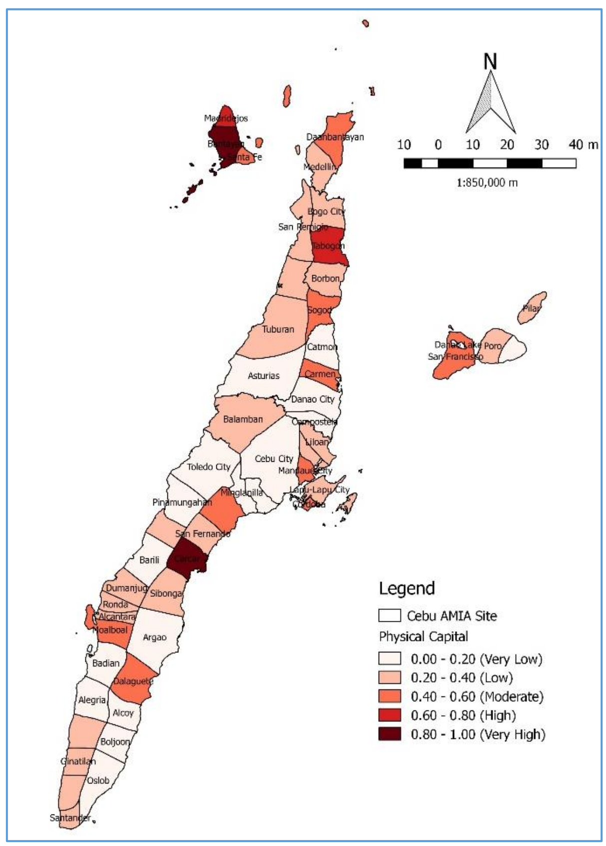
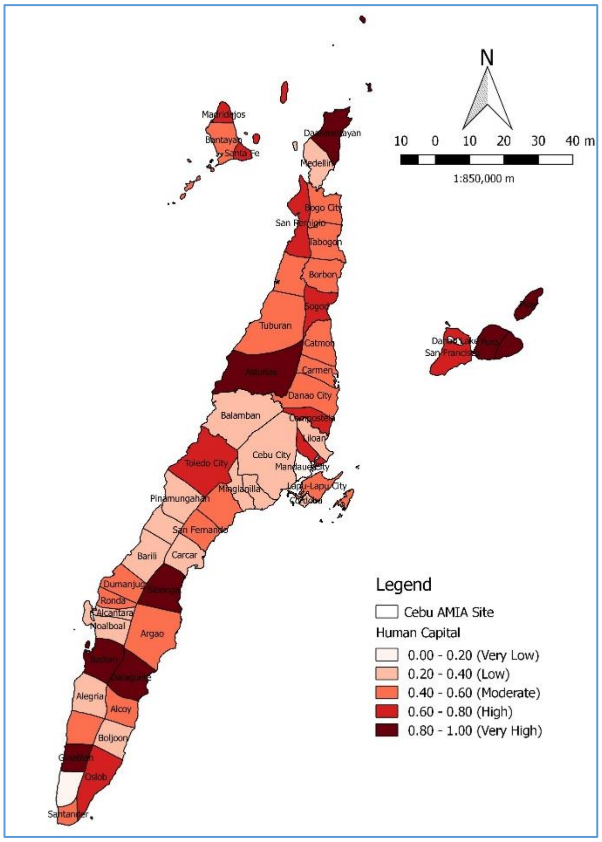
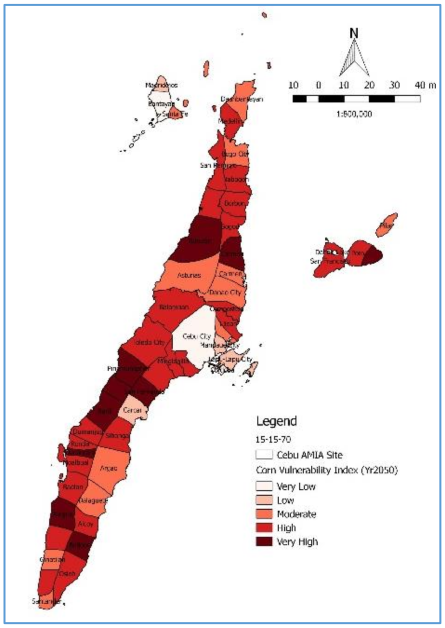
10 0 10 20 30 40 m
1:850,000 m
Legend
Cebu AMIA Site
Institutional Capital
0.00 - 0.20 (Very Low)
0.20 - 0.40 (Low)
0.40 - 0.60 (Moderate)
0.60 - 0.80 (High)
0.80 - 1.00 (Very High)

