COMPLETION REPORT

Climate Risk Vulnerability Assessment (CRVA) and Cost-Benefit Analysis (CBA) of selected Climate-Resilient Agriculture (CRA) practices in Bohol, Negros Oriental and Siquijor

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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. In 2015, the DA System-wide Climate Change Office (DA SWCCO) implemented AMIA Phase 1 aimed 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.

In 2017-18, the Department of Agriculture's Adaptation and Mitigation Initiative in Agriculture (AMIA) commissioned the International Center for Tropical Agriculture (CIAT), along with the Visayas State University (VSU) as one of the key partners, to undertake AMIA 2 and AMIA2++ to undertake climate risk vulnerability assessment (CRVA) in Cebu province. This project was implemented in close coordination with the Department of Agriculture, Regional Field Office (DA-RFO7). The CRVA results have since been used to guide investment targeting and planning for building climate-resilient agri-fisheries (CRA) communities. It also seeks to introduce complementary activities for building appropriate climate responsive financial and other key support services.

This CRVA-CRA for Central Visayas component of the project aimed to continue the implementation of AMIA 2++ activities (i.e. CRVA and CRA) in all remaining three (3) provinces of Region 7 in order to get a complete picture of the regional CRVA-CRA analysis. The remaining provinces are Bohol, Negros Oriental and Siquijor.

OBJECTIVES

1. To assess climate risks in the region's agriculture sector through geospatial & climate modelling tools;
2. To document and analyse local CRA practices in these provinces to support AMIA knowledge-sharing and investment planning;
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks; and,
4. To assist the DA-RFO7 in establishing AMIA baseline for outcome monitoring and evaluation of CRA communities and livelihoods.

METHODOLOGY

Activity 1 – Project Coordination

This activity will be spearheaded by the VSU Team in order to discuss fully with the DA-RFO7 AMIA Team the deliverables of the project, levelling-off of expectations as well as activities tasking. The project team meetings for updating of outputs is done every 6 months without prejudice to calling for a special meeting as needed by the teams.

Activity 2 - Geospatial assessment of climate risks (CRVA)

With VSU as the lead agency, in collaboration with the DA-RFO 7 AMIA team, a workshop will be done to collect and organize geo-referenced data on crop location as input in the climate sensitivity and climate vulnerability analysis of the region's agriculture sector. These datasets, from both primary and secondary sources, will be based on the methodological guidelines provided by the AMIA2^{++} CRVA project – covering climate-risk sensitivity, hazards exposure, and adaptive capacity. The preliminary analysis – using GIS and climate modelling tools – will be undertaken at the provincial level.

Activity 3 – Climate-Resilient Agriculture (CRA) practices prioritization and planning

The VSU project team will organize a series of stakeholders' meetings and Focus Group Discussion (FGD), Key Informant Interview (KII) to collect supplementary data and validate preliminary results of CRVA, as well as undertake CRA prioritization and planning. These activities will be guided by process facilitation and data collection tools developed by the AMIA2^{++} projects on CRVA and CRA decision-support platform.

Activity 4 - Documentation & Cost-Benefit Analysis of selected CRA practices

The VSU project team will conduct a semi-structured survey with local stakeholders to identify and document CRA practices, as well as collect existing CRA-relevant statistical, financial and other secondary data. These data will be systematized and analysed, using cost-benefit and trade-off analyses tools as input to AMIA2 CRA prioritization and investment planning.

Activity 5– AMIA-related seminar-workshops

The DA AMIA team, in partnership with VSU project team, will spearhead the conduct of seminar-workshops to enhance the knowledge of DA-RFO7 AMIA Team on CRVA and CRA methodologies and seamlessly be able to integrate or streamline AMIA activities into DA-RFO7's major programs. The training-workshop includes Process Documentation, Investment Appraisal, Establishment of A CRA Demo Farm. The demo farm is designed to enhance knowledge of the farmers/growers in growing crops that is responsive to the three pillars of climate resilient agriculture.

Activity 6. Project Management and monitoring

This project component on CRVA and CRA for Region 7 will be implemented by the VSU team who will be appointed by the VSU President and to be assisted by DA-RFO7's AMIA team, in accordance with the provisions of the signed MOA. This arrangement is designed in order to mentor and capacitate the DA-RFO7 AMIA Team without prejudice to involving more expertise from the collaborating three (3) provinces.

RESULTS AND DISCUSSION

CROP OCCURRENCE

Bohol Province

A workshop on crop occurrence marking was conducted by last June 10-11, 2019 for the Bohol province. It was participated by the Municipal Agricultural Officer and Agricultural Technician of respective municipalities. A follow up gathering was conducted last October 15-18, 2019 for those municipalities that lack data which includes Trindidad, Guindulman, Loay, Lila and Tubigon. Points are based on a 1 kilometer by 1 kilometer grid overlaid on the map.

Table 1. Top 9 Crops of Bohol Province

	Crops	No. of points
1	Rice	1927
2	Pinakbet	1280
3	Banana	910
4	Corn	904
5	Mango	547
6	Sweet potato	360
7	Cassava	321
8	Cacao	297
9	Ube Purple Yam	263

A total of 32 crops were considered in the marking. Among of which, rice with 1927 points is the top occurrence in the province. Followed by pinakbet, banana, corn, mango, sweet potato, cassava, cacao, and ube purple yam. Pinakbet is a combination of eggplant, ampalaya, stringbeans, squash, okra and tomato (Table 1).

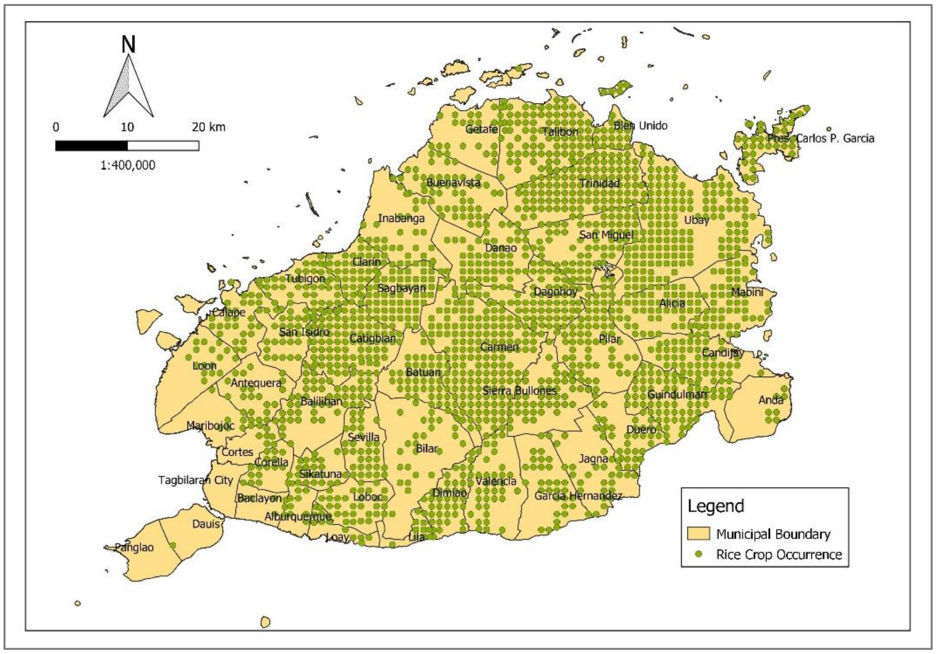


Figure 1. Rice Crop Occurrence Points in Bohol Province

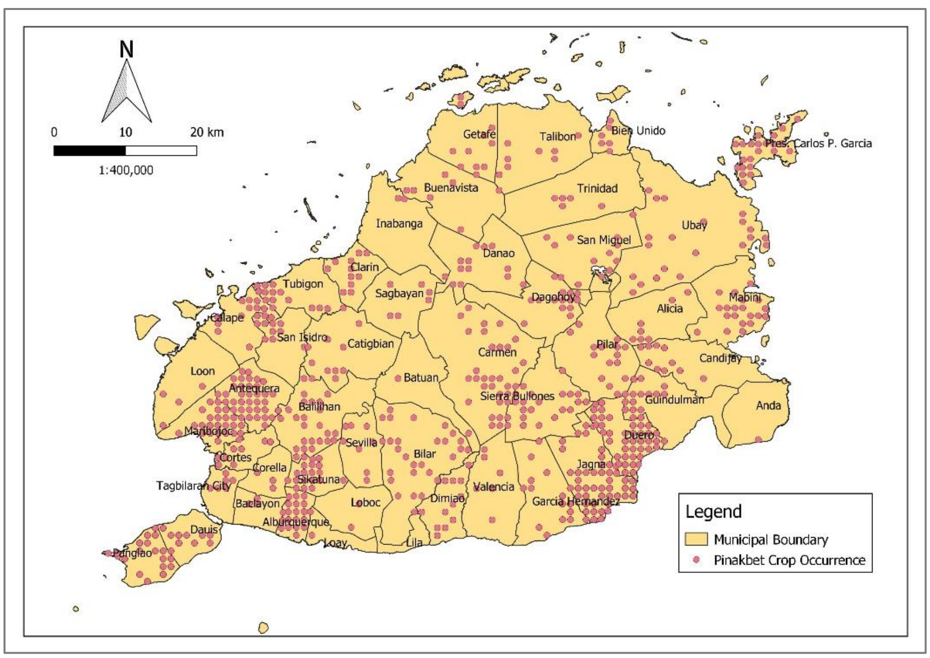


Figure 2. Pinakbet Crop Occurrence Points in Bohol Province

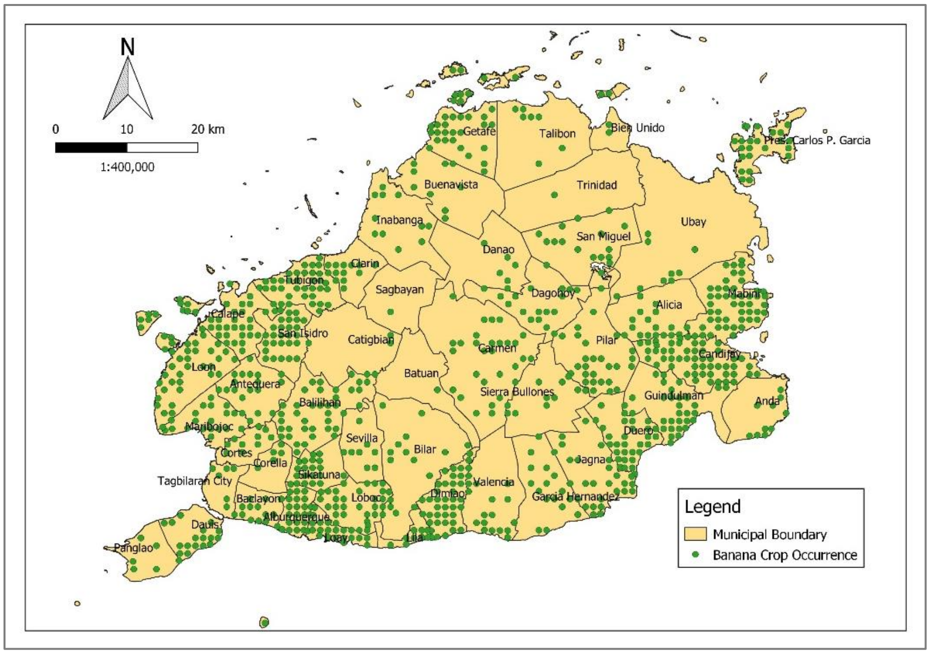


Figure 3. Banana Crop Occurrence Points in Bohol Province

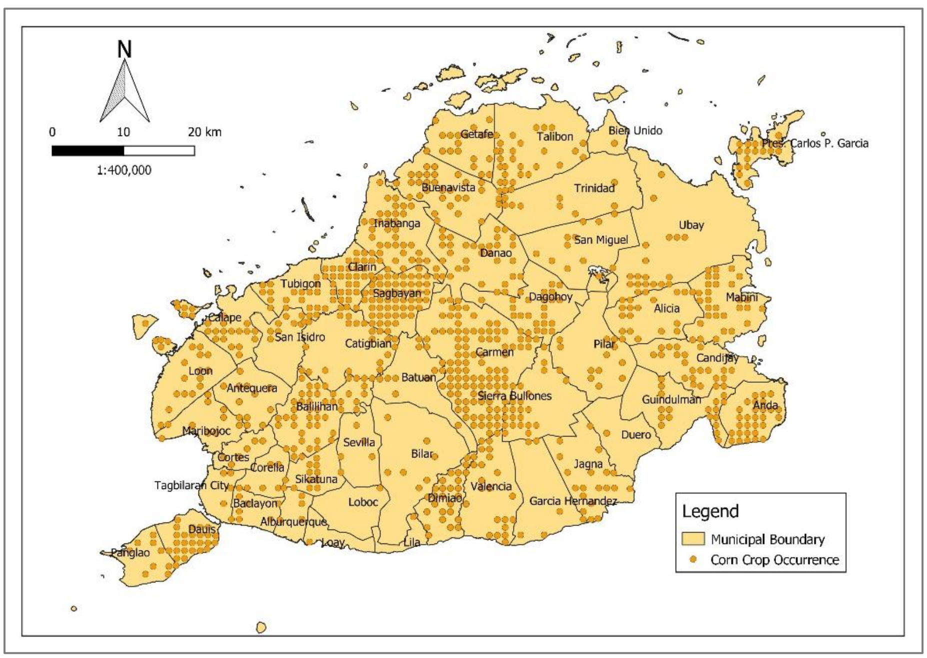


Figure 4. Corn Crop Occurrence Points in Bohol Province

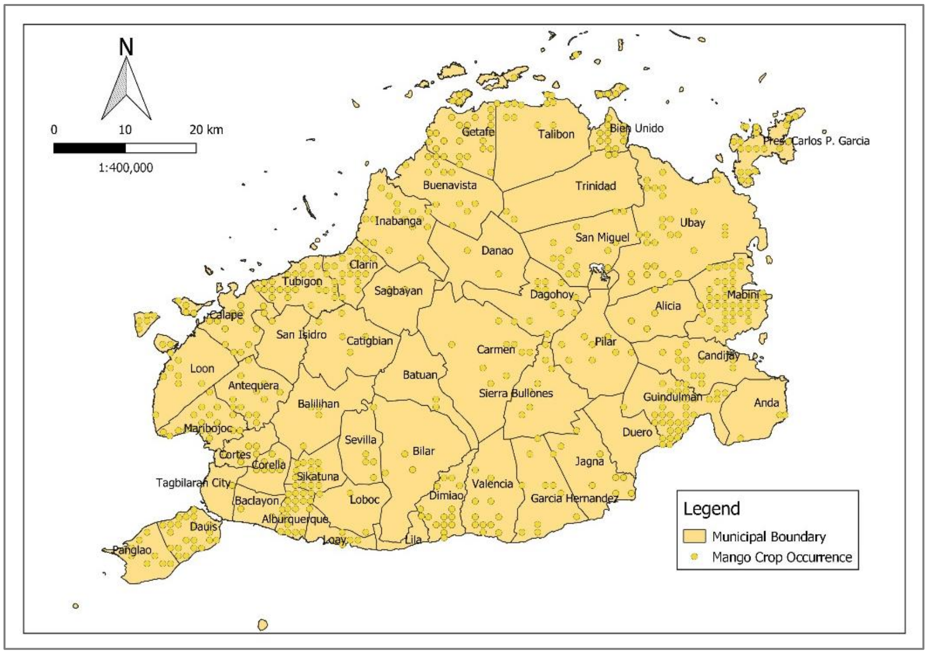


Figure 5. Mango Crop Occurrence Points in Bohol Province

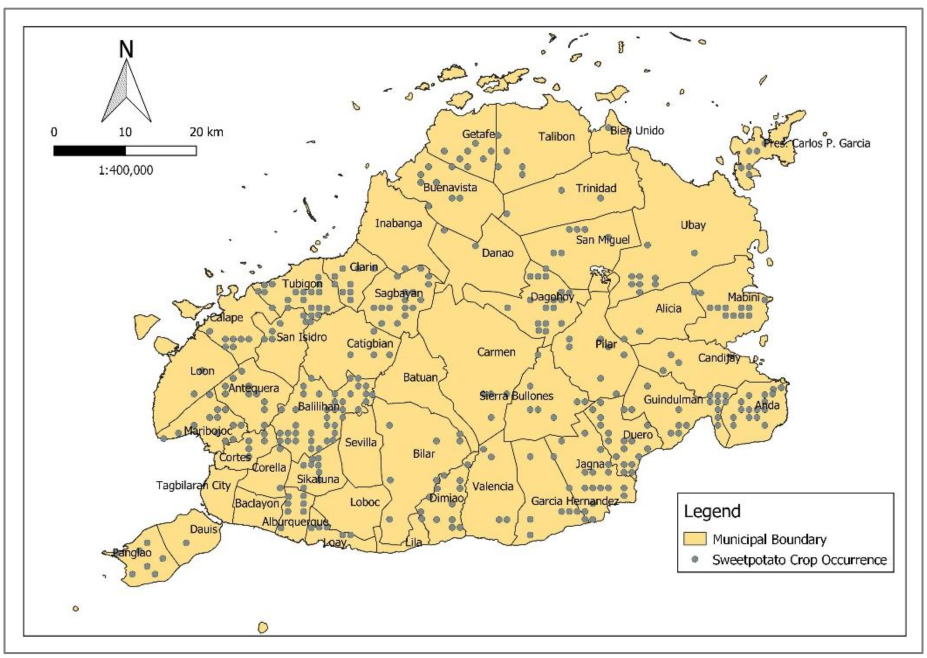


Figure 6. Sweet Potato Crop Occurrence Points in Bohol Province

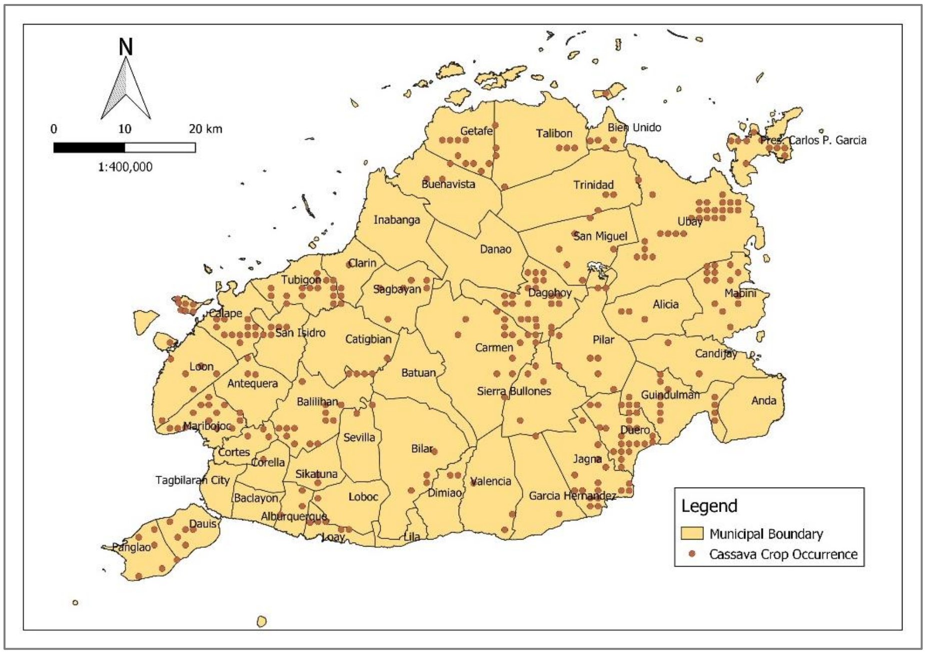


Figure 7. Cassava Crop Occurrence Points in Bohol Province

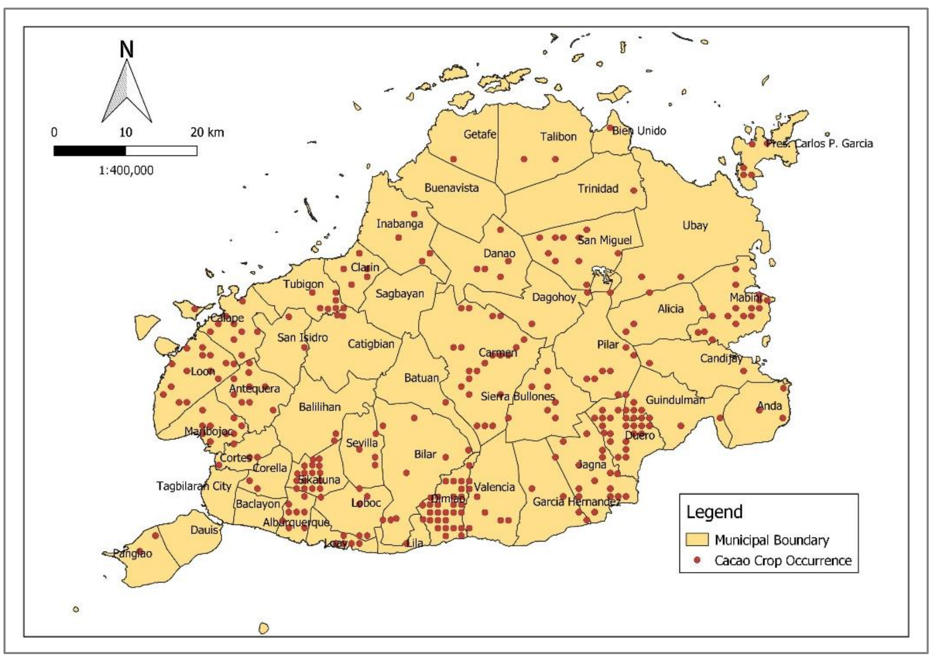


Figure 8. Cacao Crop Occurrence Points in Bohol Province

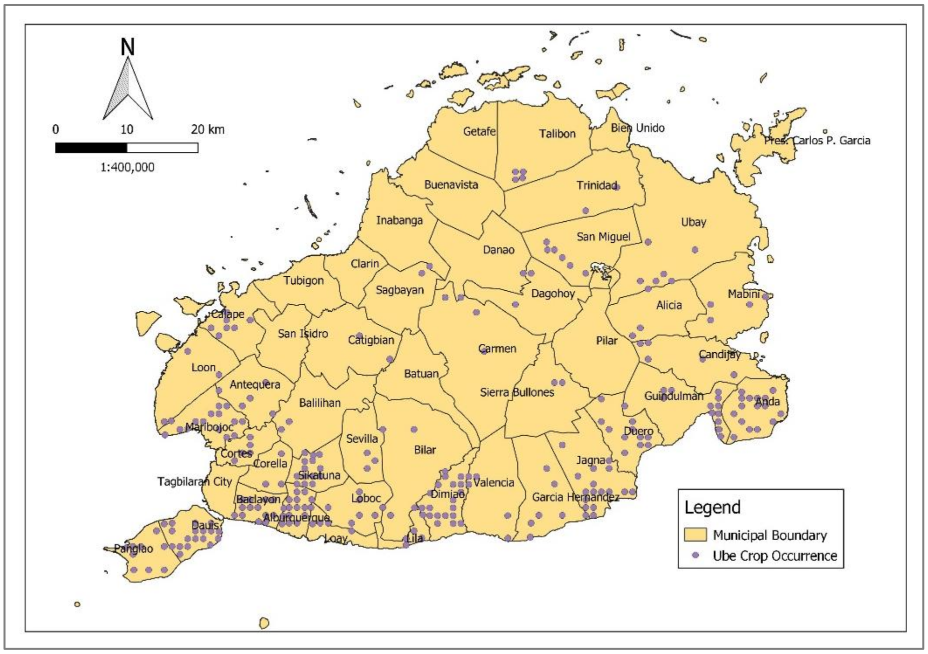


Figure 9. Ube Crop Occurrence Points of Bohol Province

Negros Oriental Province

Table 2. Top 9 Crops of Negros Oriental Province

	Crops	No. of points
1	Corn	2216
2	Sugarcane	1570
3	Rice	1266
4	Banana	939
5	Pinakbet	572
6	Coffee	504
7	Mango	430
8	Cassava	388
9	Cacao	187

Similar crop occurrence workshop was conducted at the province of Negros Oriental. A total of 37 crops were considered in the marking based on the focus group discussion with the MAOs and ATs. Results show that corn (2216) is the most commonly grown crop in Negros Oriental Province. Others include sugarcane, rice, banana, pinakbet, coffee, mango, cassava and cacao (Table 2).

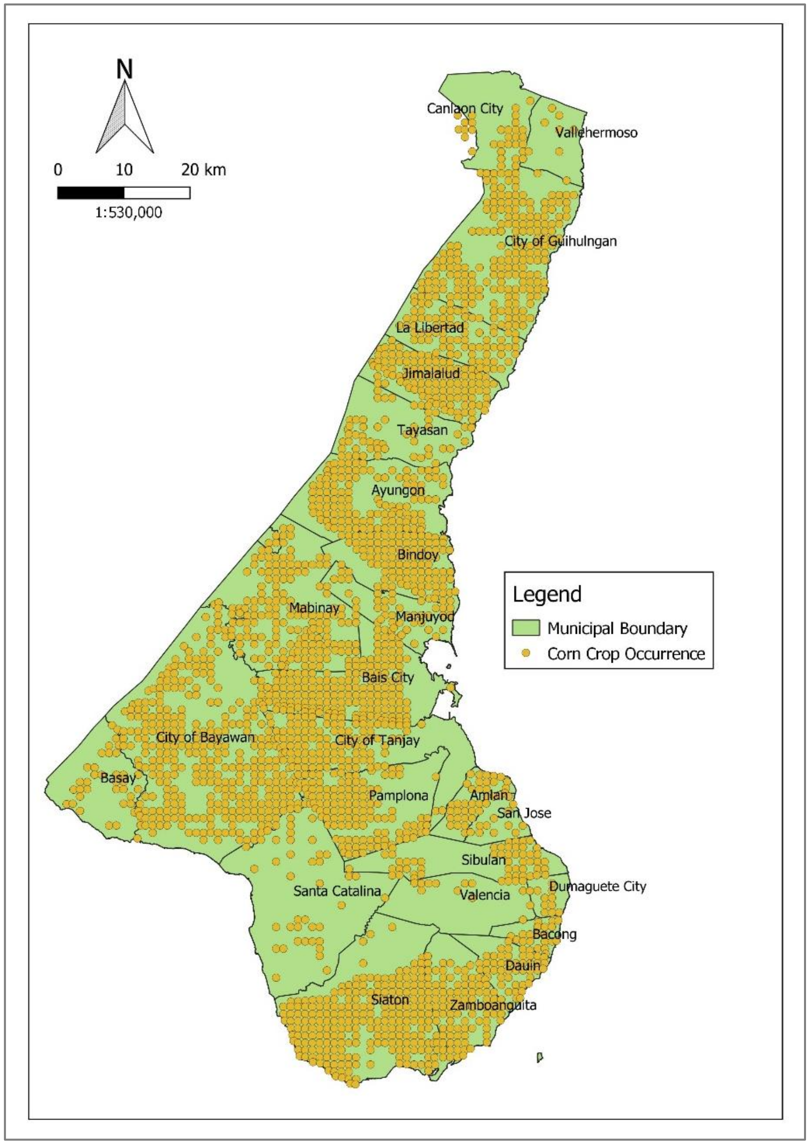
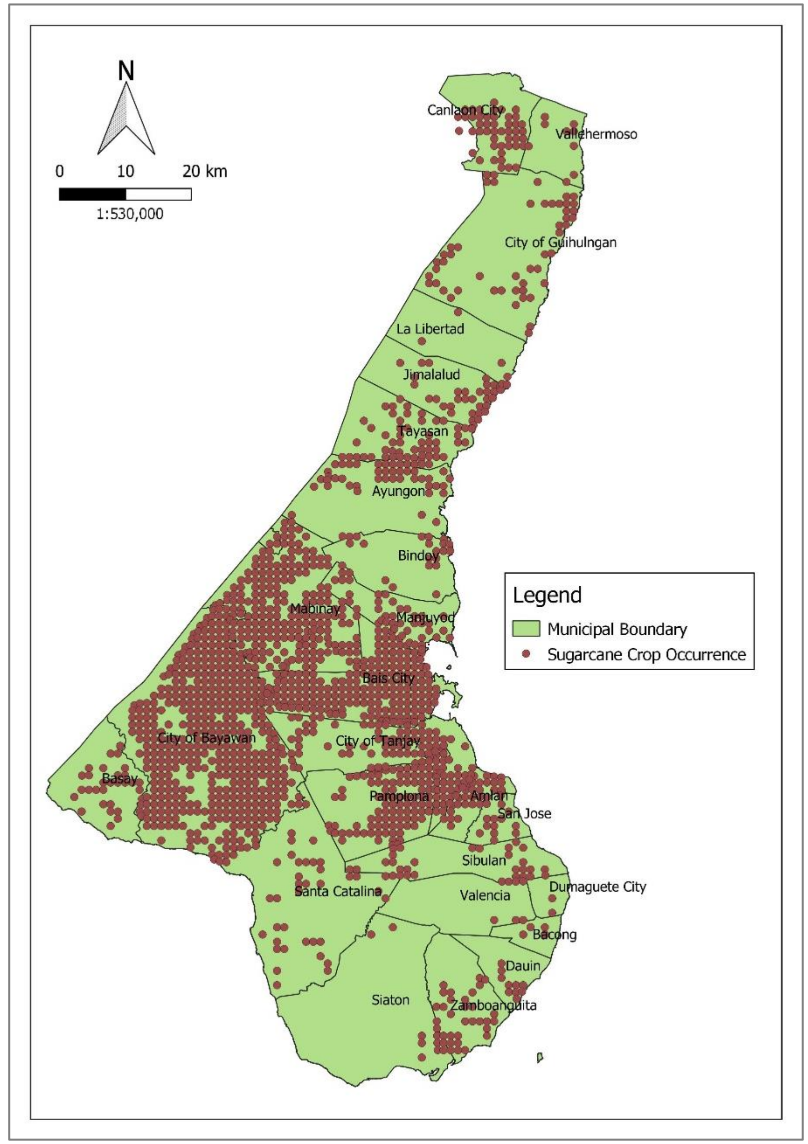


Figure 10. Corn Crop Occurrence Points in Negros Oriental



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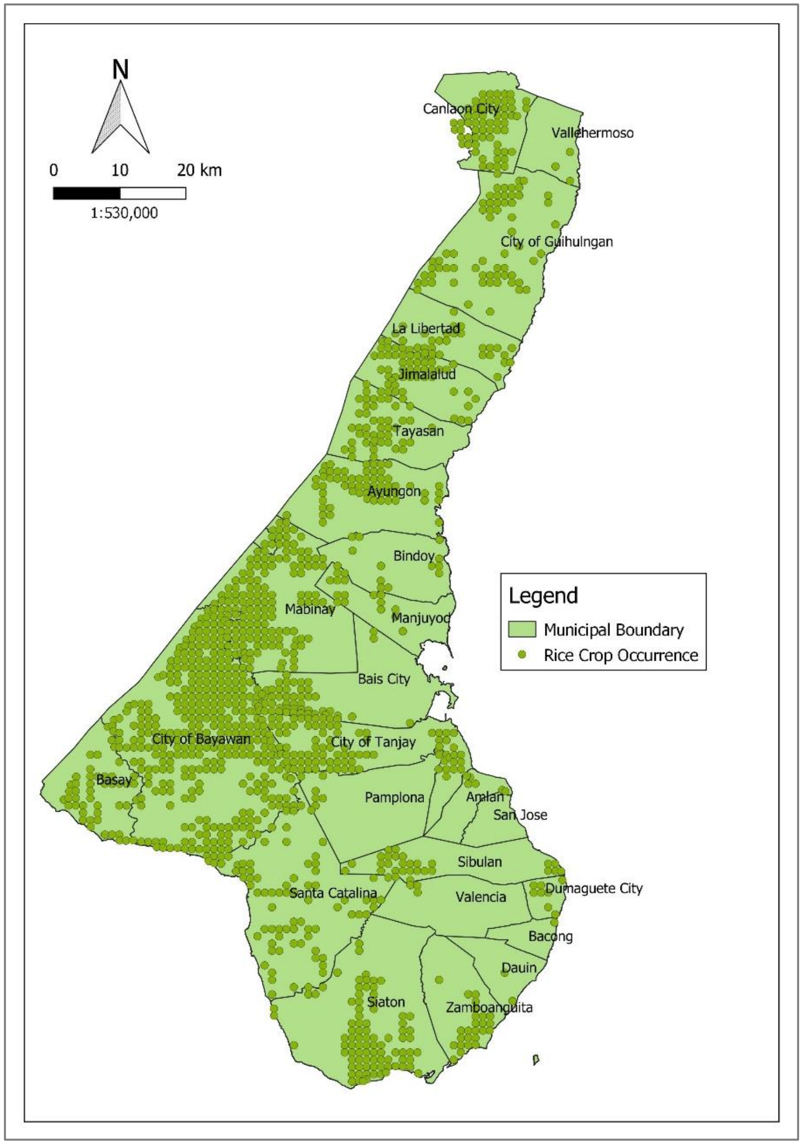

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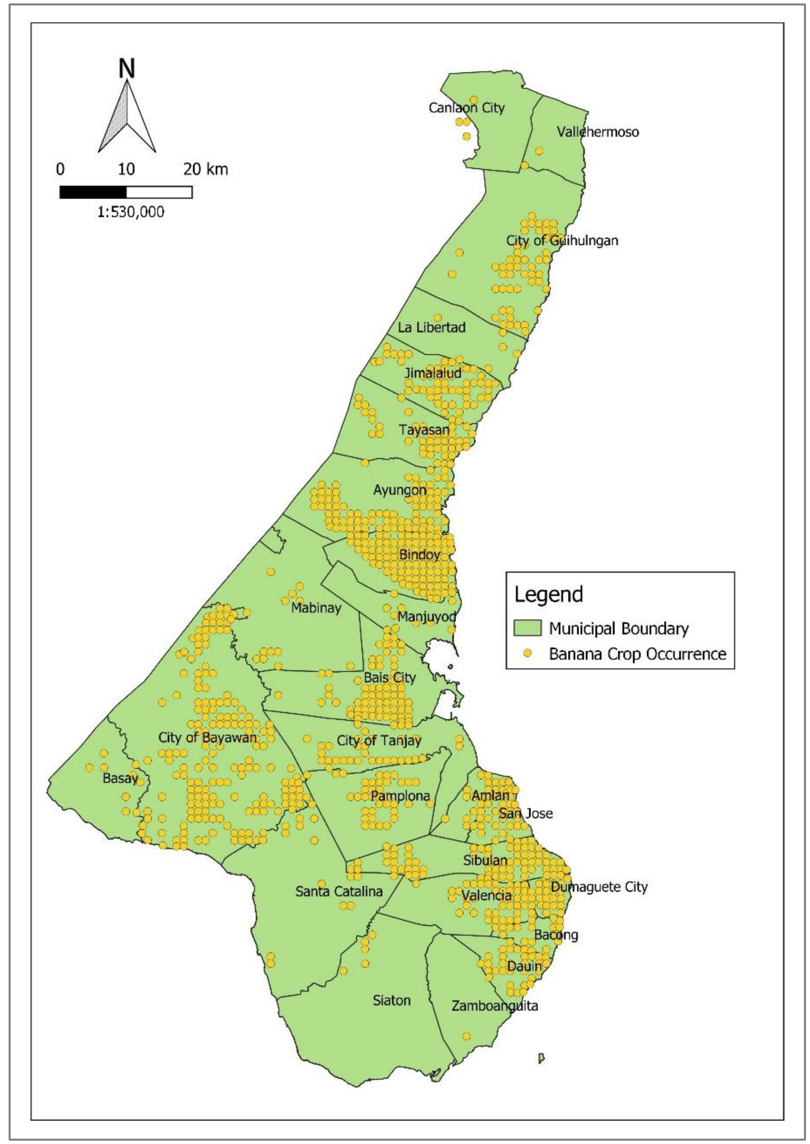


Figure 13. Rice Crop Occurrence Points in Negros Oriental

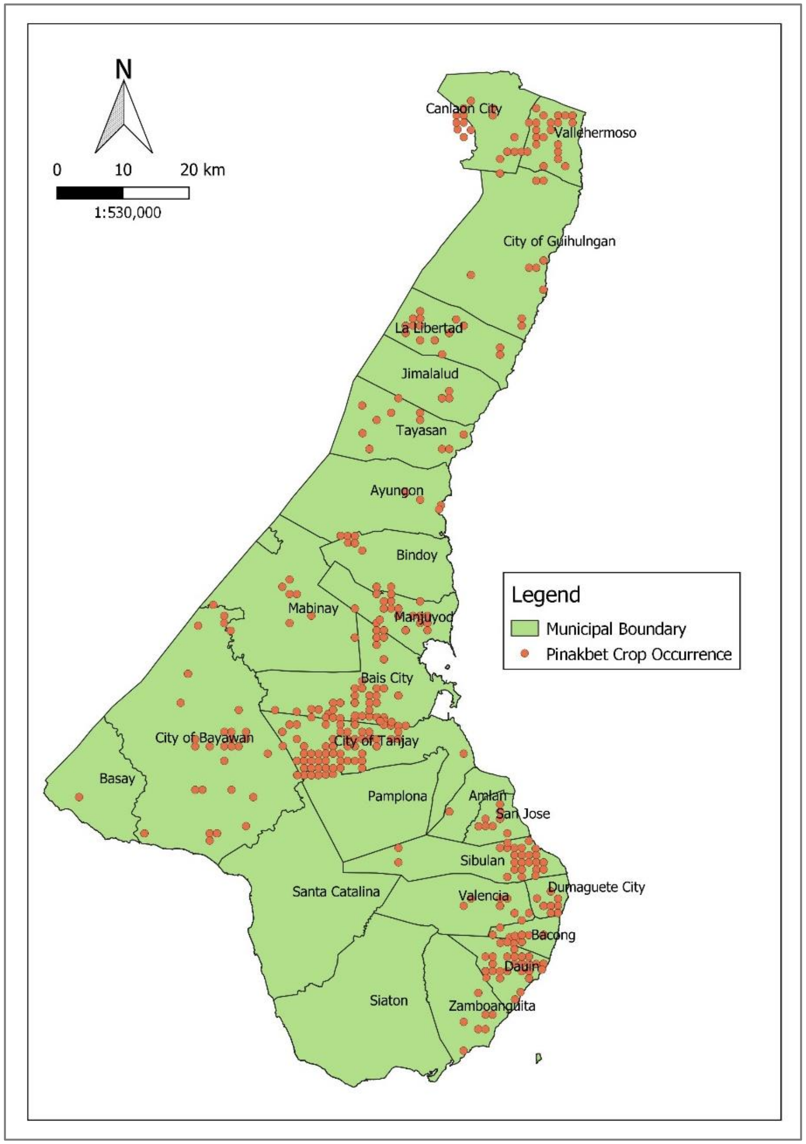


Figure 15. Pinakbet Crop Occurrence Points in Negros Oriental

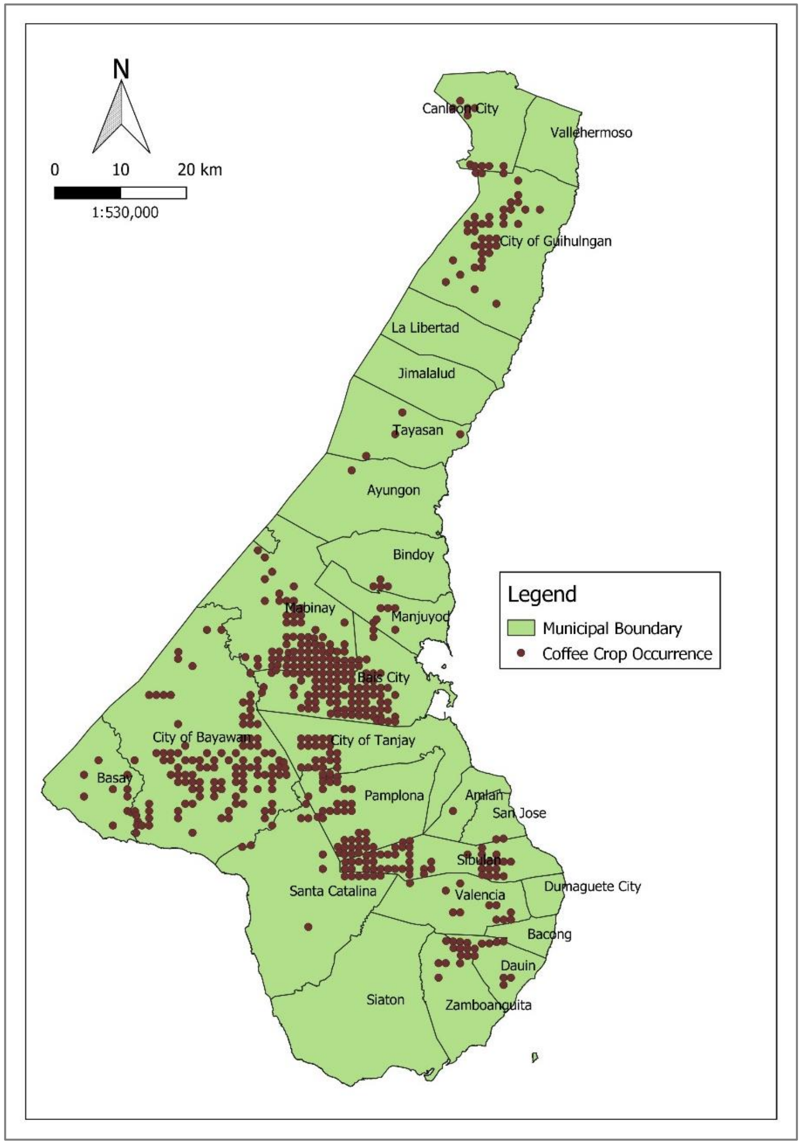


Figure 14. Coffee Crop Occurrence Points in Negros Oriental

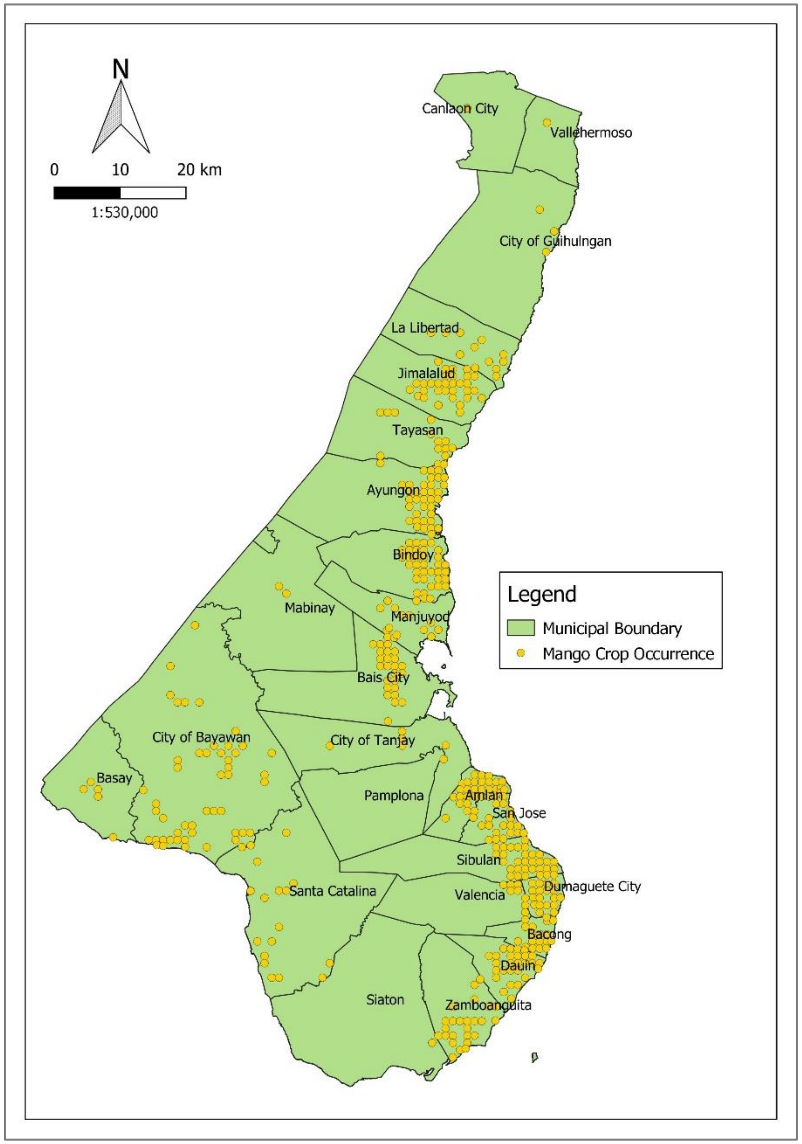


Figure 17. Mango Crop Occurrence Points in Negros Oriental

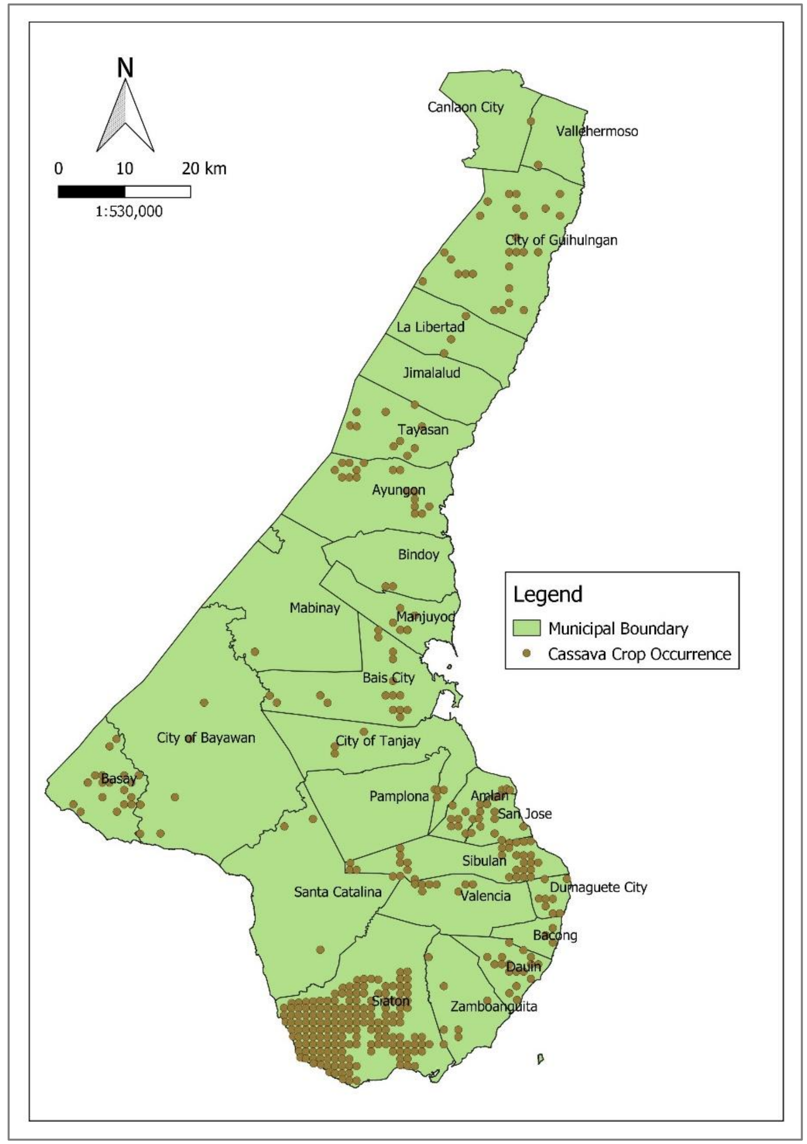


Figure 16. Cassava Crop Occurrence Points in Negros Oriental

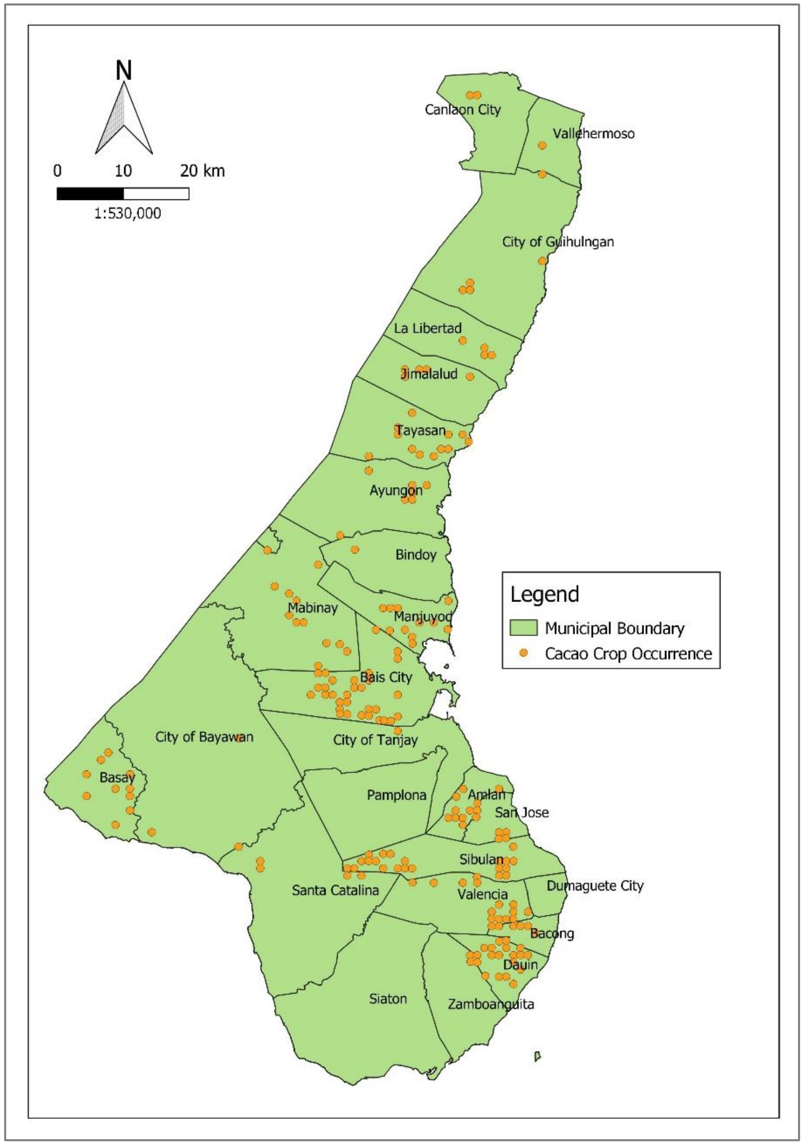


Figure 18. Cacao Crop Occurrence Points in Negros Oriental

Siquijor Province

Table 3. Top 9 Crops in Siquijor Province

	Crops	No. of points
1	Pinakbet	418
2	Corn	208
3	Banana	180
4	Mango	98
5	Cassava	83
6	Rice	50

The last crop occurrence workshop was conducted last August 15, 2019 at Siquijor, Siquijor where 37 crops were considered to be marked. Based on the occurrence points, the crops that are mostly grown in the province is pinakbet (418). Pinakbet is a combination of eggplant, ampalaya, stringbeans, squash, okra and tomato. Among of the top crops in the province are corn, banana, mango, cassava, rice, malungay, peanut and napier.