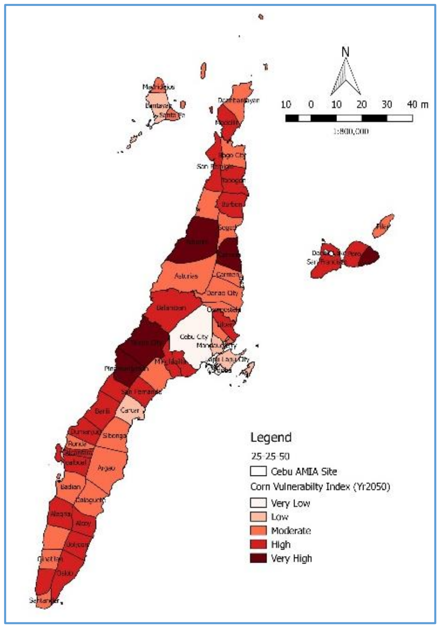

N
10 0 10 20 30 40 m
1:850,000 m
Legend
Cebu AMIA Site
Natural Capital
0.00 - 0.20 (Very Low)
0.20 - 0.40 (Low)
0.40 - 0.60 (Moderate)
0.60 - 0.80 (High)
0.80 - 1.00 (Very High)

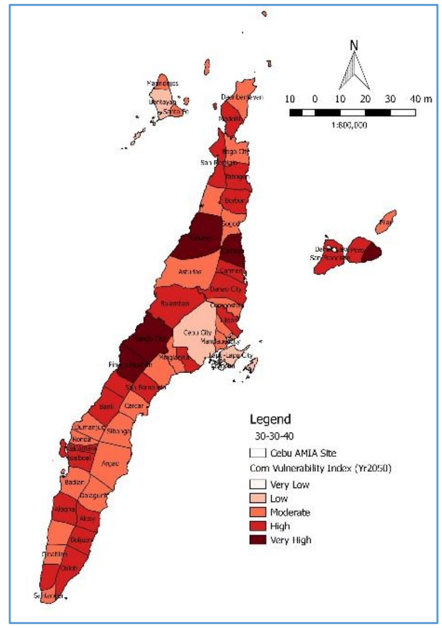

N
10 0 10 20 30 40 m
1:850,000 m
Legend
Cebu AMIA Site
Physical Capital
0.00 - 0.20 (Very Low)
0.20 - 0.40 (Low)
0.40 - 0.60 (Moderate)
0.60 - 0.80 (High)
0.80 - 1.00 (Very High)

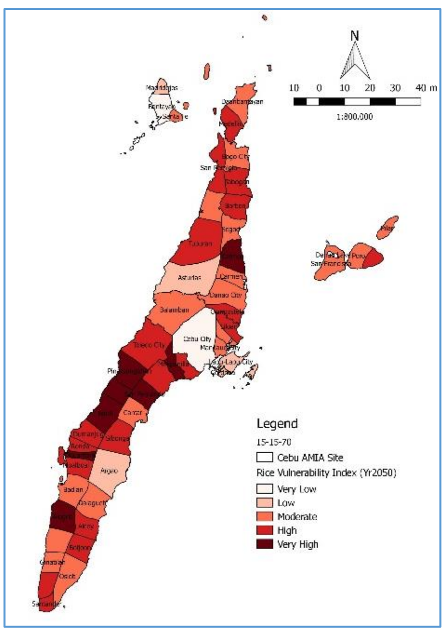

N
10 0 10 20 30 40 m
1:850,000 m
Madridejos
Bantayan
Santa Fe
Medellin
Bogo City
San Remigio
Tabogon
Borbon
Sogod
Tuburan
Catmon
Carmen
Danao City
Balamban
Compostela
Liloan
Cebu City
Toledo City
Mandaue City
Minglanilla
Lapu-Lapu City
Pinamungahan
San Fernando
Barili
Carcar
Dumanjug
Ronda
Alcantara
Moalboal
Argao
Alegria
Alcoy
Boljoon
Oslob
Santander
San Francisco
Legend
Cebu AMIA Site
Human Capital
0.00 - 0.20 (Very Low)
0.20 - 0.40 (Low)
0.40 - 0.60 (Moderate)
0.60 - 0.80 (High)
0.80 - 1.00 (Very High)

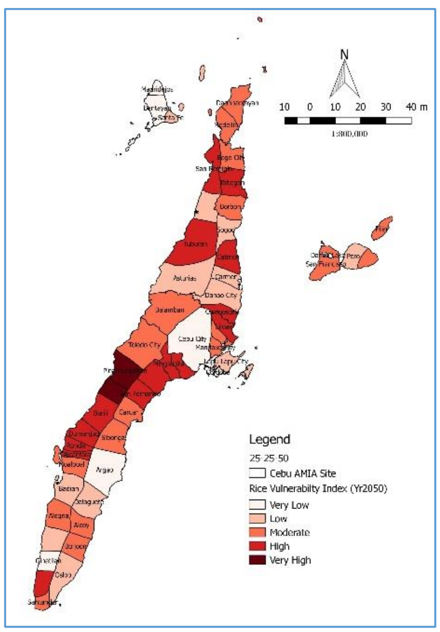
Appendix 10. Vulnerability maps of corn and rice different weight assignments of sensitivity, exposure, and adaptive capacity

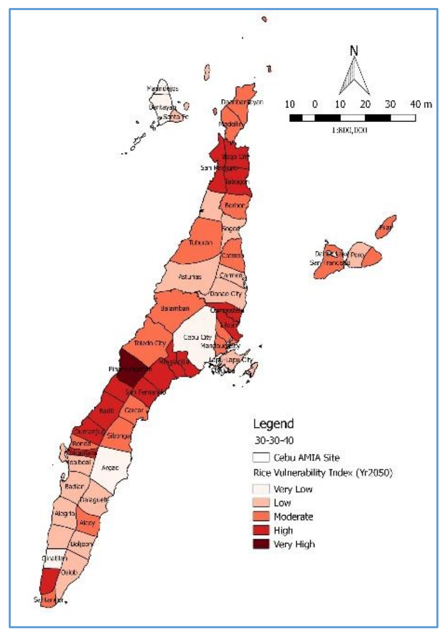












Appendix 11. Vulnerability maps of pinakbet and chopsuey using different weight assignments of sensitivity, exposure, and adaptive capacity

Appendix 12. Vulnerability maps of coffee and cacao using different weight assignments of sensitivity, exposure, and adaptive capacity

Appendix 13. Vulnerability maps of cassava and sweet potato using different weight assignments of sensitivity, exposure, and adaptive capacity

Appendix 14. Vulnerability maps of banana and mango using different weight assignments of sensitivity, exposure, and adaptive capacity

Appendix 15. Cost-Benefit Analysis (CBA) questionnaire for corn-peanut rotation

CIAT VISAYAS STATE UNIVERSITY

CRA Adaptor? (Yes/No). ___________
Enumerator. Cha2
Date. ___________

"Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 in Cebu Province"

Enumerator should read thru the introduction before starting the interview

Greetings!!

I am [**NAME OF ENUMERATOR**], an enumerator for a Department of Agriculture – Bureau of Agricultural Research (DA-BAR) funded project implemented by the Visayas State University. The research will assess the profitability of intercropping corn and peanut or mungbean compared to planting corn alone.

You have been selected as a respondent for the survey. The information gathered from you will be used as basis for creating an investment guide for corn.

09351706714

ASSURANCE OF CONFIDENTIALITY

All responses to the questionnaires will be treated with high degree of confidentiality.