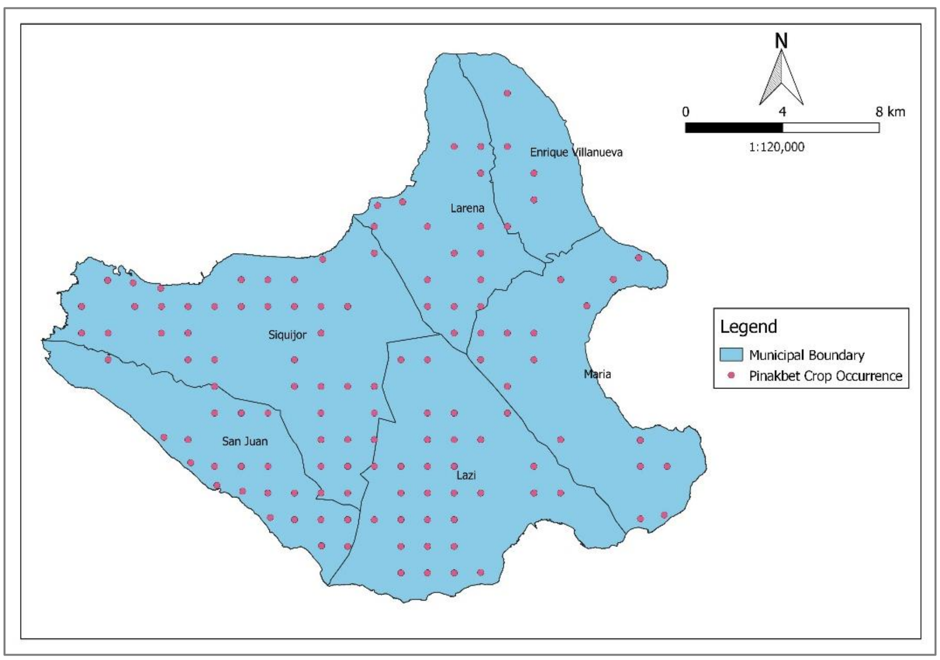


Figure 19. Pinakbet Crop Occurrence in Siquijor Province

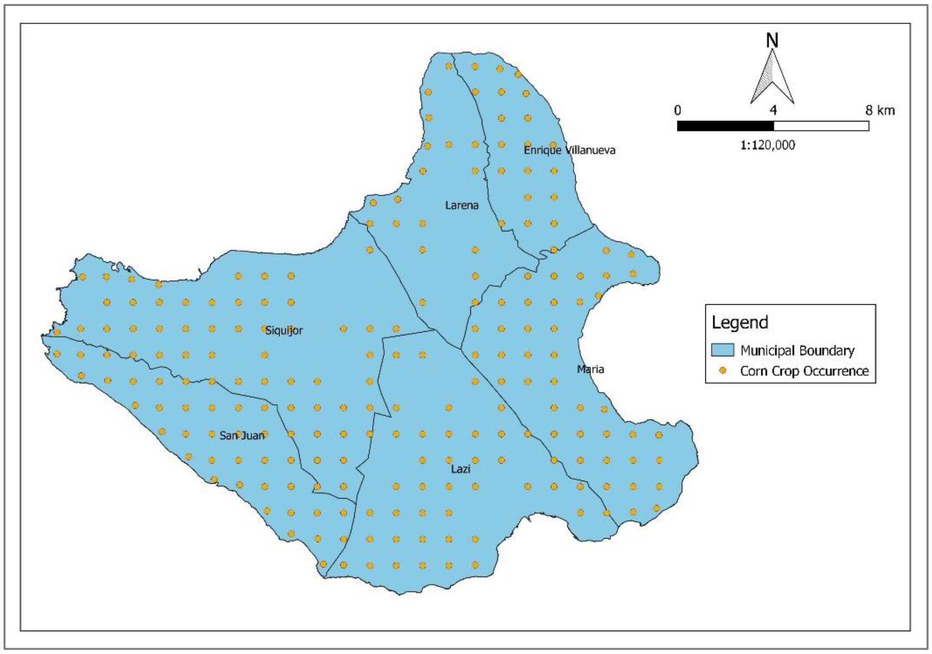


Figure 20. Corn Crop Occurrence Points in Siquijor Province

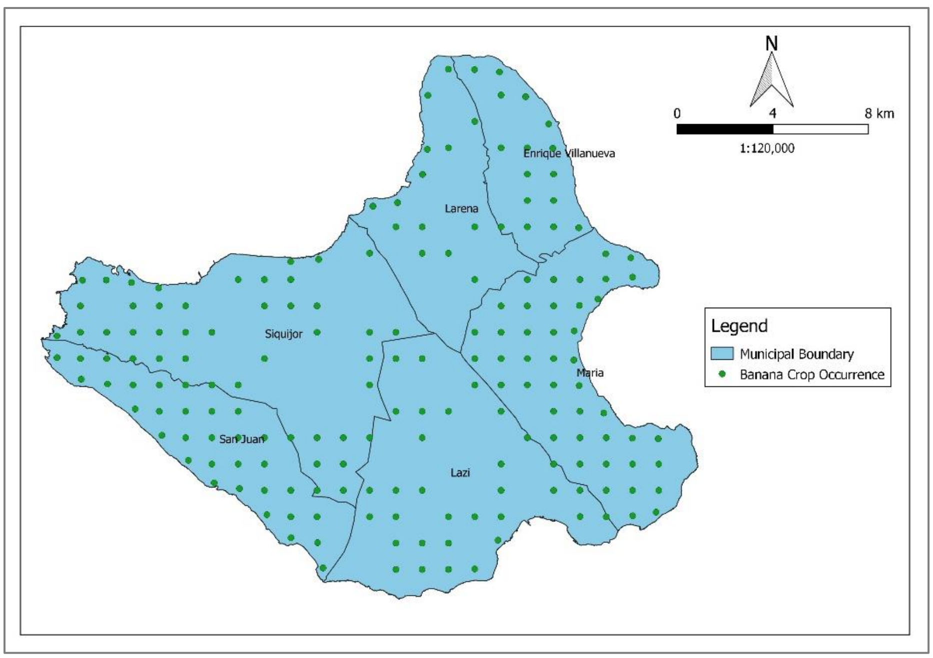


Figure 21. Banana Crop Occurrence Points in Siquijor Province

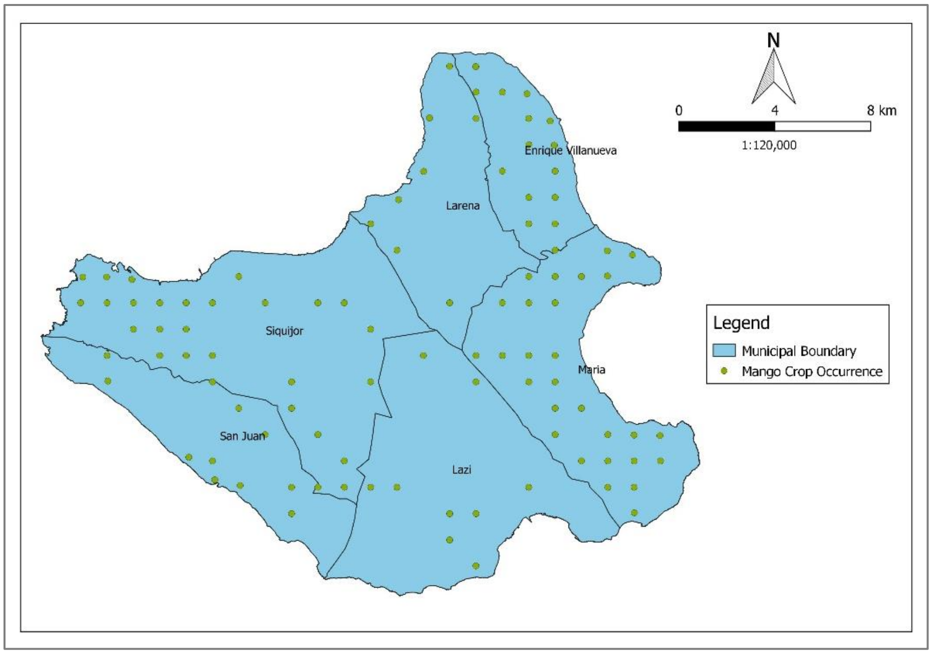


Figure 22. Mango Crop Occurrence Points in Siquijor Province

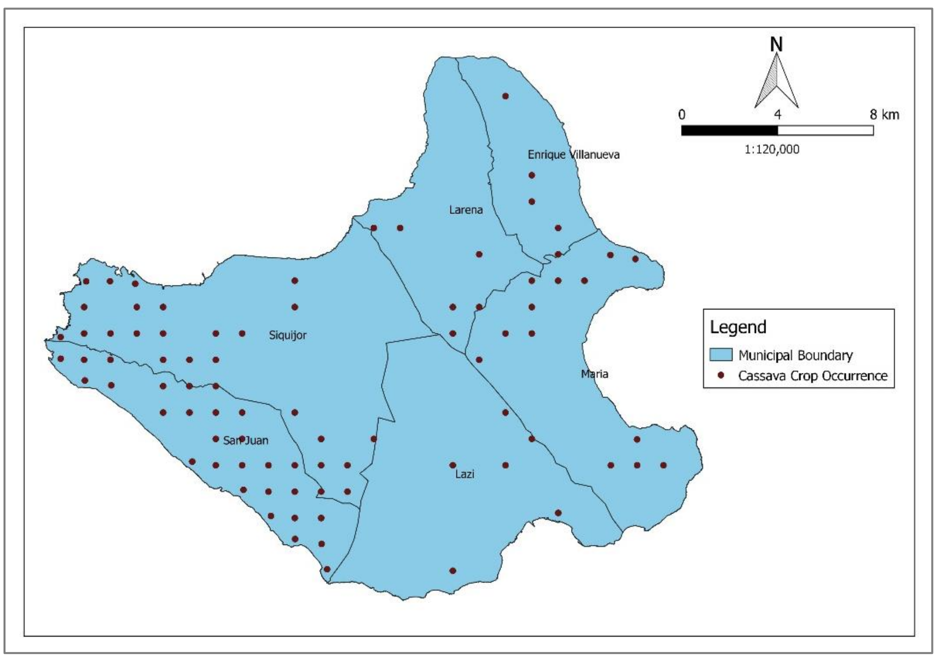


Figure 23. Cassava Crop Occurrence Points in Siquijor Province

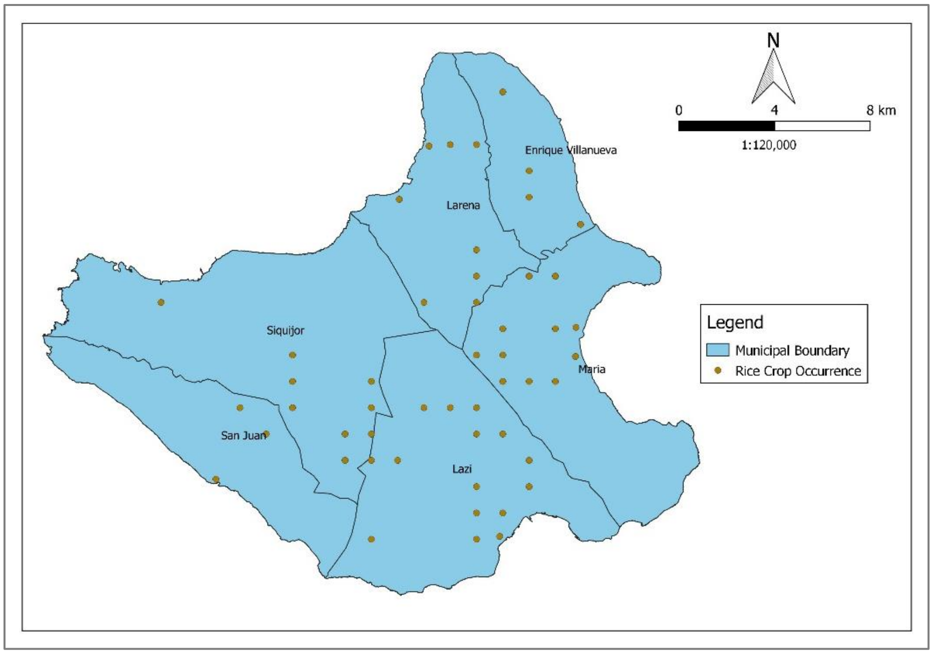


Figure 24. Rice Crop Occurrence Points in Siquijor Province

CLIMATE CHANGE SENSITIVITY

To examine the sensitivity of the prioritized crop commodities in the province of Bohol, Negros Oriental and Siquijor, the collected crop occurrence data together with the 20 bio-climatic factors from WorldClim were analyzed using Maximum Entropy (MaxEnt) modeling software. Through the analysis, the sensitivity of the prioritized crops to changes in temperature and precipitation projected in the year 2050 were determine.

Climate Change Sensitivity: Bohol Province

The south western part of Bohol generally projects a moderate to very high sensitivity for most crops in the year 2050. For rice, the western and central part of Bohol projects a high to very high sensitivity (Figure 25). Pinakbet which is the combination of eggplant, ampalaya, stringbeans, squash, okra and tomato evidently shows a moderate to very low sensitivity in the whole province (Figure 26). Meanwhile, banana is likely to have a moderate to high sensitivity on the southwestern side of Bohol (Figure 27). Corn sensitivity on some parts of Sierra Bullones, Pilar, Guindulman, Anda, Garcia Hernandez, San Isidro, Duero and Valencia are expected to have high to very high sensitivity (Figure 28). For the sensitivity of mango, the southwestern going to the northeastern part of Bohol projects a moderate to very high sensitivity (Figure 29). A moderate to high sensitivity for sweet potato is also likely on some parts of Dimiao, Bilar, Batuan, Carmern, Pilar, Alicia, Candijay, Guindulman and to the most parts of Valencia, Garcia Hernandez, Jagna Duero and Sierra Bullones (Figure 30). A very high sensitivity for cassava is possible on some parts of Bilar, Carmen, Sierra Bullones, Jagna, Garcia Hernandez, Valencia and Dimiao (Figure 31). Alarmingly for the most parts of Bohol, cacao is expected to have a high to very high sensitivity except for the northern parts (Figure 32). The southwestern parts including Anda, projects a high to very high sensitivity for ube-purple (Figure 33).

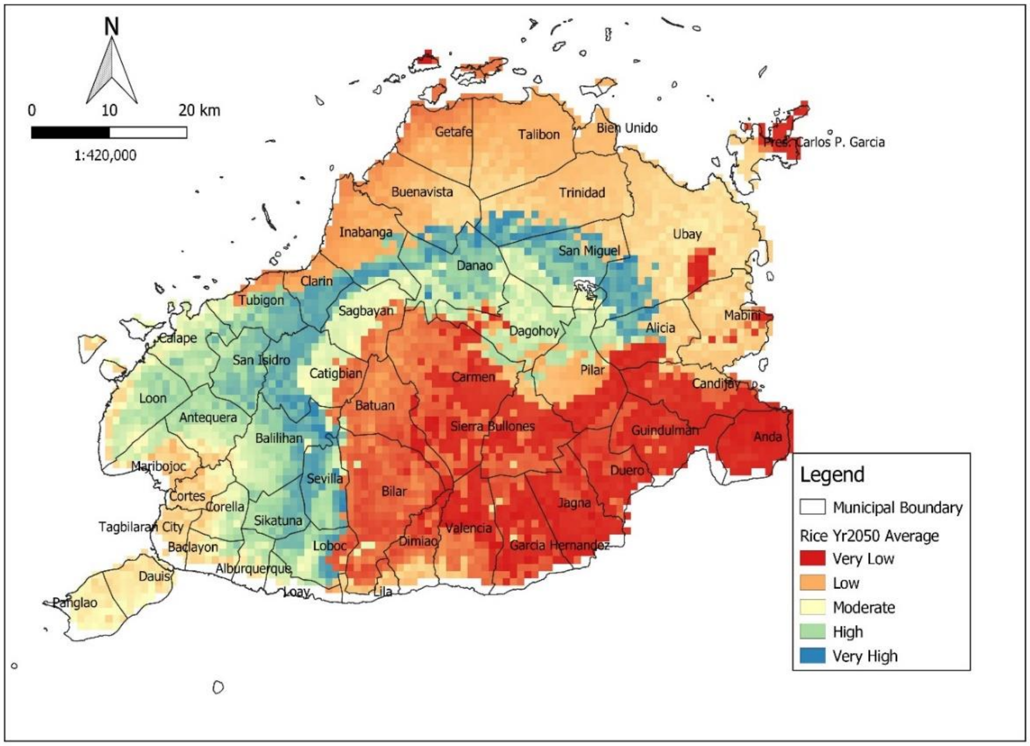


Figure 25. Rice sensitivity map of Bohol province in year 2050

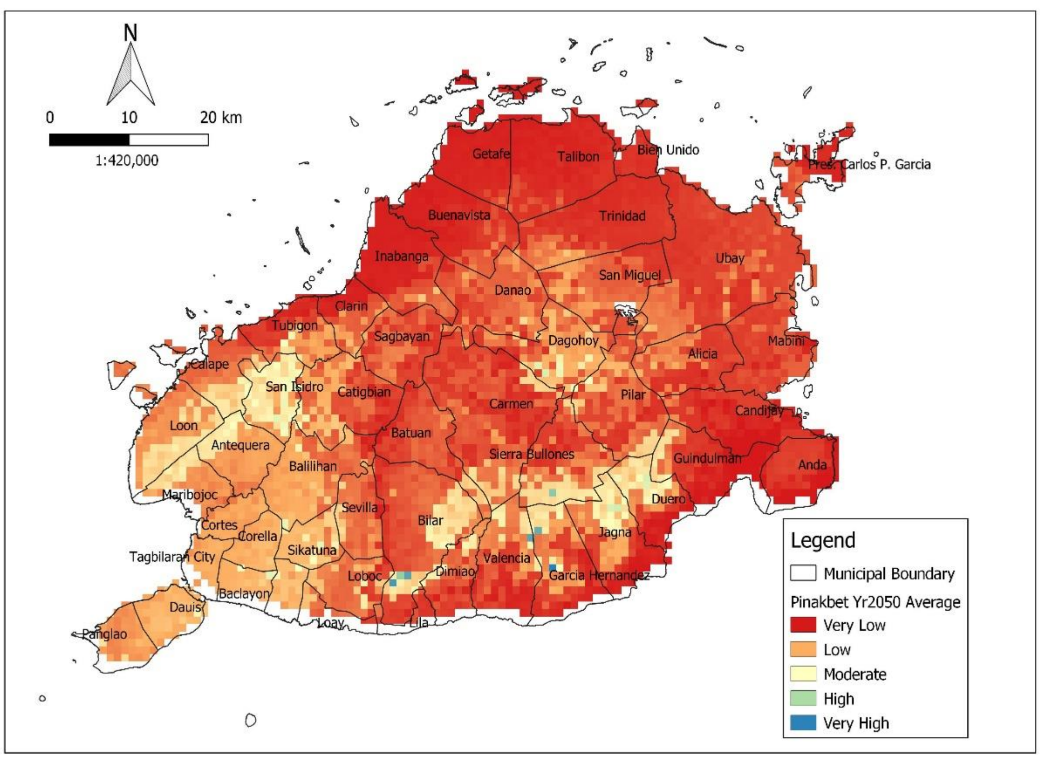


Figure 26. Pinakbet sensitivity map of Bohol province in year 2050

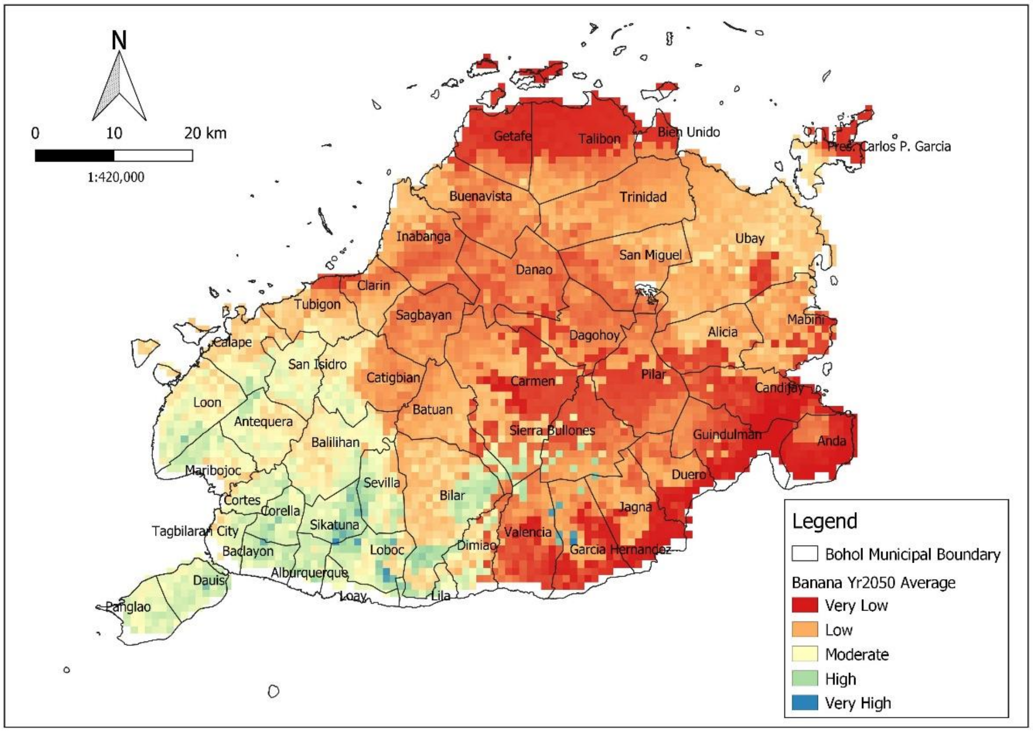


Figure 27. Banana sensitivity map of Bohol province in year 2050

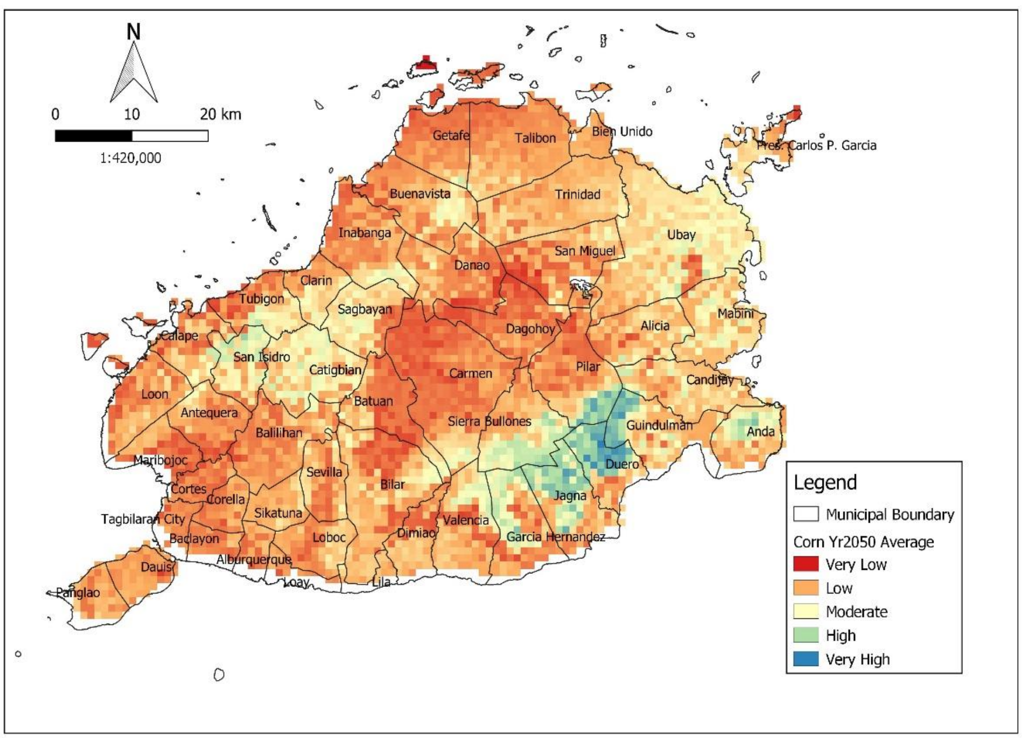


Figure 28. Corn sensitivity map of Bohol province in year 2050

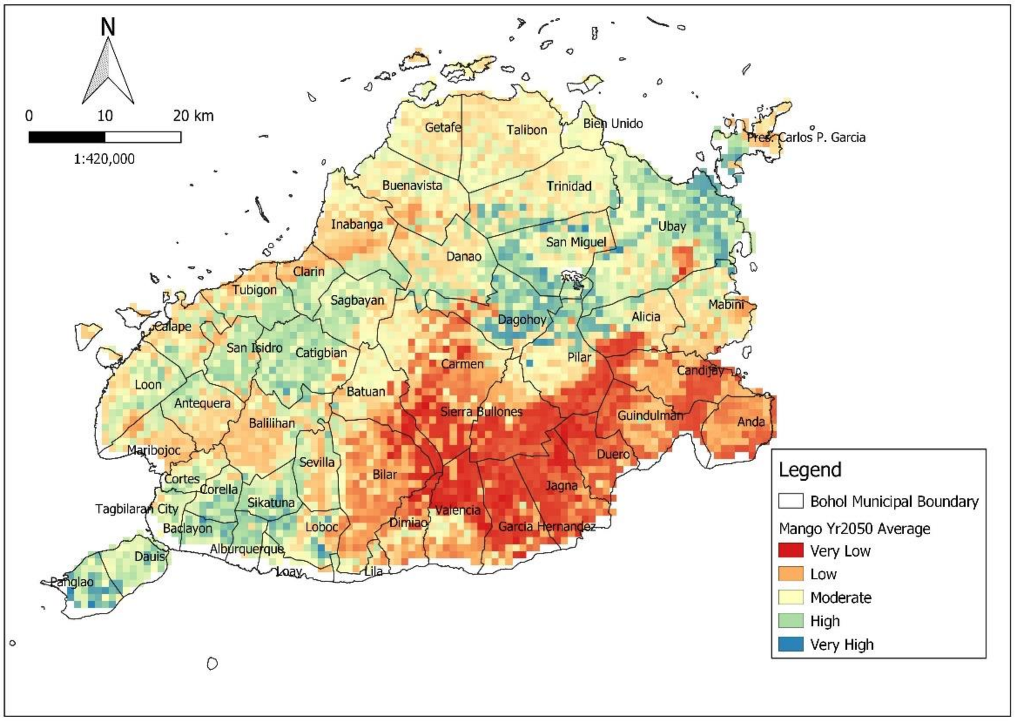


Figure 29. Mango sensitivity map of Bohol province in year 2050

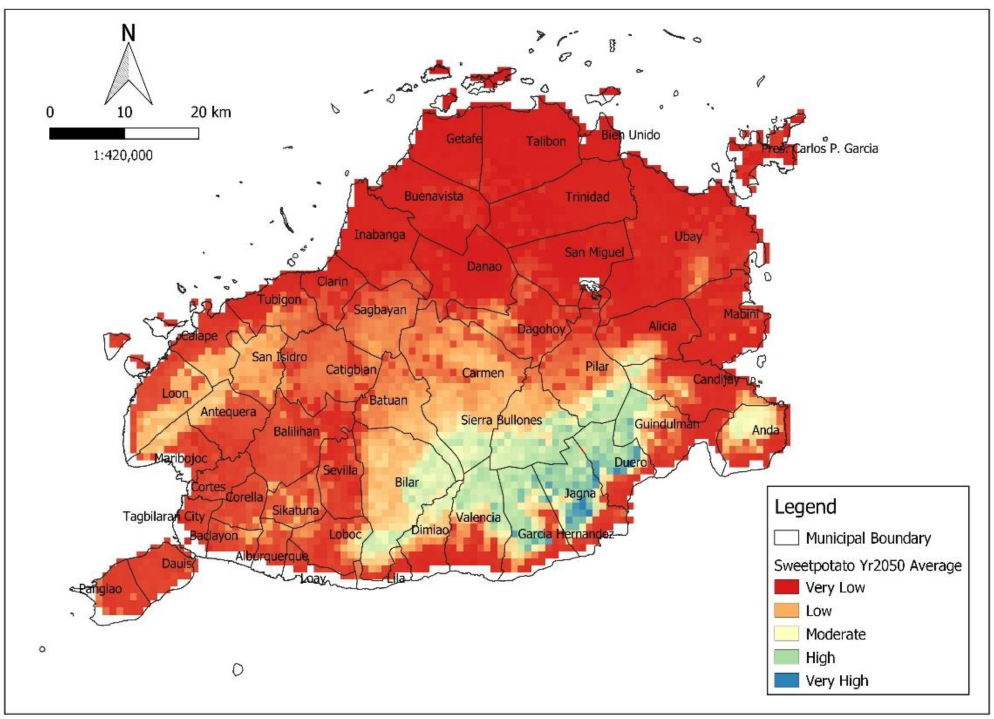


Figure 30. Sweet potato sensitivity map of Bohol province in year 2050

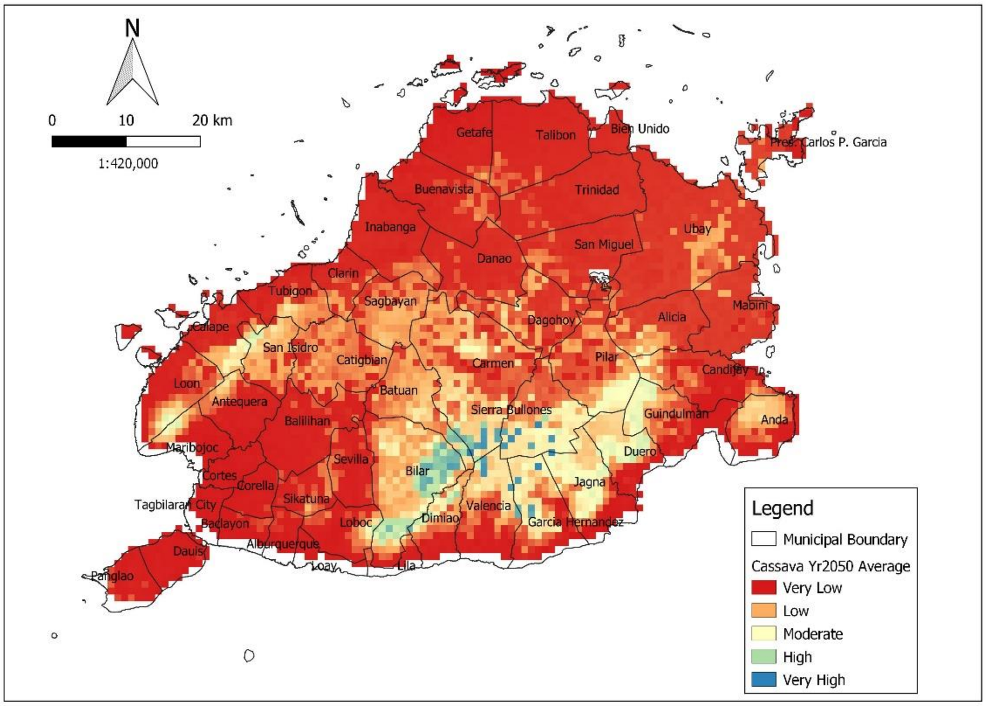


Figure 31. Cassava sensitivity map of Bohol province in year 2050

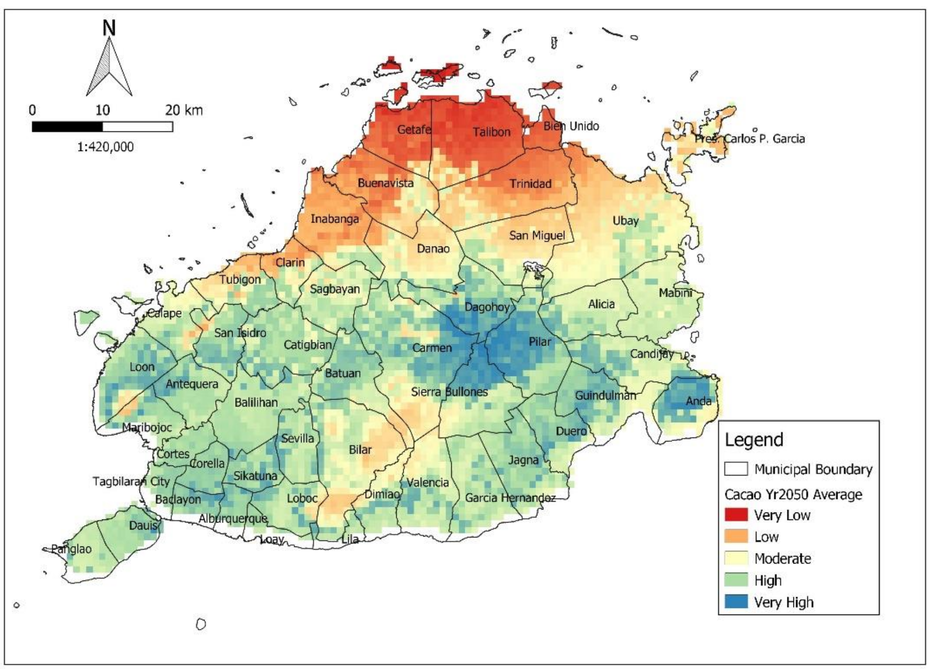


Figure 32 Cacao sensitivity map of Bohol province in year 2050

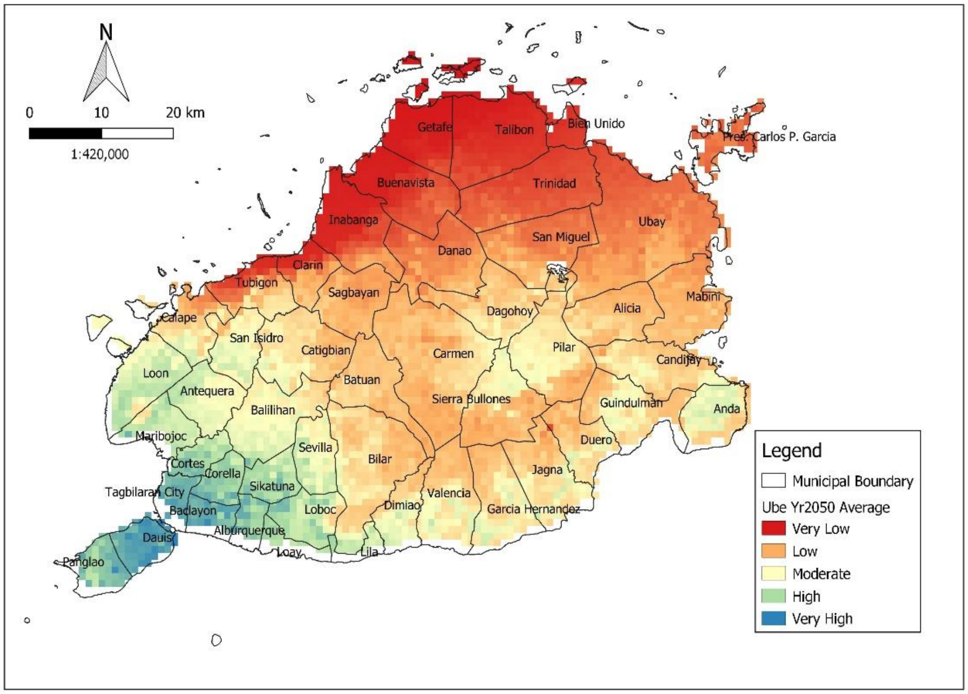


Figure 33. Ube-purple sensitivity map of Bohol province in year 2050

Climate Change Sensitivity: Province of Negros Oriental

The northern part of the province stretching from Manjuyod to Canlaon City generally shows a low to very low sensitivity for all crops. For corn, a moderate to high sensitivity is evident from the central down to the southern part of the province (Figure 34). Sugarcane sensitivity is generally moderate to high starting from Mabinay down to southern part of the province (Figure 35). Rice sensitivity on the province is projected to be high to very high in Mabinay, Bayawan City, Basay, Santa Catalina, Siaton, Zamboangita and to some parts of Tayasan, Bais City, Tanjay City, Pamplona, Dauin and Bacong, Valencia and Dumaguete City (Figure 36). Meanwhile, sensitivity for banana is moderate to very high from Bindoy down to southern part of the province (Figure 37). For pinakbet, Basay, Bayawan City, Dumaguete and Bacong shows a moderate to high sensitivity (Figure 38). For coffee, the southern part of the province has a low to high sensitivity (Figure 39). Meanwhile, the south eastern part of the province projects a high to very high sensitivity for mango (Figure 40). Cassava generally has a very low sensitivity for the most part of the province (Figure 41). Cacao generally shows a low to moderate sensitivity for the southern part of the province (Figure 42).

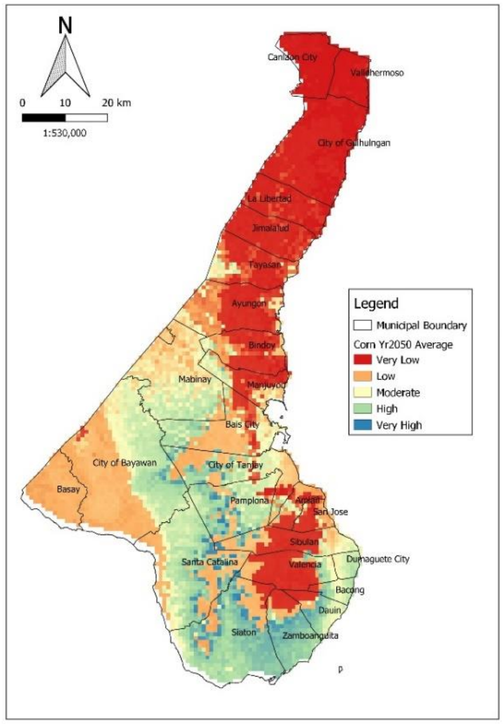


Figure 34. Corn sensitivity map of Negros Oriental province in year 2050

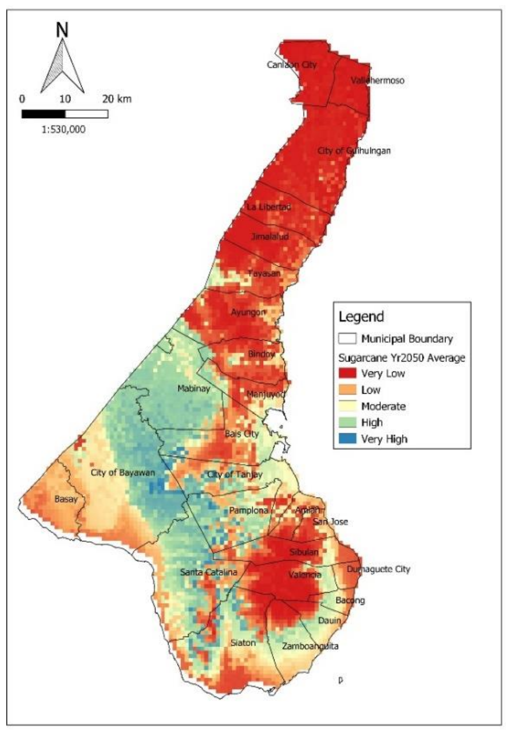


Figure 35. Sugarcane sensitivity map of Negros Oriental province in year 2050

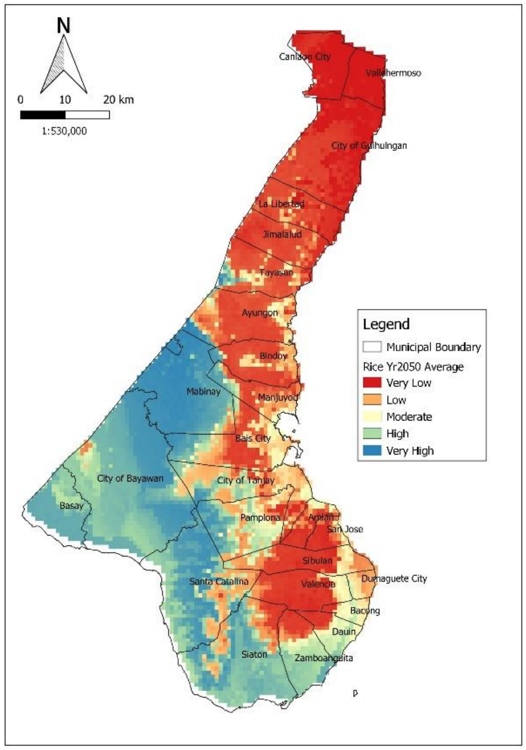


Figure 36. Rice sensitivity map of Negros Oriental province in year 2050

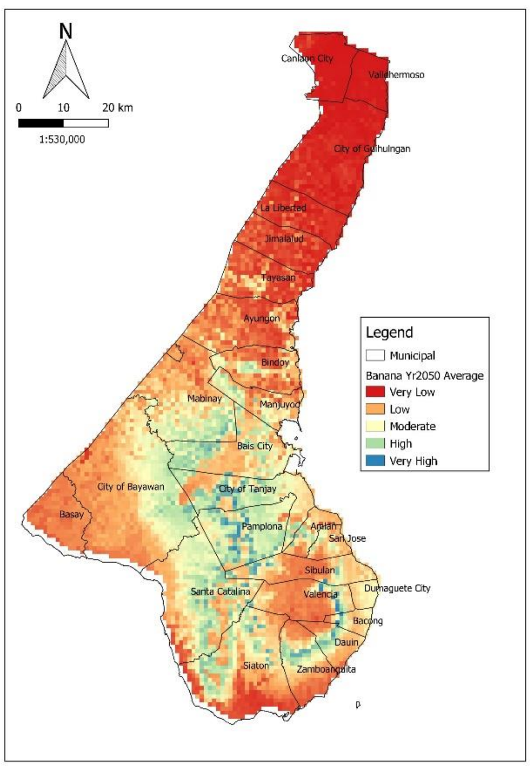


Figure 37. Banana sensitivity map of Negros Oriental province in year 2050

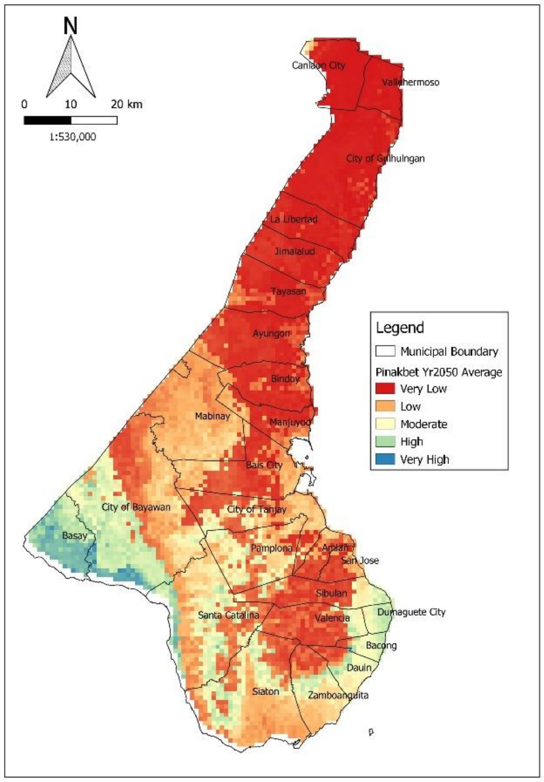


Figure 38. Pinakbet sensitivity map of Negros Oriental province in year 2050

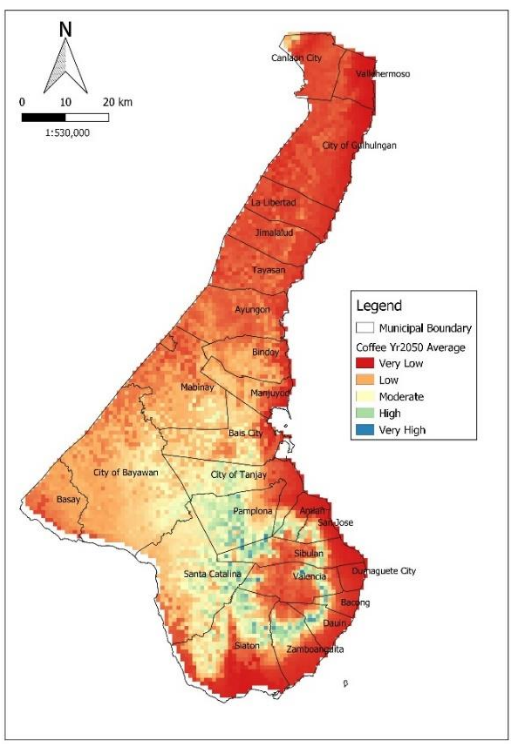


Figure 39. Coffee sensitivity map of Negros Oriental province in year 2050

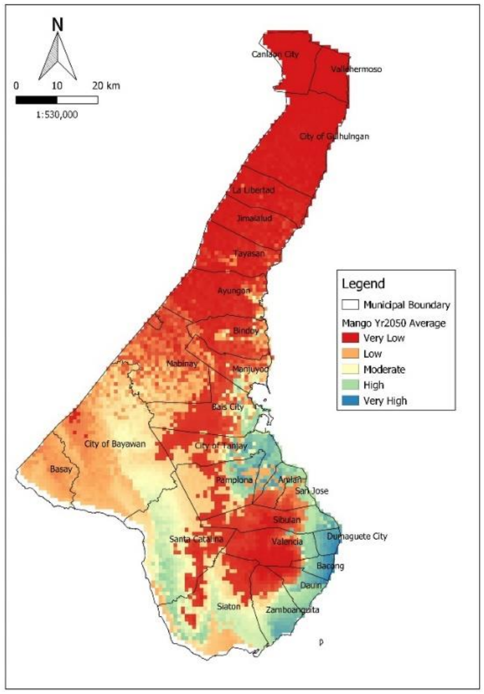


Figure 40. Mango sensitivity map of Negros Oriental province in year 2050

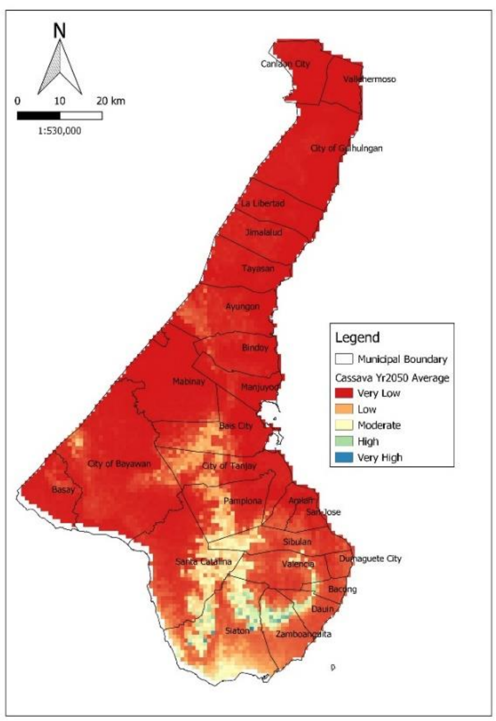


Figure 41. Cassava sensitivity map of Negros Oriental province in year 2050

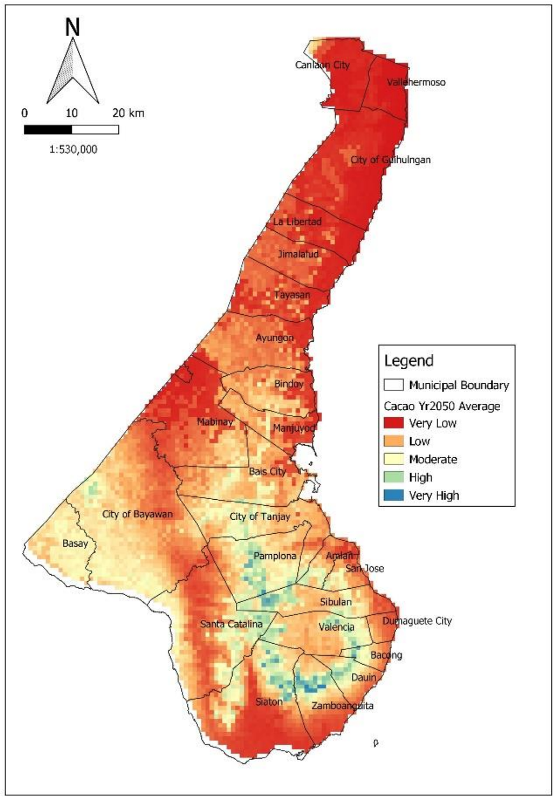


Figure 42. Cacao sensitivity map of Negros Oriental province in year 2050

Climate Change Sensitivity: Siquijor Province

Sensitivity for banana, cassava, corn for the most part of the province generally ranges from moderate to very low. But the some parts of Siquijor and San Juan projects a high to moderate sensitivity (Figure 43-45). For rice, majority of the municipalities has a low to very low sensitivity while some parts of Maria and Lazi project a sensitivity ranging from moderate to high (Figure 46). Mango are likely to have a moderate to high sensitivity except for the most parts of Siquijor and Larena (Figure 47). Pinakbet generally projects a low to very low sensitivity for the whole province while some parts of San Juan shows a moderate to high sensitivity (Figure 48).