Farmer's Socio Demographic Background

Farmer-Respondent's Name: Lucia Arsenal Tinubdan
Number of Year(s) Farming: since 17 yrs old
Address: Daantantugon
Farm Practice(s): (1 - Corn Mono cropping) 2 - Corn – Mungbean Rotation 3 - Corn – Peanut Rotation 4 – Corn - ___________
Sex: F Age: 65 Civil Status: Married
Highest Educational Attainment: Elementary Grad.
Primary Occupation: Farmer
How were you involved in farming?
(1 – Cultivating own land) 2 – Shareholder/ Tenant
Total Farm Area: 1 1/2 ha

Farm Production and Cropping Systems

Crops Planted	Number of Cropping Period per year			Production					
				Estimated harvest per cropping		Total harvest per year	Farm gate Price		Gross Income
	Count	Period 1	Period 2	Sold	Consumed		Corngrits	Tilaob	
Corn monocropping	2	June - Sept	Nov - Feb.	(1st) 3 cavans	1 cavans		1,400/cavan		
CRA practice				(2nd) 5 cavans	1 cavans		1.4k/cavan		
Corn									
Peanut									
Mungbean									

GENERAL INFORMATION	
CRA Practice	
Description of practice	

ADOPTION COST FLOW				
IMPLEMENTATION PERIOD at year 1 for CORN – LEGUMES ROTATION				
Machinery and Equipment				
Item	Unit	Price of Unit	Monocropping	CRA practice
Pick mattock	Piece			
Plough	Piece			
Carabao	Head	5000		
Scythe (sangalab/sangot) 3	Piece	200/pc	3 pcs	
Other items:				
Land rent				
Inputs during planting				
Seeds – corn (BISAYA)	kg	(given)	25 kgs	
Chicken dung	Sack			
Vermicompost	Sack			
Fermented plant juice	liter			
Farm compost	Sack			
Chemical herbicide at clearing	gallon			
21-0-0 Ammonium	sack	580/sk	5 sk	
46-0-0 Complete	sack	1200/sk	4 sk	
Other inputs:				
Seeds peanut			-	
Seeds mungbean			-	
Services				
Inputs trucking	Sacks			
Animal hauling of inputs	Sacks			
Animal rent	Day			
Other services:				
Labor SURKO		SNACK 300/day	3 days	
Clearing for corn	Md	300/ + 150/day	5 tao * 3 day	
Land cultivation for corn + Tudling	Md	5,000 (lingyo)	SUHOL	
Planting for corn	Md	300/ + 150/day	4 tao * 2 day	
Fertilizer application for corn	Md	300/ + 150/day	3 tao * 2 day	
Herbicide application at land	Md			
Food for hired labor for corn	person			
Clearing for legumes	Md			
Land preparation for legumes	Md			
Planting for legumes	Md			
Fertilizer for legumes	Md			
Food for hired labor for legumes	person			

MAINTENANCE PERIOD starting year 2 for CORN – LEGUMES ROTATION				
Machinery and Equipment				
Item	Unit	Price of Unit	Monocropping	CRA practice
Bolo	Piece	130/pc	3 pcs	
Sprayer	Piece			
Shovel	Piece	180/pc	3 pcs	
Rake	Piece			
Hoe	Piece			
Inputs				
Herbicide	gallon			
Services				
Labor				
Manual weeding	md	300/ + 150/day	2 tao * 2 days	
Composting	md			
Herbicide application at weeding	md			
Food for hired labor	person			

OPERATIONS PERIOD for CORN				
Period when operation cost initiate			2	
Period when operation cost ends			10	
Machinery and Equipment				
Item	Unit	Price of Unit	Monocropping	CRA practice
Inputs				
Sacks	pieces	5/sk	20 sks	
Services				
Shelling fee	Bushels			
Animal hauling of produce	Sacks			
Trucking of produce	Sacks			
HAULING	gasoline	5 liter	50	
Labor		snack		
Harvesting	md	100/day+150/day	4 two * 2 day	
Shelling	md	100/day+150/day	1 two * 2 day	
Food for hired labor	persons			
[illegible] Gaving (PICK UP)		500	2 two * 2 day	

Note: Only for those practicing Corn – Legumes Crop Rotation – (For monocropping proceed to next table)

OPERATIONS PERIOD- PEANUT				
Period when operation cost initiate			2	
Period when operation cost ends			10	
Machinery and Equipment				
Item	Unit	Price of Unit	Conventional practice	CRA practice
Inputs				
Sack	piece			
Services				
Output trucking	sack			
Labor				
Harvesting	md			
Selling	md			