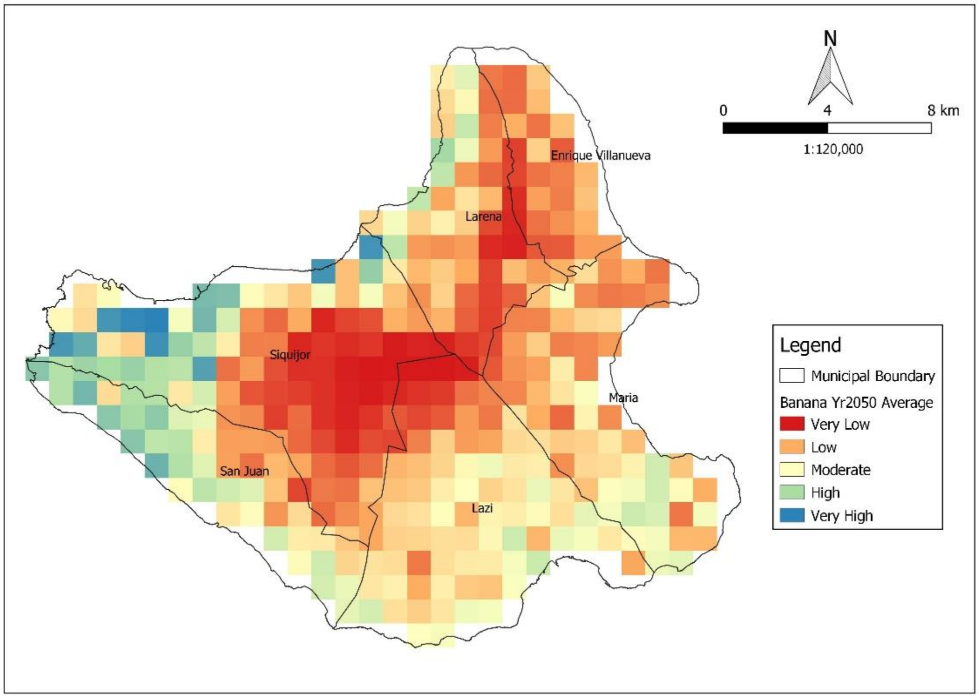


Figure 43. Banana sensitivity map of Negros Oriental province in year 2050

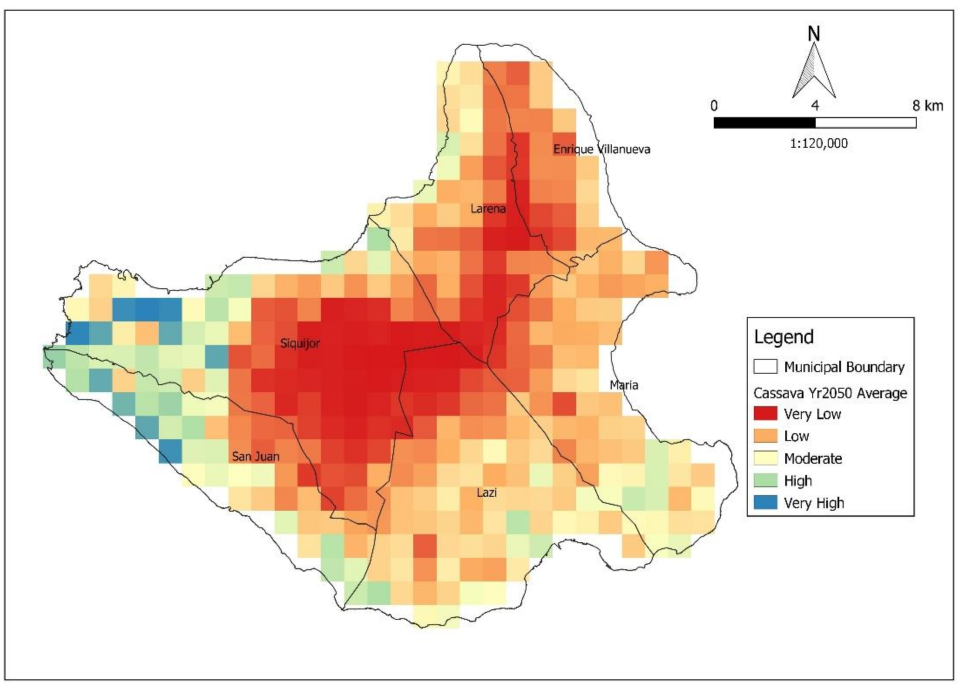


Figure 44. Cassava sensitivity map of Negros Oriental province in year 2050

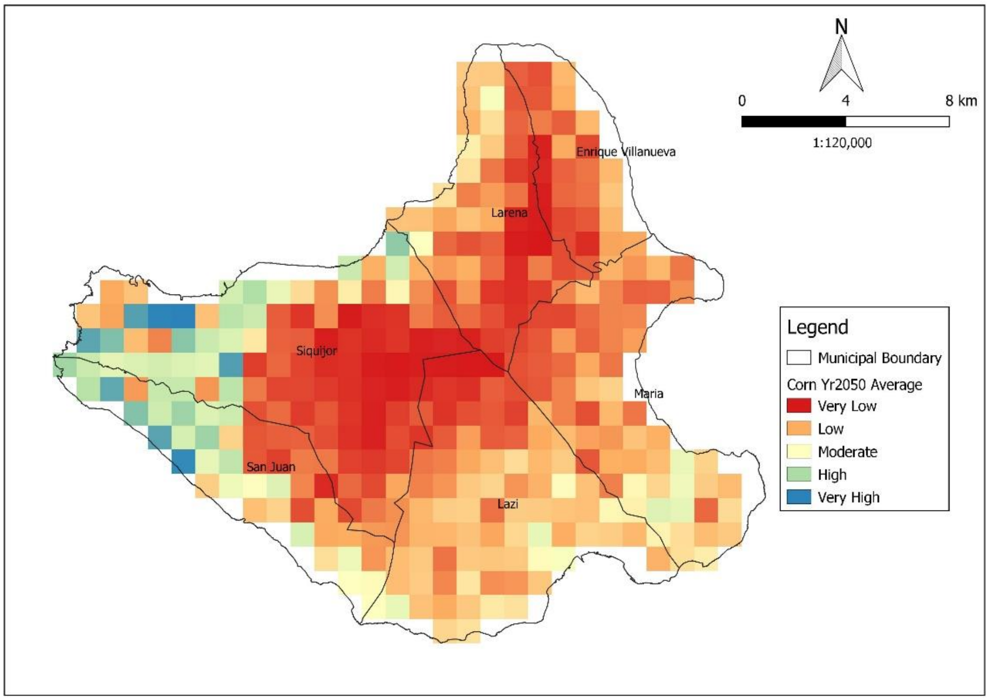


Figure 45. Corn sensitivity map of Negros Oriental province in year 2050

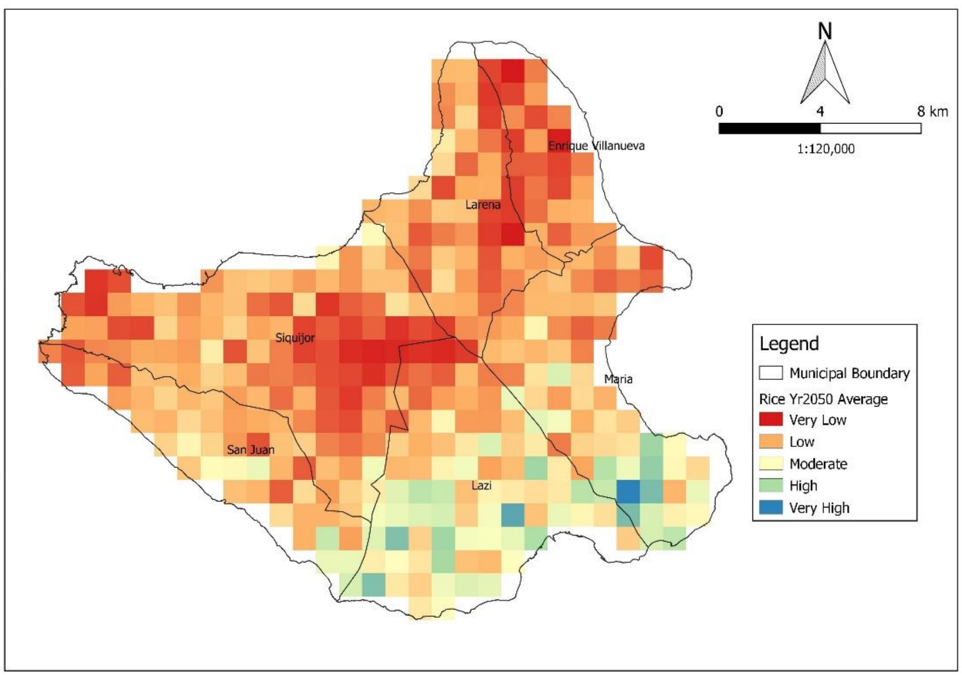


Figure 46.Rice sensitivity map of Negros Oriental province in year 2050

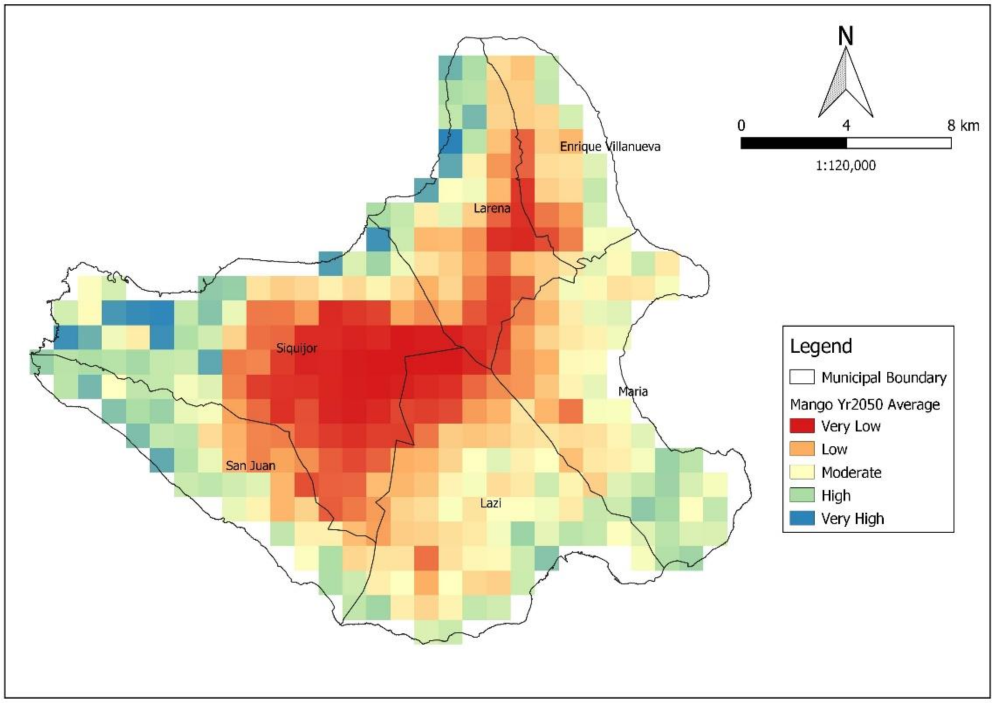


Figure 47. Mango sensitivity map of Negros Oriental province in year 2050

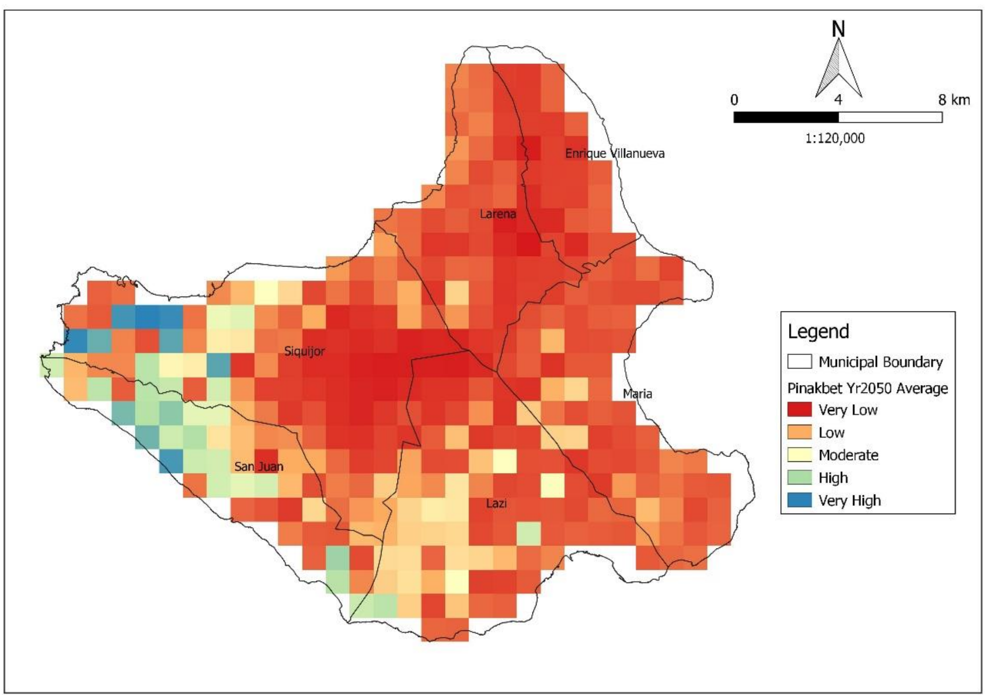


Figure 48. Pinakbet sensitivity map of Negros Oriental province in year 2050

CLIMATE CHANGE HAZARDS

Climate Change Hazards: Bohol Province

Figure 49 presents the exposure of areas in Bohol to climate change hazards. Combined exposure index of typhoon, flooding, drought, landslide, soil erosion, sea-level rise and saltwater intrusion shows that all places situated in the north eastern part of the province have a very high exposure to hazards.

In terms of specific hazard exposure, places in the northeast-part of Bohol such as Buenavista, Getafe, Talibon, Bien Unido, Trinidad, San Miguel, Ubay, Mabini and Pres. Carlos P. Garcia were noted as the most exposed to typhoon. One probable reason is the geographic location of the areas mentioned. Since these places are usually hit from the path of typhoons coming from the Pacific. The very high exposure to flooding is noted in Loay, Inabanga, Candijay and Pres. Carlos P. Garcia which is due to its low elevation and land delineation. All are located in the coastline of the island. Drought Map, on the other hand, was generated through the data acquired in the recent drought last July 2019. It shows that Bien Unido is mostly affected by drought followed by Getafe and Buenavista.

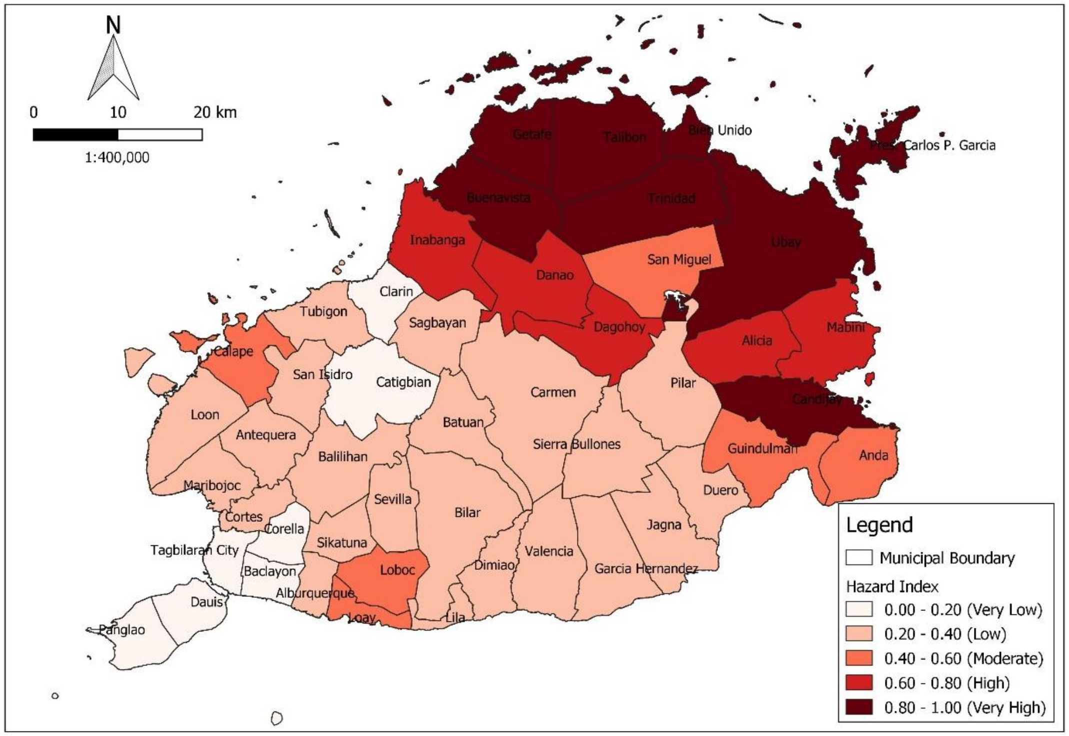


Figure 50. Hazard Index Map of Bohol

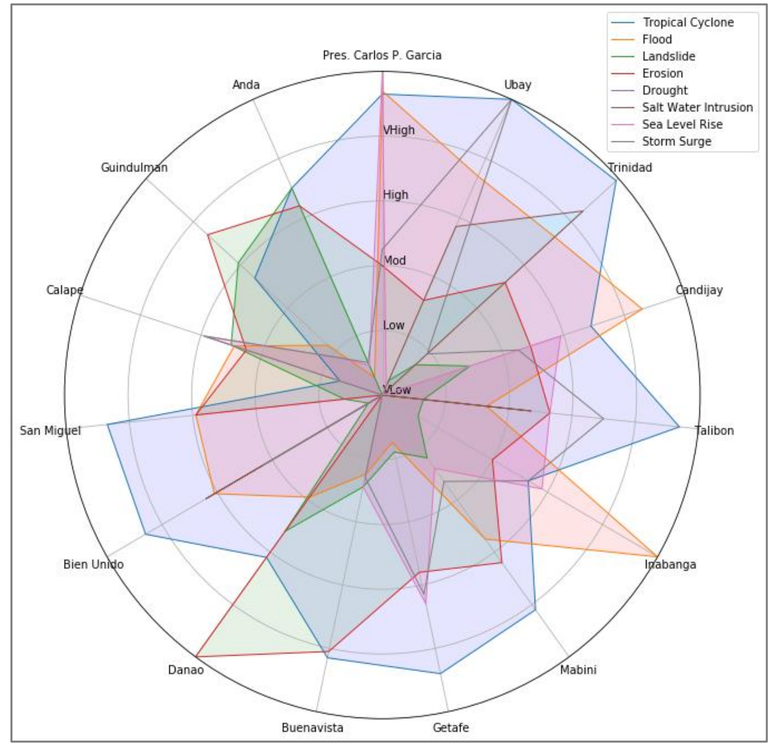


Figure 49. Hazard Radar Plot of Bohol

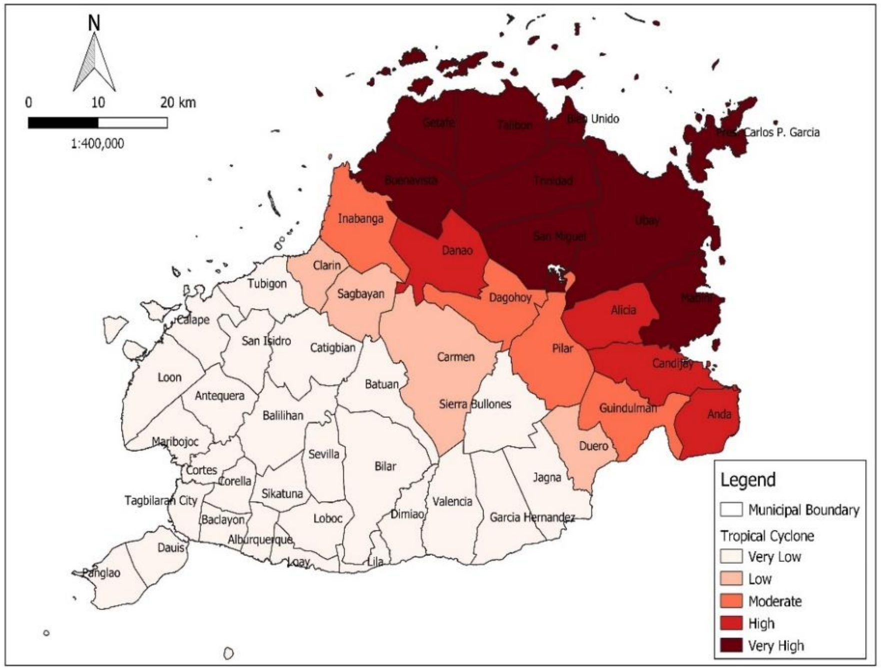


Figure 51. Tropical Cyclone Exposure of Bohol

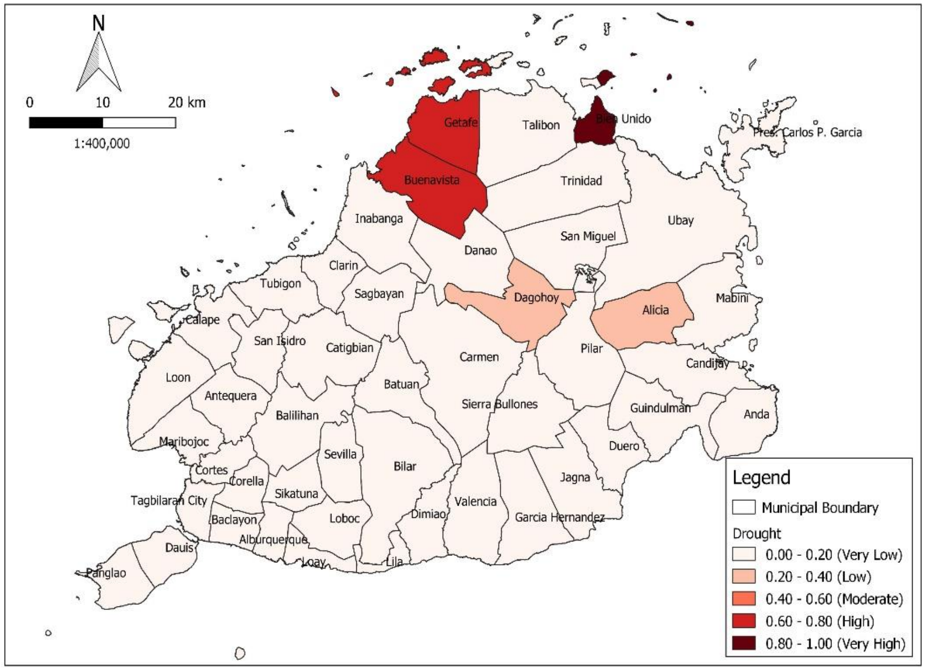


Figure 52. Drought Exposure of Bohol

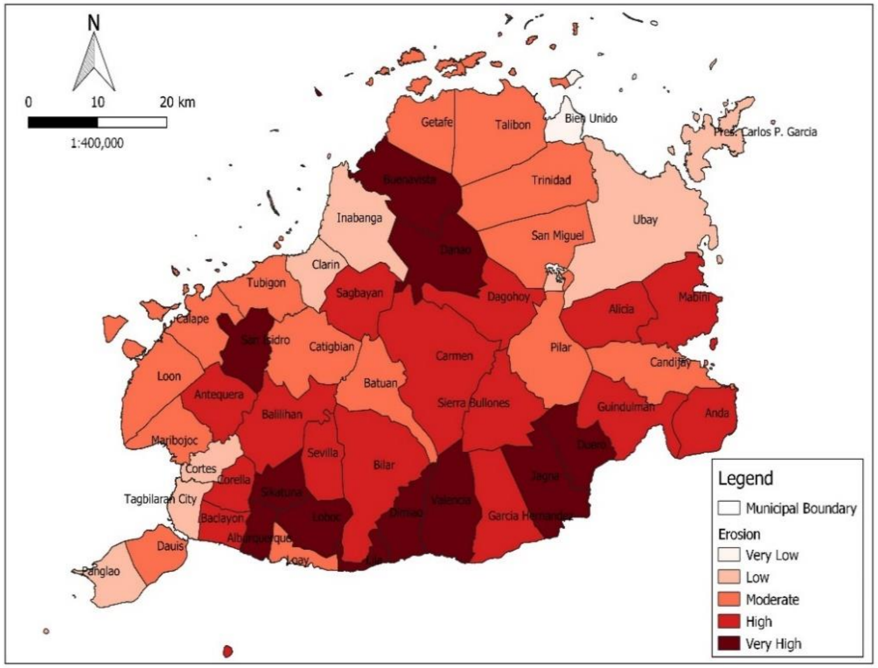


Figure 54. Erosion Exposure of Bohol

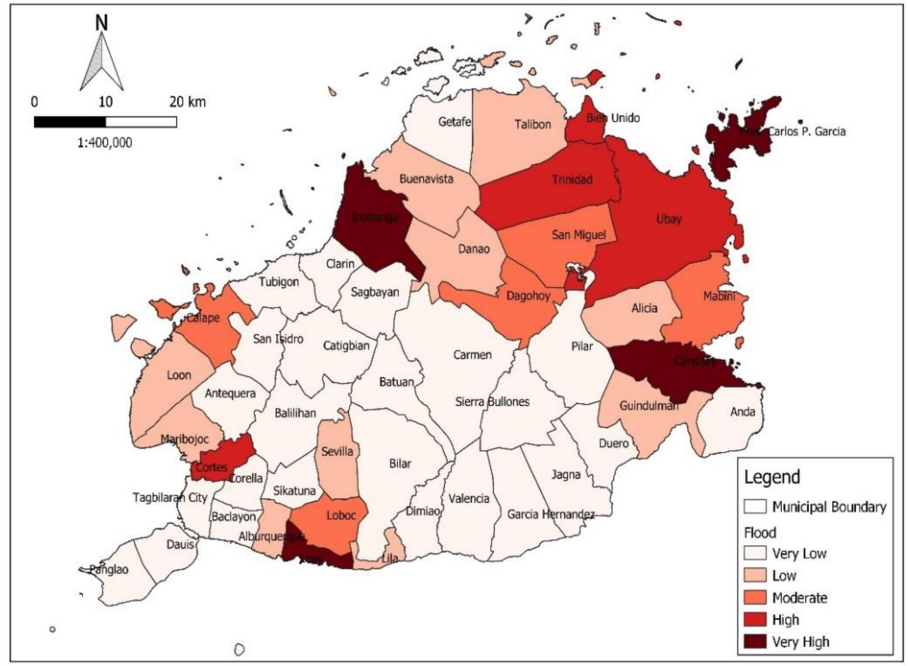


Figure 53. Flood Exposure of Bohol

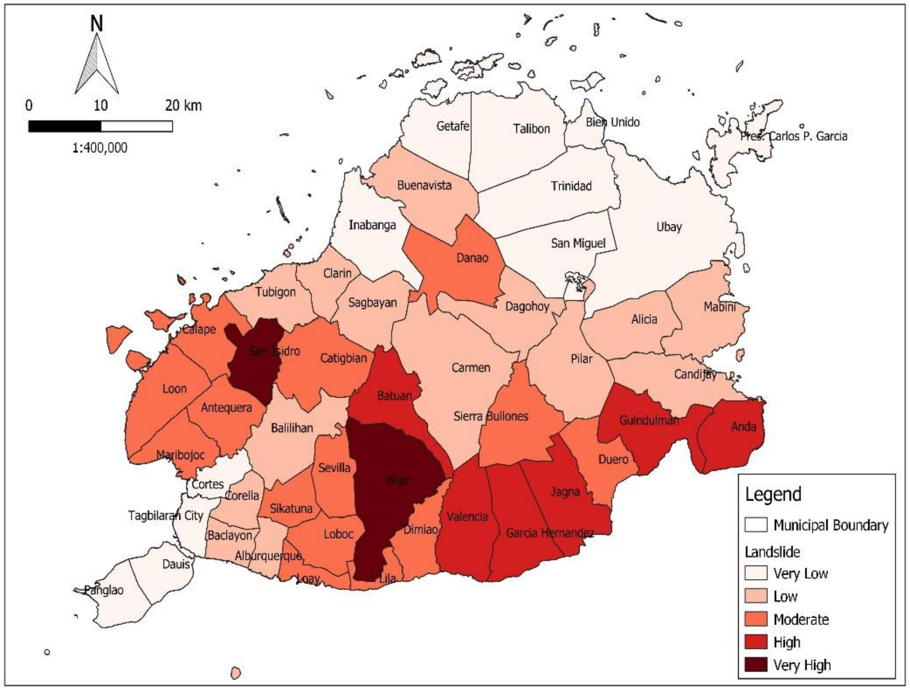


Figure 56. Landslide Exposure of Bohol

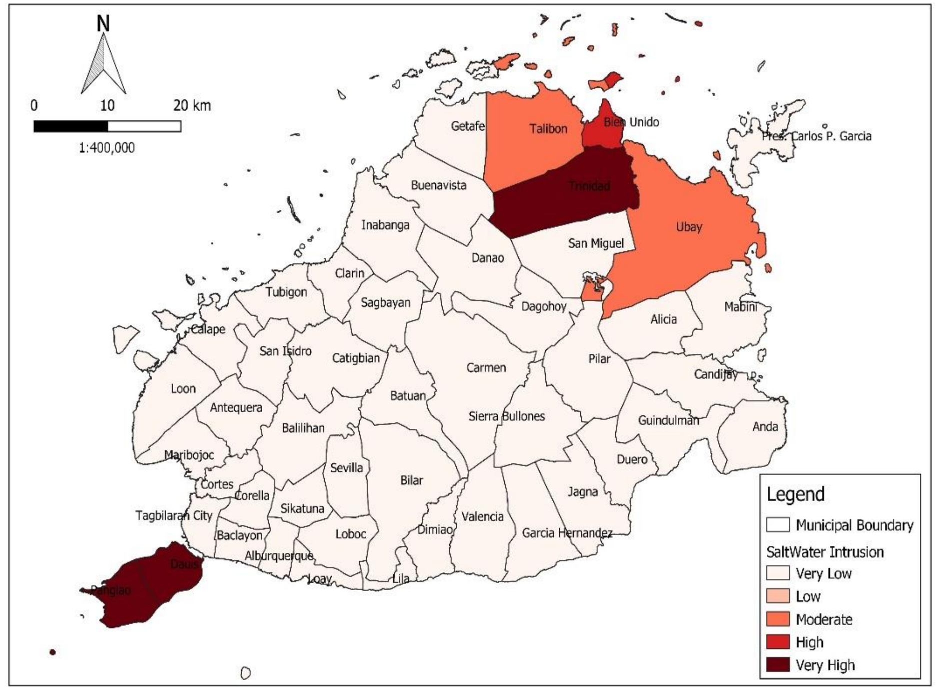


Figure 55. Saltwater Intrusion Exposure of Bohol

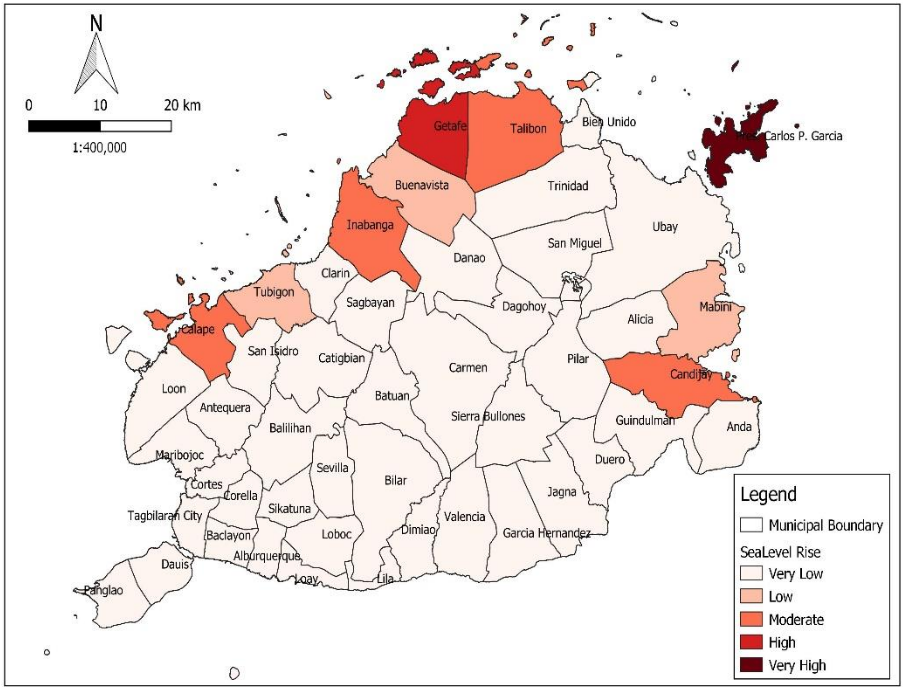


Figure 57. Sea Level Rise Exposure of Bohol

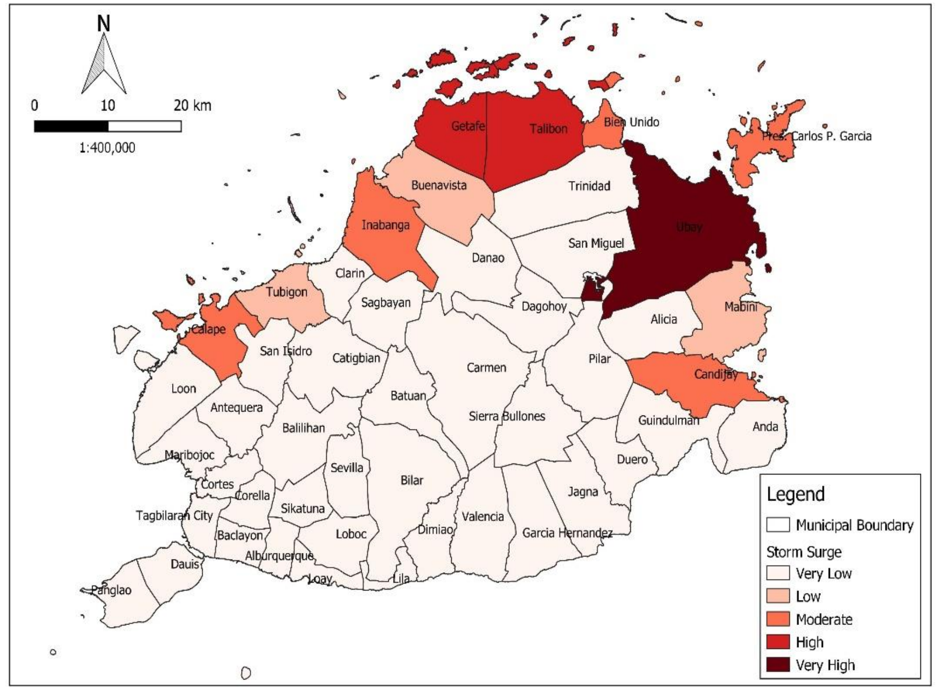


Figure 58. Storm Surge Exposure of Bohol

Climate Change Hazards: Negros Oriental

Only the City of Tanjay is exposed to very high risk when all of the hazards are combined while Mabinay, Valencia, Bacong, Dauin and Dumaguete City are at the lowest risk (Figure 59). In terms of specific hazard, the northernmost place of the island is exposed to Tropical Cyclone making Canlaon City and Vallehermoso exposed to very high risk. The exposure lessens as it traverses to the southern part of the island making cities and municipalities such as Basay, Bayawan City, Santa Catalina, Siaton and Zamboanguita the least exposed. The City of Bayawan is also noted to its very high exposure to drought followed by Santa Catalina and Siaton. The whole island is also exposed to erosion aside from Dumaguete City. The City of Tanjay is at very exposure risk for both Storm Surge, Sea Level Rise followed by Bais City and Bayawan City. Tanjay City is also at the highest risk in Flood followed by Bais City, Amlan, Bacong and Dumaguete City.

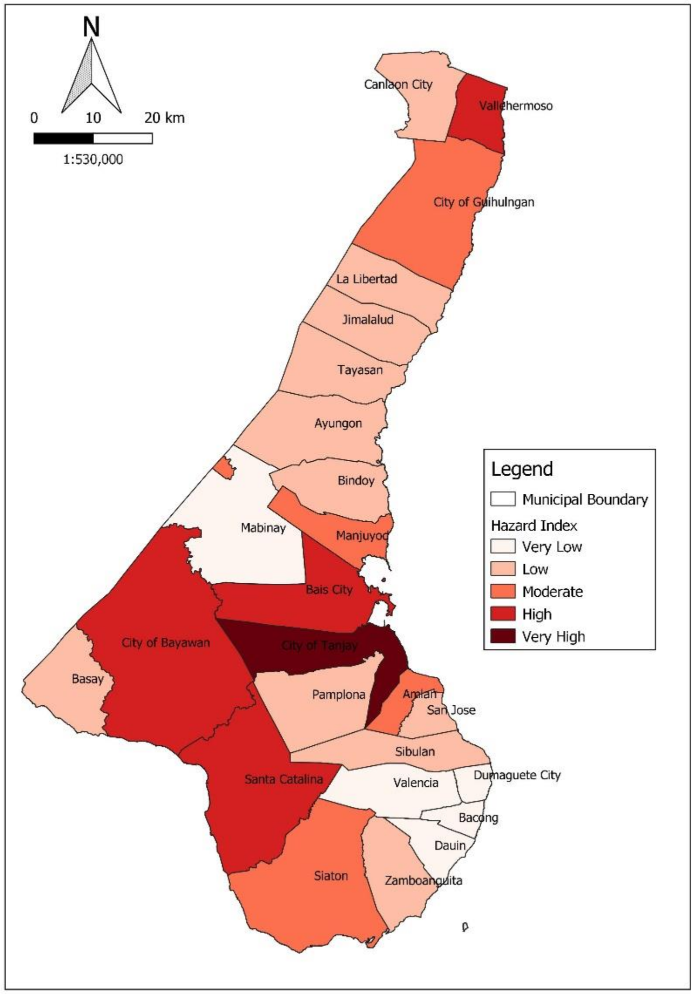


Figure 59. Hazard Index Map of Negros Oriental

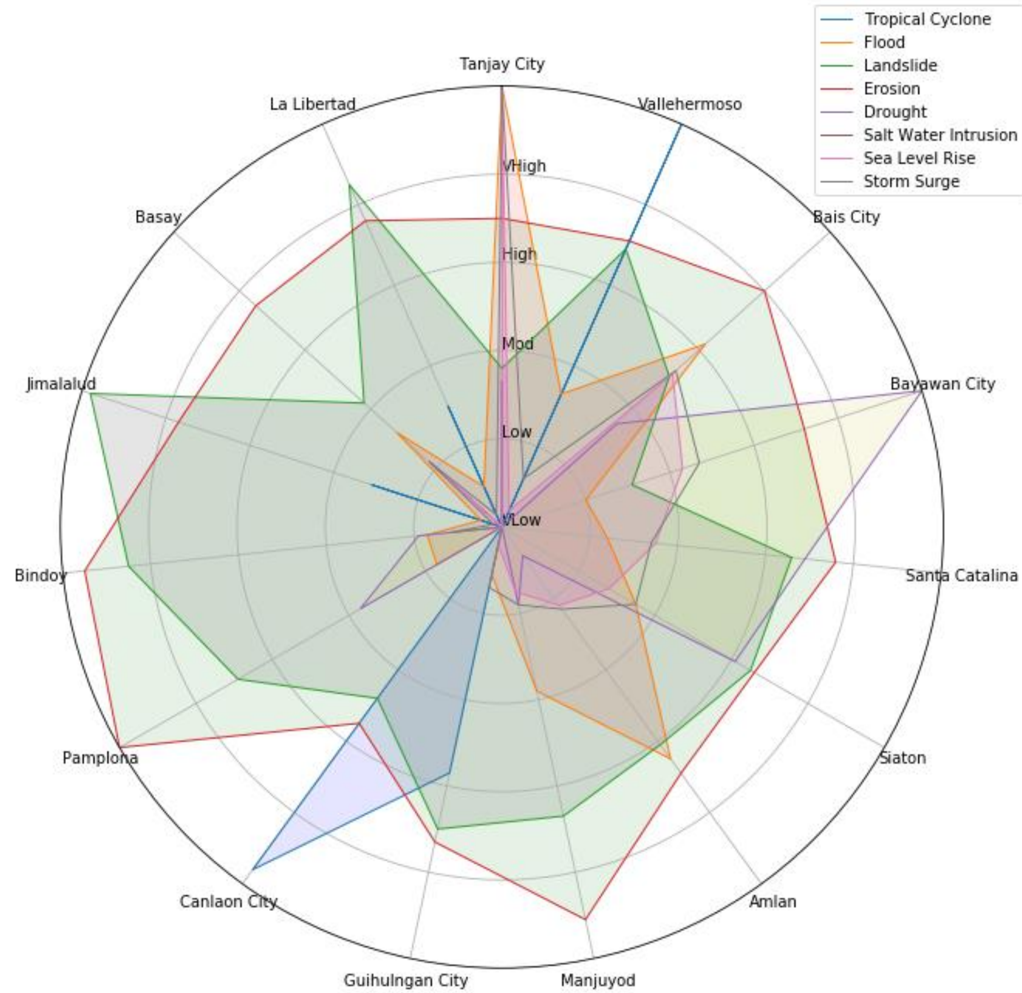


Figure 60. Hazard Index Radar Plot of Negros Oriental

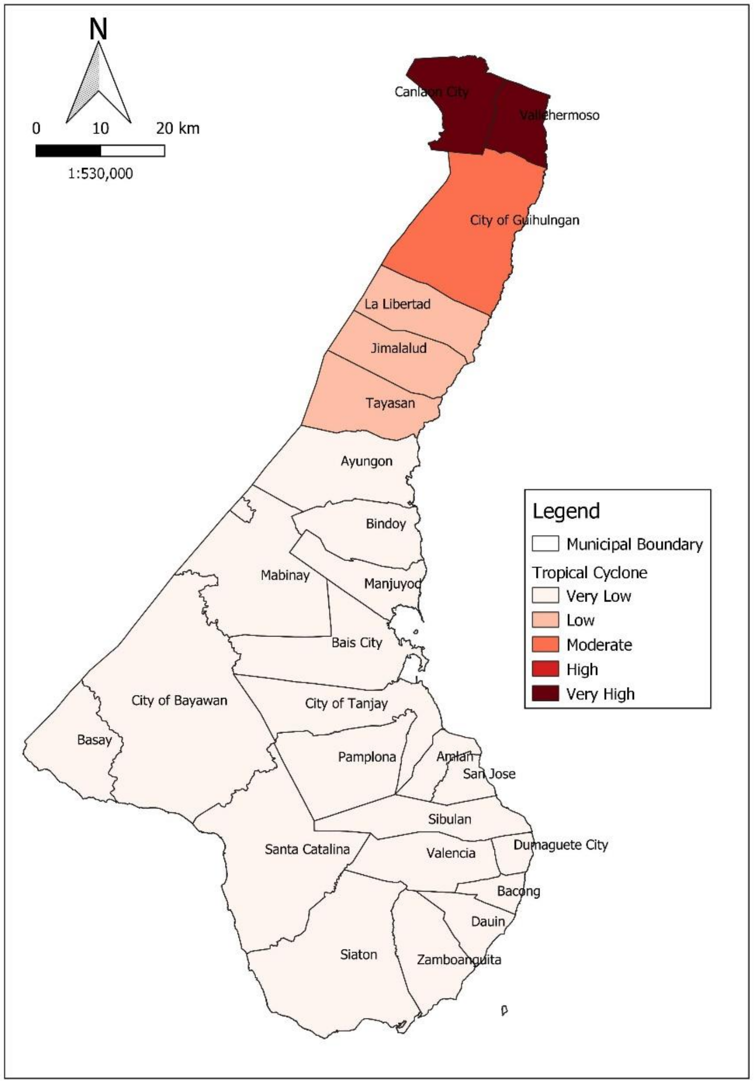


Figure 62. Tropical Cyclone Exposure of Negros Oriental

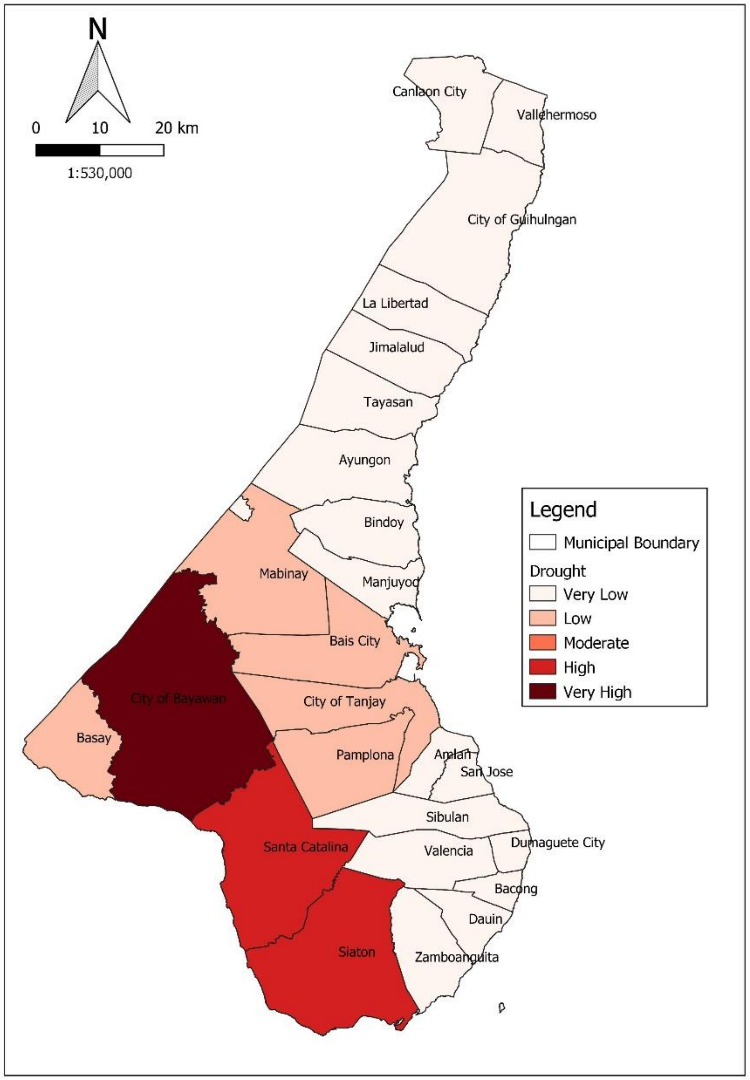


Figure 61. Drought Exposure of Negros Oriental

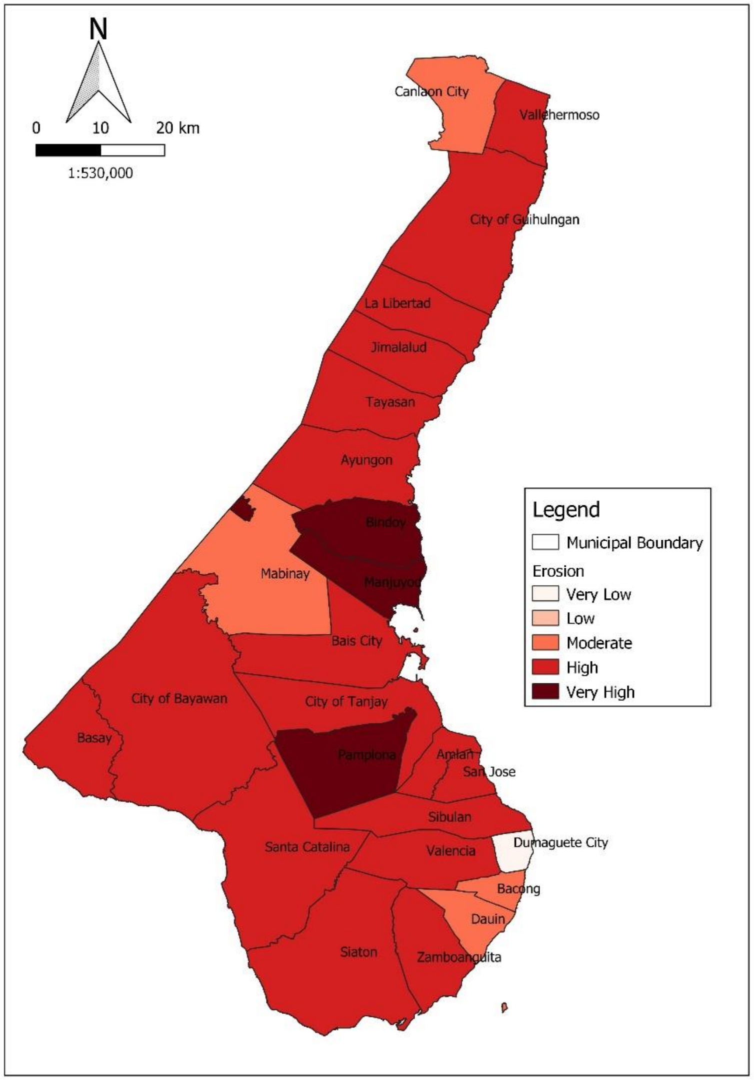


Figure 63. Erosion Exposure of Negros Oriental

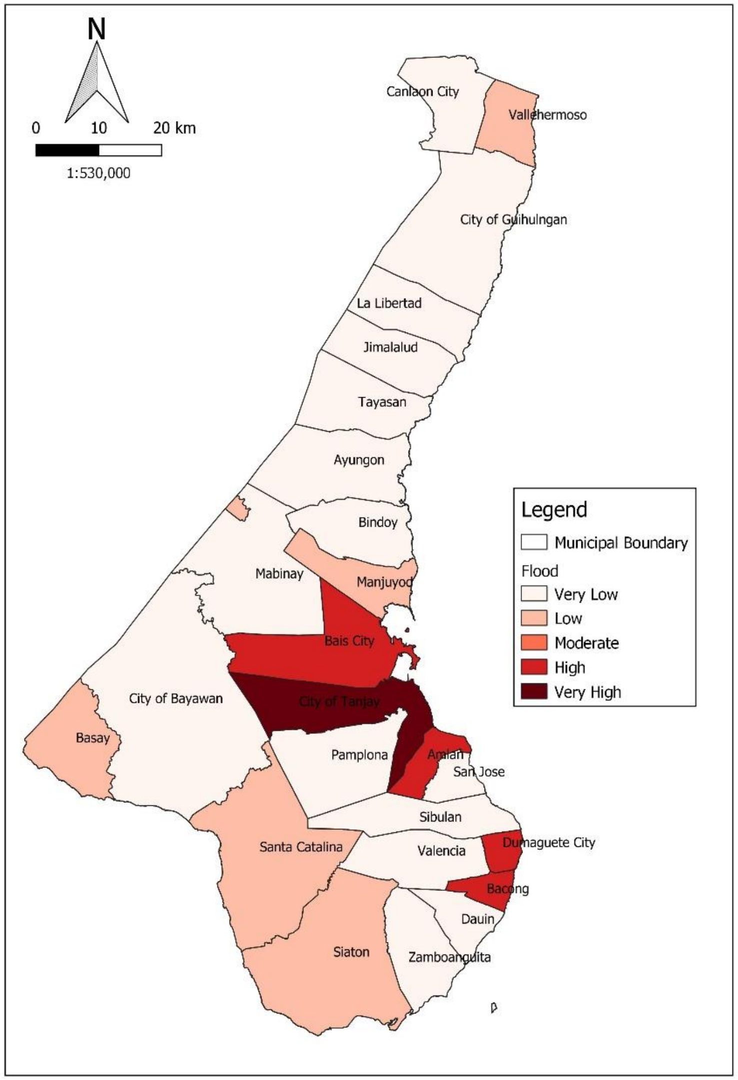


Figure 64. Flood Exposure of Negros Oriental

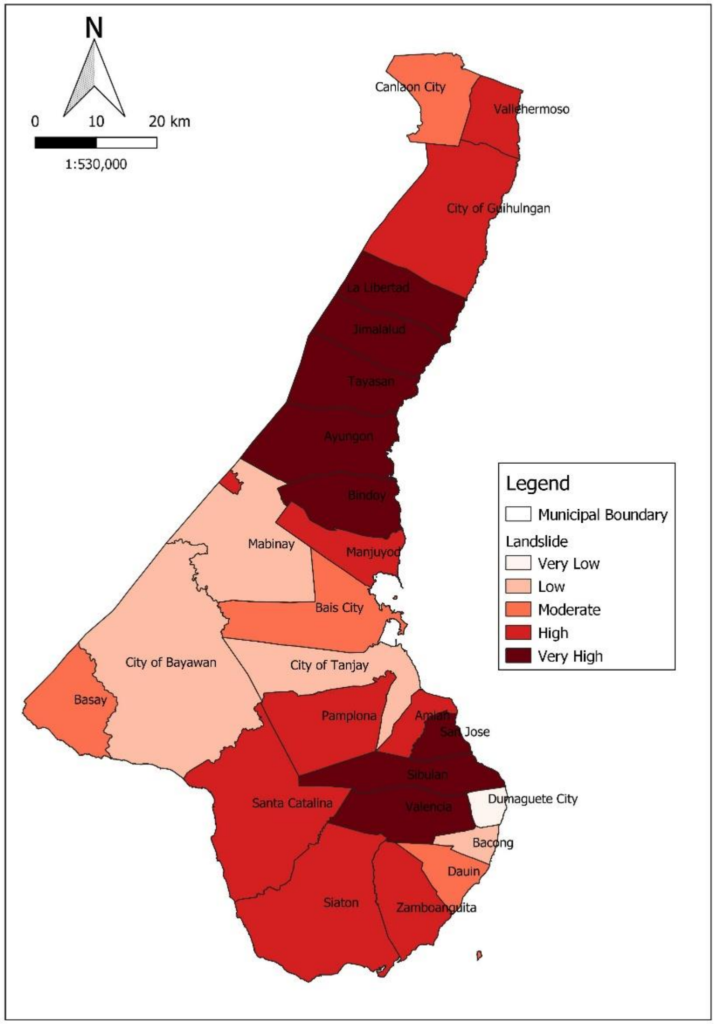


Figure 66. Landslide Exposure of Negros Oriental

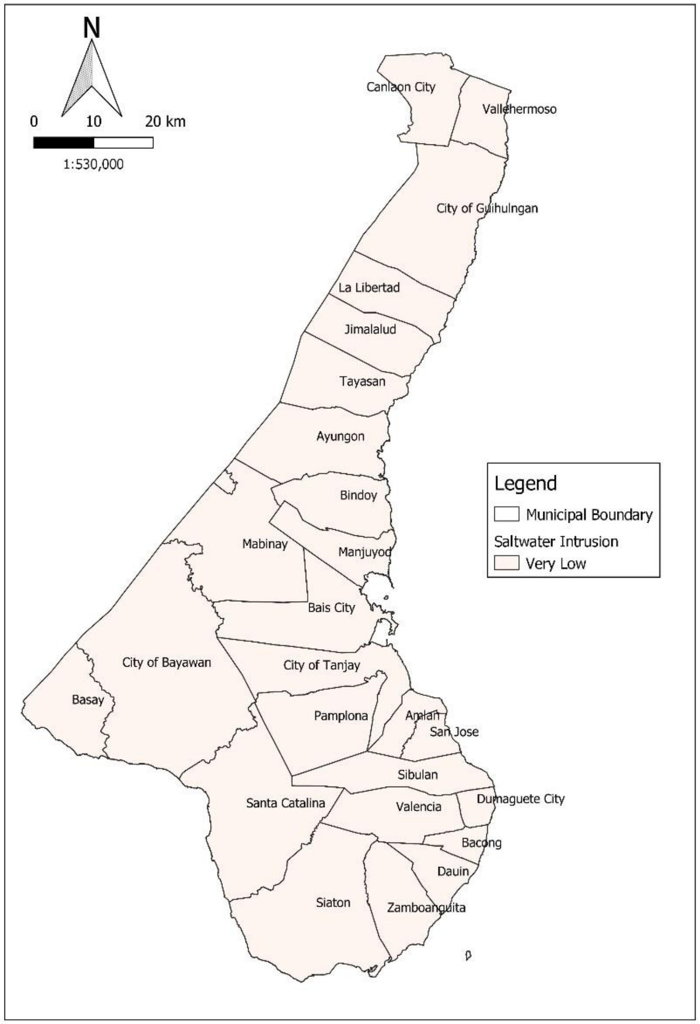


Figure 65. Saltwater Instrusion Exposure of Negros Oriental

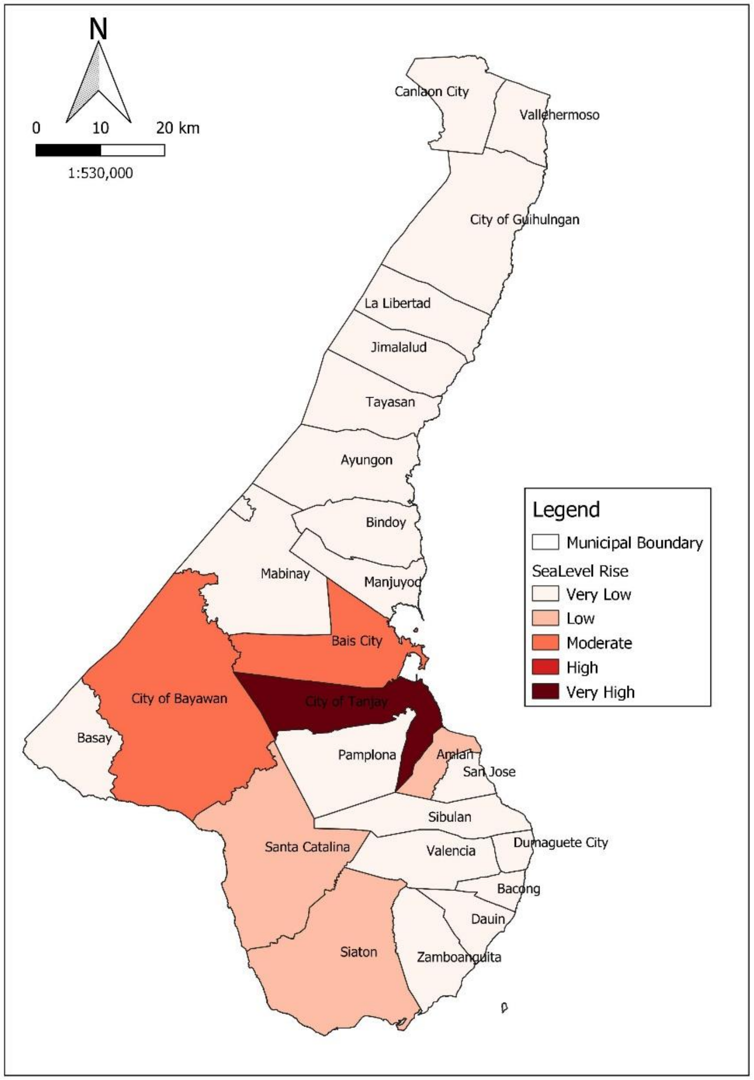


Figure 68. Sea Level Rise Exposure of Negros Oriental

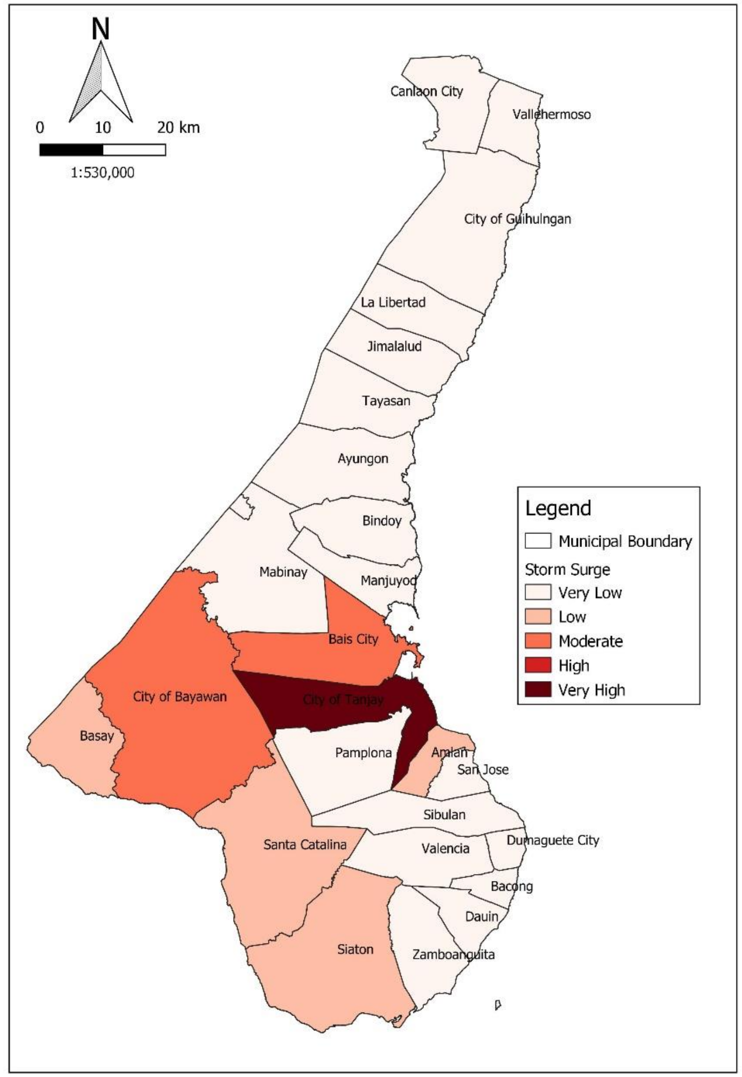


Figure 67. Storm Surge Exposure of Negros Oriental

Climate Change Hazards: Siquijor

Computed index shows that the municipality of Siquijor has the highest hazard exposure when while Enrique Villanueva and Maria has the lowest (Figure 69). Results show that the whole island is not affected by Tropical Cyclone, Landslide and Saltwater Intrusion. Siquijor displayed the highest exposure when it comes to flooding followed by San Juan. Meanwhile, Larena, Maria and Lazi has the lowest exposure to flooding. Siquijor is also at the very high exposure for both Sea Level Rise and Storm Surge compared to the other municipalities. Larena projected the highest exposure in Erosion followed by Enrique Villanueva and Lazi.