OPERATIONS PERIOD- MUNGBEAN				
Period when operation cost initiate			2	
Period when operation cost ends			10	
Machinery and Equipment				
Item	Unit	Price of Unit	Conventional practice	CRA practice
Inputs				
Sack	Piece			
Services				
Output trucking	sack			
Labor				
Harvesting	md			
Selling				

1. **Farming Externalities (For adaptors only)**

1.1. Have you noticed any significant changes to your farm productivity after you adopt corn-peanut/mungbean rotation?

1 – Yes 2 – No

1.2. If, yes what are these changes?

A. ______________________________

B. ______________________________

C. ______________________________

1.3. At what year do you usually observe this changes in your farm? ______________________________

1.4. What made you adopt this kind of crop rotation practice? ______________________________

Thank you very much for your cooperation

Appendix 16. Cost-Benefit Analysis (CBA) questionnaire for vegetable protected cultivation

CIAT VISAYAS STATE UNIVERSITY

CRA Adaptor? (Yes/No): ____________

Enumerator. Che2

Date. ____________

"Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 in Cebu Province"

Enumerator should read thru the introduction before starting the interview

Greetings!!

I am [**NAME OF ENUMERATOR**], an enumerator for a Department of Agriculture – Bureau of Agricultural Research (DA-BAR) funded project implemented by the Visayas State University. The research will assess the profitability of integrated pest management (IPM) with the use of bio-controls in vegetables compared to chemical pest controls.

You have been selected as a respondent for the survey. The information gathered from you will be used as basis for creating an investment guide for vegetables.

ASSURANCE OF CONFIDENTIALITY

All responses to the questionnaires will be treated with high degree of confidentiality.

Farmer's Socio Demographic Background

Farmer-Respondent's Name: Ma. Concepcion Alforo

Address: Sitio Alang-alang Mantalungon

Sex: F Age: 48 Civil Status: M

Highest Educational Attainment: Elem. Grad.

Primary Occupation: Farmer

How were you involved in farming?
1 – Cultivating own land (2) – Shareholder/ Tenant

Number of Year(s) Farming: 12 years old

Pests Control Practice(s): 1 – Bio-controls
2 – Chemical controls
(3) – Bio and chemical controls – Protected
4. Others (specify) ____________

Total Farm Area: 1/4 ha

Farm Production and Cropping Systems

Farm sa demo farm — PROTECTED L, PB, K – 400 per distance / rows

Crops Planted	Number of Cropping Period per year				Production					
					Estimated harvest per cropping		Total harvest per year	Farm gate Price		Gross Income
Vegetables	Count	Period 1	Period 2	Period 3	Sold	Consumed		Raw	Sorted	
lettuce	3	Mar-Apr	Aug-Oct	Nov-Dec	60 kgs	3 kg		70/kg		
Pbnee Beans	1		Aug-Nov.		120 kgs	5 kgs		100/kg		
Kamatis			Aug-Nov.		160 kgs	10 kgs		40/kg		

Codes for Vegetables
1 – Cabbage
2 – Ombok
3 – Brocolli
4 – Cauliflower
5 – Eggplant
6 – others, specify

GENERAL INFORMATION	
CRA Practice	PROPOSED – Bio control + chemical
Description of practice	