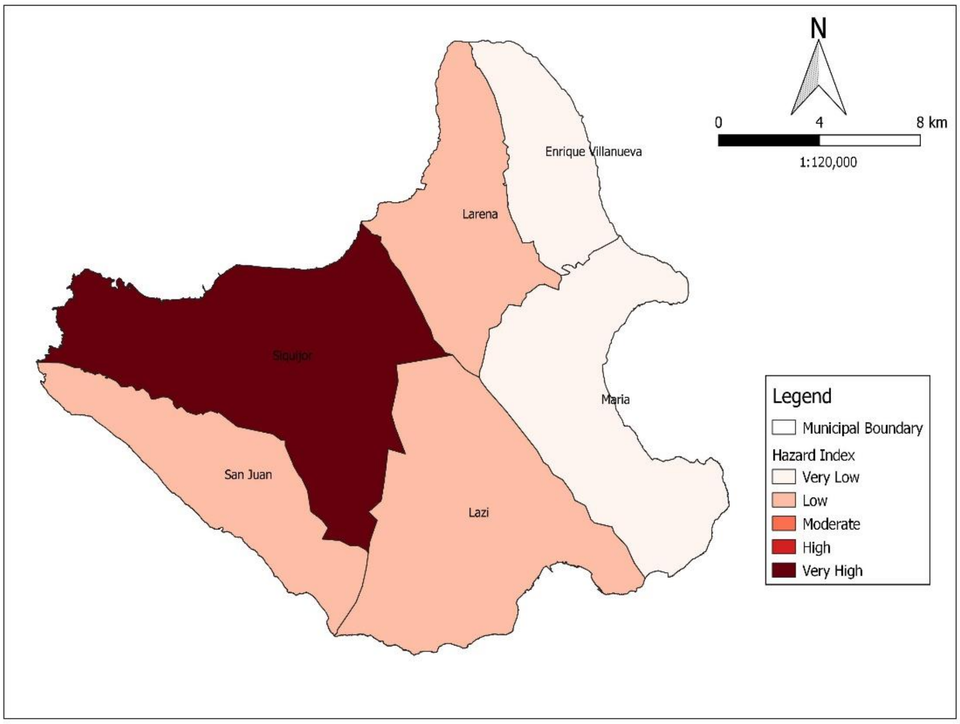


Figure 69. Hazard Index Map of Siquijor Province

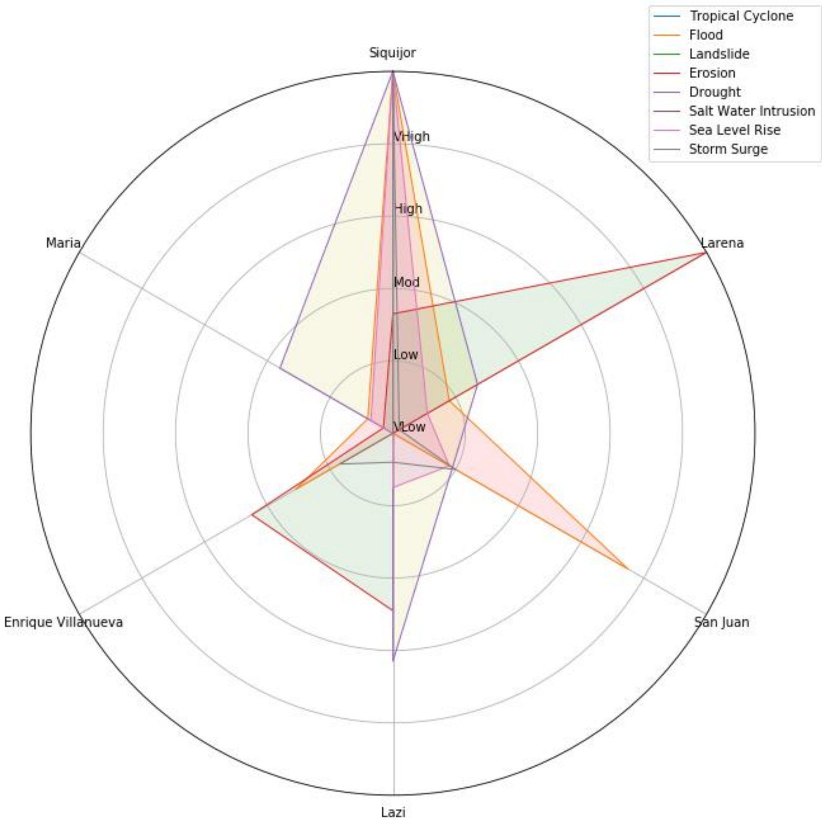


Figure 70. Hazard Index Radar Plot of Siquijor

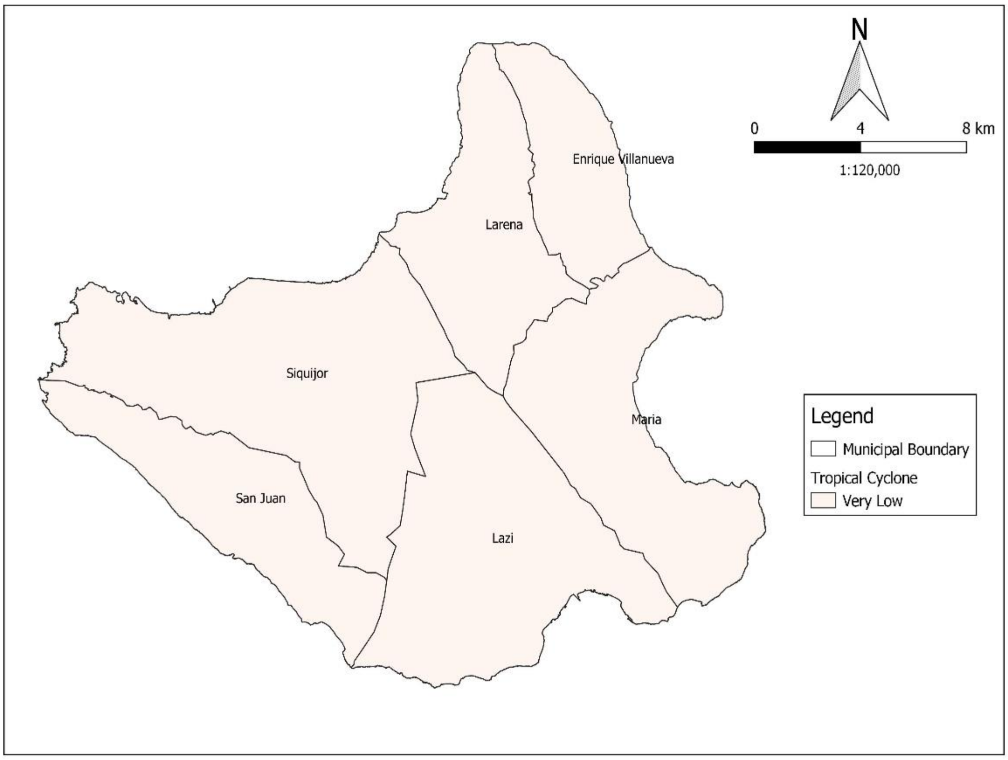


Figure 71. Tropical Cyclone Exposure of Siquijor

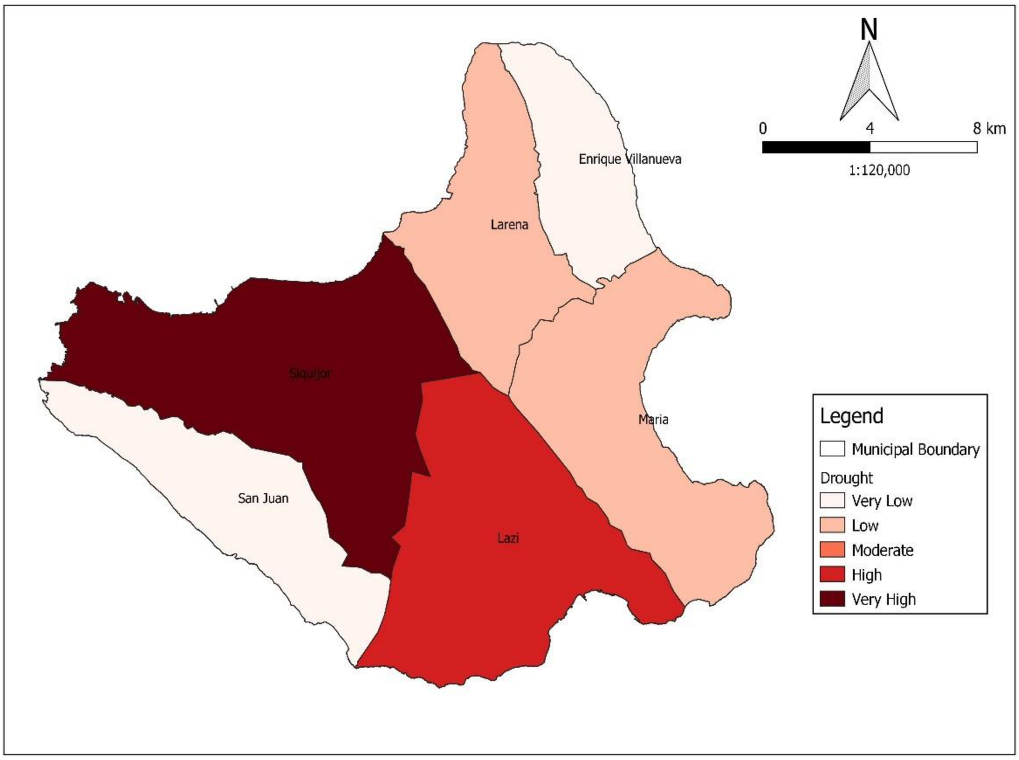


Figure 72. Drought Exposure of Siquijor

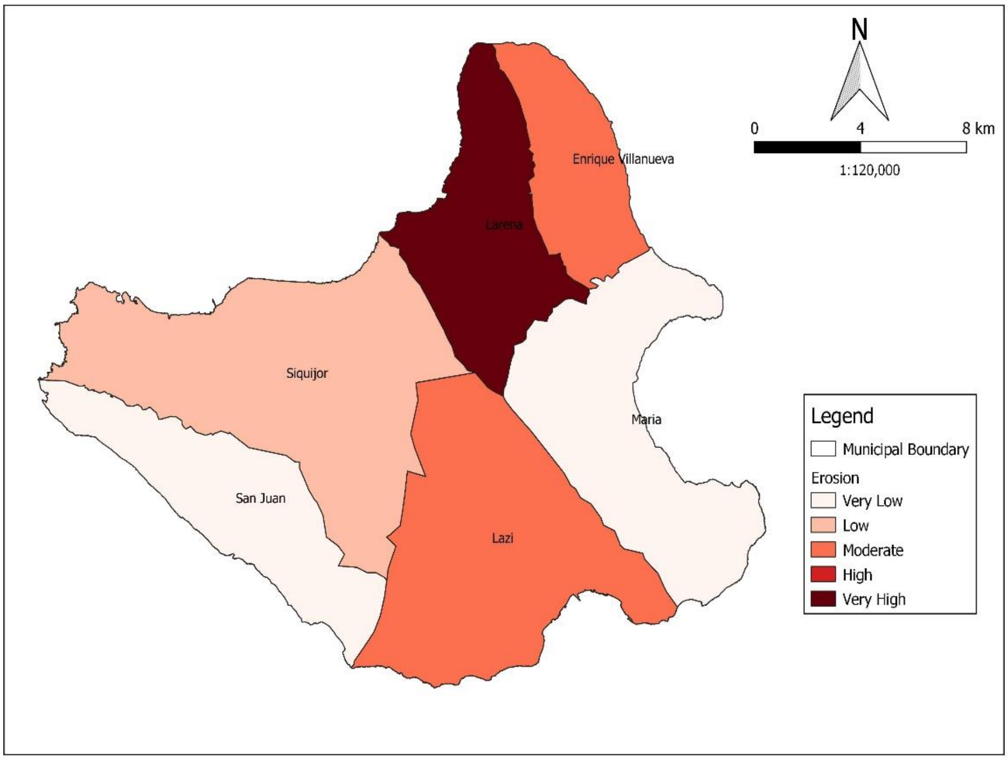


Figure 73. Erosion Exposure of Siquijor

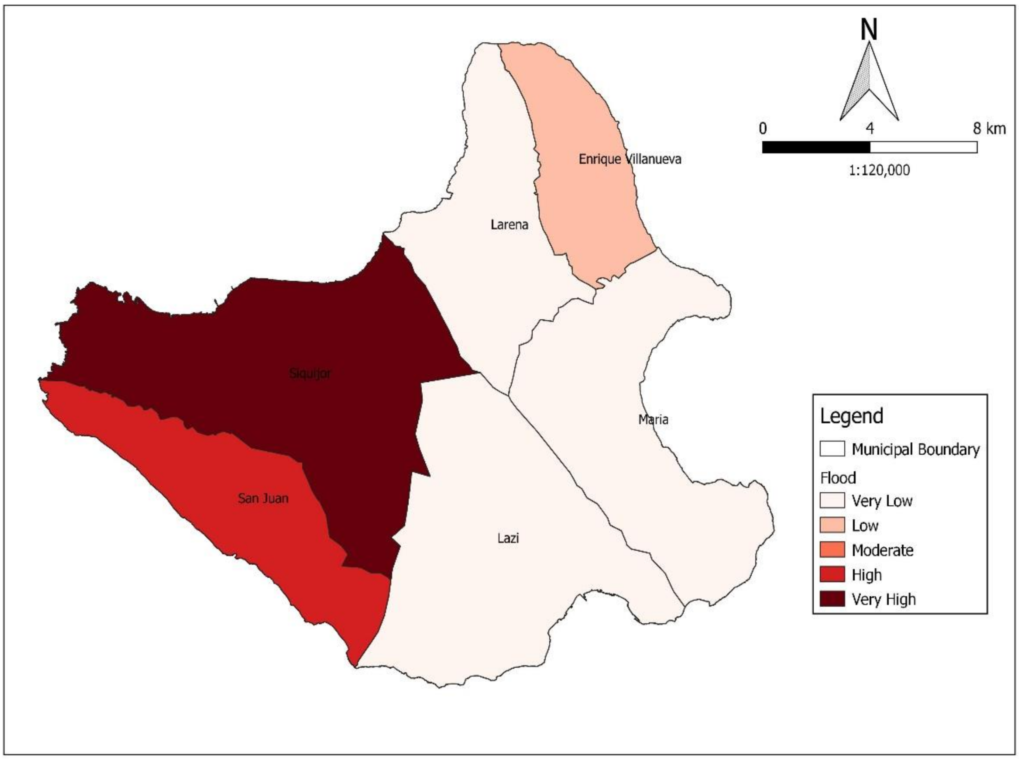


Figure 74. Flood Exposure of Siquijor

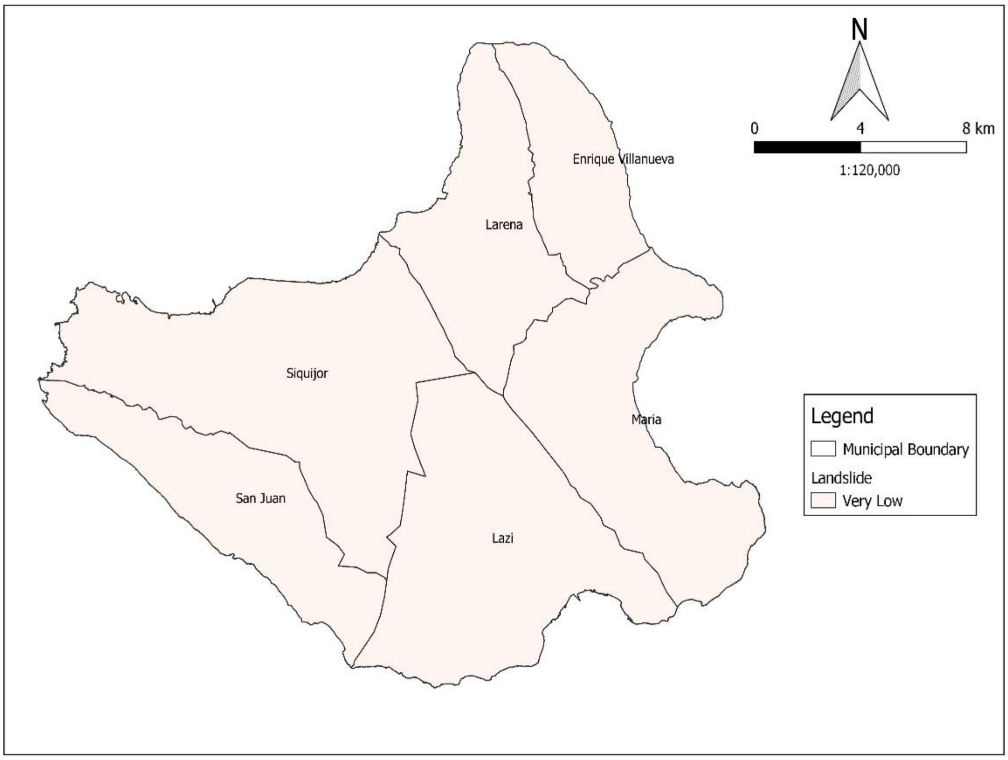


Figure 75. Landslide of Siquijor

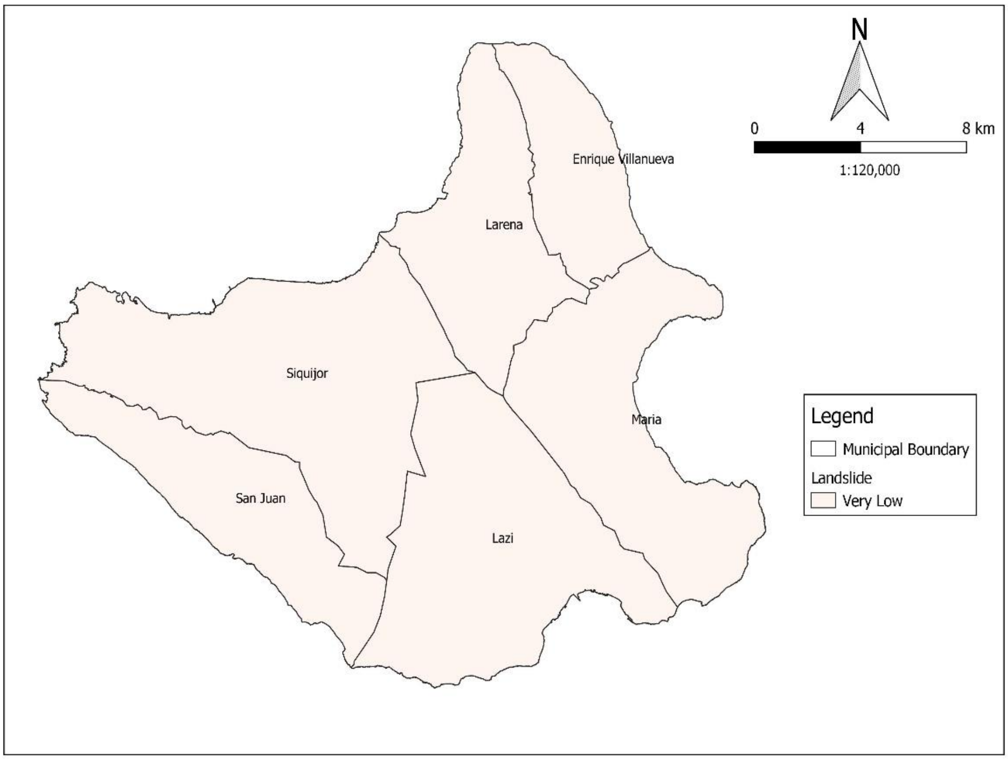


Figure 76. Saltwater Intrusion Exposure of Siquijor

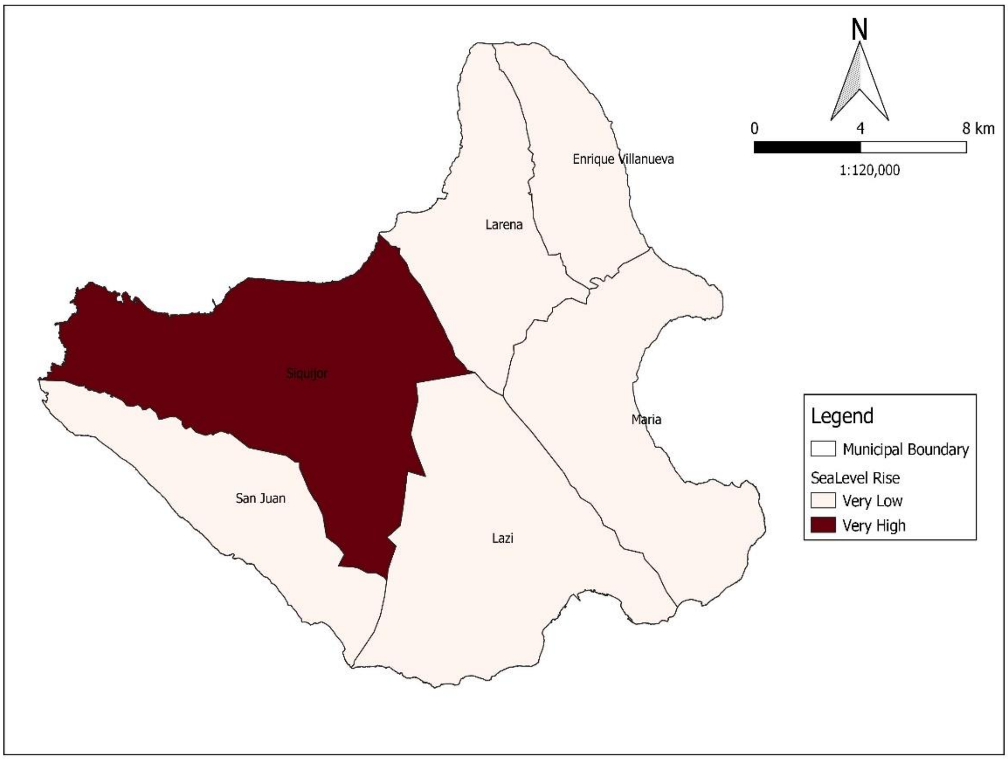


Figure 77. Sea Level Rise Exposure of Siquijor

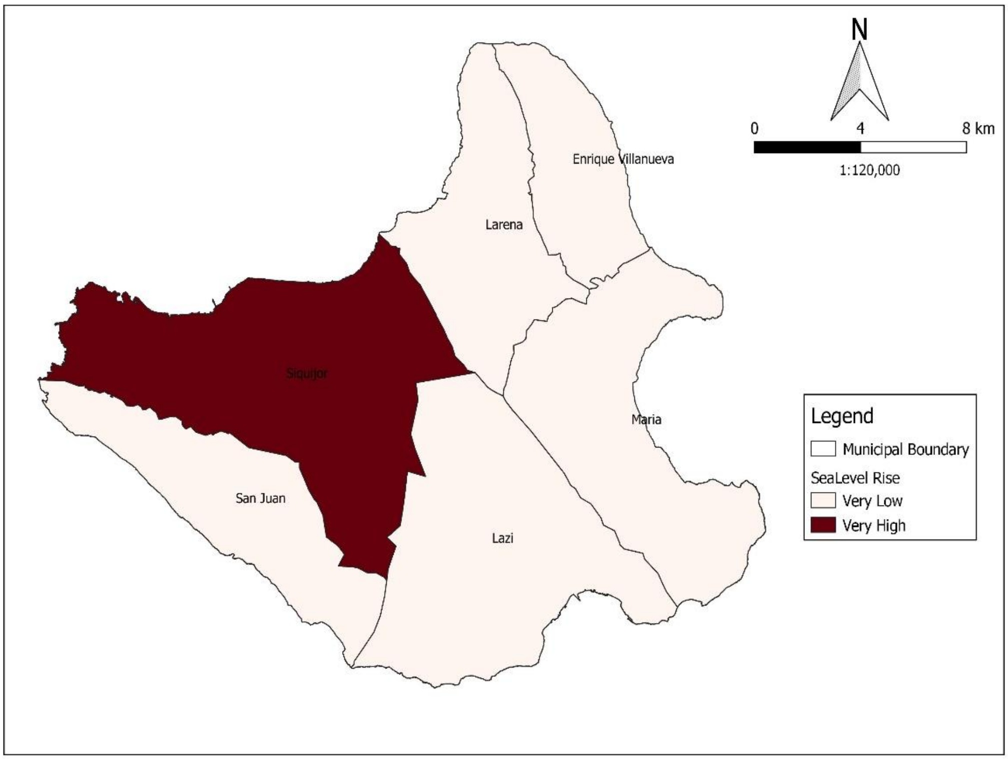


Figure 78. Storm Surge Exposure of Siquijor

ADAPTIVE CAPACITY INDICATORS

Capital Assets for Adaptive Capacity: Bohol Province

The municipality of Ubay scored very high and the highest for the anticipatory indicator. Meanwhile, Baclayon – being the lowest and along with Catigbian, displayed a very low score while most of the municipalities are in moderate to high (Figure 79).

On economic indicator, Tagbilaran City – the capital of Bohol, scored highest while Lila is at the bottom. Ubay is at moderate level while the rest of the municipalities are in low to very low level (Figure 80).

Tagbilaran City is the highest on health indicator while Trinidad score the lowest. Majority of the municipalities scored low to very low on this indicator (Figure 81).

For human indicators, most of the municipalities scored low to very low. Tagbilaran City scored highest at a very high index while Ubay and Jagna are in moderate level. Antequera for this capital scored lowest among the municipalities (Figure 82).

Getafe on institutional indicator scored lowest in the whole province. Most of the municipalities scored moderate to very high while Alburquerque, Sagbayan, Pilar, Anda, Candijay and Dimiao has a very low index. Moreover, Tagbilaran City tops on this indicator followed by the municipalities of Lila and Catigbian with very high scores (Figure 83).

Anda peaked the natural indicators followed by Tubigon, Candijay, Lila, Inabanga, Maribojoc and Pilar with very high scores. While the rest scored moderate to very low, the municipalities of Duero, Talibon, Bilar, San Miguel and Dagohoy reaches a high score on this indicator. Furthermore, Trinidad scored the lowest (Figure 84).

Most of the municipalities scored moderate to very high on the physical indicator with Duero being on top. Inabanga scored lowest on this capital followed by Baclayon, Buenavista, Batuan, Alicia with very low scores. Additionally, the municipalities that scored low includes Corella, San Isidro, Talibon, Dimiao, President Garcia, Catigbian, Danao, Bien Unido, Calape, Tagbilaran City and Trinidad (Figure 85).

On social indicator, a number of municipalities scored very high with Guindulman being on top followed by Baclayon, Antequerra, Tubigon, Lila, Balilihan, Loon, Carmen, Valencia, Sevilla, Garcia Hernandez, Loay, and San Isidro. Corella scored lowest on this capital followed by Trindidad, Getafe and Bien Unido with very low scores. Likewise, the municipalities with low score on this capital includes Tagbilaran City, Panglao, Catigbian, Dauis, Anda and Dimiao. The remaining municipalities scored moderate to high for this indicator (Figure 86).

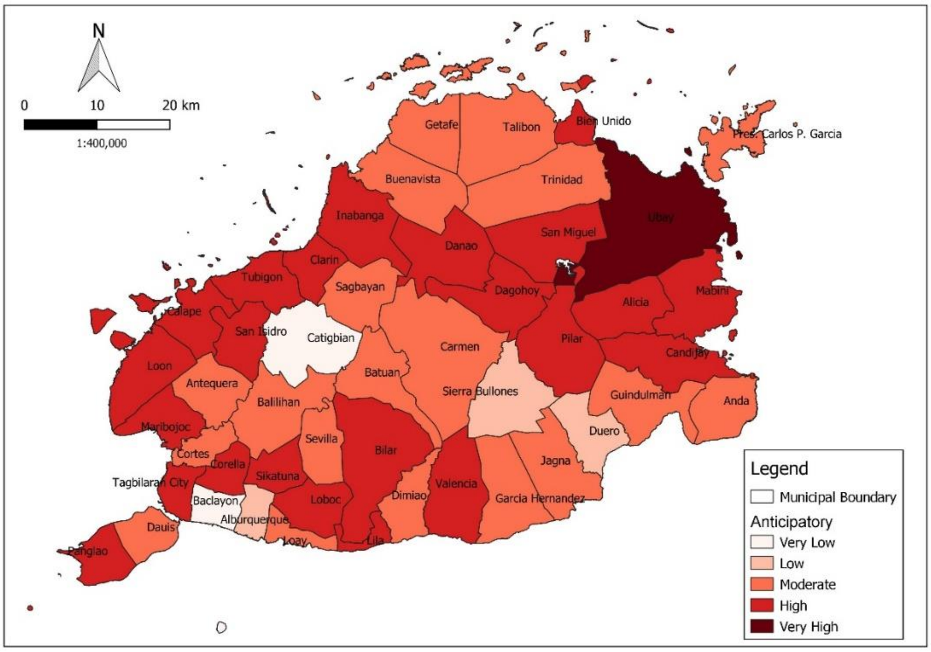


Figure 79. Anticipatory Indicator of Bohol Province

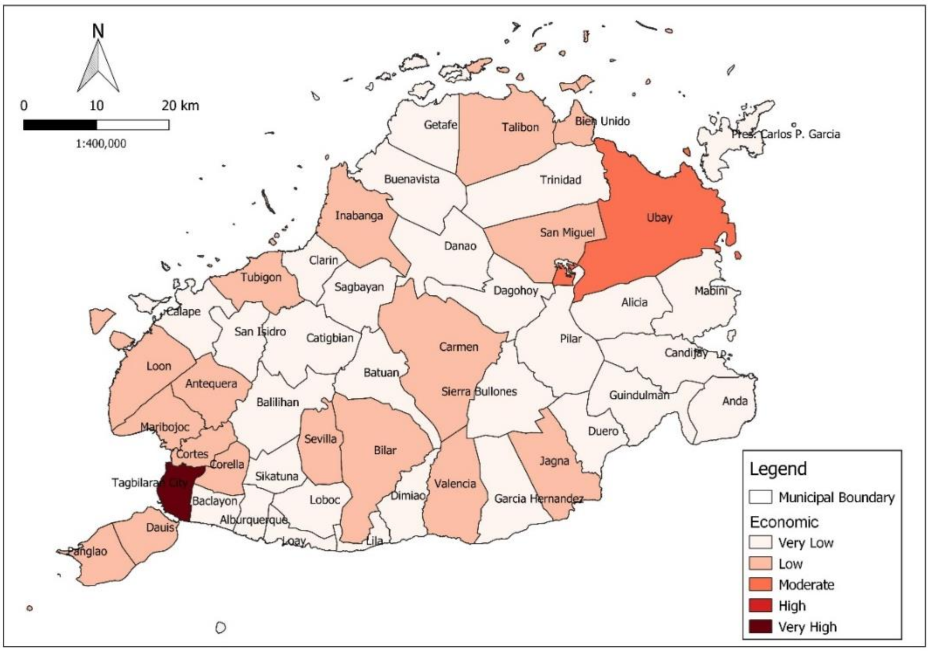


Figure 80. Economic Indicator of Bohol Province

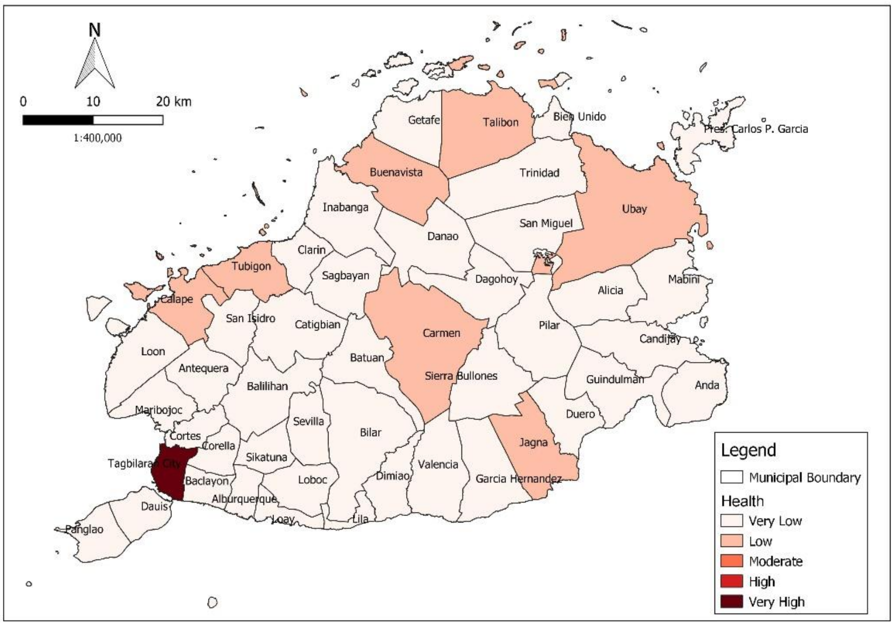


Figure 81. Health Indicator of Bohol Province

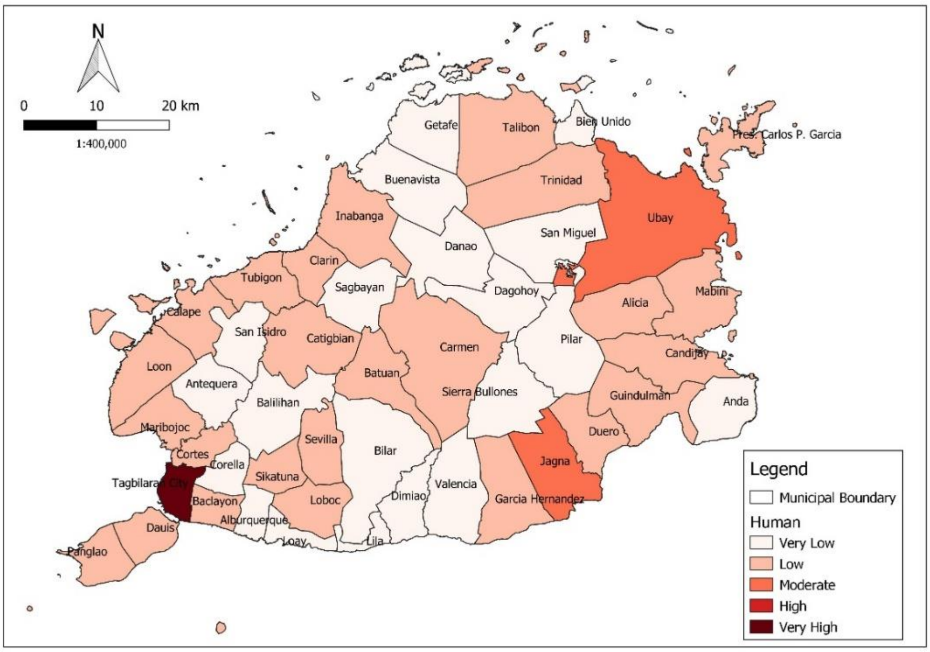


Figure 82. Human Indicator of Bohol Province

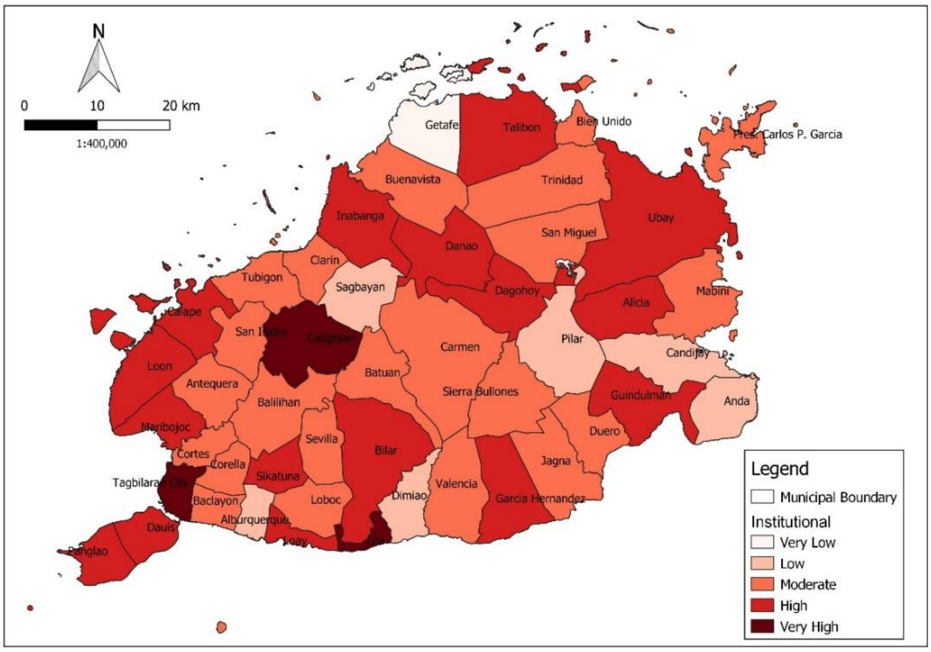


Figure 83. Institutional Indicator of Bohol Province

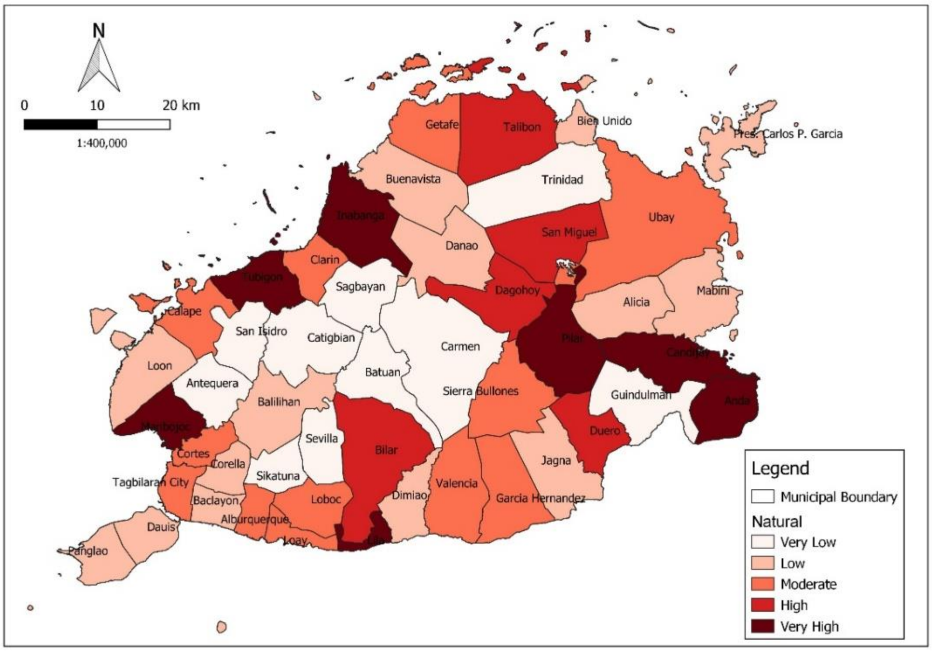


Figure 84. Natural Indicator of Bohol Province

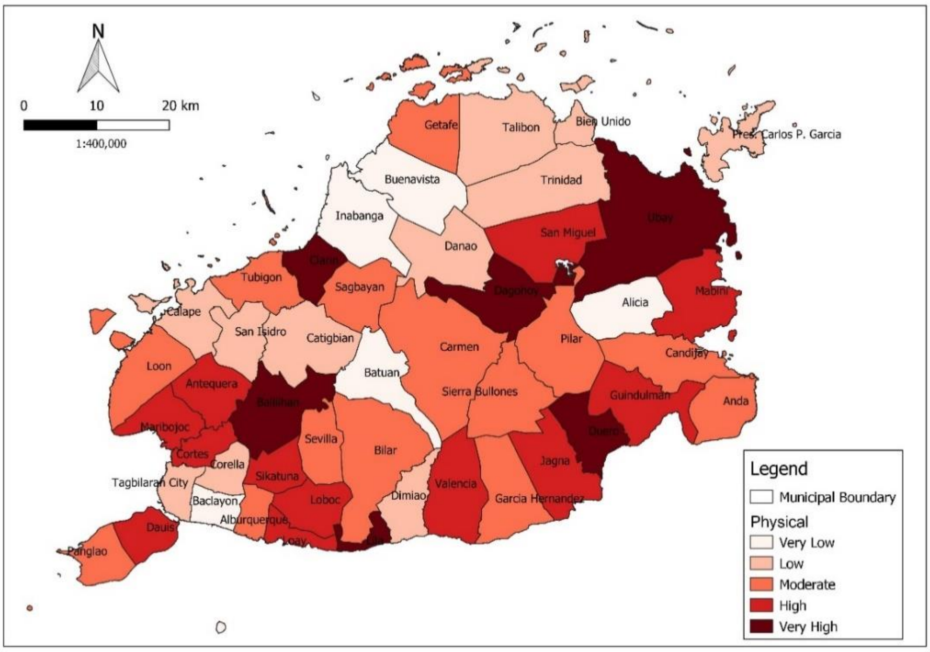


Figure 85. Physical Indicator of Bohol Province

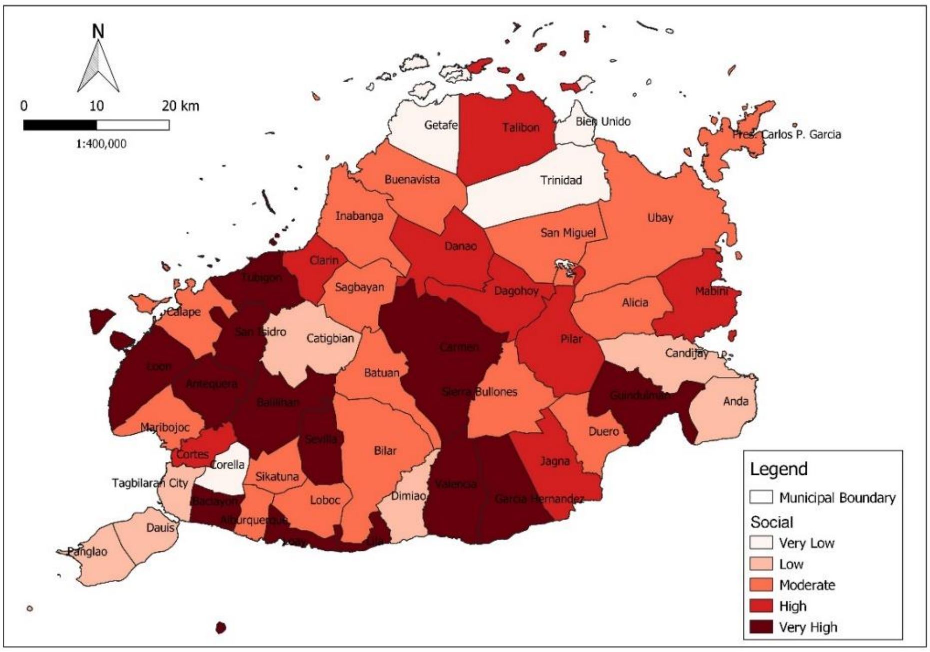


Figure 86. Social Indicator of Bohol Province

Combining all the capital assests suggests that Tagbilaran – the capital city, tops on the Adaptive Capacity Index (Figure 87). A high level of adaptive capacity is also observed in the municipalities of Ubay, Tubigon and Lila. A moderate adaptive capacity is projected in the municipalities of San Miguel, Duero, Calape, Garcia-Hernandez, Guindulman, Jagna, Mabini, Valencia, Loay, Talibon, Loon, Dagohoy, Clarin and Maribojoc. Majority of the municipalities are in low to very low level and Getafe rank lowest for the adaptive capacity in Bohol.

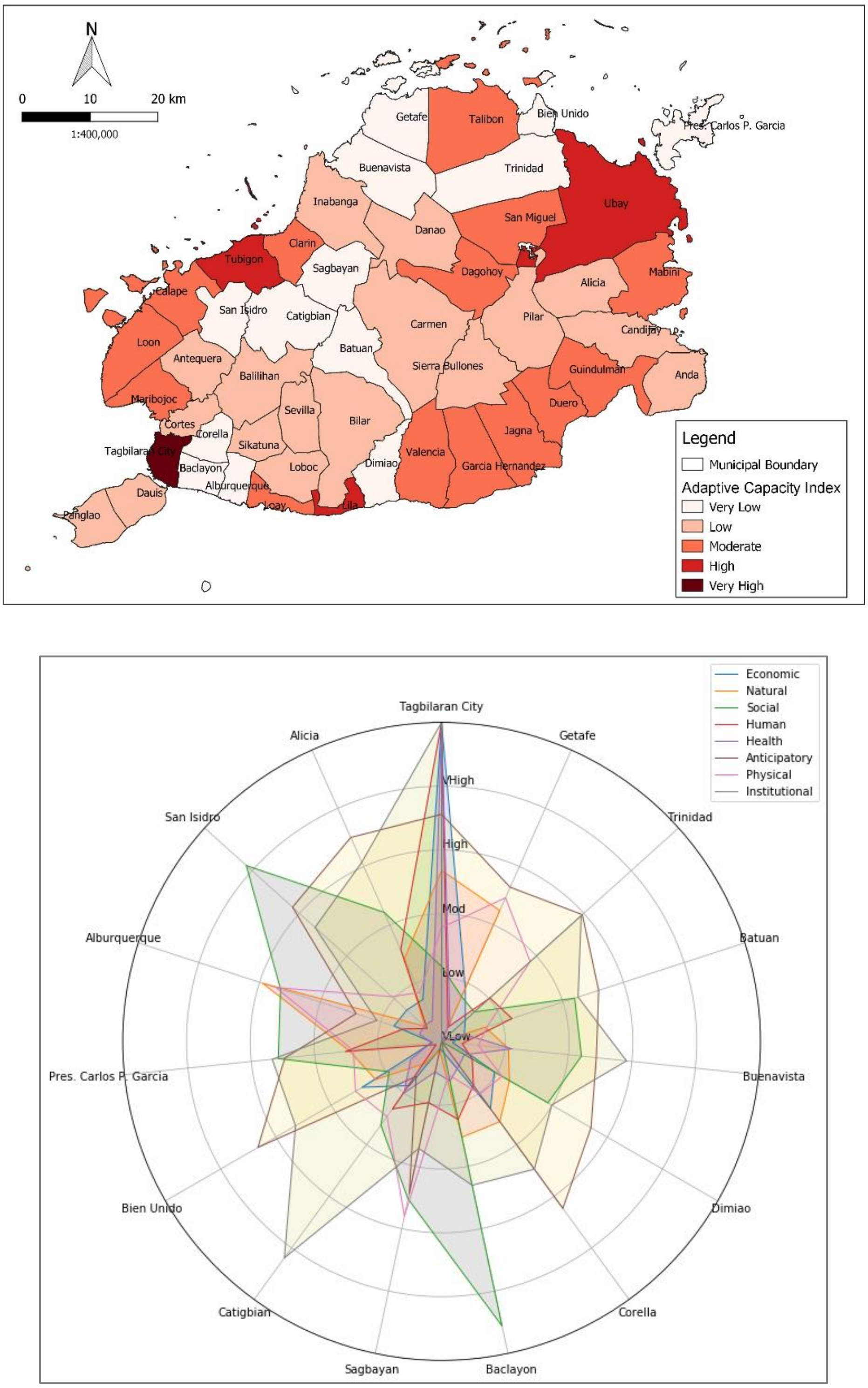


Figure 87. Adaptive Capacity Index for Bohol Province

The bottom 14 for the Adaptive Capacity includes Getafe, Trinidad, Batuan, Buenavista, Dimiao, Corella, Baclayon, Sagbayan, Catigbian, Bien Unido, Pres. Carlos P. Garcia, Alburquerque, San Isidro, and Alicia. While most of the capital assets in Tagbilaran City are in very high level, the bottom 14 ranges from moderate to very low level.