ADOPTION COST FLOW						
IMPLEMENTATION PERIOD at year 1						
Machinery and Equipment						
Item	Unit	Vegetables See codes above	Price of Unit	Bio-control	Chemical control	Bio and chemical control
Pick mattock (Gabang)	Piece	All	100			1
Spade (pala)	Piece		130			1
~~Hoe~~ Guna	Head		150			2
Scythe (sangalab/sangot)	Piece					
Harrow	Piece					
Plow	Piece					
Plastic Mulch	Piece					
Bamboo poles	Piece					
Nylon and strings	Meters					
Seedling tray	Piece					
Drip hose	Meters					
Sprinkler for irrigation	Unit		70			1
Others Galab			40.80			2
Sprayer			1,350			1
Inputs during planting						
Vegetable seeds	Pack	lettuce, P.Beans, K	(200) (1,150) (200)			3, 1.5, 1 pack
Vegetable cuttings	Piece					
Organic inputs						
Chicken dung	Sack					
Vermicompost	Sack					
Farm compost	Sack					
Carbonized rice hull	sack					
Animal Manure	sack					
Other organic inputs:						
Inorganic inputs						
Complete (14-14-14)	sack	L, PB, K	575			1/2 sack, 1/2 sk, 1/2 sk
Urea (46-0-0)	sack	L, PB, K	900/sk			1 sk, (all)
Ammonium sulfate	sack					
Potassium sulfate	sack					
Other inorganic inputs:						
insecticide Silicon		L, PB, K	350/1/4 bot.			1 bottle (1/4 L)
Services						
Inputs trucking	Sacks					
Animal hauling of inputs	Sacks					
Animal rent	Day					
Other services:						
Hatod 2		L, PB, K				20/transport
Labor						
Clearing/weeding	Md	*	200/tao/day			2 tao
Land cultivation	Md		200			1 tao
Planting/transplanting	Md		200			2 tao/ 1 day
Fertilizer application	Md	**	200			2 tao, 1 day
Herbicide application	Md					
Food for hired labor	person					
Other labor expenses:						
Spray		***	200			1 tao, 2 [illegible]

* L – once
PB – once
K – once

** L – 3 times
PB – 3 times
K – 3 times

*** L – 2 times
PB – 2 times
K – 2 times

MAINTENANCE PERIOD starting year 2						
Machinery and Equipment						
Item	Unit	Vegetables See codes above	Price of Unit	Bio-control	Chemical control	~~Bio and chemical~~ control
Bolo	Piece					
Cellophane	Pack					
Newspaper (for covering)	Kilo					
Crate	Unit					
Basket	Piece					
Kaing		L, K	60			1, 1
Salib		PB	10			1
Item	Unit		Price of Unit	Bio-control	Chemical control	Bio and chemical control
Inputs						
Chemical Herbicide				-		-
Chemical Pesticides (*Indicate the name of chemicals used*)				-	-	-
Insecticide						
Acaricide						
Fungicide						
Bactericide						
Nematicide						
For Mulching				-	-	-
Watering of plants	No of times daily	Thrice only (all)				2 times (1/2 da
Volume of water used per application	Gallons					
Biological and Non-Chemical Spray (*Indicate the name of chemicals used*)				-	-	-
Trichogramma						
Metharhiziumanisopliae (GMF)						
Bacillus thuringiensis (Bt)						
Beuvariabassiana (WMF)						
Organic concoctions (OHN, FPJ, FFJ, LABS, IMO)						
Botanical Extracts (Neem, Panyawan, Chili, Garlic, Lemon grass)						
Vermitea (Brewed or Ordinary)						
Soap Solution						
Pressurized Water Spray						
Wood Vinegar						
Trichoderma						
Services						
Labor						
Manual weeding	md					
Composting	md					
Herbicide application at weeding	md					
Pesticide application	md					
Food for hired labor	person					

OPERATIONS PERIOD	
Period when operation cost initiate	2

Item	Unit	Vegetables See codes above	Price of Unit	Bio-control	Chemical control	Bio and chemical control
Inputs						
Sacks	pieces					
Services						
Sorting of produce X	Bushels					
Animal hauling of produce	Sacks	L	200			1 tiro
Trucking of produce	Sacks	L	45/plete per	delivery		
Labor				1200		
Harvesting	md	L	200			2 tiro (3 hrs) *
~~Sorting~~	md	PB	200 +			3 tiro (1 day) *
Food for hired labor	persons	K	200	100		2 tiro (4 hrs) *

*L – 3 times
PB – 4 times
K – 4 times

1. **Farming Externalities (Farmers using Bio-controls only)**

1.1. Have you noticed any significant changes to your farm productivity after you adopt ~~bio-control~~ protected?

(1) – Yes 2 – No

1.2. If, yes what are these changes?

A. Mas mindst lati na ug nag ulan, di daling malata, daghan
B. ang tanom compared sa gawas
C. ______

1.3. At what year do you usually observe this changes in your farm? 2017

1.4. What made you adopt this kind of pest control method? Regulated by mayor to use protected kunang naa sa ila associat

Thank you very much for your cooperation

1,200
2,400
1,600