Capital Assets for Adaptive Capacity: Negros Province

Guihulngan City tops on the Anticipatory indicator, followed by Valencia, Sibulan, Dumaguete City – the capital and Bayawan City with very high scores. Siaton scored lowest among the municipalities while majority are in moderate to high level (Figure 88).

For the economic indicator, Dumaguete City tops the province followed by Bayawan City with very high scores. Bais City scored high while Guihulngan, Canlaon, and Santa Catalina displayed a moderate score. Majority of the municipalities scored low to very low with Bindoy being the lowest (Figure 89).

Dumaguete City scored highest on health indicator followed by Bais City. Bayawan City is on high level while Siaton, Santa Catalina, and Guihulngan City is on moderate level. Majority of the municipalities scored low to very low on this capital with Pamplona being the lowest (Figure 90).

Dumaguete City tops the human indicator followed by Bayawan City with very high scores. Bais City and Sibulan displays a high score while most of the municipalities projects a moderate to low scores. Lowest score was reflected by Bindoy followed by Vallehermoso and Canlaon City (Figure 91).

For the institutional indicator, Bayawan City scored highest. A high score was also displayed by Valencia. While moderate score is present in Canlaon City, Tanjay City, Bais City, La Libertad, Dumaguete City and Santa Catalina, the majority of the municipalities are in low to very low level. Among this, the municipality of Zamboangita scored the lowest (Figure 92).

On natural indicator, Ayungon scored highest followed by Bindoy and Bayawan City with very high scores. Areas that scored high includes Basay, Amlan and Guihulngan City. Majority had scored moderate to low on this capital while Bacong scored the very low followed by San Jose and Dumaguete City (Figure 93).

Amlan scored highest for the physical indicators followed by Bindoy and Bacong with very high scores. While Siaton scored high, the municipalities of Ayungon, Basay, Dauin, Zamboangita and Tayasan reflected a moderate score. Majority of the areas projected a low to very low scores with Sibulan projecting the lowest (Figure 94).

Bayawan City scored highest on social indicator. Areas such as San Jose, Canlaon City, Mabinay, Amlan, and Valencia followed with a high score for this capital. A moderate score was also reflected in Bindoy, Guihulngan City, Dumaguete City, Basaya and Santa Catalina. Majority scored low to very low with Manjuyod being the lowest (Figure 95).

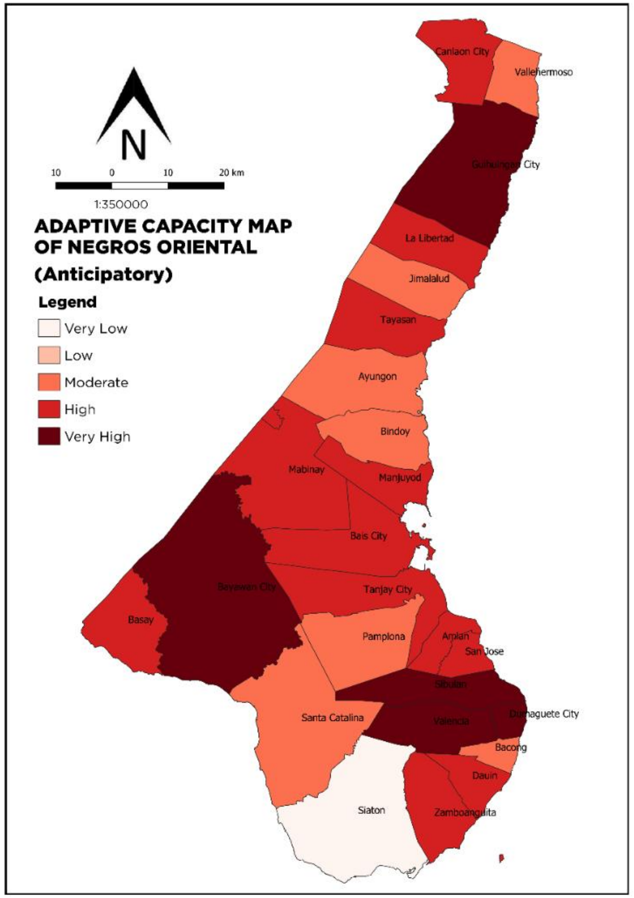


Figure 89. Anticipatory Indicator of Negros Oriental

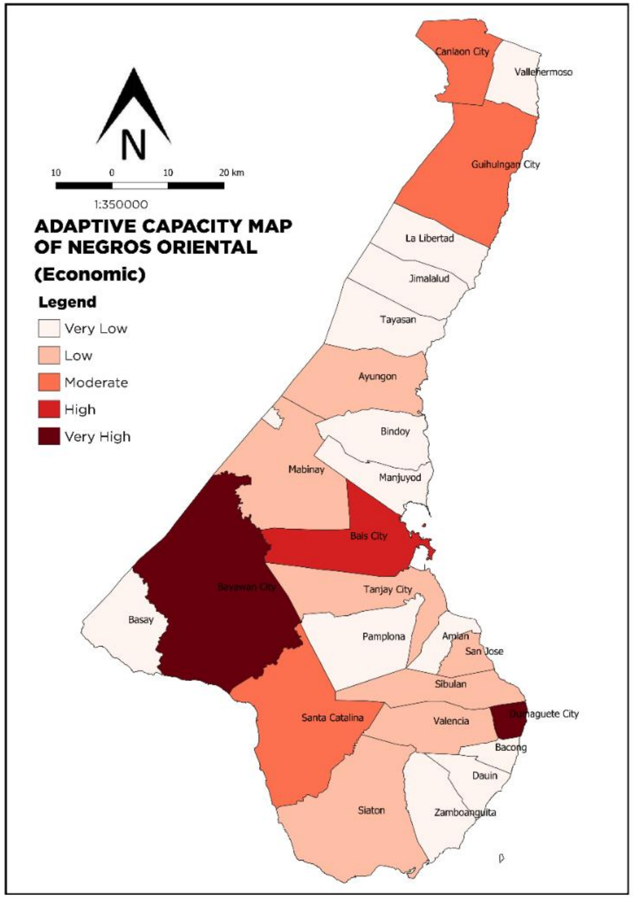


Figure 88. Economic Indicator of Negros Oriental

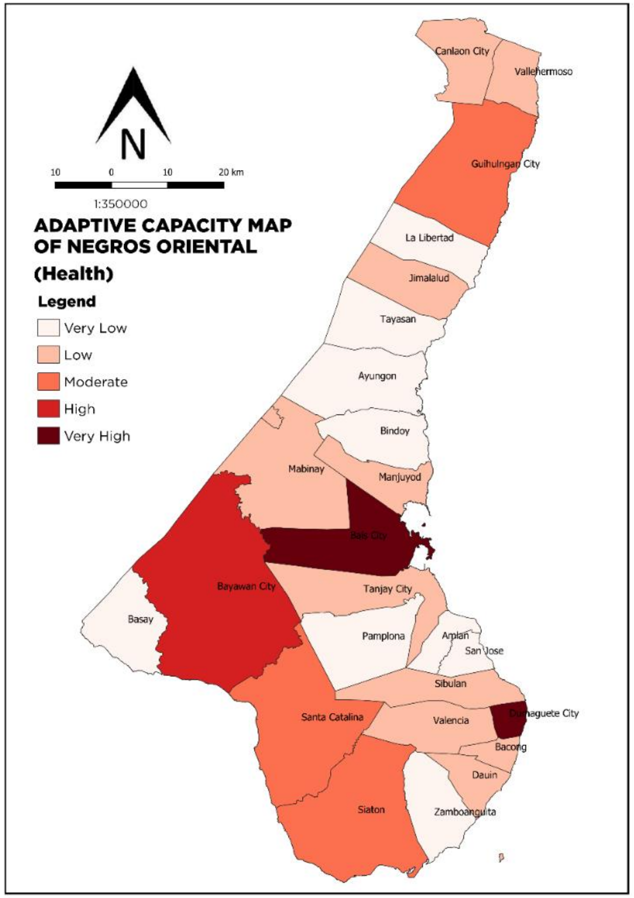


Figure 91. Health Indicator of Negros Oriental

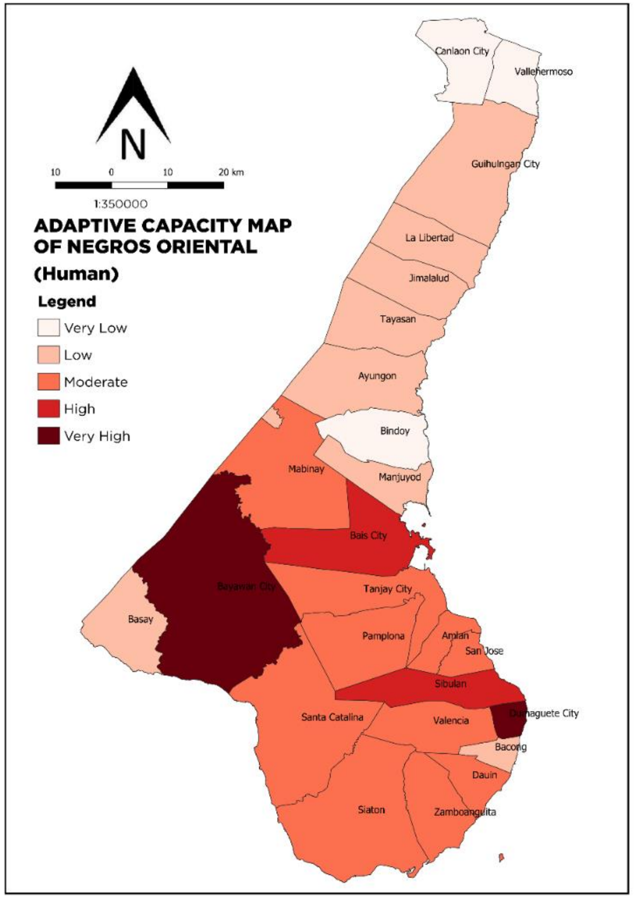


Figure 90. Human Indicator of Negros Oriental

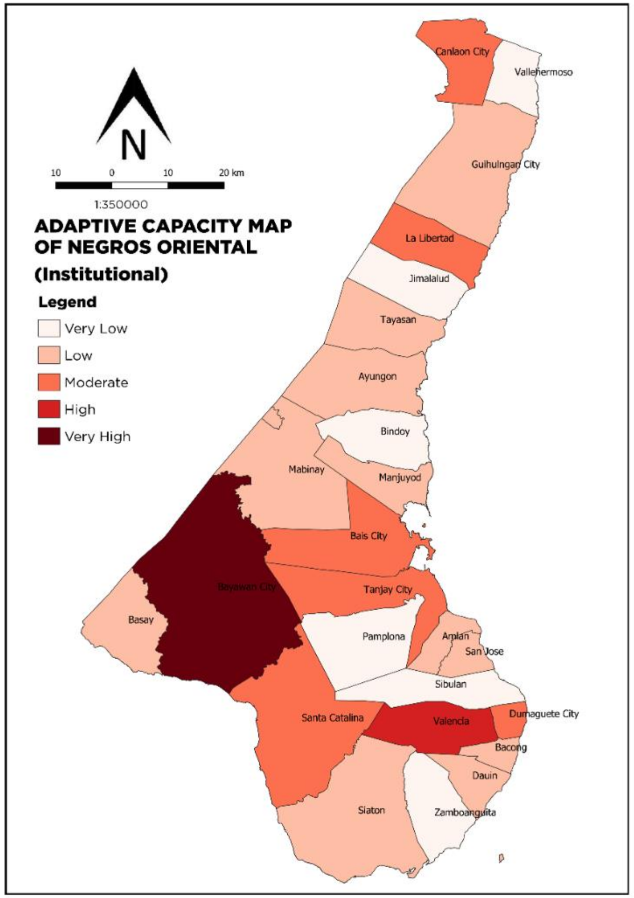


Figure 92. Institutional Indicator of Negros Oriental

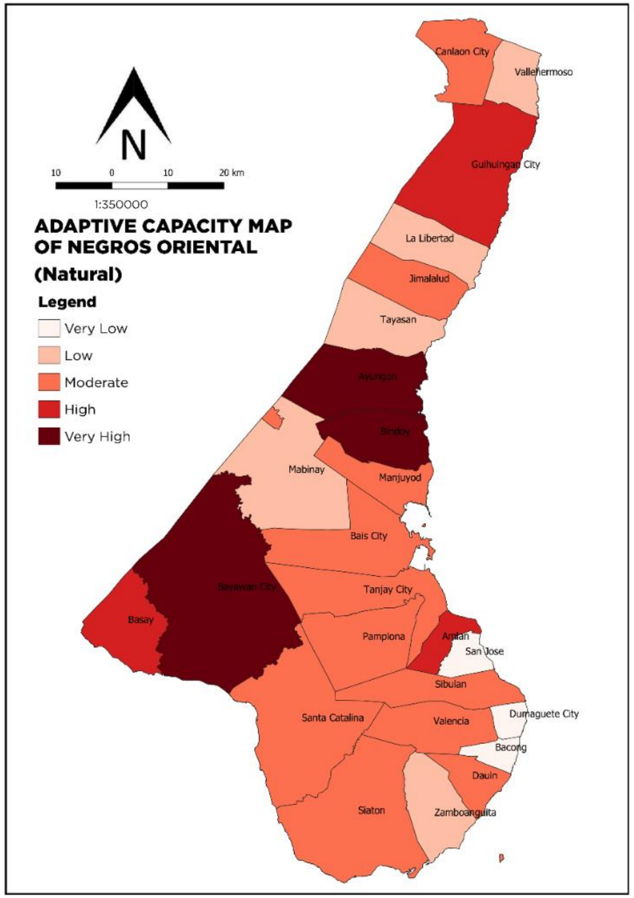


Figure 93. Natural Indicator of Negros Oriental

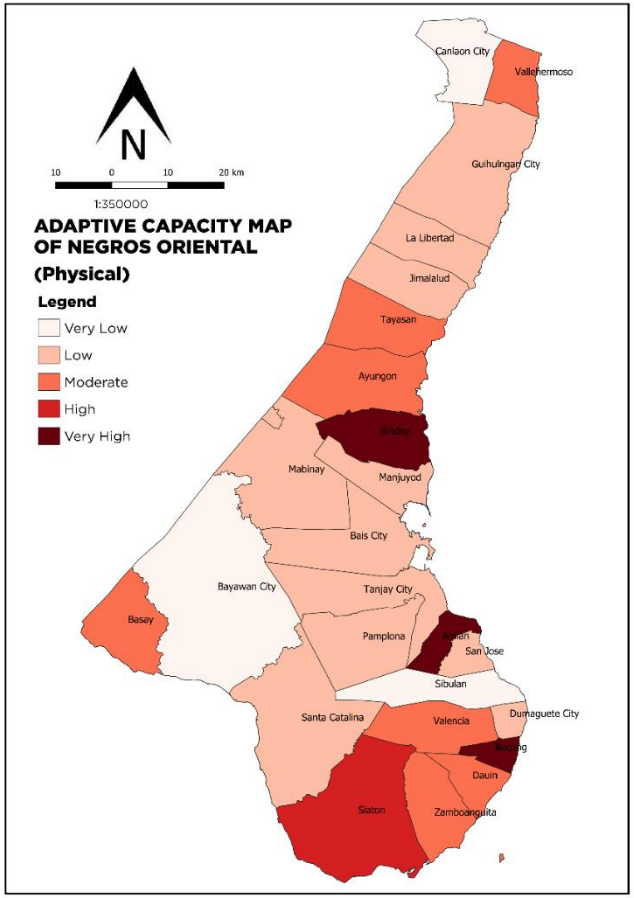


Figure 94. Physical Indicator of Negros Oriental

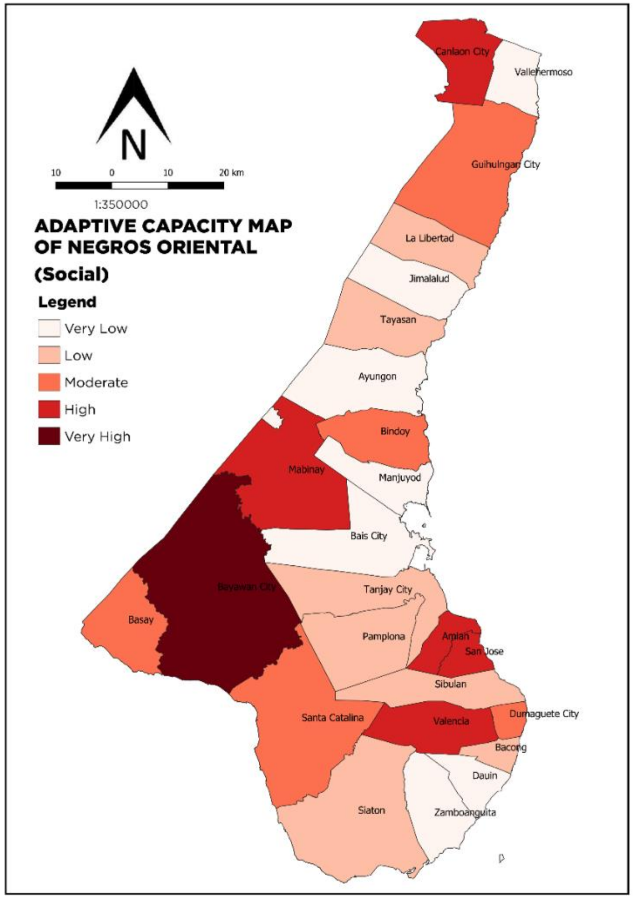


Figure 95. Social Indicator of Negros Oriental

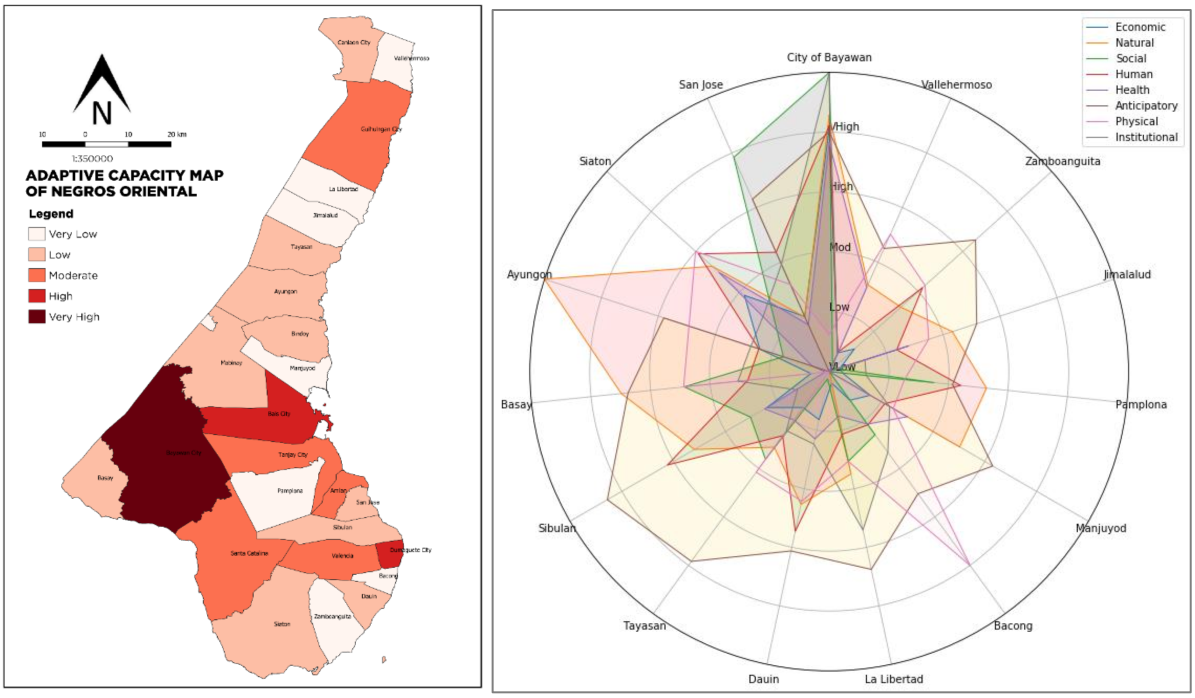


Figure 96. Adaptive Capacity Index for Negros Oriental

From all the capital assests combined, Bayawan City – with a very high index, ranked 1st in the whole province of Negros Oriental (Figure 96). Dumaguete City and Bais City followed with a high index. Areas that scored moderate for the index includes Tanjay City, Santa Catalina, Amlan, Guihulngan City and Valencia. Majority of the municipalities are in low to very low level. Furthermore, Vallehermoso is at the bottom on the index ranking.

The bottom 14 for the Adaptive Capacity includes Vallehermoso, Zamboangita, Jimalalud, Pamplona, Manjuyod, Bacong, La Libertad, Dauin, Tayasan, Sibulan, Basay, Ayungon, Siaton and San Jose. While most of the capital assets in Bayawan City are within high to very high level, the bottomlisted municipalities are mostly within moderate to very low level.

Capital Assets for Adaptive Capacity: Siquijor Province

On the anticipatory indicator, Enrique Villanueva scored highest followed by San Juan with very high scores. Lazi, Siquijor and Maria reflected a moderate score while Larena revealed the lowest score (Figure 97).

Siquijor tops the economic indicator followed by Larena reflecting a very high scores. Lazi projected a moderate score while Enrique Villanueva – the lowest and Maria projected a very low scores for the capital (Figure 98).

Lazi displayed the highest score on health indicator. This was followed by a high score from Maria and a moderate score from Siquijor and Enrique Villanueva. Larena showed a low score while San Juan projected a very low score (Figure 99).

On human indicator, the highest score was reflected by Siquijor. Furthermore, San Juan and Lazi projected a moderate score. A low score is present in Enrique Villanueva while Maria – the lowest and Larena projected a very low score (Figure 100).

Lazi scored highest on the institutional capital followed by Enrique Villanueva with very high scores. Maria projects a moderate score while San Juan and Larena shows a low score for this capital. Siquijor projected the lowest score in the province (Figure 101).

On the natural capital, Maria scored the highest followed by Larena. Enrique Villanueva displayed a moderate score while Lazi and San Juan scored low on this capital. For the whole province Lazi scored the lowest (Figure 102).

Enrique Villanueva tops on the Physical capital with a very high score. Maria and Larena projected a moderate score while Siquijor and Lazi showed a low score. San Juan among all provinces scored the lowest with a very low score on the capital (Figure 103).

For social capital, Maria scored highest followed by Enrique Villanueva with very high scores. Larena projected a moderate score while San Juan and Siquijor scored low. For this capital. Lazi scored the lowest across the province (Figure 104).

Capital Assets for Adaptive Capacity: Siquijor Province

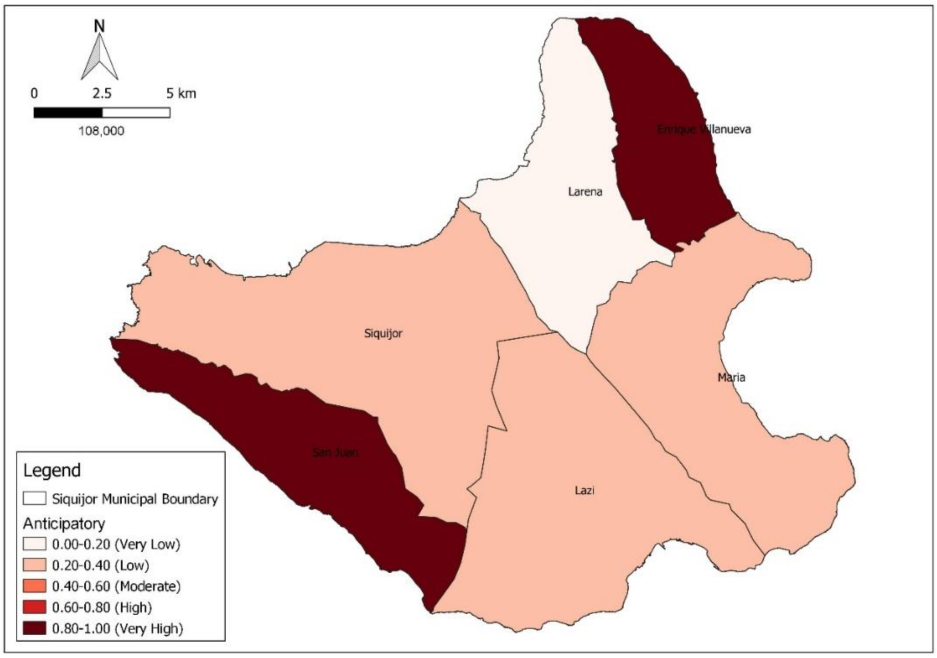


Figure 97. Anticipatory Indicator of Siquijor Province

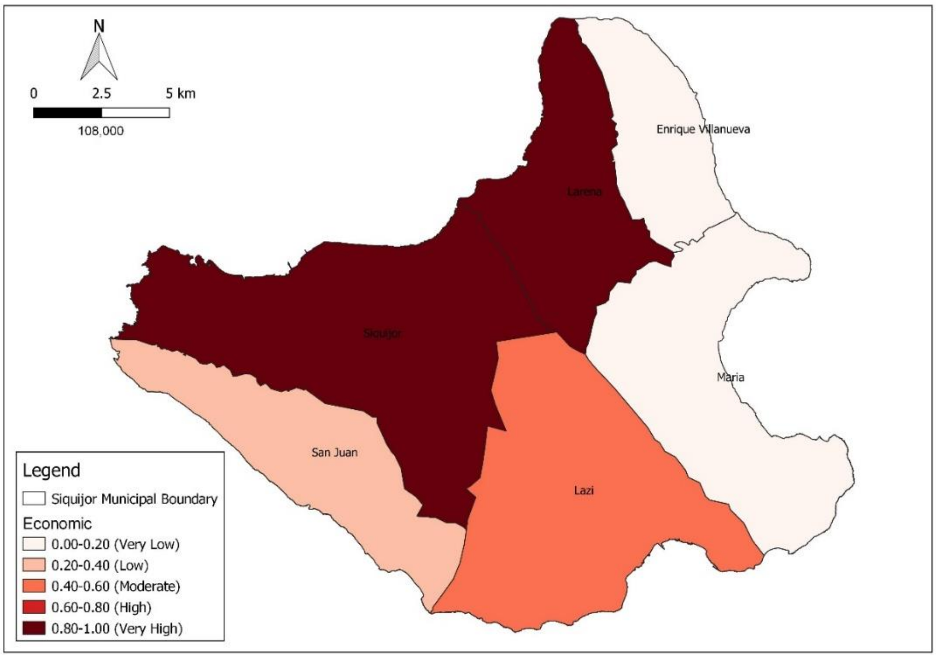


Figure 98. Economic Indicator for Siquijor Province

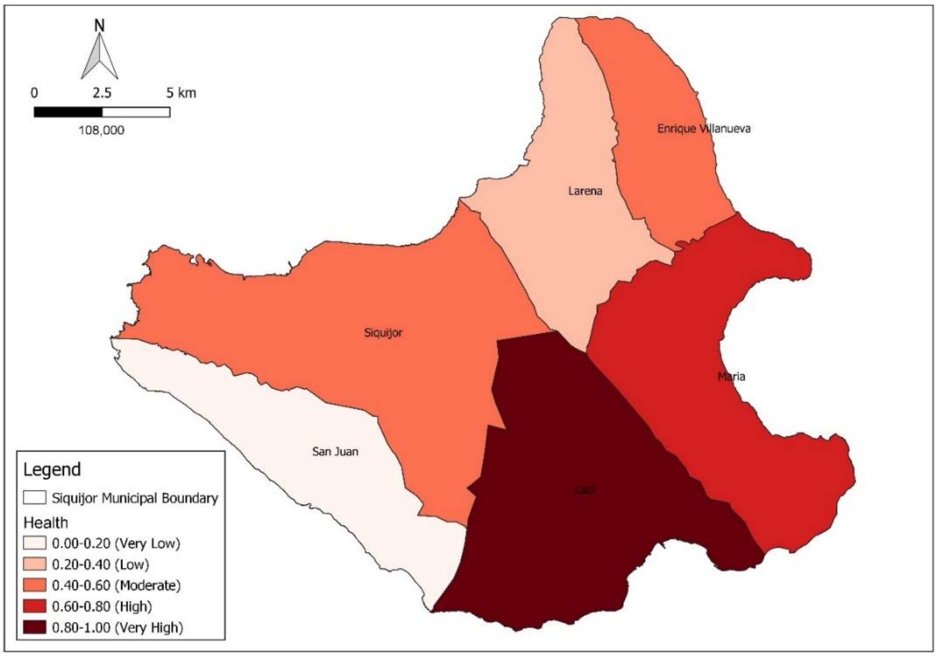


Figure 99. Health Indicator for Siquijor Province

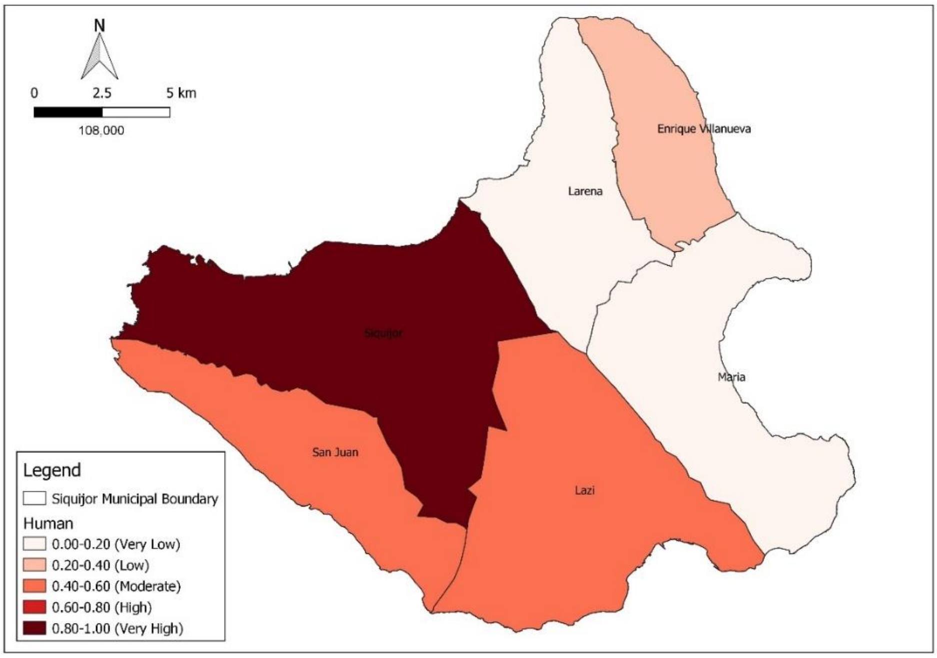


Figure 100. Human Indicator for Siquijor Province

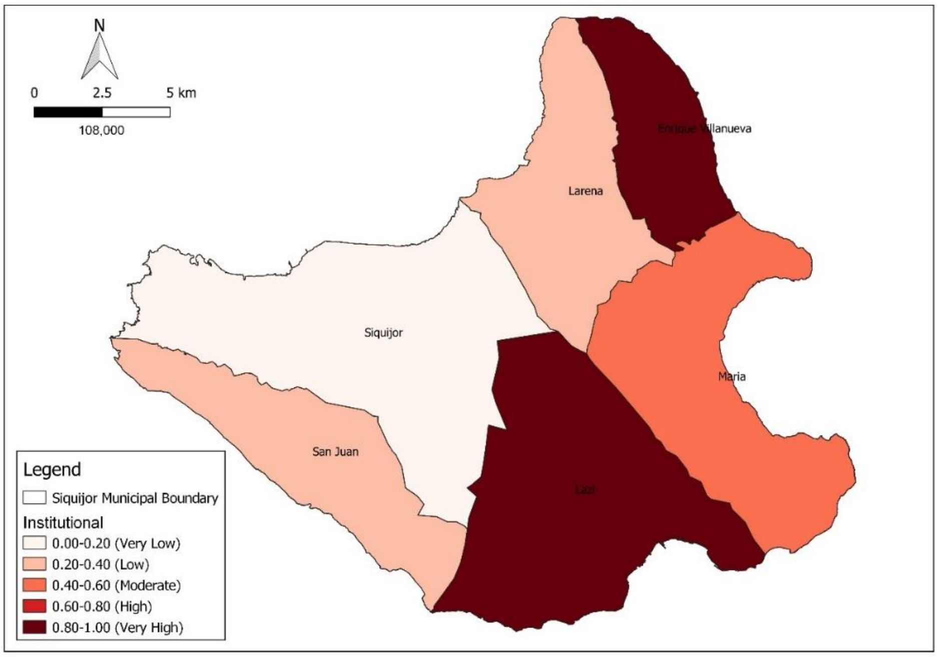


Figure 101. Institutional Indicator for Siquijor Province

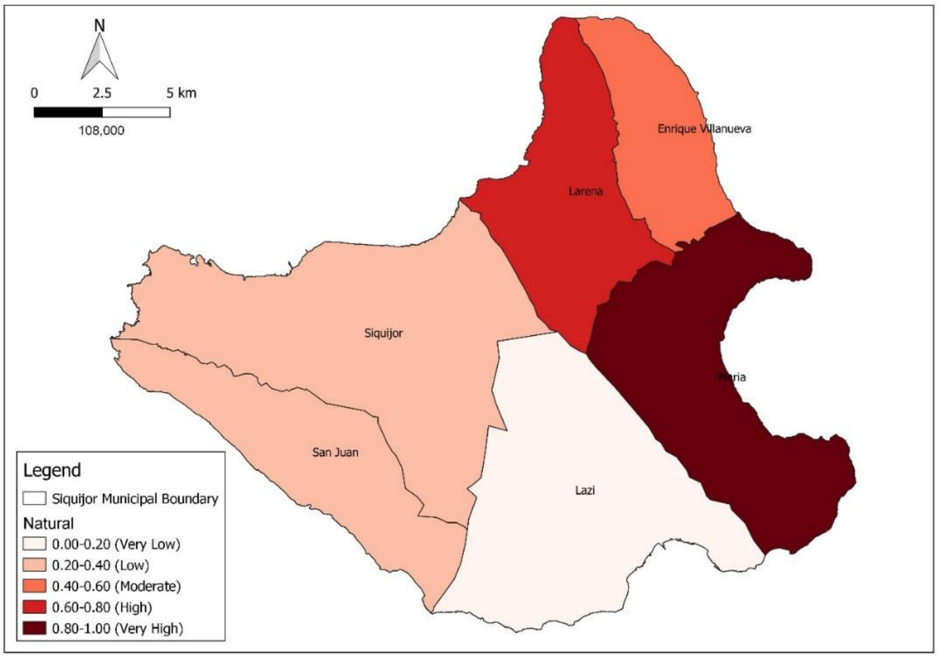


Figure 102. Natural Indicator for Bohol Province

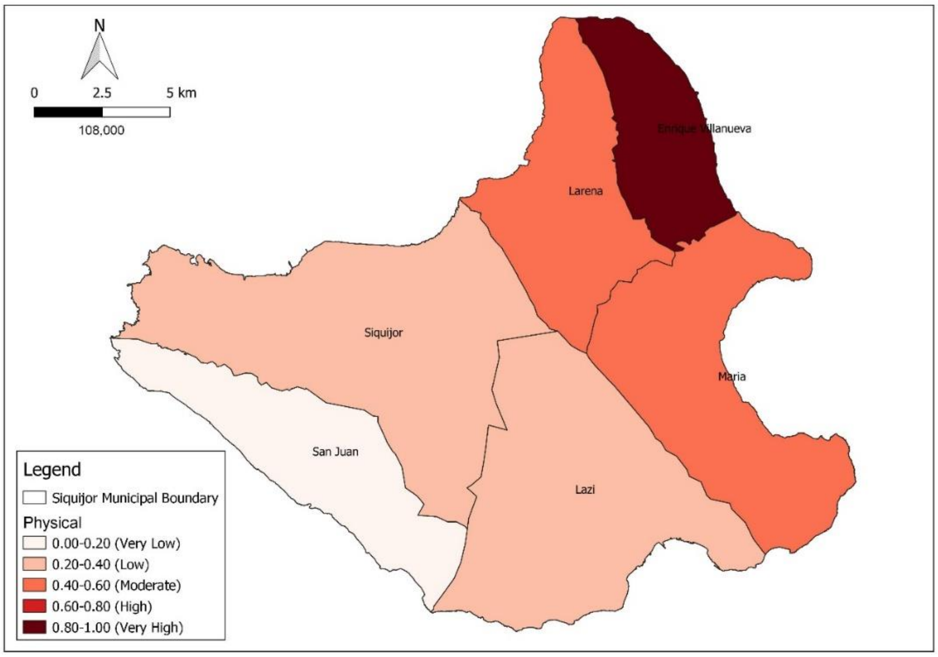


Figure 103. Physical Indicator for Siquiijor Province

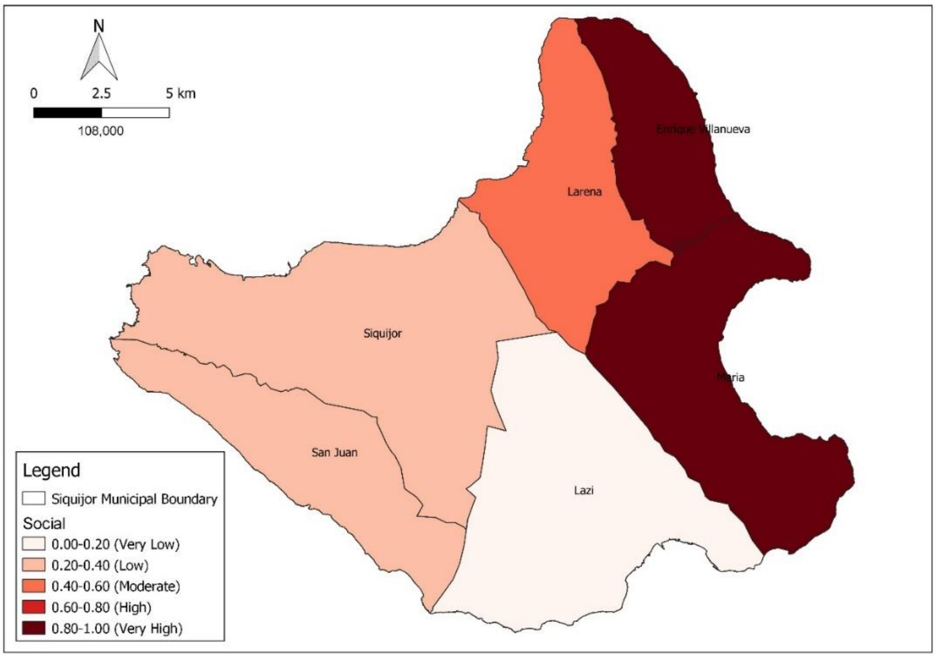


Figure 104. Social Indicator for Siquijor Province

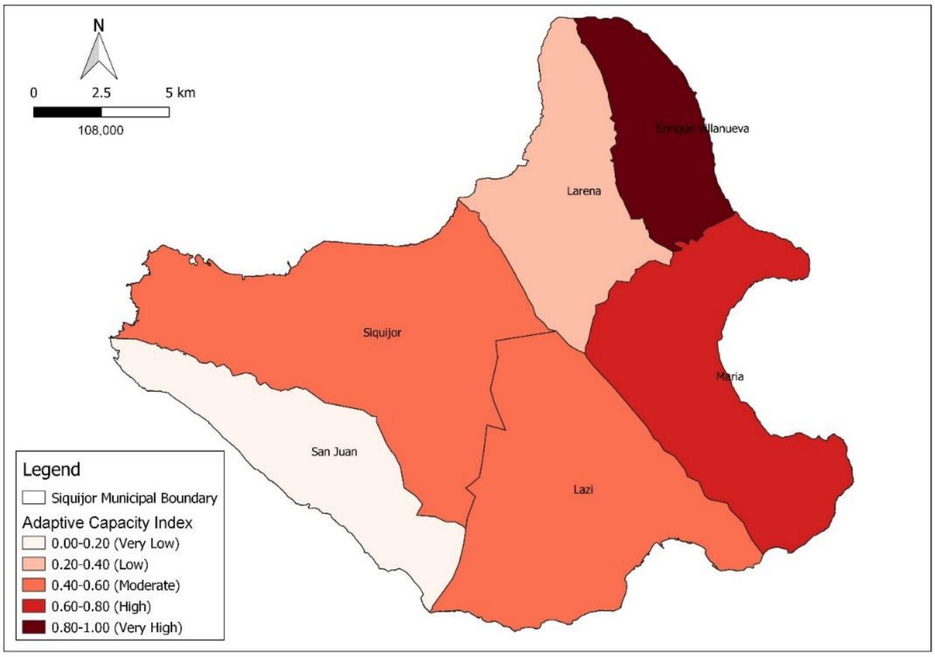


Figure 105. Siquijor Adaptive Capacity

The municipality of Enrique Villanueva - with a very high index, scored highest for the adaptive capacity in the province of Siquijor (Figure 105). This is followed by the municipality of Maria that displayed a high index. The municipalities of Lazi and Siquijor are in moderate level. Meanwhile, Larena scored low while San Juan projected a very low index on adaptive capacity.

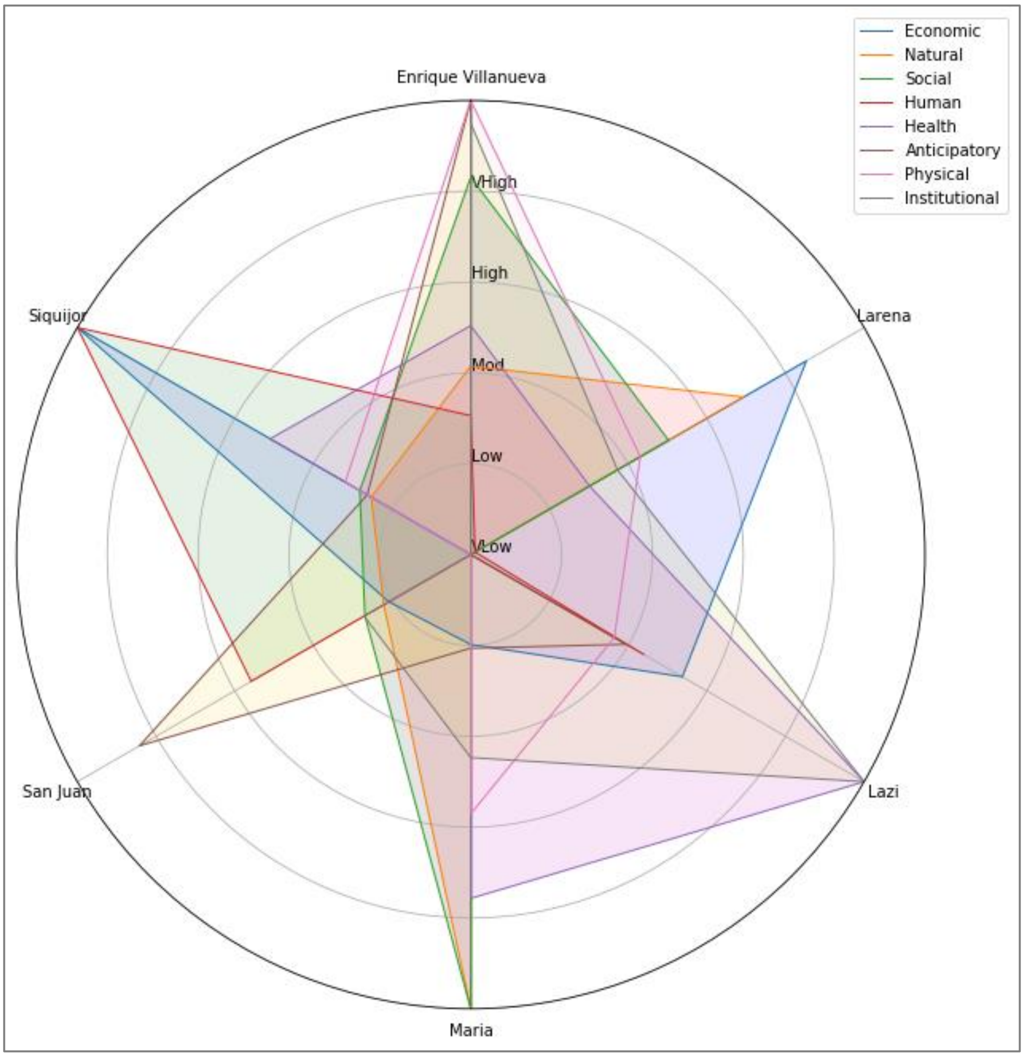


Figure 106. Siquijor's Radar Plot for Adaptive Capacity

Observably, most of the capital assets for the adaptive capacity of Siquijor are within moderate to very high level. At least one capital asset reached a very high level for all municipalities. For San Juan and Siquijor, most capital assets are within low to very low level.

CLIMATE CHANGE VULNERABILITY

Vulnerability of the agricultural sector in Bohol, Negros Oriental and Siquijor was determined using the estimated values of sensitivity, exposure, and adaptive capacity. 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. 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. The subsequent analysis only focuses on 15-15-70 as this was agreed and suggested by CIAT and other SUC AMIA implementing partners.

Climate Change Vulnerability: Bohol Province

Vulnerability for all studied crops in the city of Tagbilaran City is likely to be very low in the year 2050 (Figure 107-124). Expectedly, Tagbilaran City – the capital of Bohol projected the highest Adaptive Capacity Index off all the municipalities. A very high vulnerability for all crops is evident in Trinidad, Getafe and Pres. Carlos P. Garcia and Dimiao. A very high vulnerability is also projected in Batuan for all crops except for purple-ube. Rice also shows a very high vulnerability in Sagbayan, Catigbian, Sierra Bullones, Alicia, Candijay and Anda. In general, a vulnerability ranging from moderate to very high is evident in all crops for most municipalities.

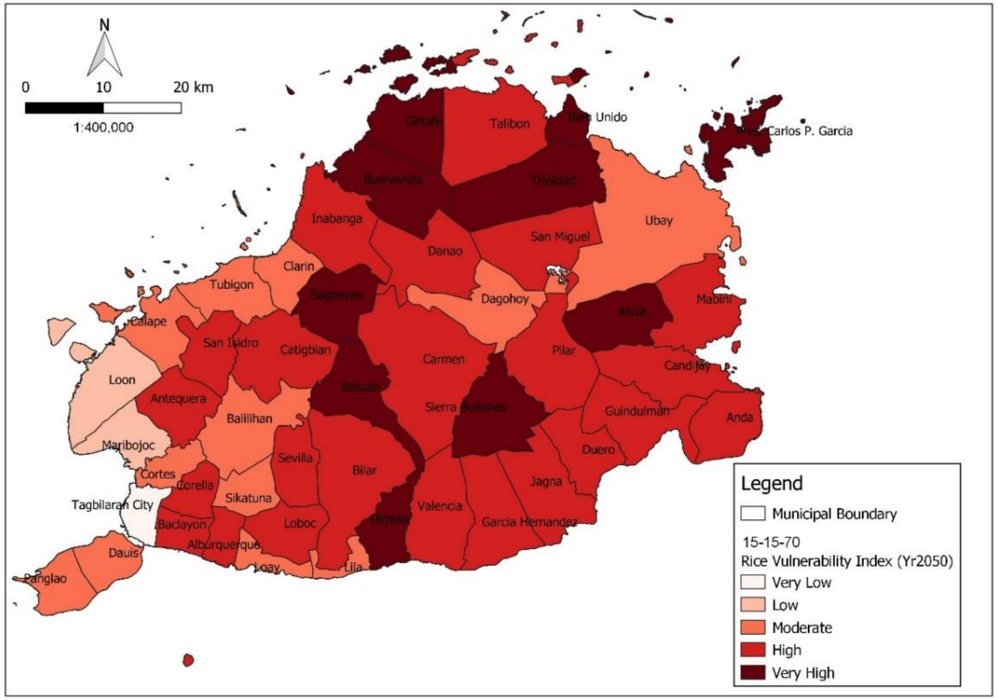


Figure 107. Vulnerability of Rice in Bohol in 2050

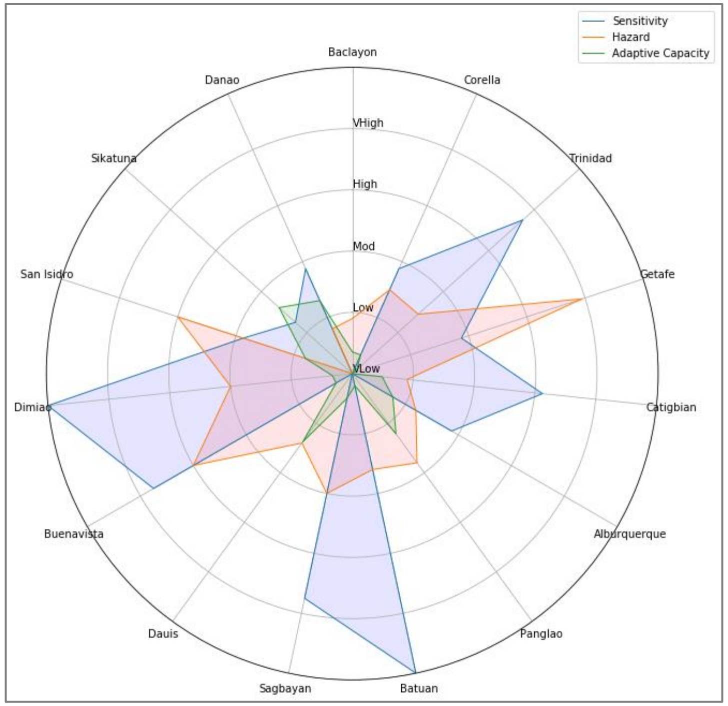


Figure 108. Rice Vulnerability Radar Plot in Bohol

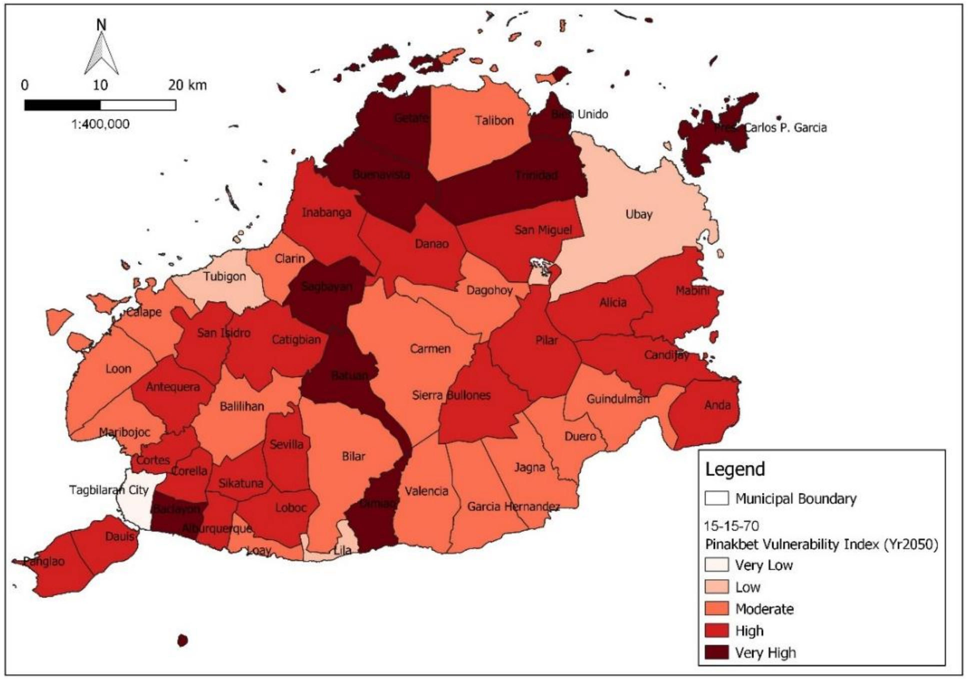


Figure 109. Vulnerability of Pinakbet in Bohol in 2050

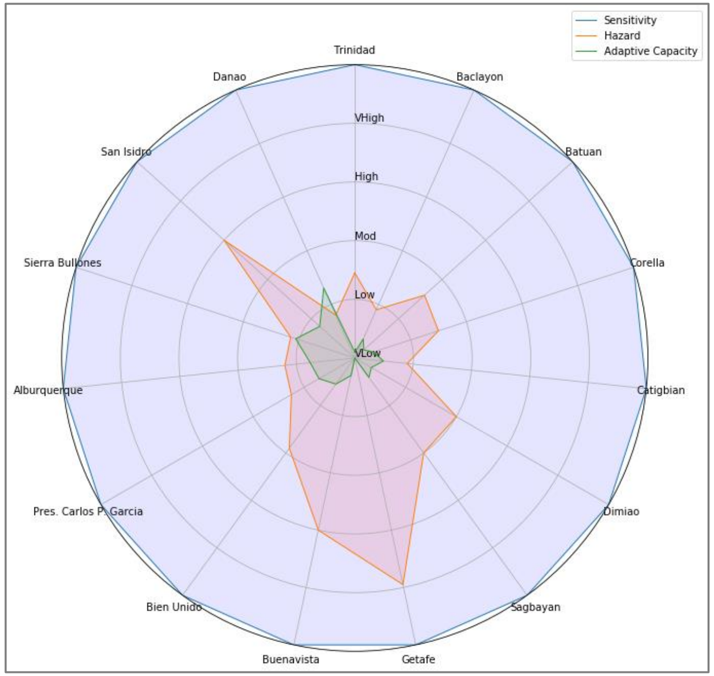


Figure 110. Pinakbet Vulnerability Radar Plot of Bohol

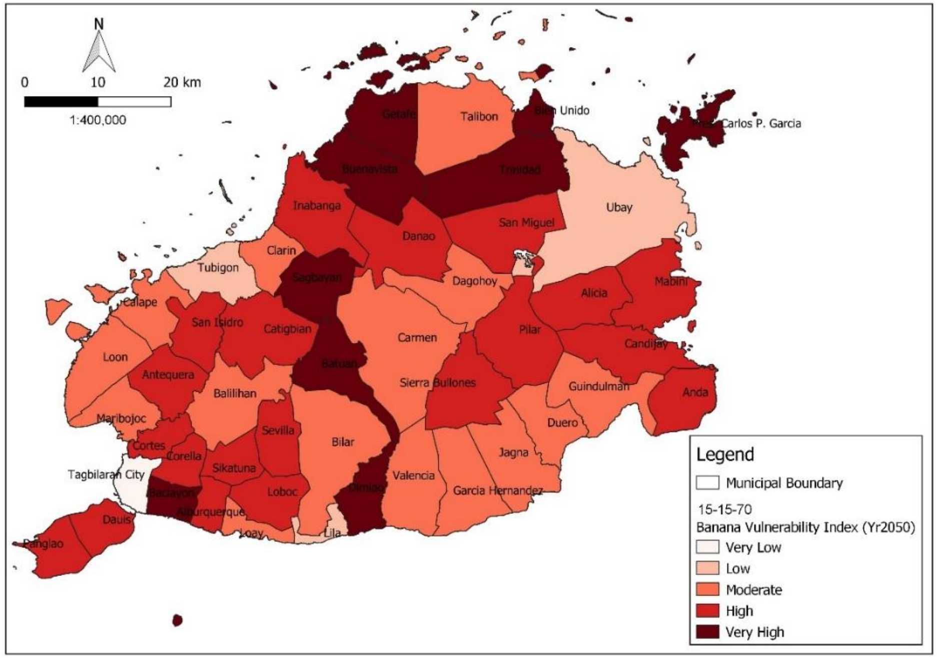


Figure 111. Vulnerability of Banana in Bohol in 2050

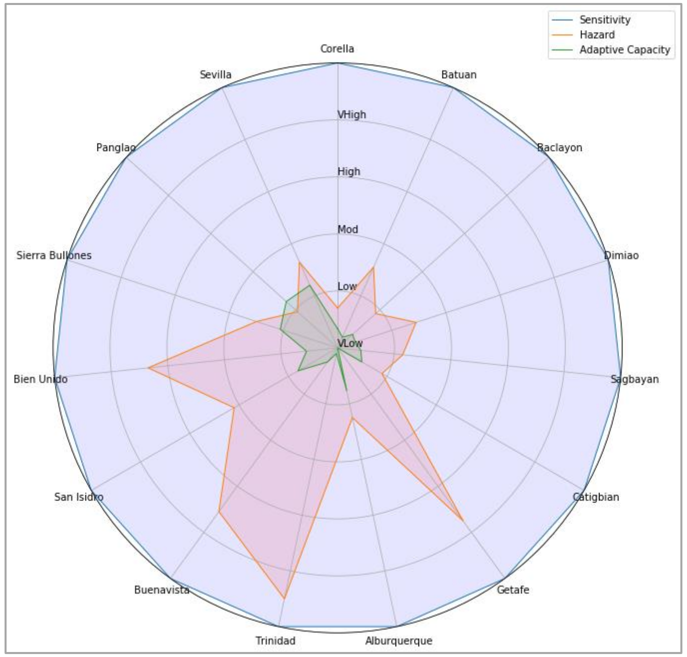


Figure 112. Banana Vulnerability Radar Plot of Bohol

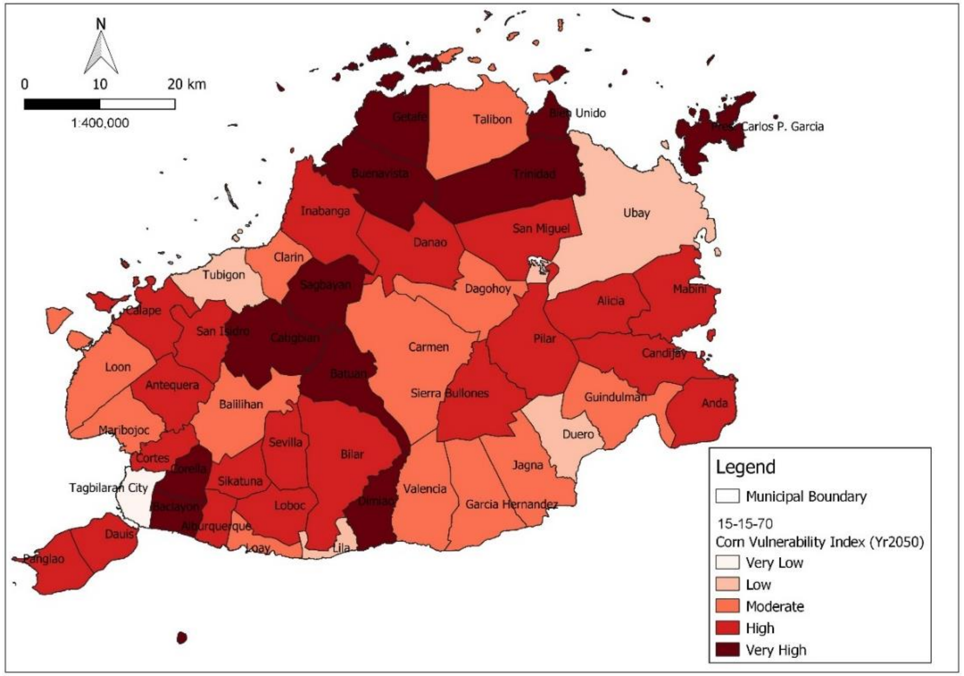


Figure 113. Vulnerability of Corn in Bohol in 2050

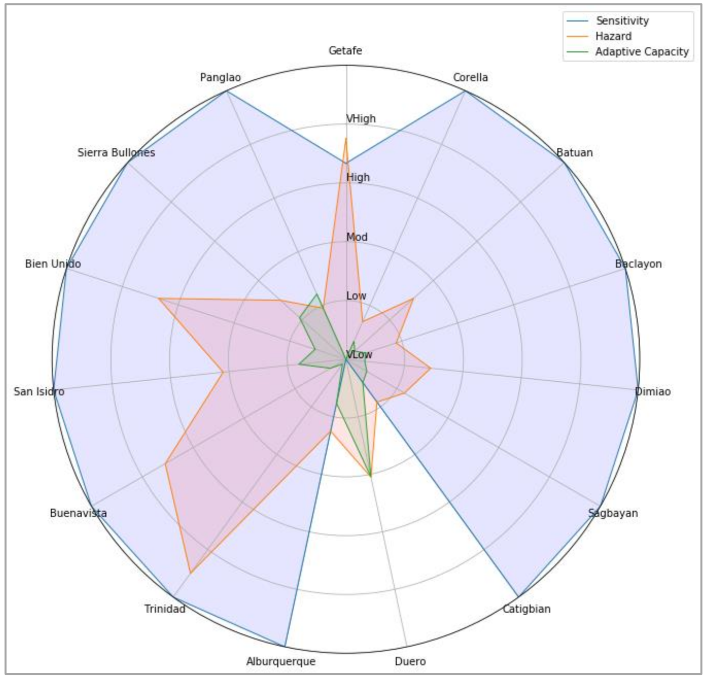


Figure 114. Banana Vulnerability Radar Plot of Bohol

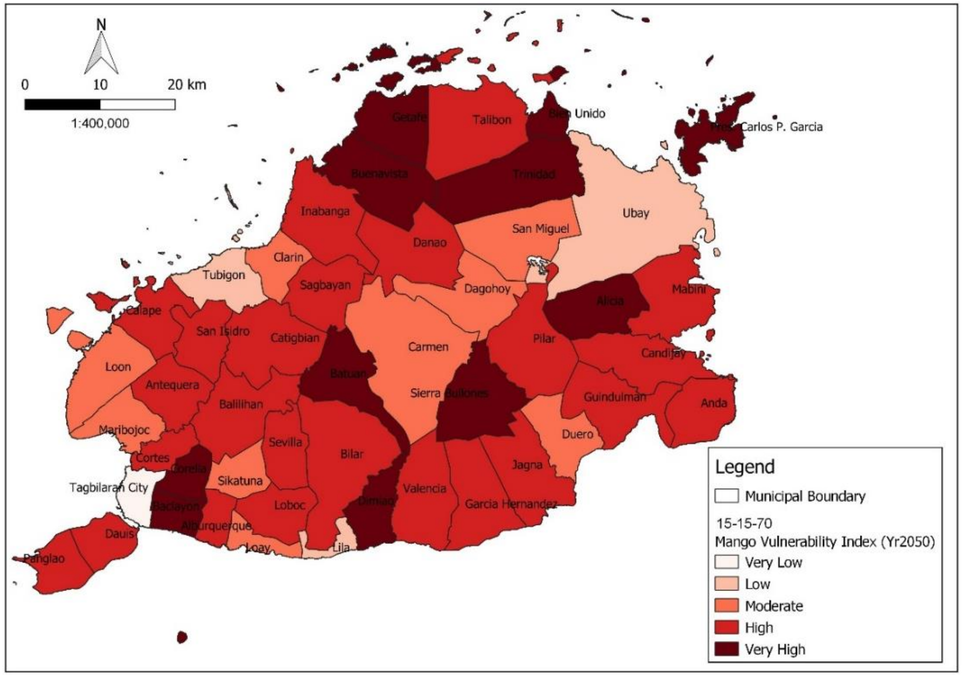


Figure 115. Vulnerability of Mango in Bohol in 2050

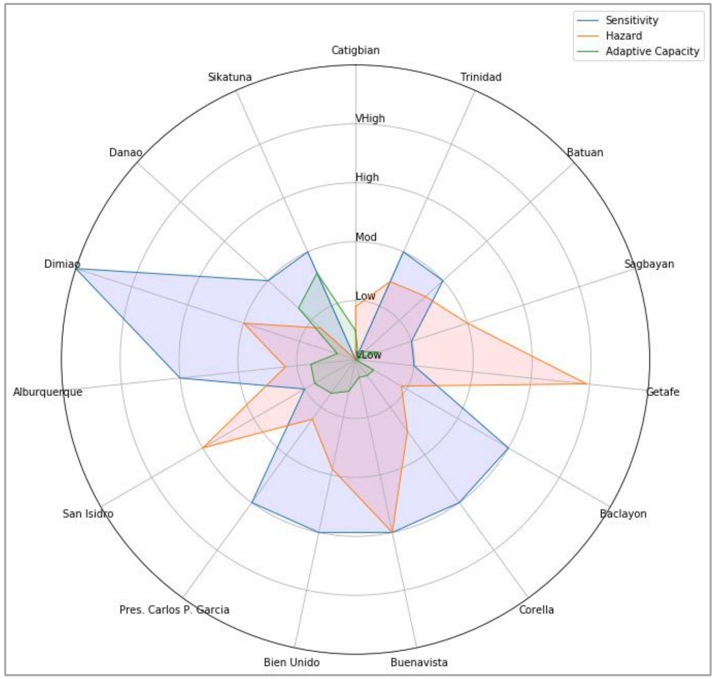


Figure 116. Mango Vulnerability Radar Plot of Bohol

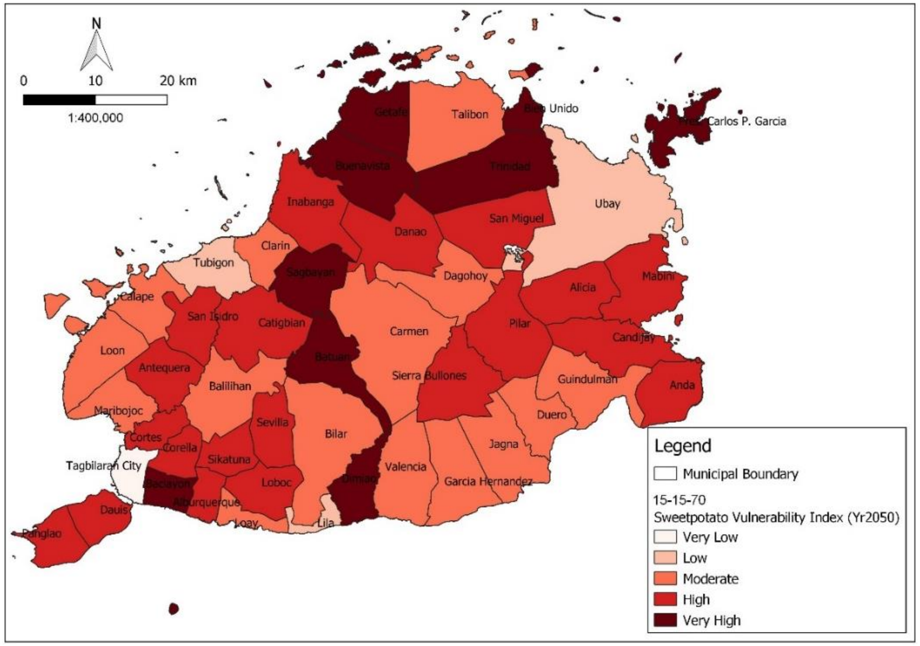


Figure 117. Vulnerability of Sweet Potato in Bohol in 2050

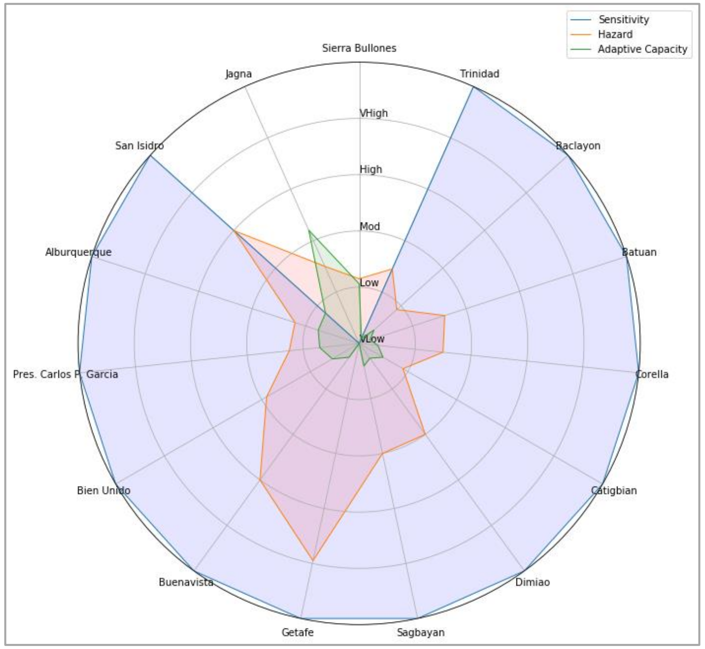


Figure 118. Sweet Potato Vulnerability Radar Plot of Bohol

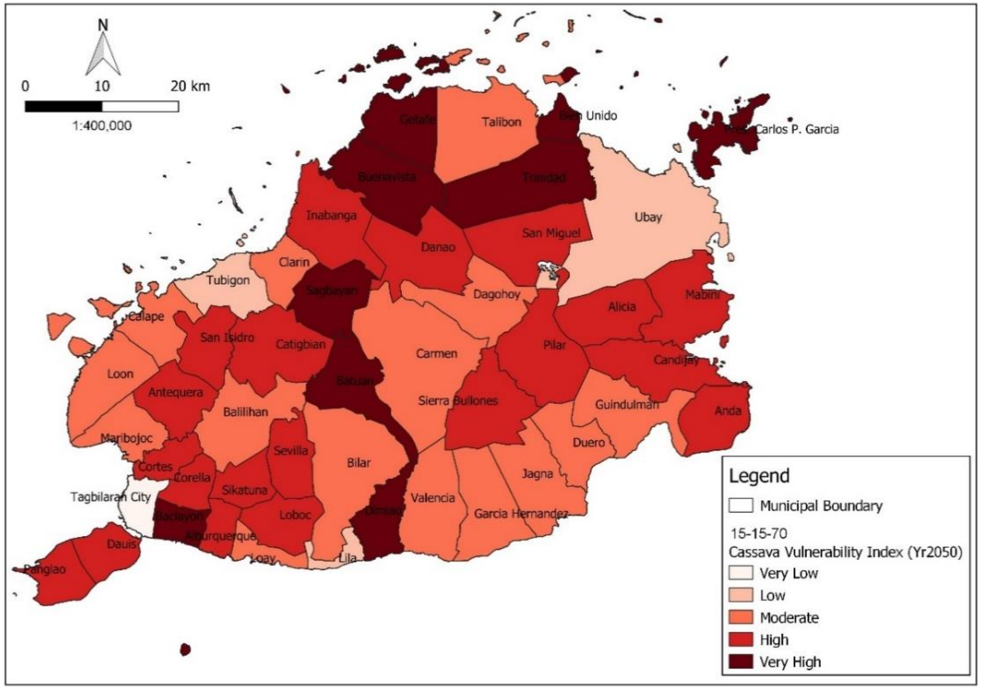


Figure 119. Vulnerability of Cassava in Bohol in 2050

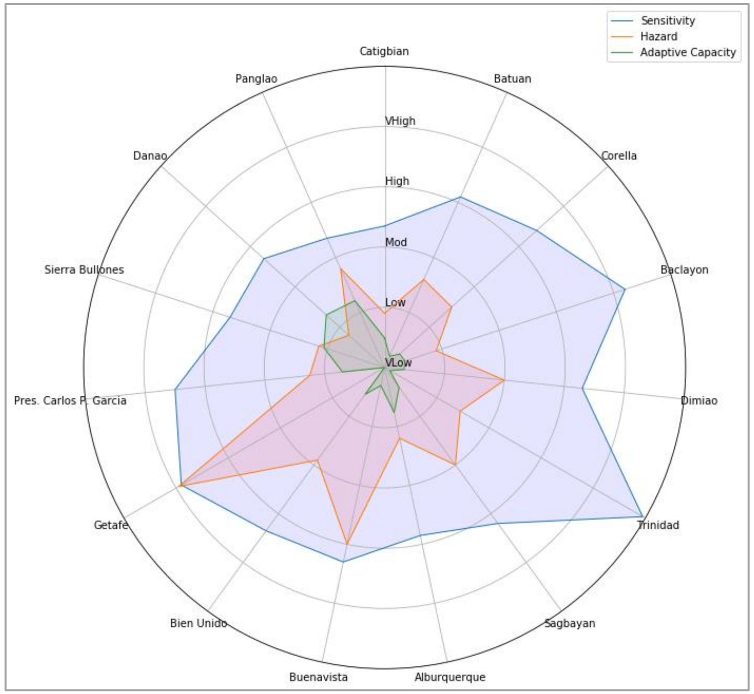


Figure 120. Cassava Vulnerability Radar Plot of Bohol

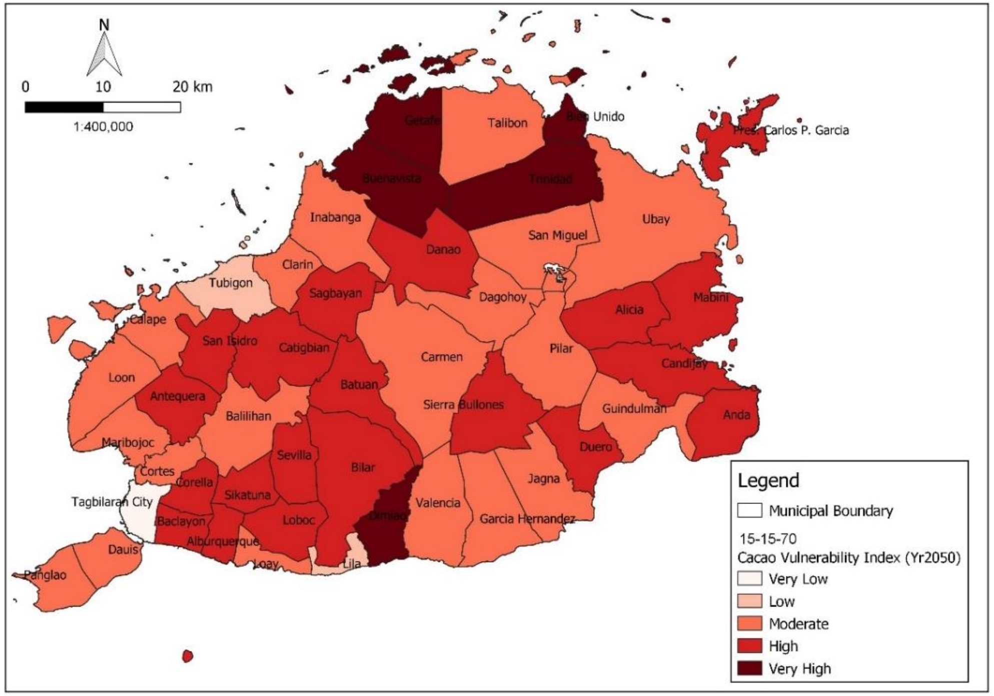


Figure 121. Vulnerability of Cacao in Bohol in 2050

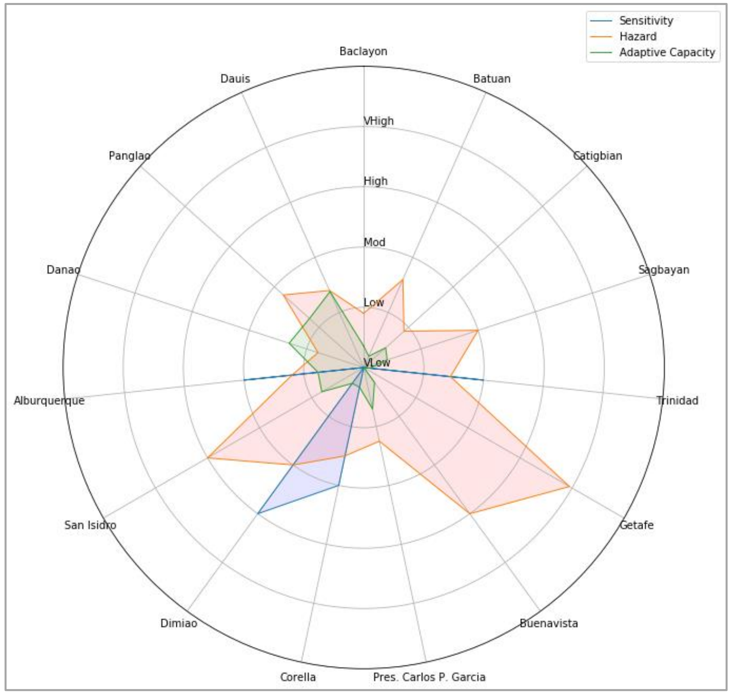


Figure 122. Cacao Vulnerability Radar Plot of Bohol

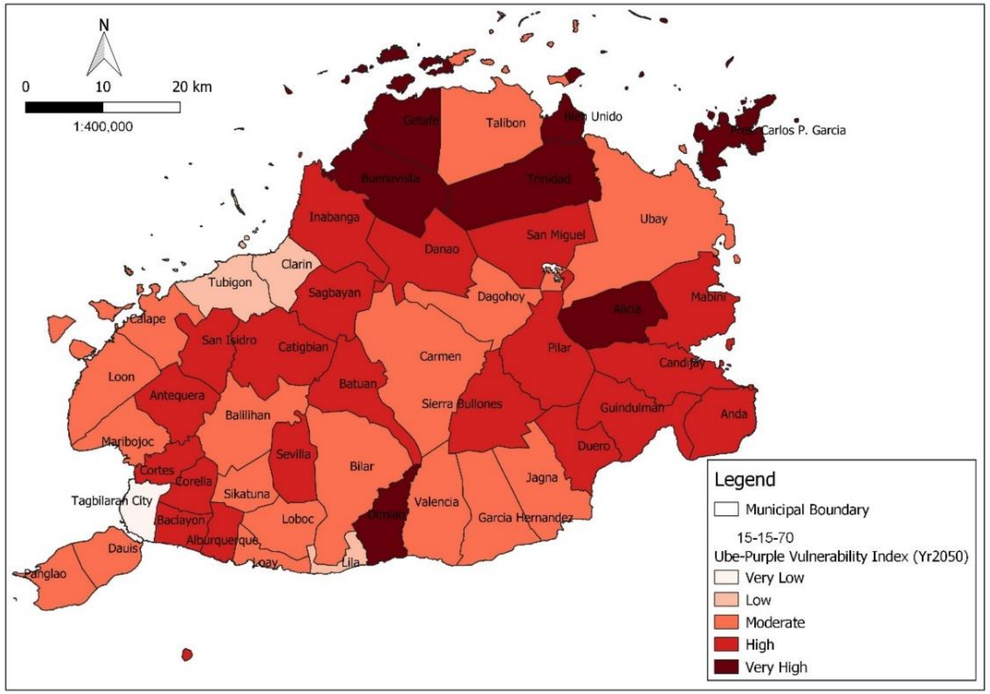


Figure 123. Vulnerability of Ube in Bohol in 2050

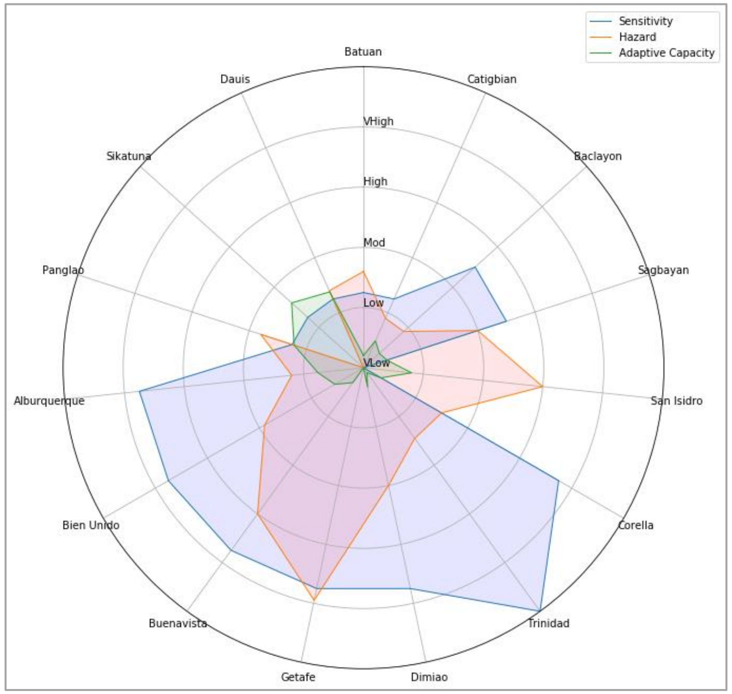


Figure 124. Ube Vulnerability Radar Plot of Bohol

Top Producers of Selected Crops and Crop Vulnerability: Bohol Province

Table 4. Top 10 Rice Producers in Bohol

Municipality	Production (Ha.)
Ubay	6,065.00
Trinidad	3,802.50
Carmen	2,886.00
Pilar	2,855.00
Dagohoy	2,815.43
Talibon	2,735.50
San Miguel	2,282.00
Alicia	2,201.00
Candijay	1,667.00
Catigbian	1,320.00

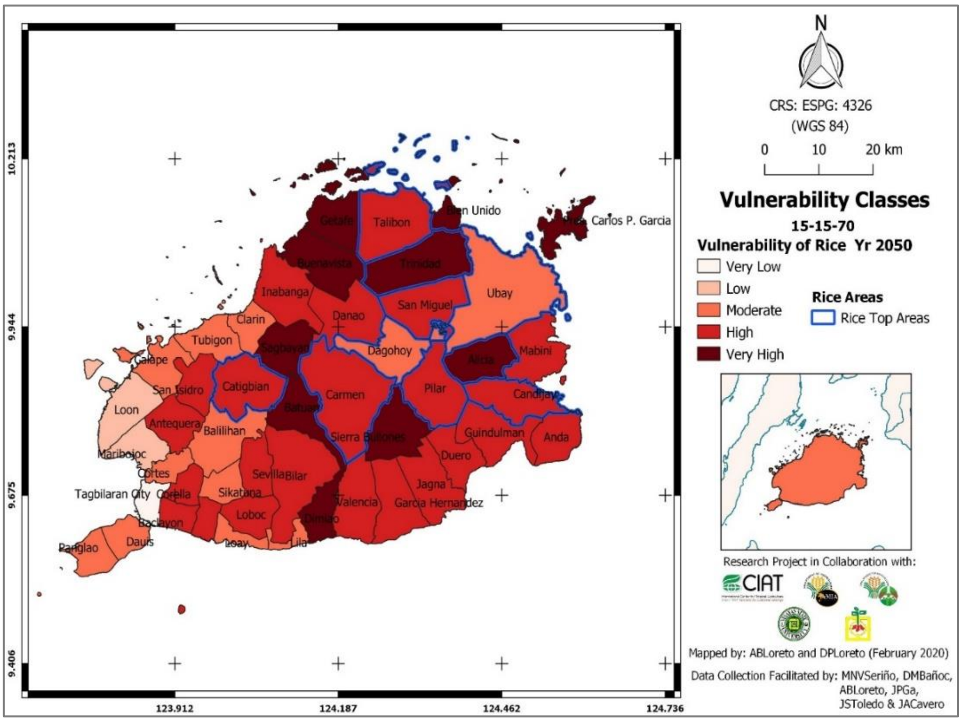


Figure 125. Rice Vulnerability of Top 10 Rice Producers in Bohol

Rice production in Carmen, Pilar, Talibon, San Miguel, and Candijay – the 3rd, 4th, 6th, 7th, 9th, and 10th rice producers respectively, are threatened with a high level of vulnerability. Likewise, Trinidad and Alicia – the 2nd and 8th top producers respectively, projected a very high vulnerability of rice. Ubay – the largest producer of rice projected a moderate vulnerability along with Dagohoy – the 5th rice producer.

Table 5. Top 10 Corn Producers in Bohol

Municipality	Yield (Metric Ton)
Trinidad	74,000.00
Carmen	5,582.21
Sevilla	2,000.00
Ubay	2,000.00
Buenavista	1,955.00
Valencia	1,852.09
Bilar	1,275.00
Dagohoy	1,080.00
Garcia-Hernandez	625.00
Balilihan	350.00

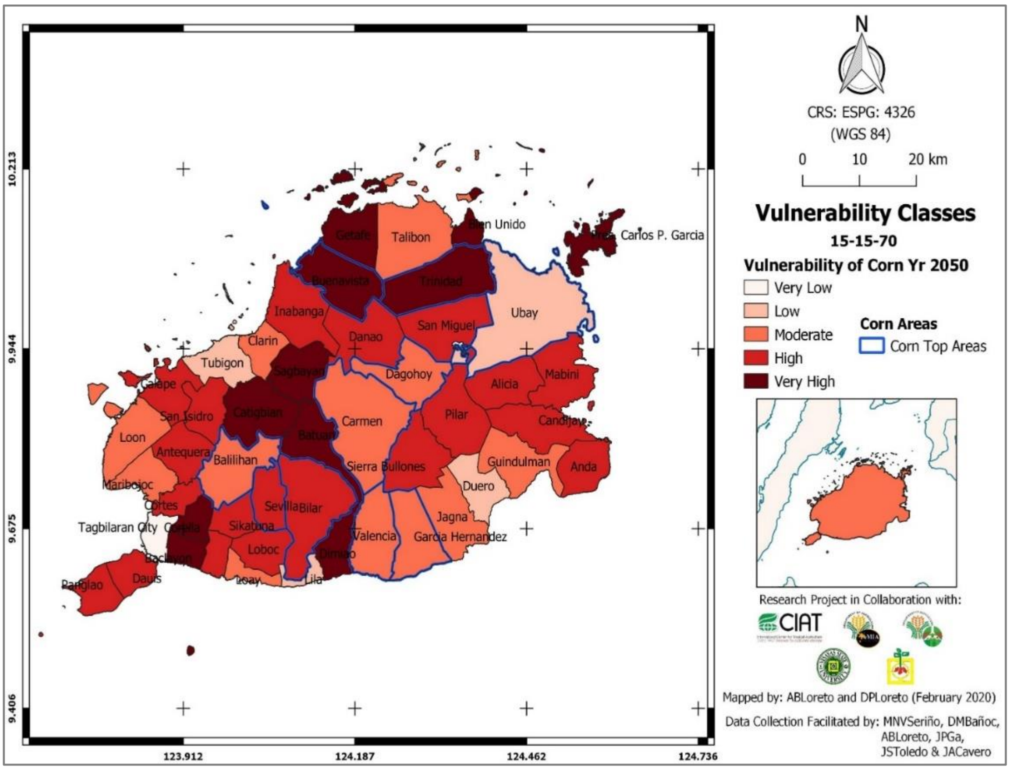


Figure 126. Corn Vulnerability among Top Corn Producers in Bohol

Among Bohol's top corn producers, only Ubay- the 4th top producer municipality projected a low corn vulnerability to climate risk. Trinidad – the province's largest corn producer projected a very high vulnerability along with Buenavista that ranked 6th. The rest of the top producers namely, Carmen, Sevilla, Valencia, Bilar, Dagohoy, Garcia-Hernandez, and Balilihan displayed a moderate corn vulnerability to climate risk.

Table 6. Top 10 Pinakber Producers in Bohol

Municipality	Yield (Metric Ton)
Sagbayan	12,653.30
Cortes	594.55
Carmen	518.85
Bilar	249.3
Jagna	20.8
Tubigon	16.04
Loboc	16
Duero	5.75
Trinidad	5.6
Guindulman	5.4

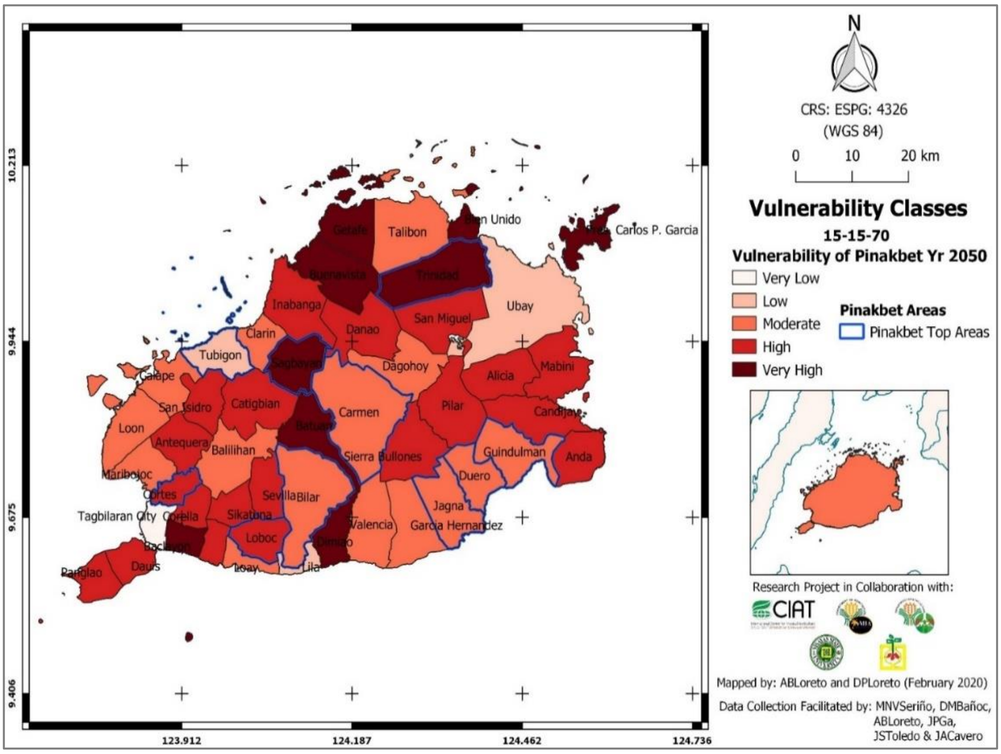


Figure 127. Pinakbet Vulnerability among Top Pinakbet Producers in Bohol

Sagbayan and Trinidad, the province's highest and 9th pinakbet producer respectively, are threatened with a very high level of vulnerability of the said crop while a high level is seen at Cortes and Loboc, the 2nd and 7th pinakbet producer respectively. Medium level of vulnerability of the crop can be expected at Carmen, Bilar, Jagna, Duero, and Guindulman while a low level can be expected at Tubigon - the 6th pinakbet producer.

Table 7. Top 10 Banana Producers in Bohol

Municipality	Yield (Metric Ton)
Carmen	11,906.61
Ubay	8,000.00
San Isidro	5,632.00
San Miguel	3,780.00
Tubigon	1,260.50
Carlos P. Garcia	1,125.00
Candijay	1,093.00
Loay	1,000.00
Sevilla	937.00
Buenavista	830.00

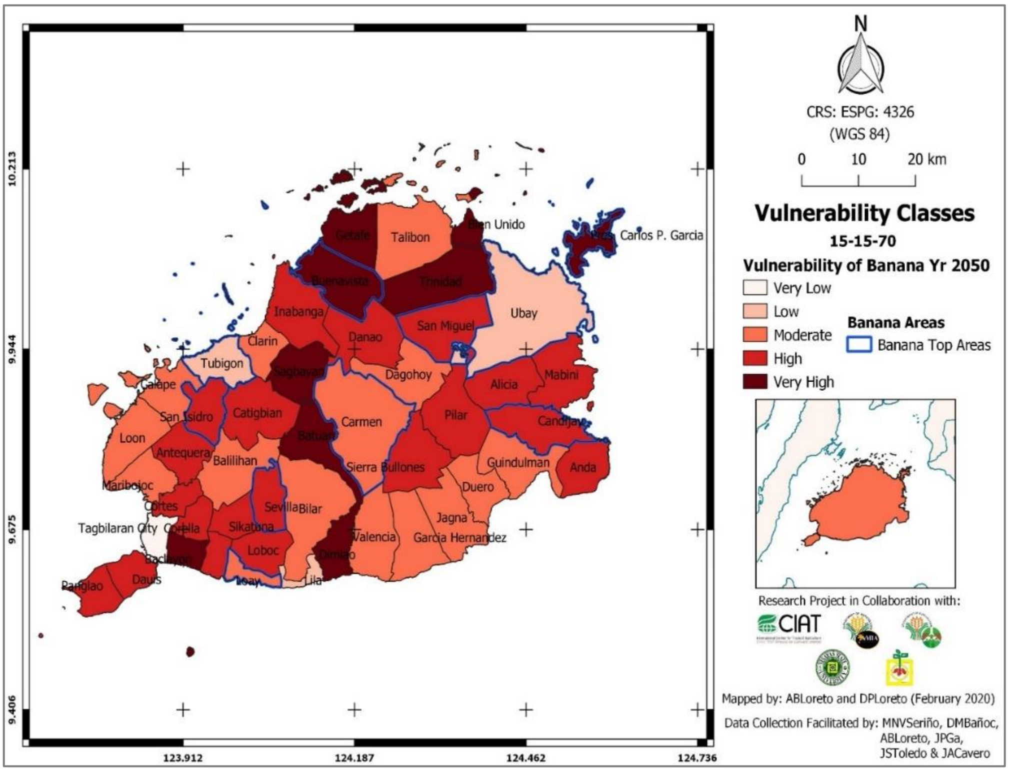


Figure 128. Banana Vulnerability among Top Banana Producers in Bohol

Very high level vulnerability of banana is projected at Carlos P. Garcia and Buenavista that ranked 6th and 10th respectively in terms of banana production in Bohol. Likewise, high vulnerability can be gleaned in San Miguel, Candijay, and Sevilla – the province's 3rd, 6th, and 8th banana producers. Meanwhile, Carmen – the top producer projected a moderate vulnerability for banana. Ubay, Tubugon, and Loay – the province's 2nd, 4th, and 7th banana producer respectively, positions a low vulnerability.

Table 8. Top 10 Mango Producers in Bohol

Municipality	Yield (Metric Ton)
Tubigon	27,300.00
Buenavista	1,485.00
Inabanga	1,395.00
Carlos P. Garcia	320.00
Alicia	258.20
Maribojoc	118.56
Loon	75.00
Carmen	69.90
Alburquerque	50.00
Lila	42.25

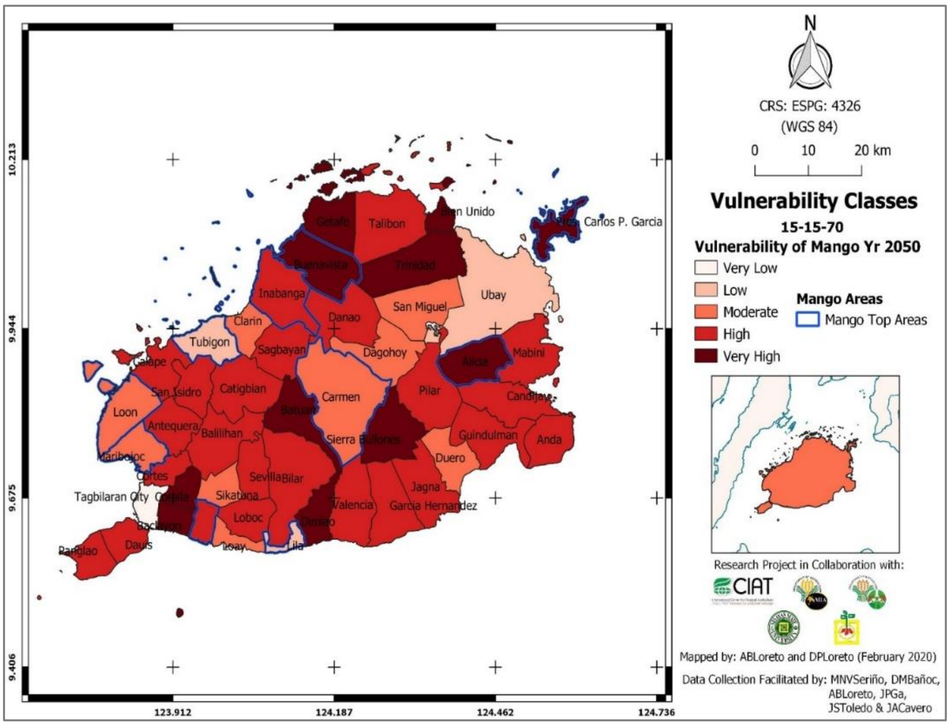


Figure 129. Mango Vulnerability among Top Mango Producers in Bohol

The largest mango producer in Bohol had shown a low level of climate risk vulnerability of the said crop along Lila – the 10th mango producer. A very high level of vulnerability of the crop can be observed at Buenavista, Carlos P. Garcia, and Alica – the 2nd, 4th, and 5th mango producers. Likewise, a high level is projected at Inabanga and Alburquerque – the 3rd and 9th mango producer. Municipalities of Maribojoc, Loon, and Carmen that ranked 6th, 7th, and 8th respectively, poses a moderate mango vulnerability respectively.

Table 9. Top 10 Sweet Potato Producers in Bohol

Municipality	Yield (Metric Ton)
Tubigon	8,289.00
Dagohoy	270.00
San Isidro	240.00
Anda	140.00
Sagbayan	120.00
Inabanga	108.00
Guindulman	52.00
Loon	48.60
Buenavista	14.35
Dauis	13.30

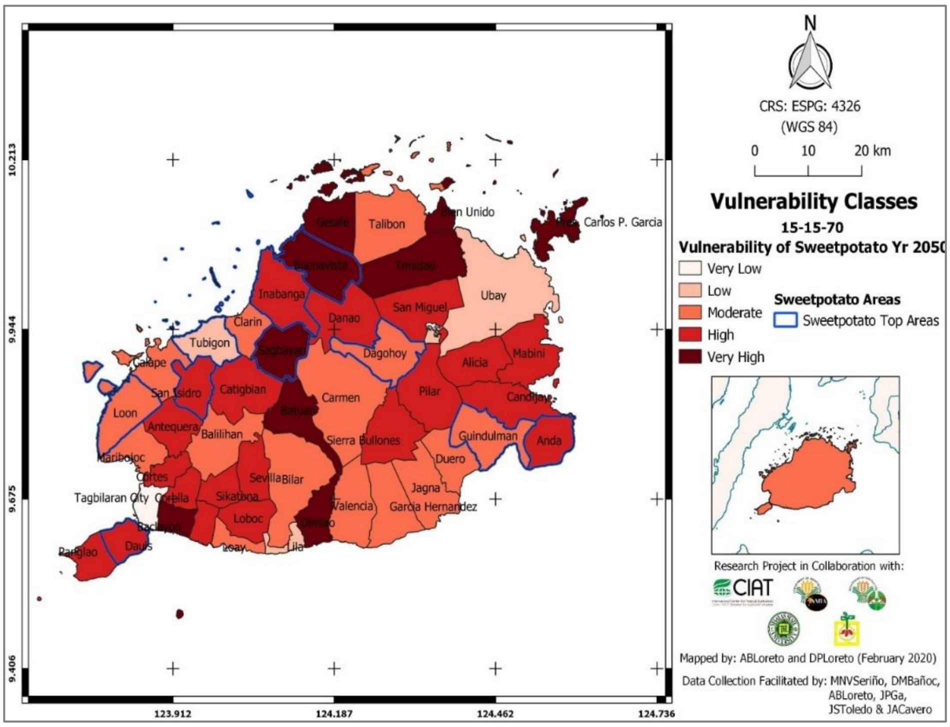


Figure 130. Sweet Potato Vulnerability among Top Sweet Potato Producers in Bohol

Among its top producers, sweet potato is least vulnerable to climate risks in Tubigon by projecting a low vulnerability. Very high level can be observed at the municipalities of Sagbayan and Buenavista – the 5th and 9th top producer respectively of the similar crops.

Likewise, high vulnerability can be gleaned at the municipalities of San Isidro, Anda, and Dauis that ranked 3rd, 4th, 6th, and 10th on sweet potato production respectively. The crop is moderately vulnerable in Dagohoy and Guindulman that ranked 2nd and 7th on sweet potato production respectively.

Climate Change Vulnerability: Negros Oriental Province

All studied crops consistently projects a very high vulnerability in the municipality of Jimalalud and Vallehermoso except for pinakbet (Figure 128-144). Bayawan City and Dumaguete City have very low vulnerability for all crops except pinakbet that has low vulnerability. This is because the adaptive capacity index of both of the cities are categorized as very high and high respectively and this greatly affects the vulnerability index. Meanwhile, sugarcane and mango shows same areas for very high vulnerability in Vallehermoso, Jimalalud, and Manjuyod while it shows very low vulnerability in Valencia and both cities – Bayawan and Dumaguete. Like sugarcane, rice also shows less vulnerable in Valencia and both cities while very vulnerable in Vallehermoso, La Libertad and Jimalalud. Banana displays a very high vulnerability in Vallehermoso and Jimalalud while only the two cities – Bayawan and Dumaguete are categorized as very low in vulnerability. Same as for coffee but Manjuyod is added in very high vulnerable area. Cassava also project a very high vulnerability in Vallehermoso, Jimalalud, Manjuyod, Pamplona and Zamboanguita while vulnerability is very low in both cities – Bayawan and Dumaguete.

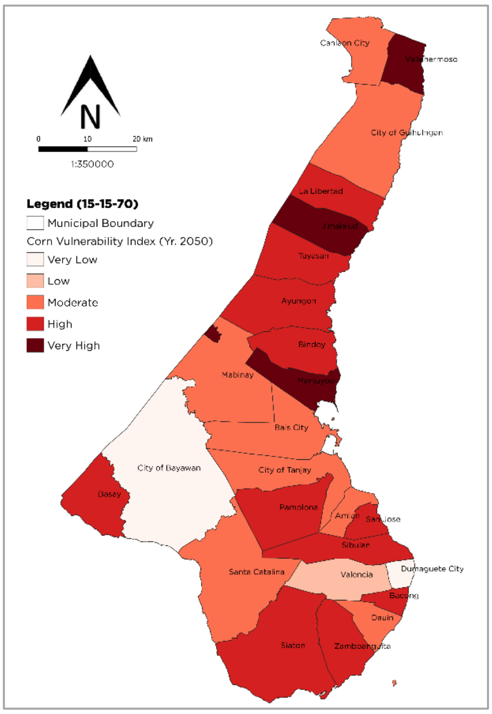


Figure 132. Vulnerability of Corn in Negros Oriental in 2050

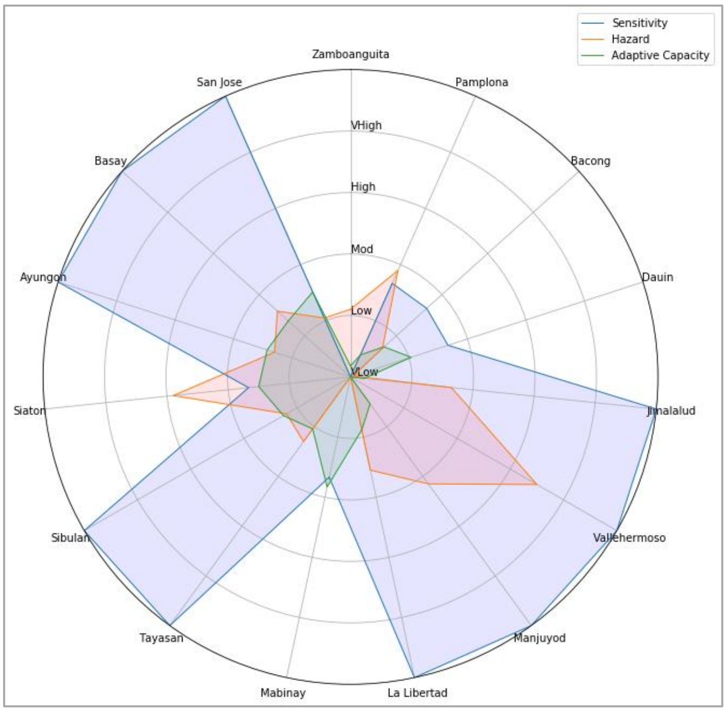


Figure 131. Corn Vulnerability Radar Plot of Negros Oriental

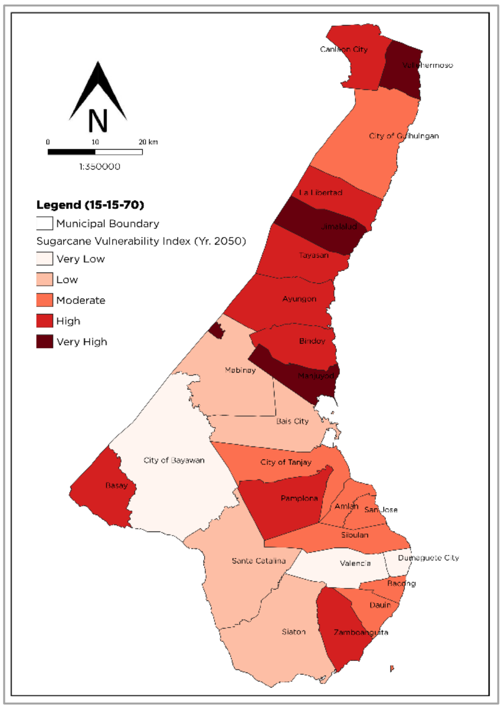


Figure 134. Vulnerability of Sugarcane in Negros Oriental in 2050

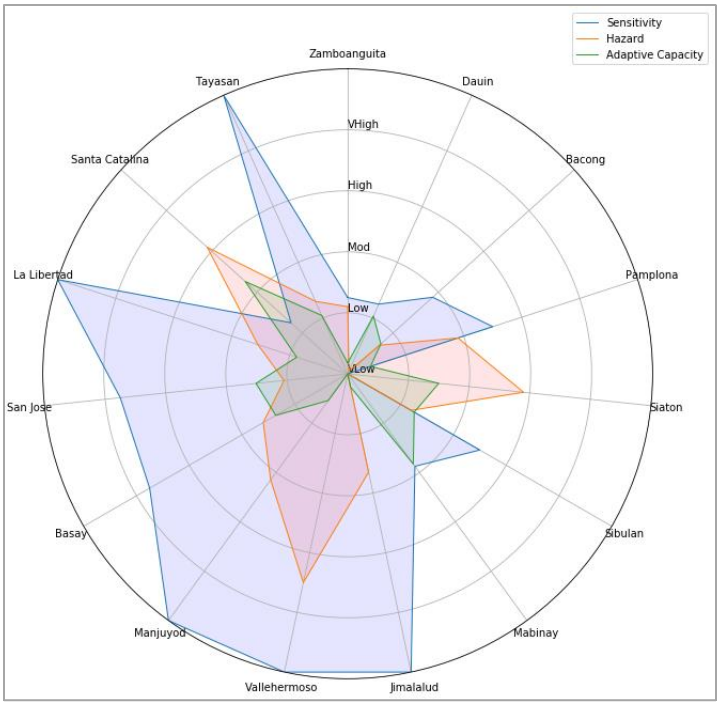


Figure 133. Sugarcane Vulnerability Radar Plot of Negros Oriental

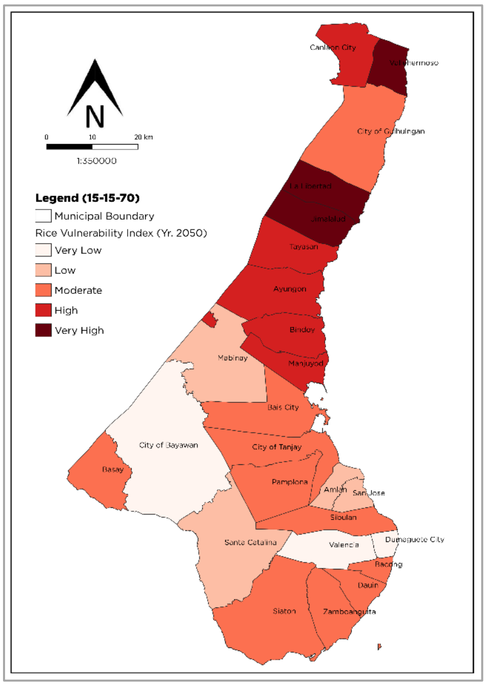


Figure 135. Vulnerability of Sugarcane in Negros Oriental in 2050

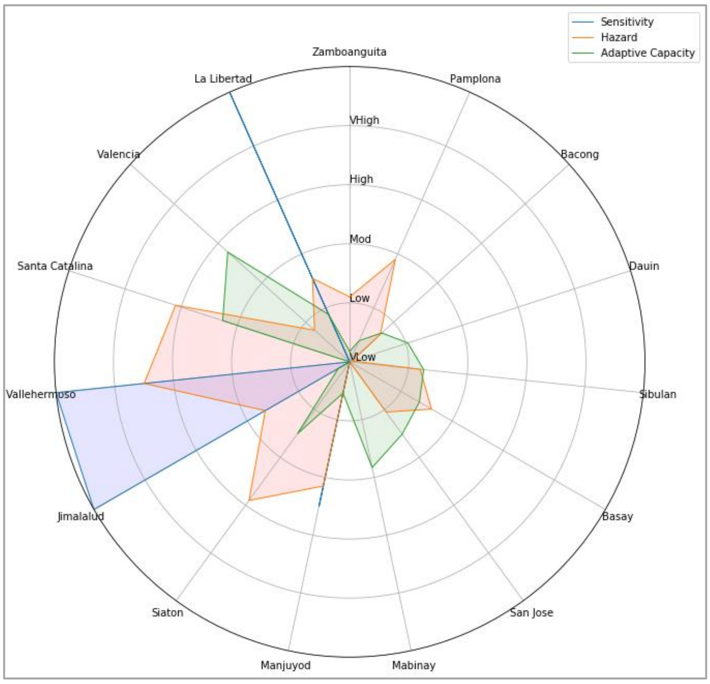
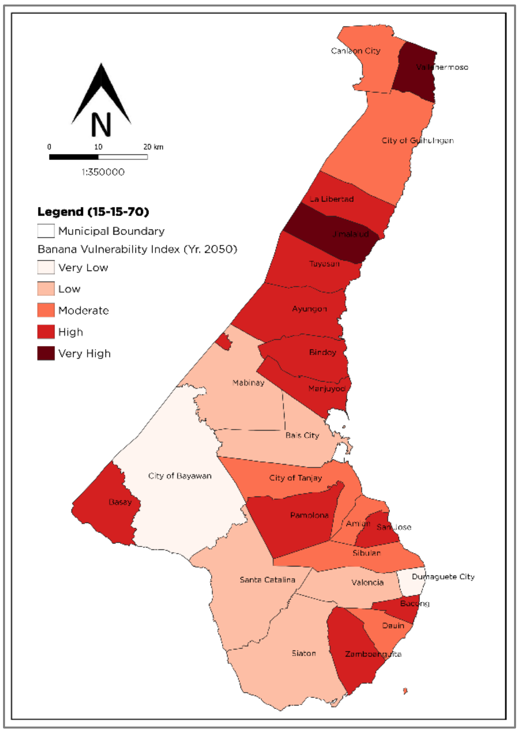


Figure 136. Sugarcane Vulnerability Radar Plot of Negros Oriental



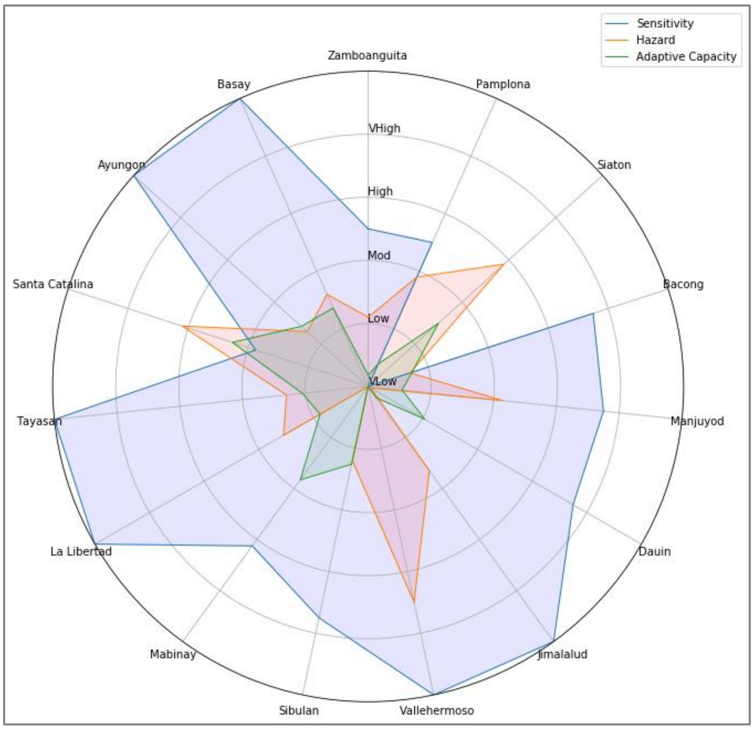
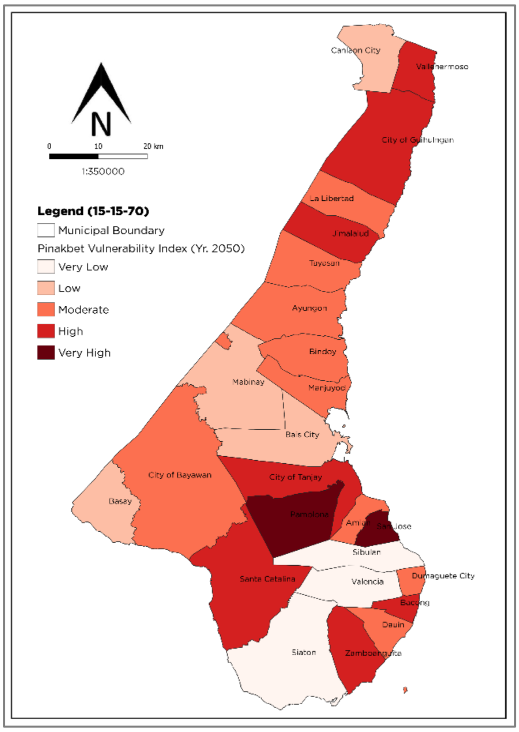


Figure 139. Vulnerability of Banana in Negros Oriental in 2050

Figure 140. Banana Vulnerability Radar Plot of Negros Oriental



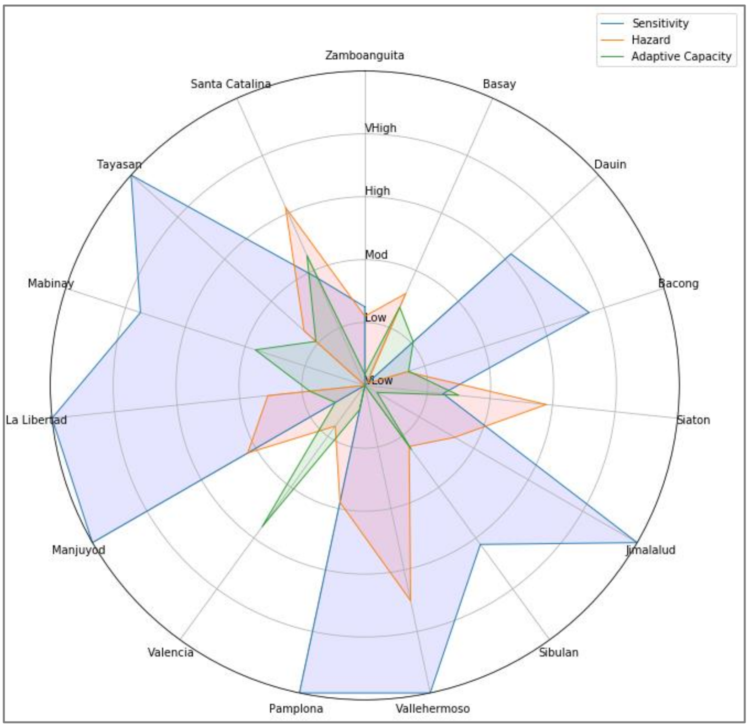


Figure 138. Vulnerability of Pinakbet in Negros Oriental in 2050

Figure 137. Pinakbet Vulnerability Radar Plot of Negros

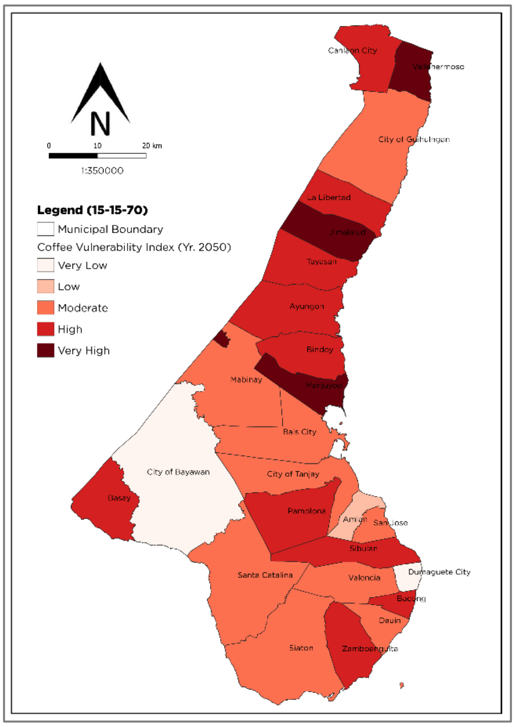


Figure 144. Vulnerability of Coffee in Negros Oriental in 2050

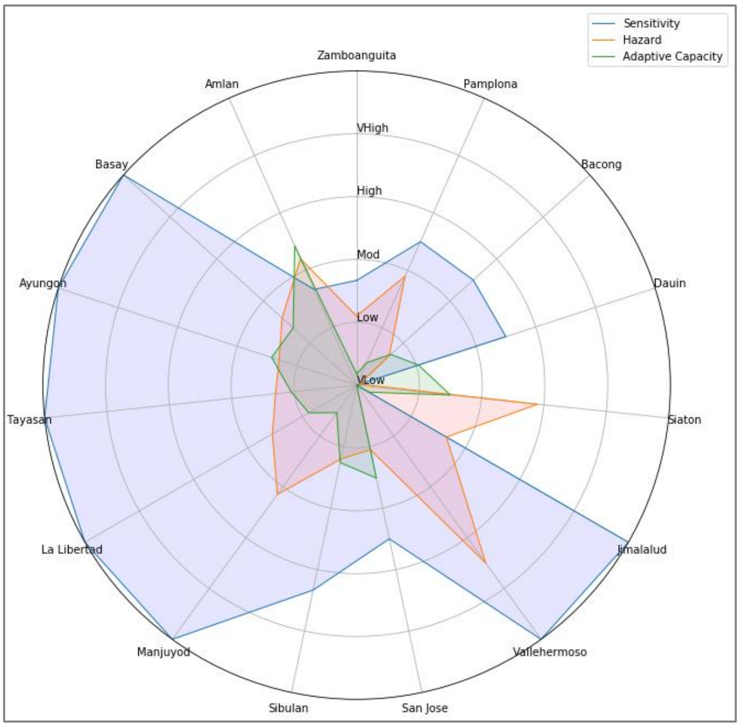


Figure 143. Coffee Vulnerability Radar Plot of Negros Oriental

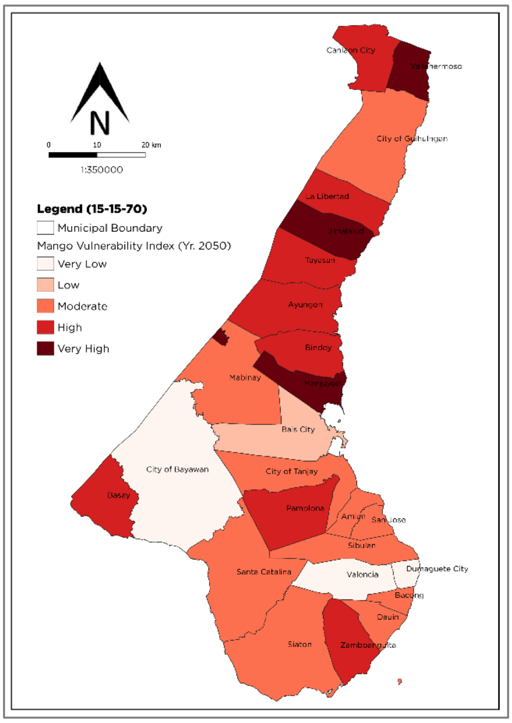


Figure 141. Vulnerability of Mango in Negros Oriental in 2050

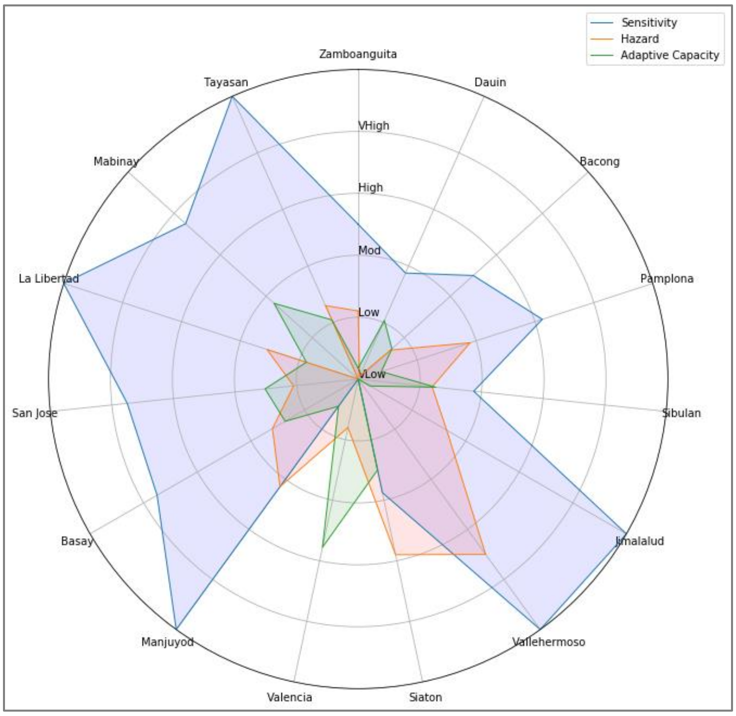


Figure 142. Mango Vulnerability Radar Plot of Negros Oriental

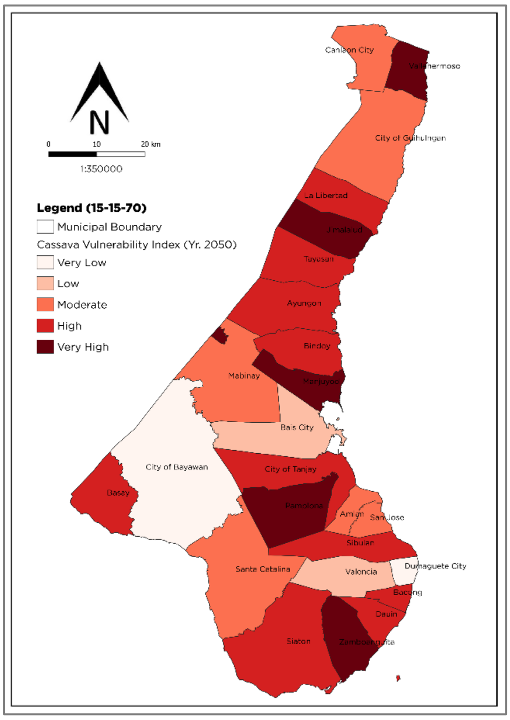


Figure 146. Vulnerability of Cassava in Negros Oriental in 2050

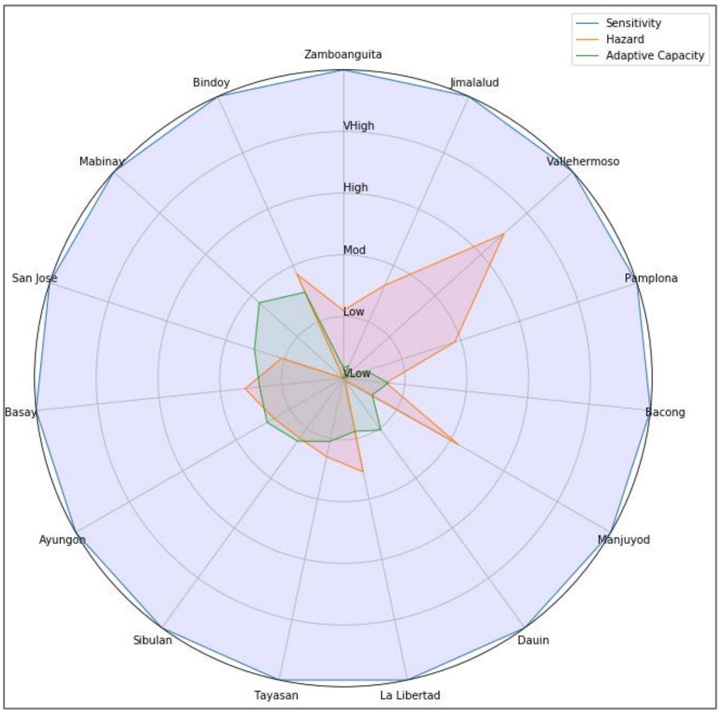


Figure 145. Cassava Vulnerability Radar Plot of Negros Oriental

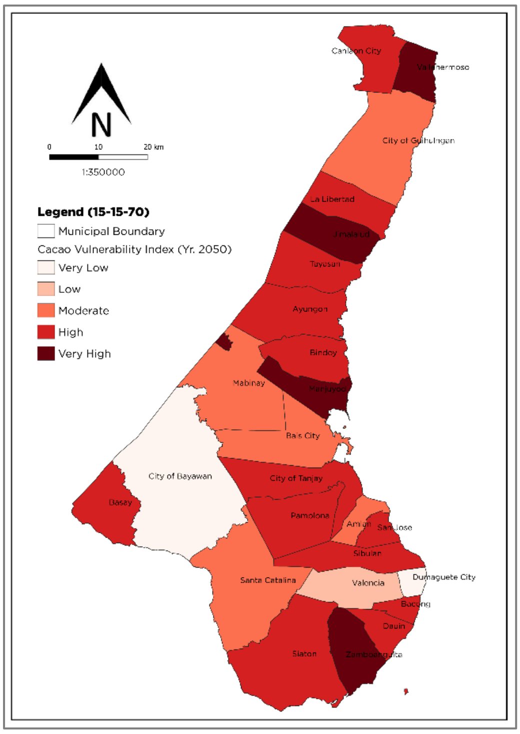


Figure 148. Vulnerability of Cacao in Negros Oriental in 2050

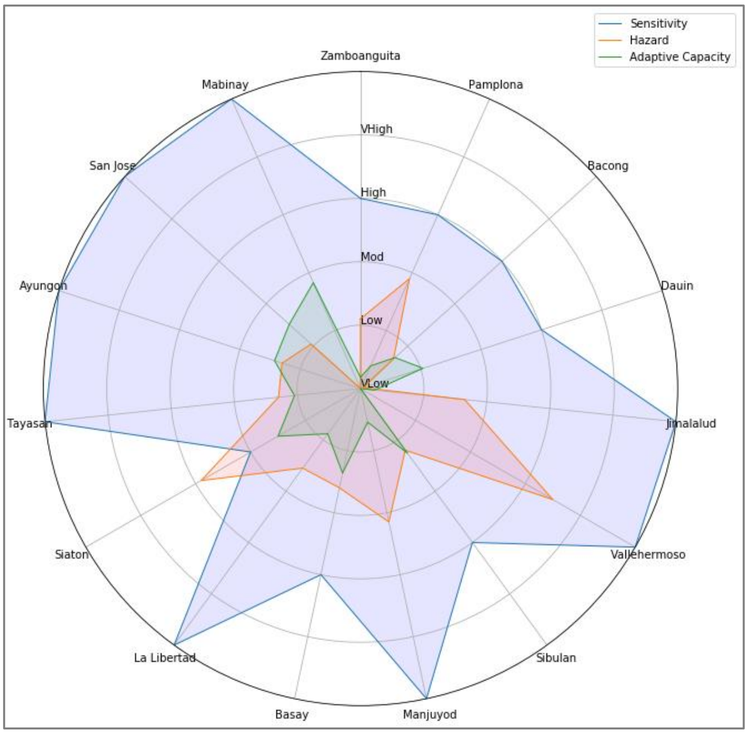


Figure 147. Cacao Vulnerability Radar Plot of Negros Oriental

Top Producers of Selected Crops and Crop Vulnerability: Negros Oriental Province

Table 10. Top 10 Rice Producers in Negros Oriental

Municipality	Production (Ha.)
Bayawan City	3,721.92
Tanjay City	1,589.35
Mabinay	1,105.73
Siaton	841.72
Sta. Catalina	764.91
Tayasan	755.00
Bais City	618.50
Zamboanguita	458.00
Basay	320.00
Vallehermoso	163.70

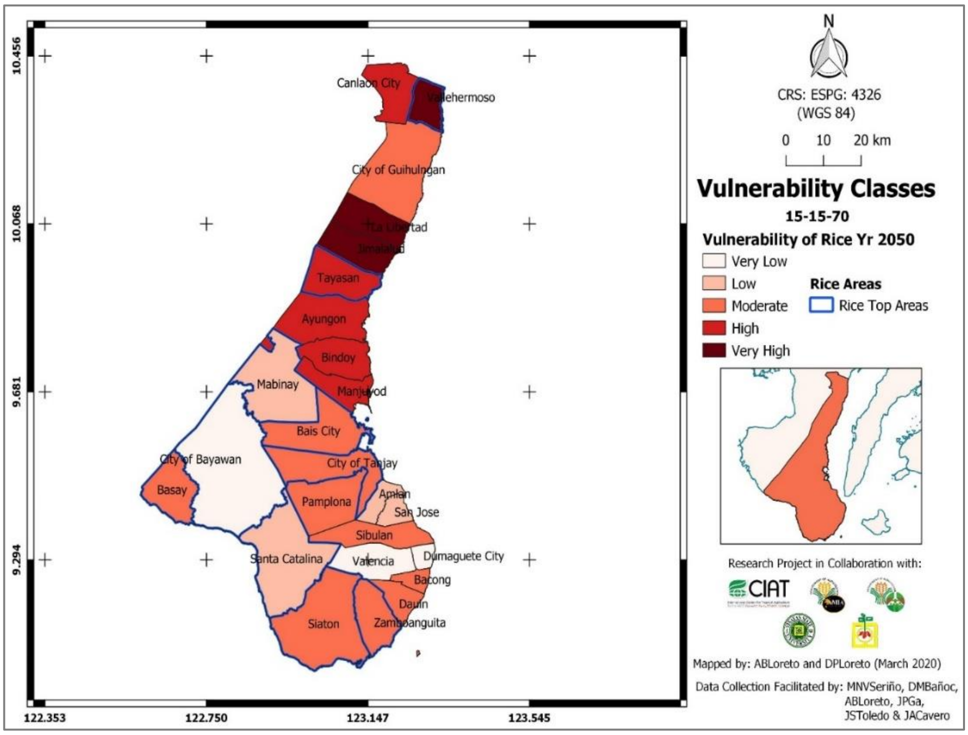


Figure 149 Rice Vulnerability of Top 10 Rice Producers in Negros Oriental

Bayawan City – the top rice producer of Negros Oriental projected a very low vulnerability of rice. Moreover, Mabinay – the 3rd top producer projected a low level of vulnerability. A moderate vulnerability of similar crop is projected at Tanjay City, Siaton, Bais

City, Zamboangita, and Basay. Meanwhile, Vallehermoso – its 10th top rice producer projected a very high level of vulnerability. A high level is also evident at Basay City.

Table 11. Top 10 Corn Producers in Negros Oriental

Municipality	Yield (Metric Ton)
Guihulngan City	11,680.50
Bayawan City	6,306.94
Bais City	5,787.61
Zamboanguita	3,718.00
Mabinay	2,046.10
Santa Catalina	1,991.26
Siaton	1,878.69
Ayungon	1,839.00
La Libertad	1,575.00
Dauin	1,104.40

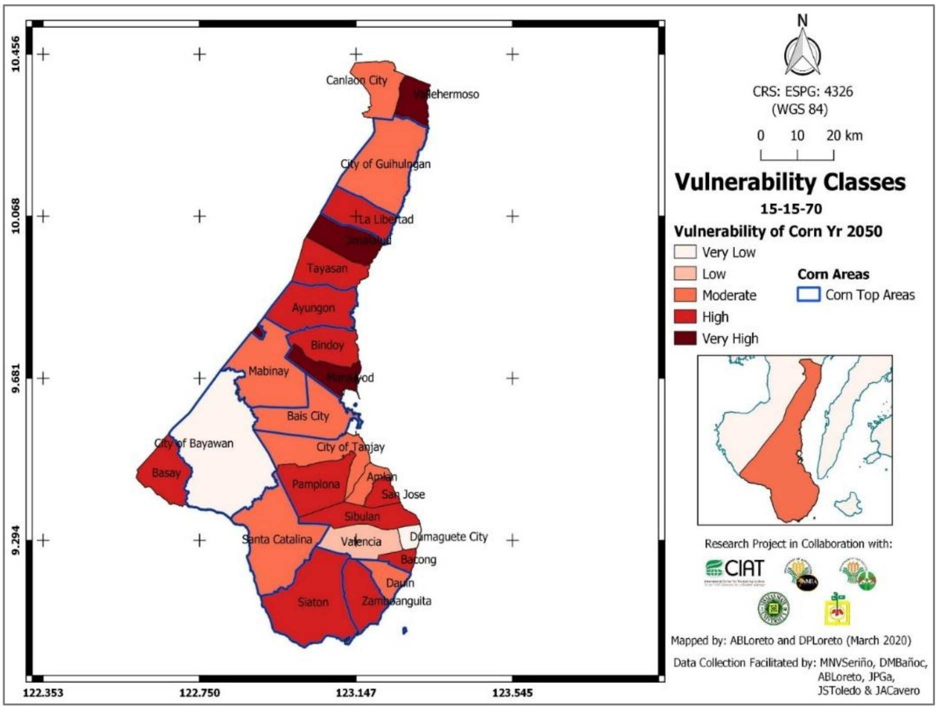


Figure 150. Corn Vulnerability among Top Corn Producers in Bohol

Corn is seen to have a medium level of vulnerability to climate risks in Guihulngan City - the top producer of corn in Negros Oriental. Similar level of vulnerability is projected in Bais City, Mabinay, Santa Catalina, and Dauin. Bayawan City that seconds Guihulngan City in terms of corn productin projected a very low level of vulnerability. Meanwhile, high levels of vulnerability is projected in Zamboangita, Siaton, Ayungon, and La Libertad.

Table 12. Top 10 Banana Producers in Negros Oriental

Municipality	Yield (Metric Ton)
La Libertad	21,000.00
Santa Catalina	7,663.18
Ayungon	3,798.00
Valencia	2,143.44
Amlan	680.00
Bais City	644.00
Basay	240.00
Vallehermoso	73.00
Guihulngan City	36.60
Dumaguete City	10.00

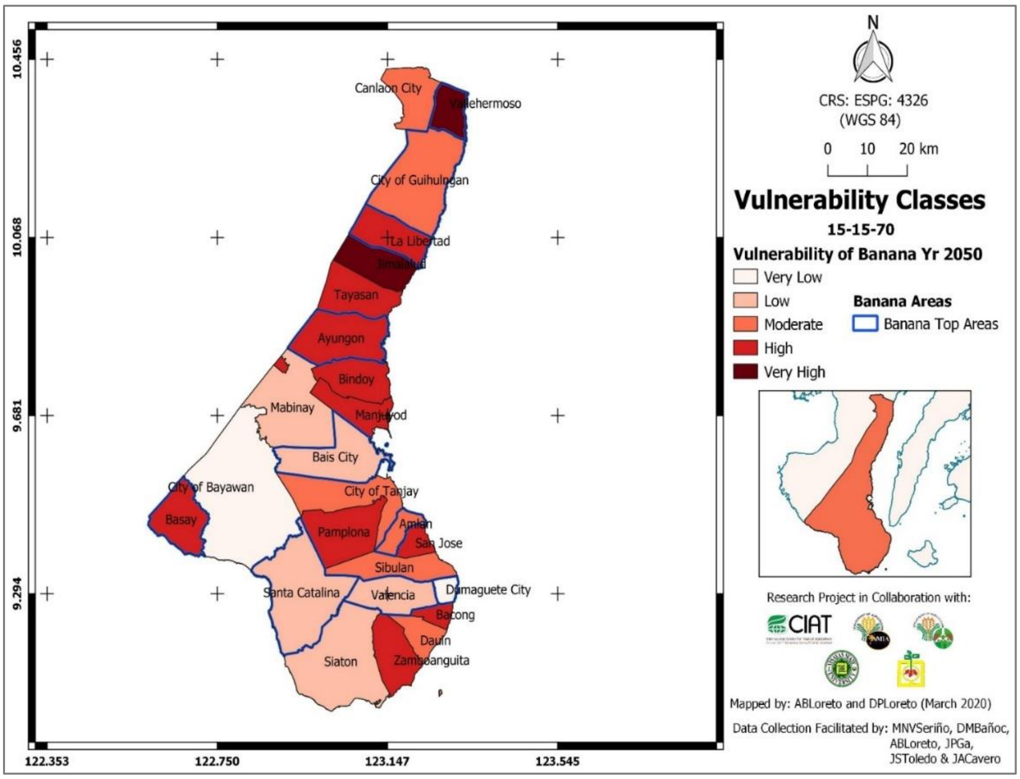


Figure 151. Banana Vulnerability among Top Banana Producers in Negros Oriental

Among its top producers in Negros Oriental, banana is seen with very high vulnerability in Vallehermoso – the 8th top producer of the said crop. Likewise, high vulnerability can be observed in La Libertad – the top banana producer. Ayungon and Basay, the 3rd and 7th producer also projected high vulnerability. Banana is seen with medium vulnerability in Amlan and Guihulngan City – the 5th and 9th producer of the crop respectively. Banana projected low vulnerability in Santa Catalina and, Valencia, and Bais City – the 2nd, 4th, and 6th top producer respectively. Furthermore, banana projected a very low vulnerability on climate risk in Dumaguete City – the 10th top producer of the crop.

Climate Change Vulnerability: Siquijor Province

Vulnerability of corn, rice, banana, mango, cassava and pinakbet is similar across the municipalities of Siquijor (Figure 152-161). San Juan displays a very high vulnerability for all crops. Meanwhile, the municipalities of Siquijor and Larena projects a high vulnerability for all crops. All studied crops projects a moderate, low and very low vulnerability in Lazi, Maria and Enrique Villanueva respectively.

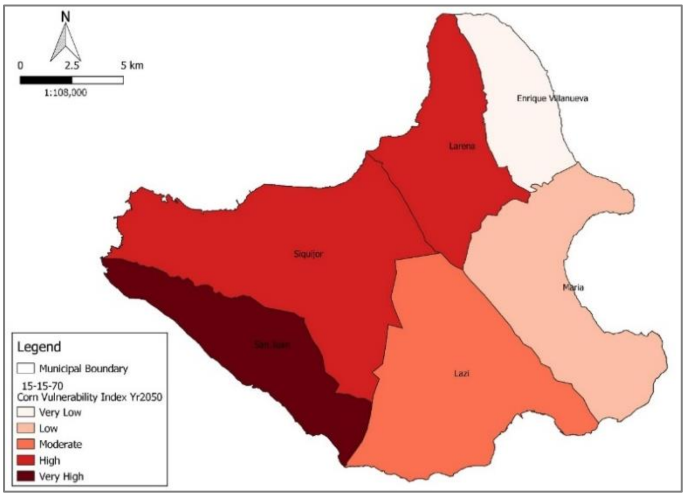


Figure 153. Vulnerability of Corn in Siquijor in 2050

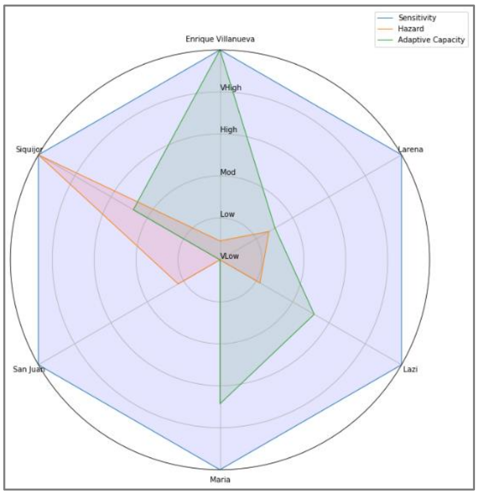


Figure 152. Corn Vulnerability Radar Plot of Siquijor

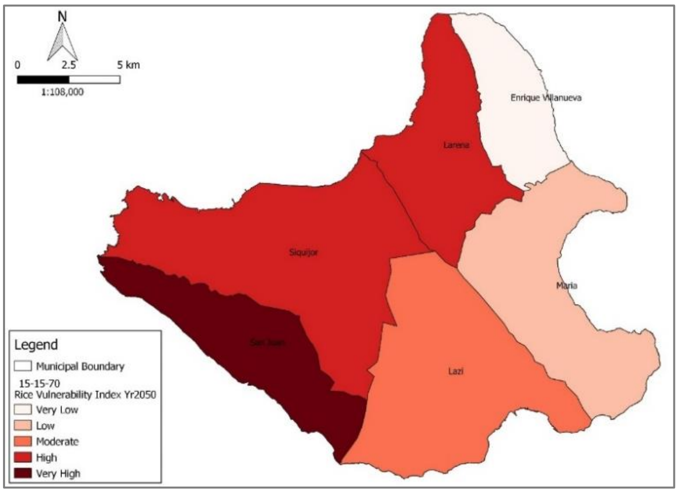


Figure 155. Vulnerability of Rice in Siquijor in 2050

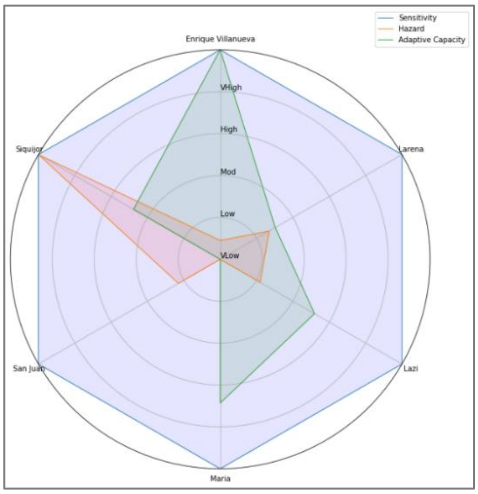


Figure 154. Rice Vulnerability Radar Plot of Siquijor

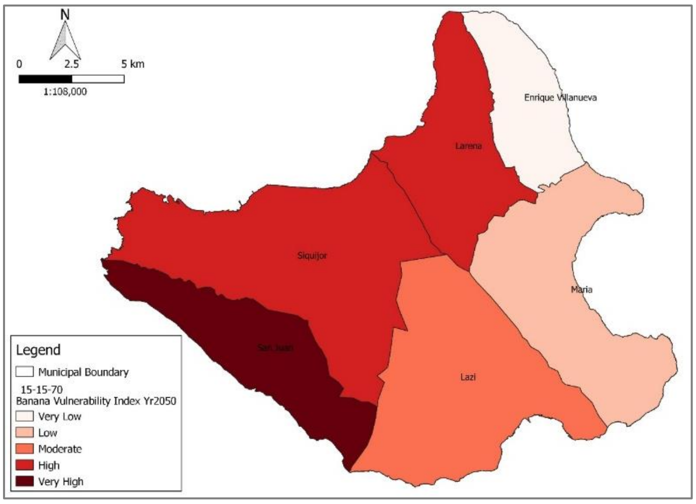


Figure 157. Vulnerability of Banana in Siquijor in 2050

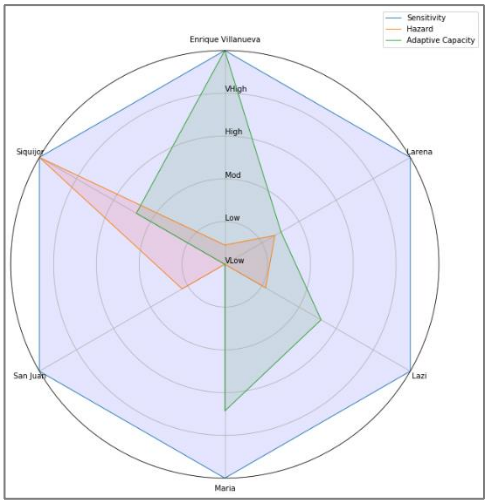


Figure 156. Banana Vulnerability Radar Plot of Siquijor

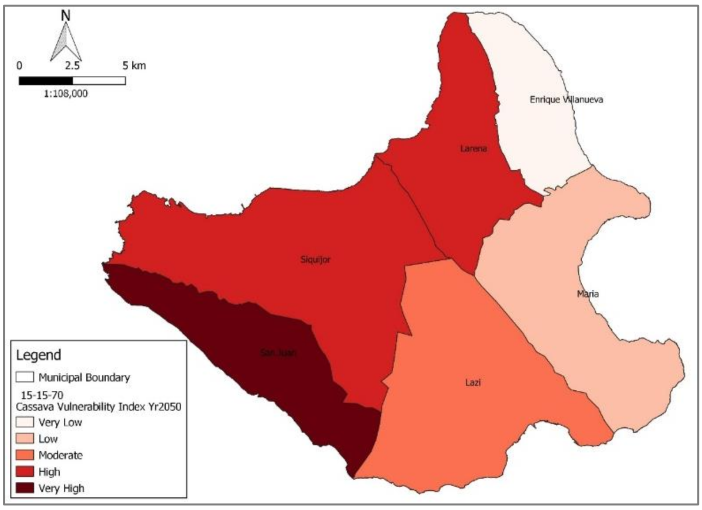


Figure 161. Vulnerability of Cassava in Siquijor in 2050

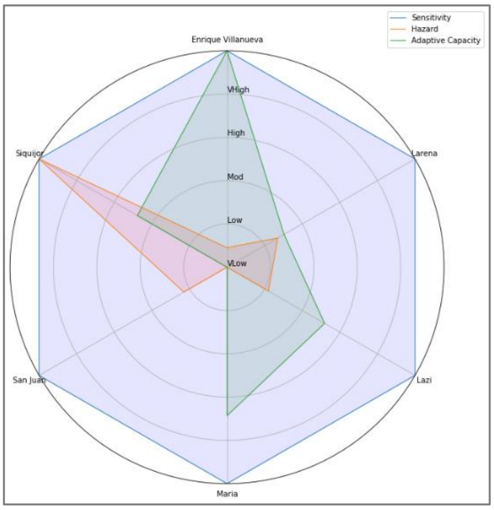


Figure 160. Cassava Vulnerability Radar Plot of Siquijor

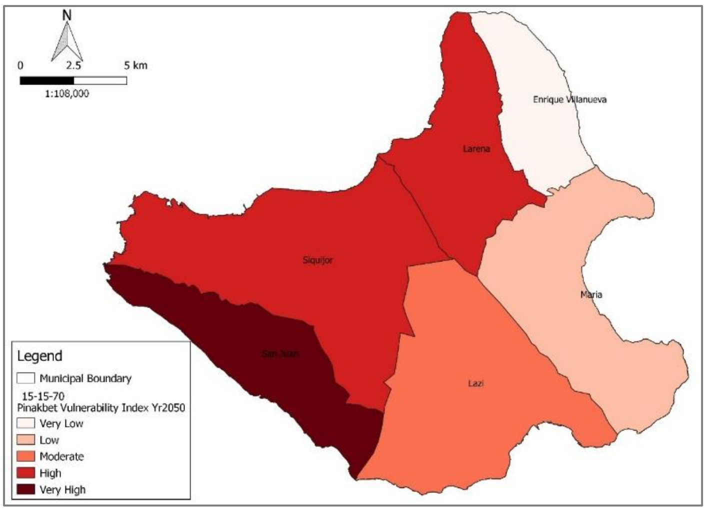


Figure 159. Vulnerability of Pinakbet in Siquijor in 2050

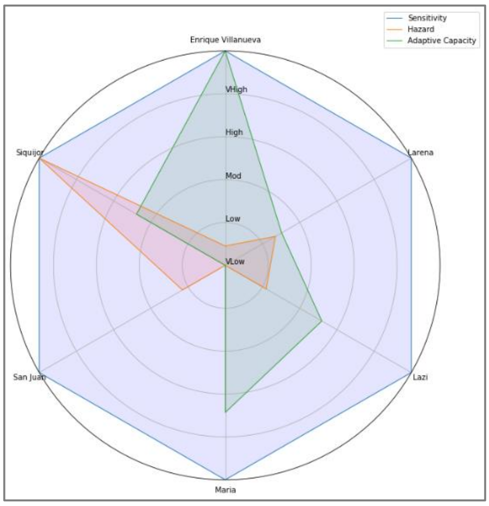


Figure 158. Pinakbet Vulnerability Radar Plot of Siquijor

Top Producers of Selected Crops and Crop Vulnerability: Siquijor Province

Table 13. Top Rice Producers in Siquijor

Municipality	Production (Ha.)
Lazi	239.60
Larena	79.12
Siquijor	60.75
Maria	58.00
San Juan	57.87
Enrique Villanueva	7.63

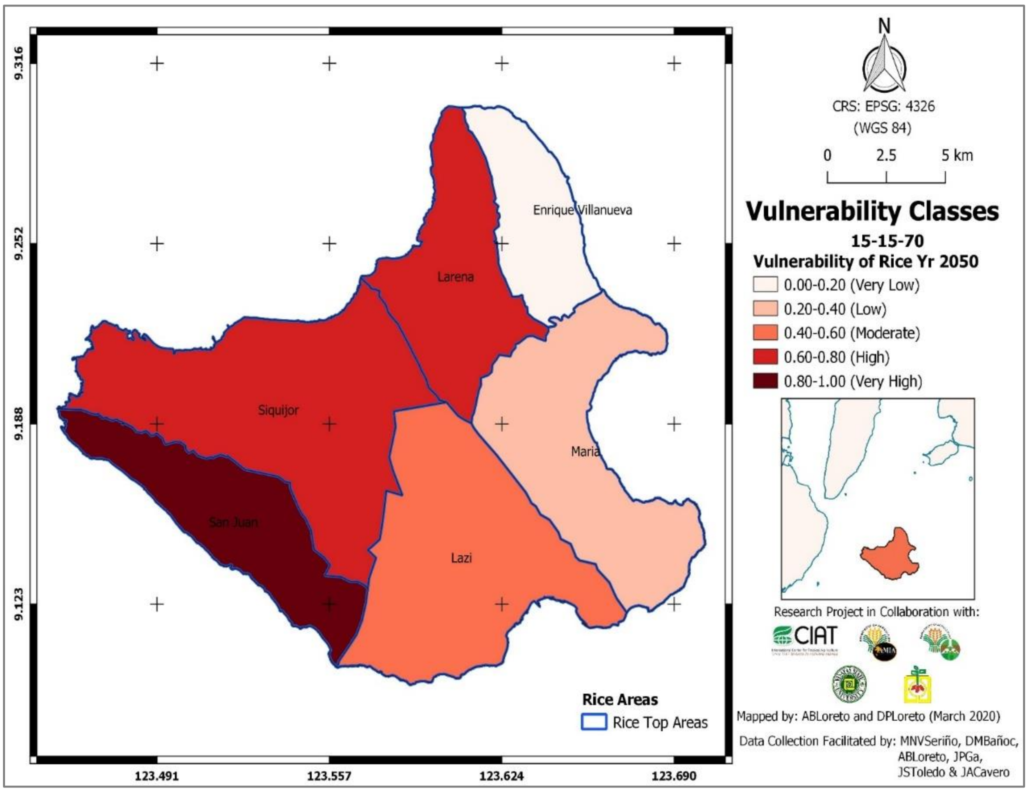


Figure 162. Rice Vulnerability of Top Producers in Siquijor

Lazi – the top rice producer, projected a moderate level of rice vulnerability to climate change together with Maria - its 4th rice producer. Very high level of vulnerability is expected at San Juan - the 5th rice producer. High level is expected at Larena and Siquijor – the 2nd and 3rd top rice producer, respectively. Very low level of vulnerability of the same crop is expected at Enrique Villanueva – the least rice producing municipality.

Table 14. Top Corn Producers in Siquijor

Municipality	Yield (Metric Ton)
San Juan	1,741.00
Maria	1,353.00
Siquijor	1,153.97
Lazi	992.32
Larena	214.20
Enrique Villanueva	0.68

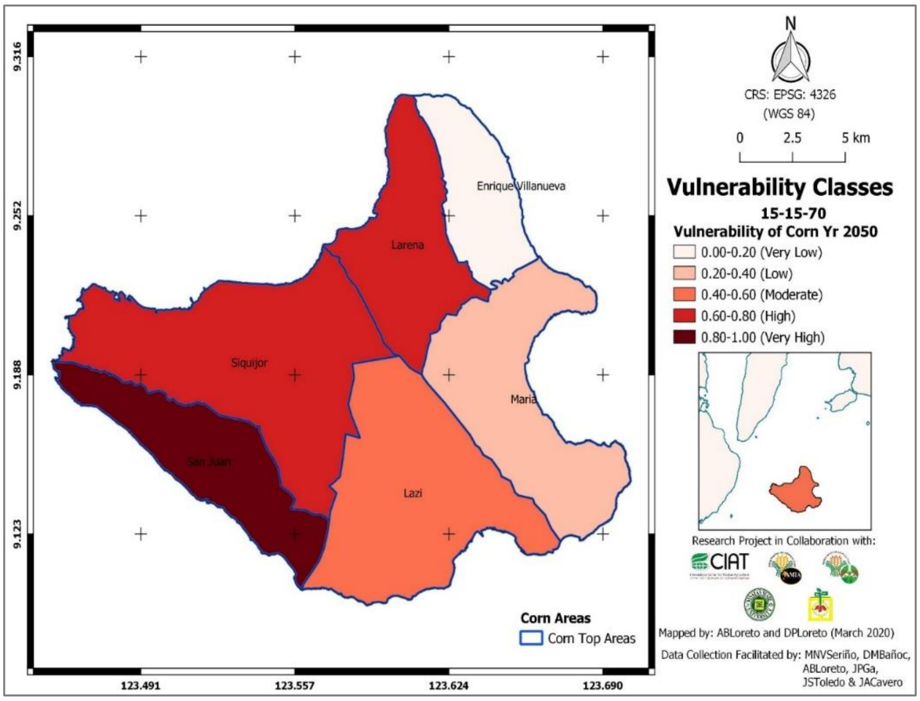


Figure 163. Corn Vulnerability among Top Corn Producers in Siquijor

While San Juan ranked highest in Siquijor in terms of corn production, the crop projected a very high vulnerability on climate risks. Likewise, Siquijor and Larena – the 3rd and 5th top corn producing municipality projected a high vulnerability. Corn also projected a medium level of vulnerability in the municipality of Larena. Meanwhile, Enrique Villanueva – the least corn producing municipality, projected a very low vulnerability.

COST-BENEFIT ANALYSIS (CBA) OF CLIMATE-RESILIENT AGRICULTURAL (CRA) PRACTICES

CRA practices were identified during the workshops for crop occurrence per province. A questionnaire on CRA were filled out by respective MAOs and CAOs. After the selection, series of interview was conducted to preselected farmers by the MAOs and CAOs.

CBA of CRA Practice: Bohol Province

For Bohol, selected CRA practice is the growing of Traditional Cultivars/Varieties of rice. Most commonly grown variety was red rice. On this study, through CBA, results were compared with the non-CRA, particularly the inbred variety focusing on Triple 2.

Table 15. Top CRA practices in Bohol

	CRA Practices/Technologies	Count	Percent*
1	Non-burning of rice straw and other biomass	282	25.43%
2	Rice crop manager	238	21.46%
3	Different cropping systems	203	18.30%
4	Agroforestry	145	13.07%
5	Crop-animal integration	144	12.98%
6	Traditional cultivars/varieties	143	12.89%
7	Crop switching or rotation	131	11.81%
8	Water harvesting	103	9.29%
9	Vermi-compost application	100	9.02%
10	Indigenous crop species	87	7.84%

**With respect to 1,109 barangays (Philippine Standard Geographic Code, 2018)*

The farmer interview was conducted in Bohol for the municipalities of Sagbayan, Jagna and Ubay. A total of 42 farmers were interviewed - 11 of which practices CRA while the remaining 31 were not.

Table 16. Bohol Respondents

Locale	Date of Data Collection	Practice		Total
		Inbred	Traditional	
Ubay	January 15, 2020	15	0	15
Jagna	January 16, 2020	9	5	14
Sagbayan	January 17, 2020	7	6	13
	Total	31	11	42

Description of the CRA Practice: Traditional Cultivars/Varieties of Rice

Traditional rice varieties also known as heirloom rice are mostly grown in the northern Cordillera Administrative Region (CAR). In 2005-2014, CAR was able to produce and export

142.4 million tons of heirloom rice that was worth 8.6 million pesos from 2,098 farmers in the region (GRiSP 2018). However, these varieties only accounts for about 3% of the country's rice production. The Latin American Fund for Irrigated Rice or FLAR (2010) also remarked that as the Philippines become a net importer of rice, it had lost 90% of its traditional rice varieties.

Traditional varieties are generally low yielding. But de Leon (2012) stressed that production of these varieties only involves minimal input and management practice. Such varieties observably competes with weeds and are tolerant to water level variations and other environmental stresses such as drought, flood and salinity (IRRI 2018). These varieties had also shown high resistance to pests and diseases which reduces the synthetic chemical requirements. Traditional varieties also have lower sugar content making it a healthier option for people who are regulating sugar intake and those suffering from diabetes and are overweight (IRRI 2018). In the Cordilleras, traditional varieties of rice are much preferred due to its exceptional taste, texture, and mild aroma (Eighth Wonder 2020).

Impacts: Traditional Rice Cultivars/Varieties

1. Productivity

   Despite of a relatively lower yield, profitability is higher than the non-CRA due to a reduced operational cost.

2. Adaptation

   Traditional varieties are tolerant to water level variations and other environmental stresses such as drought, flood and salinity.

3. Mitigation

   Due to its ability to compete with weeds and tolerance with pests and diseases, it requires minimal usage of synthetic chemicals which in return helps in mitigating climate change.

Cost and Benefit Analysis: Traditional Rice Cultivars/Varieties and Inbred Varieties

Traditional rice yield and price are lower than inbred varieties by 17% and 7.6%, respectively. But due to an operational cost that is lower by 37%, traditional varieties offers a gross margin that is 34% higher than the non-CRA practice. Assuming that farmers could find a market that will offer a price as high as the non-CRA or even higher (e.g. up to 1,000), gross margin could go higher by 126% to 233%.

Table 17. Farm Production of Traditional and Inbred Rice

Unit	Traditional Rice Variety	Inbred Rice Variety
Price Per Bag of Palay	860.00	925.00
Yield Per Hectare (Bag)	90.00	109.00
Total Revenue (Php)	**77,400.00**	**100,886.01**
Labor Input (Php)	40,914.66	51,620.76
Other Variable Input (Php)	27,943.71	42,847.24
Operational Cost (Php)	68,858.38	94,468.00
Gross Margin (Php)	**8,541.38**	**6,418.00**

Both practices offer a favorable results on CBA indicators. However, the CRA practice offers a higher profit within ten years period by 29%. Computed net present value is about Php 41,457 pesos per hectare in an annual basis at 10% discount rate. Adoption of the CRA suggests a return of 84% from the initial cost of investment that is recoverable within one year. Sensitivity analysis had also shown that Investment is viable up to a 10% decrease in benefits, 12% increase in cost and within a simultaneous 5% increase in cost and 5% decrease in benefits.

Table 18. CBA Analysis for Traditional Varieties and Inbred Varieties

Financial Indicators	Traditional Rice Varieties	Inbred Rice Varieties
Net Present Value (Php)	41,457.65	29,435.90
Internal Rate of Return	84.17%	63.72%
Benefit Cost Ratio	1.10	1.05
Payback Period	1	1
Initial Investment Cost (Php)	15,000.00	15,000.00

Growing traditional rice varieties – particularly the red rice is applicable to areas suffering water scarcity. Due to its relatively higher level of resistance, it is well-suited to areas with frequent problems of pests, diseases and weeds. In the northern part of the Philippines, rice can be cultivated from June to November or the wet season and from January to May for the dry season. Meanwhile for the southern part, the crop can be grown from October-November to March-April for the wet season and May-June to November for the dry season.

While it finds a niche in the local and international market, concerned government agencies in partnership with LGUs should empower the rice farmers by providing seed subsidy and training rice growers to enhance productivity. Health benefits of traditional rice varieties must be promoted across the country along with its cultural significance to stimulate demand. Aside from frequent expos, the government may opt for cuisine shows or “vlogers” in promoting the product from the farmers.

Rice growers association must be strengthened where members are trained to produce not just for their subsistence but also for profit. The organization should be able to manage the overall rice production and post-production undertakings. Farmers must have an easy access to agro-input suppliers, financing and lending entities, trainings and marketing experts.

CBA of CRA Practice: Negros Oriental Province

Negros Oriental was the province with the most studied CRAs. Identified CRA practice were organic farming focused on rice, different cropping system focused on corn-peanut intercropping, and crop switching focused on rice and watermelon.

Table 19. Top CRA Practice in Negros Oriental

	Top CRA Practices/Technologies	Count	Percent*
1	Different Cropping Systems	226	40.57%
2	On-farm Value added enterprise	192	34.47%
3	Crop-Animal Integration	188	33.75%
4	Agroforestry	128	22.98%
5	Crop Switching or Rotation	127	22.80%
6	Ratooning	126	22.62%
7	Rice Crop Manager	99	17.77%
8	Slopping Agriculture Land Technology (SALT)	82	14.72%
9	Vermi-Compost Application	78	14.00%
10	Organic Farming	69	12.39%

**With respect to 557 barangays (Philippine Standard Geographic Code, 2018)*

The interview was conducted in Bais City, Tanjay City, and Bayawan City in Negros Oriental. Pre-identified by respective CAOs, a total of 27 farmers were interviewed – 12 of which are practicing CRA and 15 are not. For the interview, Bayawan City was the site for respondents practicing Organic Rice Farming and Conventional Rice Farming; Bais City for Corn-Peanut Intercropping and Corn Monoculture; and Tanjay City for Rice-Watermelon Switching and Rice Monoculture.

Table 20. Negros Oriental Respondents

Practice	Site and Date of Data Collection		
	Bais City	Tanjay City	Bayawan City
	March 3, 2020	March 4, 2020	March 4, 2020
Organic Rice Farming			5
Conventional Rice Farming			5
Corn-Peanut Intercropping	4		
Corn Monoculture	4		
Rice-Watermelon Switching		3	
Rice Monoculture		6	
Total	8	9	10

Description of the CRA Practice: Corn-Peanut Intercropping

Corn is currently the second most produced crop in the world next to sugarcane. Around 1.1 billion metric tons of this crop is produced worldwide with a production utilization that is over two times the rate of the world population growth in the past 5 years (Martinez & Fernandez 2019). It is among the three major crops that occupies 50% of the world's entire agricultural land leaving the rest to 152 other crops (University of Toronto 2019). For a massive and commercial growing of corn, commonly applied method is monoculture. However, this method is attributed to several disadvantages due to the singularity of grown crops for every cropping season.

For corn, the monoculture or sole cropping makes the crop susceptible to weeds, pest and diseases (Salaheen & Biswas 2019). In turn, this forces the farmers to rely on synthetic chemicals including fertilizers that contributes to environmental degradation. The practice causes air pollution as it releases large amounts of reactive nitrogen compound into the atmosphere (Fung et al., 2019). Monoculture also results to a low forage quality (Belel et al., 2014) and exacerbates the loss of soil nutrients (Salaheen & Biswas 2019). The practice could also result to a decline on corn yield which in larger scale could threaten food security (Salaheen & Biswas 2019; Bennet et al., 2014).

Intercropping in contrast to monoculture simultaneously grows two or more crops through a definite row arrangement on the same land area. Although, a proper selection of crops is essential so that crops will not end up competing for nutrients, sunlight and space, the practice accounts for several benefits.

Intercropping with legumes which includes peanut, could serve as a better alternative to sole cropping. Aside from the increased crop diversity, Stagnari et al. (2017) emphasized that intercropping could lower the risk of climate change due to the reduction of greenhouse gas emission, sequestration of carbon dioxide and saving of fossil energy inputs due to the reduced nitrogen fertilizer usage. Liu et al. (2016) and Wang et al. (2014) stressed that intercropping practice could help in maintaining soil fertility properties.

This cropping system with legumes allows the fixation of biological nitrogen and transfer it to the maize which means a considerable part of synthetic fertilizers could be replaced by intercropped legumes (Raji and Dörsch 2020; Maitra 2020). The option could also help in having taller plants with more leaves (Adeyeye et al., 2017) while it reduces weed density (Workayehu 2014; Bilalis et al., 2010) and the incidence of corn borer infestations (Palomar 1998). Aside from an increase in land utilization rate by 14-17% through corn-peanut intercropping (Jiao et al., 2008), the practice could also result to an increase in corn yield due to higher kernel number per ear (KNE). A study by Li et al. (2019) suggested that corn-peanut intercropping could provide higher yield by 61.05% compared to sole cropping. Estimate is higher compared to Punyalue et al. (2018) that suggested a yield of 31–53% when corn is planted with different legumes such as cowpea, mungbean, rice bean, and lablab. Punyalue et al. (2018) also suggested that intercropping is an alternative to sole crop cultivation that sometimes depends on residue burning that causes further environmental degradation.

Impacts: Corn-Peanut Intercropping

1. Productivity

   Adoption of the CRA results to a corn yield that is 138% higher than monoculture due to higher kernel per ear (KNE). The practice also provides a gross margin higher than the non-CRA.

2. Adaptation

   Corn and peanut could withstand the rising temperature and longer period of droughts. Through this CRA, farmers could adopt to these harsh impact of climate change.

3. Mitigation

   Reduced nitrogen fertilizer usage lessens the emission of nitrogen in the atmosphere which helps in mitigating the impacts of climate change.

Cost-Benefit Analysis: Corn-Peanut Intercropping

When corn is intercropped with peanut, yield of main crop could reach 71 sacks or 3,553.57 kilos per hectare annually that is 138% higher than sole cropping practice. Combined gross margin of corn and peanut intercropping is 567% higher than the non-CRA practice despite incurring a 261% higher operational cost.

Table 21. Farm Production of Corn-Peanut Intercropping and Corn Monoculture

Unit	Corn-Peanut Intercropping		Corn Monoculture
	Corn	Peanut	Corn
Price *	15.60	36.00	15.60
Output*	3,553.57	2,771.43	1,489.58
Revenue	55,435.71	99,771.43	23,237.50
Total Revenue (Php)		**155,207.14**	**23,237.50**
Labor		90,367.71	29,849.55
Variable inputs		7,520.69	7,709.38
Operational Cost (Php)		**97,888.40**	37,558.92
Gross Margin (Php)		**57,318.74**	**-14,321.42**

*Note: *Price and output: corn is kernel per kilo; peanut is per kilo*
Analysis is in per hectare

NPV computation suggests that profit within 10 years could reach 292,373.87 per hectare given a 10% discount rate. This indicates a return of 96% on the initial investment that can be recovered within one year. Aside from a better grasp on financial indicators, adopting to CRA practice also contributes positive externalities to the environment through better carbon sequestration, lower greenhouse emission and reduced nitrogen usage. Additional NPV from social and environmental externalities reaches Php 418,907.48 bringing the overall NPV to Php 711,281.3. Sensitivity analysis suggests that investment is viable up to a 30% decrease in benefits, 44% increase in cost and a simultaneous decrease in benefits and increase in cost by 18%.5. The practice also contributes 190.17% social IRR bringing the overall IRR to 286.13%.

Table 22. CBA Analysis for Corn-Peanut Intercropping and Corn Monoculture

Financial Indicators	Corn-Peanut Intercropping	Corn Monoculture
Net Present Value (Php)	292,373.87	(115,348.93)
Internal Rate of Return	95.69%	No return within 10 years
Benefit Cost Ratio	1.44	0.55
Payback Period	1 year	Unrecovered within 10 years
Initial Investment Cost (Php)	17,060.00	27,350.00

The CRA practice is applicable to areas that bears the brunt of climate change – particularly on low precipitation. It is also applicable to farm areas with low soil fertility, burdened with corn borer and weed density. Corn production for upland areas peaks from July to September while the lean months are from January to June. The crop is grown in rain fed lowlands, where it is planted during the dry season. Best growth status of both crops can be achieved by planting a total of 3 rows for corn and 4 rows of peanut (Geng et al. 2017).

Concerned government agencies with partnerships from Local Government Units (LGUs) should develop an improved corn variety, provide seed subsidy, production training to corn growers to enhance productivity of corn in the province. Corn growers should form an organization that manages the overall corn production and post-production undertakings. With this, they have an easy access to agro-input suppliers, financing and lending entities, trainings, and marketing experts.

Description of CRA Practice: Rice and Watermelon Switching

Rice is grown by more than a hundred of countries in the world with an estimated 158 million hectares of total harvested area that produces more than 700 million tons annually (Global Rice Science Partnership [GRiSP] 2013). Meanwhile, the Philippine Statistics Authority (PSA) indicated that palay production in the Philippines totaled to 19.07 million metric tons in 2018. Production is growing at an average annual rate of 0.3%. The total area harvest grew from 4.08 million hectares in 2014 to 4.74 million hectares in 2018. The common practice of growing rice is through monoculture. However, this practice is attributed with several disadvantages. Due to its primary aim of increasing yield and profitability, monoculture cropping system heavily depends on synthetic fertilizers, herbicides, insecticides, and bactericides that causes irreversible damage to the environment (Watts 2018). The unabated growing of a single crop year after year also results to the reduction of soil nutrients and pressures the build-up of pests and diseases (Salaheen and Biswas 2019).

Crop switching effectively overcomes the successive cropping obstacle. It optimizes the scarce land usage and results to additional farm income which helps the farmers in recovering income losses due to unforeseen circumstances such as typhoons, pests and diseases, and price changes (International Institute of Rural Reconstruction [IIRR] 1990). Crop switching also prevents the transmission of crop diseases and improves weed-control opportunities (Beck 2018; Sissons et al 2012). It improves soil organic matter and nutrient pools, reduces soil erosion, improves pest control, reduces greenhouse emission and water pollution (Walker 2013). Crop switching also helps in soil moisture retention leading to better canopy temperature control. This aspect greatly helps the crop withstand drought stresses (Degani et al 2019).

Impacts: Rice and Watermelon Switching

1. Productivity

   The practice results to a rice yield that is 26% higher than monoculture. Combined annual incremental benefits of rice and watermelon is 127% higher compared to the non-CRA.

2. Adaptation

   Consistent crop rotation results to better soil moisture retention and by extension a better canopy temperature control. This in turn helps the crop withstand drought stress.

3. Mitigation

   Favorable attributes of the CRA includes the preventive disease transmission, weed pressure reduction, and soil quality improvement. These attributes lessens the reliance to synthetic chemical which in turn reduces greenhouse gas emission.

Cost -Benefit Analysis: Rice and Watermelon Switching and Rice Monoculture

Investment on the CRA practice results to a rice yield that is 35% higher than the monoculture. Combined revenue is about 389% higher than the non-CRA. Although operational cost is 73% higher due to added cost from watermelon, annual gross margin per hectare is climb as high as Php 201,696.54 per hectare while monoculture is losing annually by more than Php 50,000 pesos per hectare.

Table 23. Farm Production of Rice and Watermelon Switching and Corn Monoculture

Unit	Switching		Monoculture
	Rice	**Watermelon**	**Rice**
Price	700.00	16.00	700.00
Output	181.00	20,749.00	134.00
Revenue	126,705.43	331,989.66	93,673.61
Total Revenue	**458,695.09**		**93,673.61**
Labor	78,605.52	69,767.44	78,605.52
Variable inputs	95,060.00	13,565.58	69,445.00
Operational Cost	**256,998.55**		**148,050.52**
Gross Margin (Php)	**201,696.54**		**-54,376.91**

Note: Price and output: rice is palay per bag; watermelon is per kg
Analysis is in per hectare

Further analysis suggests that within 10 years, the CRA practice profits up to 1.5 million pesos per hectare at 10% discount rate. Initial investment will require Php 87,100.00 that is recoverable within 1 year. Also, the CRA practice will return 231.57% of this initial investment. Sensitivity analysis showed that investment is is viable up to 40% decrease in benefits, 69% increase in cost and a simultaneous decrease in benefits and increase in cost by 25%.

Table 24. CBA Analysis for Rice and Watermelon Switching and Rice Monoculture

Financial Indicators	Switching	Monoculture
Net Present Value (Php)	1,152,237.95	(403,800.75)
Internal Rate of Return	231.57%	No return within 10 years
Benefit Cost Ratio	1.69	0.59
Payback Period	1 year	Unrecovered within 10 years
Initial Investment Cost (Php)	87,100.00	69,678.17

Rice and watermelon crop switching is a much-needed practice for areas suffering from significant soil nutrient losses due to the adverse impacts of mono-cropping. The practice can be of great help to disease stricken farms as the break-up crop eases disease transmission. For this practice, watermelon does not necessarily replace rice for the entire cropping season. The crop is planted once a year - around March right after the harvest of rice in February.

Local government units (LGUs) in partnership with concerned government agencies should provide seed subsidy for watermelon and rice. The growers must be trained to further enhance their farm productivity. The government should also find traders where farmers can sell their produce in bulk. Farmers should also be trained to process their produce after harvest to avoid wastage.

Rice growers association must be strengthened where members are trained to produce not just for their subsistence but also for profit. The organization must be able to manage the overall rice production and post-production undertakings. Farmers must have an easy access to agro-input suppliers, financing and lending entities, trainings and marketing experts.

Description of the CRA Practice: Organic Rice Farming

Rice production in the Philippines is mostly driven by conventional farming. The organic agriculture sector in the Philippines is still on its formative years compared to many Asian countries according to the National Organic Agriculture Board (NOAB) (2016). The minimal production comes from less than 1% of agricultural land – where rice is one of its common agricultural goods. Its contribution is still at miniscule despite the enactment of Organic Agriculture Act of 2004.

While conventional farming keeps the yields high, it heavily depends on synthetic chemical intervention to provide plant nutrition as well as to combat pests and diseases. The Rodale Institute – an American non-profit organization that supports research for organic farming, remarked that reliance to synthetic chemicals elevates greenhouse emissions, soil erosion, water pollution, and threatens human health. With all these at stake, organic agriculture is a better alternative in rice farming. Shown below are some of the environmental, health and economic impacts of conventional and organic farming:

Table 25. Impacts of Conventional and Organic rice farming

Impacts	Conventional Farming	Organic Farming
Environmental	▪ Increased greenhouse gases and exacerbates climate change. ▪ Soil acidity, water pollution, and death of beneficial insects (Ara 2002)	▪ Increased biodiversity, improved quality of water in the paddies, better air quality, and improved soil quality (Rola & Madlangbayan 2015). ▪ Saves about 30–50% of water consumption in diluting farm chemicals (Johannes et al 2019). ▪ Lower greenhouse gas emissions for crop production and enhanced carbon sequestration (FAO 2010)
Health	▪ Toxins in food, air, water and soil results to increased rates in asthma, autism, physical disabilities, learning disabilities, reproductive disorders, diabetes, Parkinson disease, Alzheimer disease, and cancer (Owens et al., 2010).	▪ Offers consumers high-quality and healthy food (Forster et al 2013).
Economic	Particularly for rice; ▪ In 2050 due to climate change, price will increase between 32-37%. ▪ Productivity will decrease by 14% in South Asia, 10% in East Asia and the Pacific, and 15% in Sub-Saharan Africa (GRiSP 2013).	▪ Produces high-value exports (Forster et al 2013). ▪ Organic farmers may profit from ready access to local markets (Forster et al 2013). ▪ For rice, production requires lesser cash capital (Mendoza 2004).

According to Rola & Madlangbayan (2015), organic agriculture improves soil, air, and water quality. The practice also capacitates the farmers in climate change adaptation and mitigation as it enhances carbon sequestration and lowers greenhouse emissions. Since organic farming are relatively free from synthetic materials, it offers healthy and high quality food that qualifies for exportation. Hence, it commands a relatively higher price in the market.

Besides, it only requires lesser cash capital compared to conventionally produced goods.

Impacts: Organic Rice Farming

1. Productivity

   Revenue and profit of organically produced products are higher than conventionally grown rice despite from its lower yield. Produce from this CRA commands higher price in the market due to high quality and healthy farm produce. It has lower input cost due to a reduction on fertilizers and pesticides use. Profit of organic farm produce is higher by 78% than those from conventional farming.

2. Adaptation

   Insufficient water supply and minimal rainfall are the major drawbacks faced among rice farmers. Organic farming can help farmers adapt to this pressing environmental concern as it utilizes less water in contrast to conventional farming.

3. Mitigation

   Organic crop production results to lesser soil emissions of nitrous oxides and methane. The practice aids the soil in sequestering more carbon dioxide from the atmosphere compared to conventional farming.

Cost-Benefit Analysis: Organic Rice Farming

While it has proven its potential in climate change adaptation and mitigation, the growing number of health conscious people in the country and abroad can provide a promising market for organically grown products including rice. Investment on this CRA practice entails a revenue that is 116% higher than conventionally grown rice. Operational cost of organic farming is 52% lower compared to conventional farming. Although production is lower by 42%, the profit is higher by 372.33% at an annual gross margin of more than Php 55,000 per hectare. This is due to its price that could go high as 113% or 1,300 pesos per bag.

Table 26. Production of Organic Rice Farming and Conventional Farming

Unit	Organic Rice Farming	Conventional Farming
Price Per Sack of Palay (Php)	1,300.00	610.00
Yield Per Hectare (Sack)	80.00	147.00
Total Revenue	104,000.00	89,614.81
Labor Input (Php)	36,050.88	53,664.00
Other Variable Input (Php)	12,800.00	47,626.67
Operational Cost (Php)	48,850.88	101,290.67
Gross Margin (Php)	**55,149.12**	**11,675.86**

Investment on this practice entails a net present value (NPV) of more than 300,000 pesos per hectare in 10 years period – much better than the observably losing practice of conventional farming. The initial investment of Php 33,950.00 that is 43% lower than conventional farming can be recovered within one year or two cropping seasons. Sensitivity analysis had shown that investment of the CRA is still viable even up to a 47% decrease in benefits, 91% increase in cost, and a simultaneous increase in cost and decrease in benefits by 31%

The practice reduces the greenhouse gas emission and increases carbon sequestration. Valuing the externalities suggests a social and environmental NPV of Php 967,267.92 per hectare ate 10% interest rate and a social IRR of 463.69%.

Table 27. CBA Analysis for Organic Rice Farming and Conventional Rice Farming

Financial Indicators	Organic Rice Farming	Conventional Rice Farming
Net Present Value (Php)	304,917.49	(131,493.09)
Internal Rate of Return	162.43%	No return within 10 years
Benefit Cost Ratio	1.91	0.81
Payback Period	1	Unrecovered within 10 years
Initial Investment Cost (Php)	33,950.00	59,750.00

Organic rice farming is applicable to areas that aims to produce high value exports. The practice saves water that is supposedly used in diluting chemical hence, well-suited to areas suffering water scarcity. In the northern part of the Philippines, rice can be cultivated from June to November or the wet season and from January to May for the dry season.

Meanwhile for the southern part, the crop can be grown from October-November to March-April for the wet season and May-June to November for the dry season.

Concerned government agencies in partnership with LGUs should provide seed subsidy and train rice growers to enhance productivity in the province. The government should identify a special market place or an intermediary where farmers could directly sell their organically produced rice. This intermediary should also be assisted in finding a niche across the globe. To stimulate demand, promotion of its health benefits should be intensified.

Rice grower associations must be strengthened so that farmers can seek support in managing the overall rice production and post-production undertakings. Farmers must have an easy access to agro-input suppliers, financing and lending entities, trainings and marketing experts.

CBA of CRA Practice: Siquijor Province

Selected CRA practice is corn-peanut intercropping under different cropping systems.

Table 28. Top CRA Practices in Siquijor Province

	Top CRA Practices/Technologies	Count	Percent*
1	Crop-Animal Integration	133	99.25%
2	Rice Crop Manager	26	19.40%
3	Vermi-Compost Application	18	13.43%
4	Different Cropping Systems	14	10.45%
5	Protective Cultivation	12	8.96%
6	Indigenous crop species	10	7.46%
7	Crop Switching or Rotation	9	6.72%
8	Microbial Technology	9	6.72%
9	Organic Farming	8	5.97%
10	Mulching	8	5.97%

**With respect to 134 barangays (Philippine Standard Geographic Code, 2018)*

The interview was conducted in Siquijor, San Juan, and Maria. There were 20 farmers interviewed. Ten of which are practicing corn-peanut intercropping.

Table 29. Siquijor Respondents

Site	Date of Data Collection	Corn-Peanut Intercropping	Monoculture	Total
San Juan	March 5, 2020	0	3	3
Maria	March 6, 2020	1	4	5
Siquijor	March 5, 2020	9	3	12
	Total	10	10	20

Description of the CRA Practice: Corn-Peanut Intercropping

To date, corn is the world's second most produced crop after sugarcane. Around 1.1 billion metric tons of corn is produced worldwide with a production utilization that averaged a yearly growth of 2.2% in the past 5 years, which is over two times the rate of the world population growth (Martinez & Fernandez 2019). In 2018, the Food and Agriculture Organization indicated that approximately 70 million hectares were planted with corn in America and 63 million in Asia. Aside from that, corn is among the three major crops that occupies 50% of the world's entire agricultural land leaving the rest to 152 other crops (University of Toronto 2019). In connection, a study by Martin et al (2019) detected increases in the similarity of crops across 22 sub continental-scale regions from 1961–2014. The study suggests that crops worldwide are looking the same and monoculture is growing in number from which corn is no exception.

Monoculture of crops have been attributed to several disadvantages due to the singularity of grown crop every cropping season. For corn, the practice makes the crop susceptible to weeds, pests and diseases (Salaheen & Biswas 2019) which forces the farmers to rely on synthetic chemicals including fertilizers that contributes to environmental degradation (Yap 2019). The practice causes air pollution as it releases large amounts of reactive nitrogen compound into the atmosphere (Fung et al 2019). Monoculture also results to a low forage quality (Belel et al 2014) and exacerbates the loss of soil nutrients (Salaheen & Biswas 2019). The practice could also result to a decline on corn yield which could threaten food security (Salaheen & Biswas 2019; Bennet et al 2011).

Intercropping in contrast to monoculture or sole cropping simultaneously grows two or more crops through a definite row arrangement on the same land area. Although, a proper selection of crops is essential so that crops will not end up competing for nutrients, sunlight and space, the practice accounts for several benefits.

Intercropping with legumes which includes peanut, could serve as a better alternative to sole cropping. Aside from the increased crop diversity, Stagnari et al (2017) emphasized that intercropping could lower the risk of climate change due to the reduction of greenhouse gas emission, sequestration of carbon dioxide and saving of fossil energy inputs due to the reduced nitrogen fertilizer usage. The Food and Agriculture Organization (2016) and Wang et al (2014) stressed that intercropping practice could help in maintaining soil fertility properties.

This cropping method with legumes allowed the fixation of biological nitrogen and transfer it to the maize which means a considerable part of synthetic fertilizers could be replaced by intercropped legumes (Raji and Dörsch 2020; Maitra 2020). The method could also help in having taller plants with more leaves (Adeyeye et al 2017) while it reduces weed density (Workayehu 2014; Bilalis et al 2010) and the incidence of corn borer infestations (Palomar 1998).

Aside from an increase in land utilization rate by 14-17% through corn-peanut intercropping (Jiao 2008), the practice could also result to an increase in corn yield due to higher kernel number per ear (KNE). A study by Li et al (2019) suggested that corn-peanut intercropping could provide higher yield by 61.05% compared to sole cropping. Estimate is higher compared to Punyalue et al (2018) that suggested a yield of 31–53% when corn is planted with different legumes such as cowpea, mung bean, rice bean, and lablab. Punyalue et al (2018) also suggested that intercropping is an alternative to sole crop cultivation that sometimes depends on residue burning which causes further environmental degradation.

Impacts: Corn-Peanut Intercropping

1. Productivity

   Corn yield is higher compared to monoculture due to higher kernel number per ear (KNE). Combined revenue of corn and peanut is 429% higher than the non-CRA.

2. Adaptation

   Corn and peanut could withstand the rising temperature and longer period of drought. Through this CRA, crop components could adapt to these harsh impact of climate change.

3. Mitigation

   The CRA practice reduces that usage of nitrogen fertilizer. This will lessen the presence of nitrogen gas in the atmosphere which helps in mitigating the impacts of climate change.

Cost-Benefit Analysis: Corn-Peanut Intercropping

Production of corn kernel per hectare could go as high as 6,000 kilograms annually that is 346% higher than monoculture. Combined revenue with peanut could go as high as Php 136,780.47 that is 429% higher than the non-CRA with Php 25,854.48. This translates to an annual gross margin of Php 16,737.70 per hectare that is better than the non-CRA that incurs an annual loss of Php 25,853.40 per hectare.

Table 30. Farm Production of Corn-Peanut Intercropping and Corn Monoculture

Unit	Corn-Peanut Intercropping		Corn Monoculture
	Corn	Peanut	Corn
Price	19.00	500.00	19.00
Output	6,071.87	42.83	1,360.76
Revenue	115,365.47	21,415.00	25,854.48
Total Revenue (Php)	**136,780.47**		**25,854.48**
Labor		114,506.80	37,084.37
Variable inputs		17,596.37	14,623.51
Operational Cost		**132,103.17**	**51,707.88**
Gross Margin (Php)		**16,737.70**	**-25,853.40**

Note: Price and output: corn is kernel per kilo; peanut is per taro
Analysis is in per hectare

Within 10 years, the CRA reflects an NPV of around Php 11,679.98 per hectare that returns 24% of the initial cost of investment. Given this condition, the Php 17,060 initial investment will be recovered within one year. Meanwhile, non-CRA suggests a loss of Php 179,697.98 per hectare within a 10-year period. This also suggests that 10 years is not sufficient to recover the initial cost of investment. Meanwhile, sensitivity analysis had shown that investment is viable up to 1% decrease in benefits and 1% decrease in benefits. A simultaneous 0.06% increase in cost and 0.06% decrease in benefits is also viable for the CRA investment.

Higher productivity, better carbon sequestration, lowered greenhouse gas emissions, and reduced nitrogen fertilizer usage makes corn and peanut intercropping a better option than monoculture. The CRA could provide a social and environmental NPV of Php 980,295.25 per hectare in 10 years' time at 10% interest rate with a social IRR of 670.51%.

Table 31. CBA Analysis under Corn-Peanut Intercropping and Corn Monoculture

Financial Indicators	CRA Practice	Non-CRA Practice
Net Present Value	11,679.98	(179,697.98)
Internal Rate of Return	24.30%	No return within 10 years
Benefit Cost Ratio	1.01	0.47
Payback Period	1 year	Unrecovered within 10 years
Initial Investment Cost	17,060.00	20,840.00

The CRA is applicable to areas that bears the brunt of climate change particularly low precipitation. The practice is applicable to farms areas with low soil fertility, burdened with corn borer and weed density. Corn production for upland areas peaks from July to September while the lean months are from January to June. The crop is also grown in rain fed lowlands, where it is planted during the dry season. For intercropping, agronomists suggest that when corn is planted in three rows and peanuts are planted in four rows, both crops will achieve an excellent growth.

Concerned government agencies in collaboration with LGUs should develop an improved high-yielding corn variety, provide seed subsidy, production training to corn growers to enhance productivity of corn in the province.

Corn growers should form an organization that manages the overall corn production and post-production undertakings. With this, they have an easy access to agro-input suppliers, financing and lending entities, trainings and marketing experts in supporting their corn production undertakings.

TRANSECT SURVEY

A series of transect survey were conducted from October to November in 2019. Soil samples were gathered from upland plains, irrigated lowland, rain fed lowland, hilly land and mountainous areas of the provinces. On October 9-11, 2019 a transect survey was conducted in Bohol, October 24-25, 2021, in Siquijor and November 5-8, 2019, in Negros Oriental. Soil samples were gathered across the provinces.

Transect Survey: Bohol Province

The first route of Bohol transect survey covered Ubay, Alicia, San Miguel, Dagohoy and Carmen. The second route covered Lila, Dimioa, Valencia, Garcia Hernandez, Jagna, and Sierra Bullones. The final route covered Clarin, Sagbayan, Catigbian, Batuan, Bilar, Loboc, Sikatuna, and Loay.

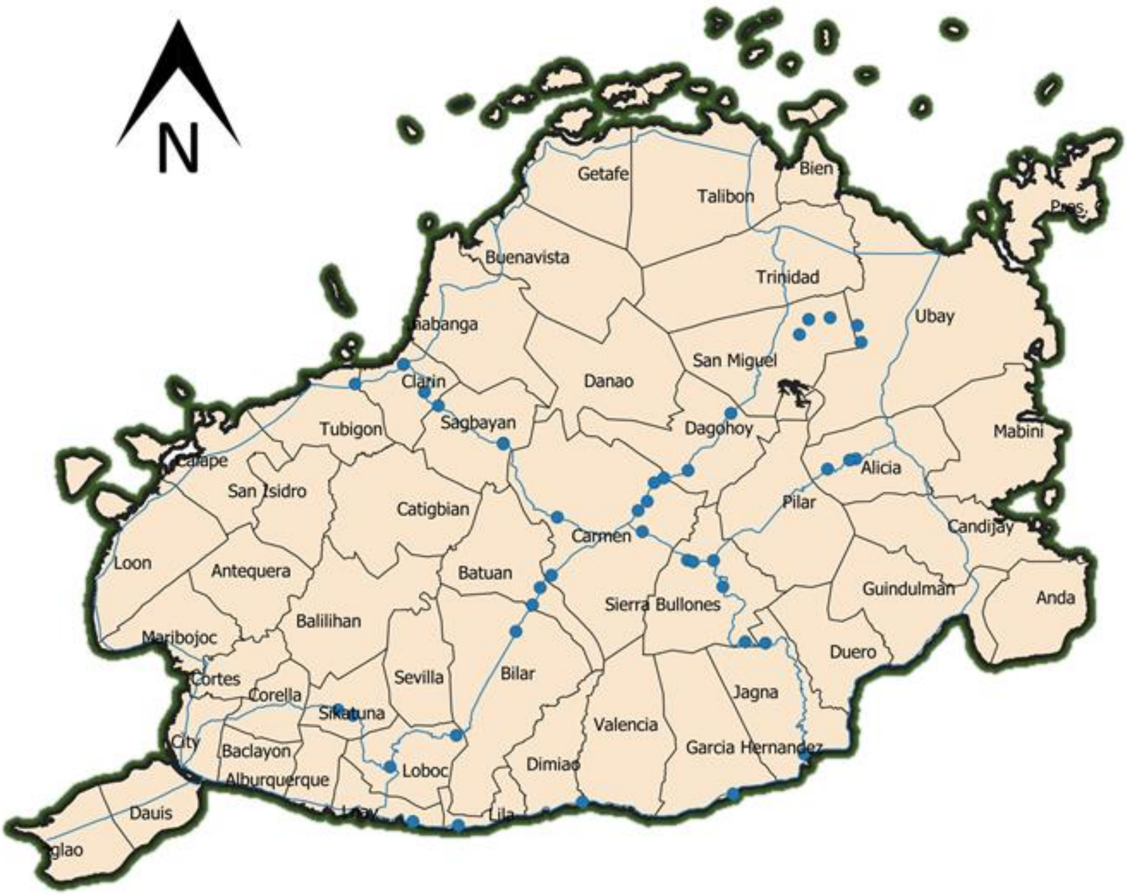


Figure 164. Soil Sampling Points in Bohol

Table 32. Route 1 for Bohol Transect Survey

	Upland Plain	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Soil Type	clay, loam	clay, sandy clay loam, clay loam	clay, sandy clay loam, clay loam	clay, clay loam	clay, clay loam
Cropping Systems	intercropping, multiple cropping	mono-cropping	crop rotation, sole cropping, sequential cropping	multi-storey, alley, multiple cropping	multi-storey, multiple cropping
Dominant Crops	coconut, banana, fruitcrops, palm oil, corn	rice	rice, corn, legumes, rootcrops	coconut, banana, corn, fruitcrops, forest/timber trees, palm oil	forest/timber trees, coconut, palm oil
Weeds	grasses, sedges, broadleaves	grasses, sedges	grasses, sedges, broadleaves		broadleaves, grasses
Animals	carabao, cattle, chicken	carabao, cattle, chicken			chicken
Constraints	poor soil nutrients, limited moisture (severe during dry period)	poor soil nutrients, flooding, limited irrigation water		unproductive hills, degraded soil, acidic, soil erosion, limited soil moisture	soil erosion, prone to landslide

As shown on table 32, the first route is generally clay, loam, clay loam, and sandy clay loam. Cropping systems that are commonly practiced in the area are intercropping, genera cropping, mono-cropping, crop rotation, sole cropping, sequential cropping, multi-storey, and multiple cropping. Dominant crops in the area are coconut, banana, fruit crops, palm oil, corn, rice, legumes and forest timber trees. Common weeds growing on the first route are grasses, sedges and broadleaves. Animals that are generally raised in the area are carabao, cattle, and chicken. Constraints faced in the area are poor soil nutrients, limited moisture, flooding, limited irrigation water, unproductive hills, degraded soil, acidic soil, soil erosion and prone to landslide.

Table 33. Route 2 for Bohol Transect Survey

	Upland	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Soil Type	loam, clay loam		clay loam	clay, clay loam, calcareous	calcareous soil
Cropping Systems	alley, mixed, multiple cropping	mono-cropping	sole, crop rotation	alley, multiple, multi-storey	multi-storey, multiple cropping
Dominant Crops	coconut, banana, fruitcrops, corn, vegetables	rice	rice, rootcrops, corn, vegetables	coconut, banana, corn, fruitcrops, rootcrops, legumes, forest trees	forest/timber trees, vegetables, ornamentals
Weeds	grasses, sedges, broadleaves				grasses, broadleaves
Animals	cattle, carabao, hogs, chicken	carabao, cattle, chicken		carabao, cattle, goat	chicken
Constraints	limited soil moisture	flooding, flashflood, siltation	limited water for irrigation	limited soil moisture, soil erosion, landslide	soil erosion and landslide

On the second route of the transect survey in Bohol, the common soil type are loam, clay loam and calcareous (Table 33). Common cropping systems are alley, mixed, multiple cropping, mono-cropping, crop rotation, and multi-storey cropping. Meanwhile, the dominant crops includes coconut, banana, fruit crops, root crops, corn, vegetables, legumes, and forest trees with grasses, sedges and broadleaves as the common weeds. The mostly raised animals are cattle, carabao, hogs, chicken and goat. For the constraints, the second route generally has a limited soil moisture for the upland areas, flooding, flash floods and siltation for the irrigated lowland areas, limited irrigation for the rain fed lowland, limited soil moisture, soil erosion and landslide for the hilly land areas, and soil erosion landslide for the mountainous areas.

Table 34. Route 3 for Bohol Transect Survey

	Upland	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Soil Type	clay, clay loam			clay	
Cropping Systems	mixed cropping	mono-cropping	crop rotation, sole cropping	multi-storey, multiple, strip cropping	multi-storey, mixed cropping
Dominant Crops	coconut, banana, vegetables, melon, rootcrops	rice	rice, corn, vegetables, rootcrops	coconut, banana, corn, vegetables, fruitcrops	forest/timber trees, coconut, banana, fruitcrops
Weeds	grasses, broadleaves	grasses			
Animals	carabao, cattle, hogs, chicken			cattle, goats, chicken	chicken
Constraints	limited soil moisture	limited irrigation water, flooding	limited water supply	unproductive hills, oil erosion, limited soil moisture	soil erosion, poor nutrients, shallow topsoil

The last route of the transect survey in Bohol identified clay, clay loam are the common soil type (Table 34). The common cropping system are mixed cropping, mono-cropping, crop rotation, sole cropping, multi-storey, strip cropping. The dominant crops in the area includes coconut, banana, melon, root crops, rice, vegetables, and fruit crops. Also, forest/timber trees are dominant in the area. Moreover, carabao, cattle, hogs, chicken, and goats. On the last route, upland areas has a limited soil moisture while the irrigated lowland has a limited irrigation water and flooding. The rain fed lowland has limited water supply while the hilly land are constrained by unproductive hills, soil erosion and limited soil moisture. Finally, the mountainous areas are constrained by soil erosion, poor nutrients, and shallow top soil.

Soil samples gathered from Bohol were analyzed at the Regional Soils Laboratory of Department of Agriculture, Mandaue Experimental Station. The result is as shown on table 35.

Table 35. Soil Sample Test Result of Bohol

Municipalities	pH	%OM	P(ppm)	K(ppm)
San Miguel	4.6	Medium High-Moderately High	Low	Low-Sufficient
Ubay	4.8	Moderately Low-Medium High	Moderately low	Sufficient
Dagohoy	5.7	High-Very High	Low	Low-Sufficient
Carmen	5.8	Medium High-Very High	Low-Moderately low	Sufficient
Alicia	6.1	High-Very High	Moderately low	Sufficient
Sierra Bullones	6.6	Medium High-Very High	Low-Moderately high	Low-Sufficient
Garcia Hernandez	7.1	Medium High	Moderately high	Sufficient
Dimiao	7.2	Medium High	Moderately high	Sufficient
Sikatuna	7.2	Very High	Low	Sufficient
Tubigon	7.2	Medium High	Moderately high	Sufficient
Clarin	7.5	Medium High-Very High	Low-Moderately low	Low-Sufficient
Batuan	7.6	High-Moderately High	Low-Moderately low	Sufficient
Bilar	7.6	Very High	Low	Sufficient
Jagna	7.6	High-Very High	Low-Moderately low	Sufficient
Lila	7.6	Medium Low	Moderately high	Sufficient
Loay	7.6	Medium	High	Sufficient
Loboc	7.6	High-Very High	Moderately low-Moderately high	Low-Sufficient
Sagbayan	7.6	High-Medium High	Low-Moderately high	Low-Sufficient

Transect Survey: Siquijor Province

Two routes was covered during the transect survey in Siquijor province. The first route was the eastern part that covers Siquijor, Larena, Enrique Villanueva and the northern part of Maria. Meanwhile, the southern part covers the municipality of Maria, Lazi, San Juan and the western part of Siquijor.

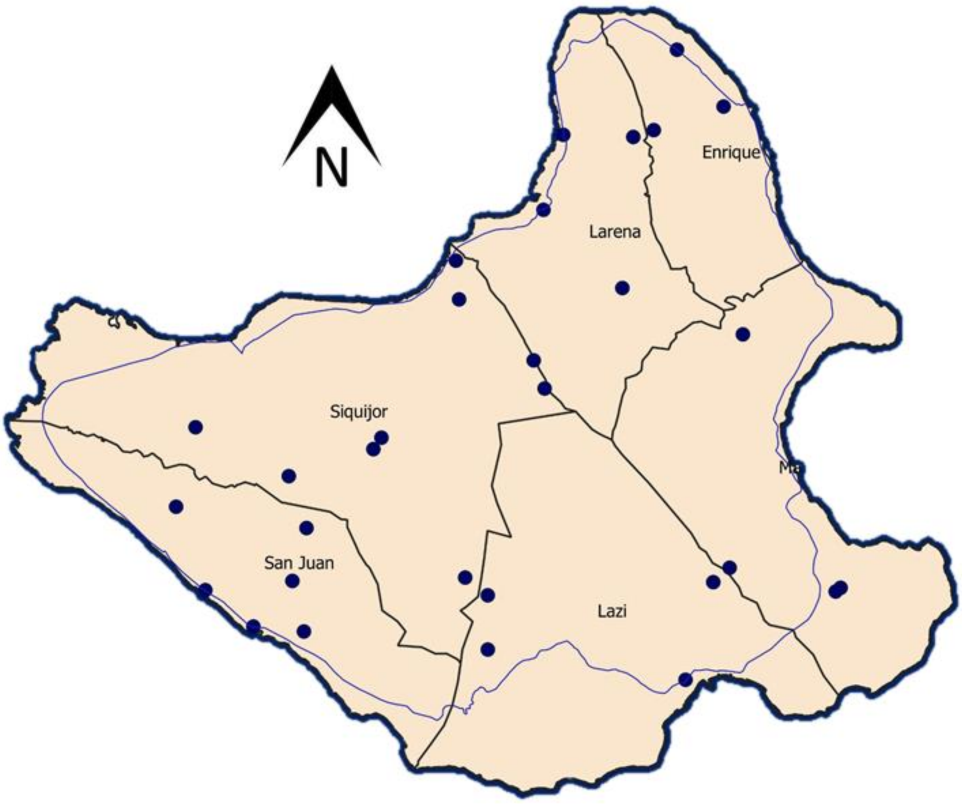


Figure 165. Soil Sampling Points in Siquijor

Table 36. Route 1 for Siquijor Transect Survey

	Upland	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Soil Type	clay loam, loam, clay, silty clay, silty loam, calcareous	clay loam, loam	clay loam	weathered soil, rocks, calcareous	
Cropping Systems	multi-storey, mixed cropping	mono-cropping	sole cropping, sequential	mixed cropping, multi-storey	mixed cropping
Dominant Crops	coconut (productive), banana, mango, corn, peanut, rootcrops, lomboy/duhat (Java plum), sineguelas (Spanish plum), guyabano, sweet potato, jackfruit, vegetables	rice	rice, corn, peanut	cassava, sweet potato, coconut, lomboy/duhat (Java plum), sineguelas (Spanish plum), banana, cacao, dragonfruit, peanut, sineguelas, acacia, vegetables	forest/timber trees, coconut (unproductive), gmelina
Weeds	grasses				

	Upland	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Animals	carabao, goat, cattle, chicken, hogs	carabao, cattle, chicken, hogs			chicken
Constraints	limited soil moisture	flooding	limited irrigation water	soil erosion, limited soil moisture and nutrients (unproductive)	

The general soil type of Siquijor based from the first route are generally clay loam, loam, clay, silty loam, calcareous, weathered soil, and rocks (Table 35). Prevalent cropping practices includes multi-storey, mixed, mono, sole, and sequential cropping. Dominant crops on the first route are coconut, banana, mango, corn, peanut, rootcrops, java plum (locally known as lumboy/duhat), spanish plum (locally known as sineguelas, guyabanno, sweet potato, jackfruit, vegetables, rice, forest/timber, and trees. Visible weeds are grasse while mostl grown animals are carabao, goat, cattle, chicken, and hogs. Identified constraints are limited soil moisture, flooding, limited irrigation water, soil erosion, limited soil moisture and nutrients.

Table 37. Route 2 for Siquijor Transect Survey

	Upland Plain	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Soil Type	loam, clay, calcareous, clay loam, sandy loam	clay loam		loam, clay, clay loam, weathered rocks	clay, clay loam, calcareous, weathered rocks
Cropping Systems	alley, mixed, multiple cropping	mono-cropping	sole cropping, crop rotation	strip, mixed, multi storey, alley	mixed cropping
Dominant Crops	corn, peanut, root crops, coconut, banana, fruit crops, mango, lomboy/duhat (Java plum), saksak (nipa like), sampalok	rice	rice, corn, peanut, rootcrops, vegetables	coconut, banana, fruitcrops, saksak (nipa like), vegetables, strawberry, papaya, oregano	forest/timber trees, coconut, banana

	Upland Plain	Irrigated Lowland	Rain fed Lowland	Hilly land	Mountainous
Weeds	grasses				
Animals	carabao, cattle, hogs, chicken	carabao, chicken		carabao, cattle, goat, chicken	chicken
Constraints	limited soil moisture	limited irrigation water	limited irrigation, limited soil moisture	soil erosion, limited soil moisture, poor soil nutrients	soil erosion/landslide, degraded soil

Identified soil types on the second route are loam, clay, calcareous, clay loam, sandy loam and weathered rocks (Table 36). Commonly practiced cropping system includes alley, mixed, multiple, mono and crop rotation. Similar with the first route, grass is the most common weed on the second route. Meanwhile, commonly raised animals includes carabao, cattle, hogs, chicken and goat. The observed constraints in the area are limited soil moisture, limited irrigation water, soil erosion, poor soil nutrients, landslide and degraded soil.

Transect Survey: Negros Oriental Province

Three routes was covered during the Negros Oriental transect survey. The route 1 covers Valencia, Dumaguete City, Sibulan, San Jose, Amlan, Pamplona and Tanjay City. Likewise, route 2 covered Basay City, Bayawan City, Sta, Catalina, Siaton, Zamboangita, Dauin, and Bacong. The last route of the Negros Oriental transect survey covered Canlain City, Vallehermoso, Guihulngan City, La Libertad, Jimalalud, Tayasan, Ayungon, Bindoy, Manjuyod, and Bais City.

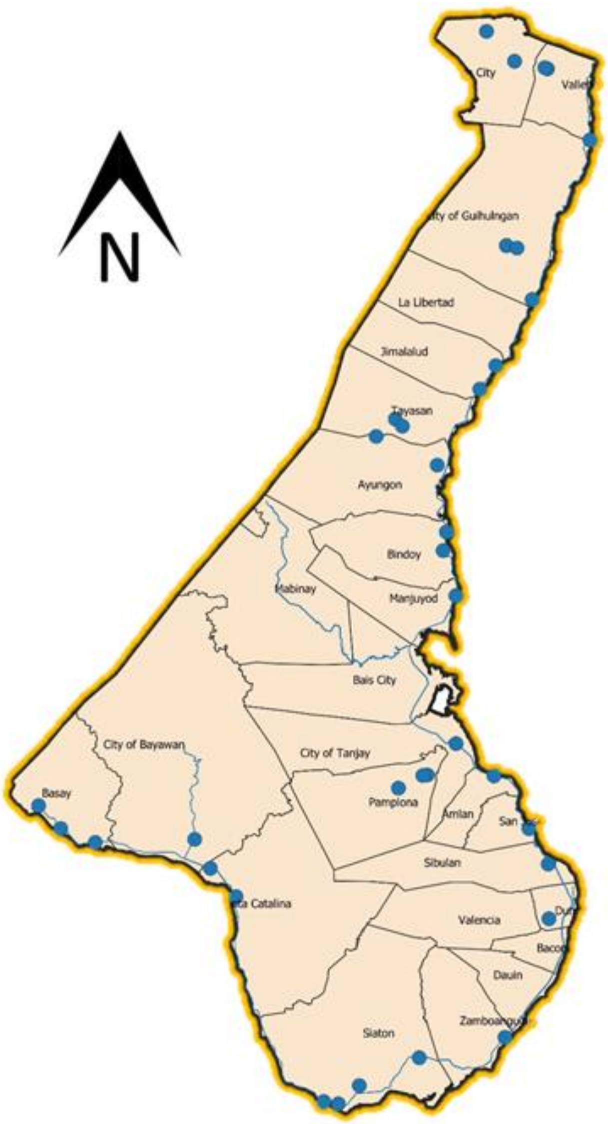


Figure 166. Soil Sampling Points in Negros Oriental

Table 38. Route 1 for Negros Oriental Transect Survey

	Upland	Irrigated	Rainfed	Hilly land	Mountainous
Soil Type	silty clay loam, clay loam, silty loam, loam	loam soil	clay loam		clay
Cropping Systems	mixed cropping, monocropping, alley cropping	mono-cropping	sole cropping, sequential	mixed cropping, alley	multi storey, multiple cropping
Dominant Crops	corn, sugarcane, coconut, mango, fruitcrops	rice	rice, corn, legumes, rootcrops	sugarcane, corn, coconut, banana, fruitcrops	forest/timber trees, vegetables, ornamentals, fruitcrops
Weeds	grasses, broadleaves	grasses, sedges		grasses, broadleaves	grasses, broadleaves
Animals	cattle, carabao, chicken, goat, hogs	cattle, carabao, chicken		cattle, carabao, chicken, goats	chicken
Constraints	limited soil moisture	limited irrigation water		limited soil moisture	soil erosion

The first route common soil type includes silty clay loam, clay loam, silty loam and clay. The commonly practiced cropping systems are mixed, mono, alley, sequential, multi storey and multiple cropping (Table 37). Dominant crops found in the area are corn, sugarcane, coconut, mango, fruit crops, rice, corn, legumes, banana, forest/timber trees, and vegetable ornamentals. Weeds that are commonly growing in this route are grasses, broadleaves, and sedges. Animals that are raised are observably cattle, carabao, goat, hogs and chicken. Also, the evident constraints in the area are limited soil moisture, limited irrigation water and soil erosion.

Table 39. Route 2 for Negros Oriental Transect Survey

	Upland	Irrigated	Rain fed	Hilly land	Mountainous
Soil Type	silty clay loam, clay loam	clay loam, silty clay loam, loam	clay loam	clay, clay loam	clay, clay loam, calcareous
Cropping Systems	mixed, multiple copping	mono-cropping	sole, sequential cropping	mixed, multiple cropping	

Dominant Crops	coconut, banana, corn, sugarcane, fruitcrops, vegetables	rice	rice, corn, legumes	coconut, banana, sugarcane, legumes, corn	fruitcrops, forest/timber trees
Weeds	grasses, broadleaves	grasses		grasses, broadleaves	
Animals	cattle, carabao, hogs, chicken, goat	cattle, carabao, chicken, hogs		cattle, carabao, goat, chicken	chicken
Constraints	limited soil moisture	enough irrigation water -rivers have enough water supply	limited soil moisture		soil erosion

On the second route of Negros Oriental, the common soil type are silty clay loam, clay loam, loam and clay (Table 38). Cropping systems commonly practiced in the area are observably mixed, multiple, mono, and sequential cropping. Dominant crops includes coconut, banana, sugarcane, fruit crops, vegetables, rice, corn, legumes, and forest/timber trees. Visibly growing weeds in the area are grasses and broadleaves. The commonly raised animals are cattle, carabao, hogs, chicken, and goat. Prevailing constraints in the area are limited soil moisture, limited soil moisture and soil erosion.

The soil samples gathered from Negros Oriental were analyzed at the Central Analytical Services Laboratory of Philippine Root Crop Research and Training Center, Visayas State University. The result is as shown on table 40.

Table 40. Soil Sample Test Result of Negros Oriental

Municipalities	**pH**	**OM**	**Total N**	**Avail P**	**Exch K**
	(1:2.5)	(%)		(mg/kg)	
Canlaon	5.60	3.11	0.2	331.6	0.931
Ayungon	5.68	3.14	0.2	12.72	2.405
Tayasan	5.73	3.81	0.27	41.16	0.484
Dumaguete City	5.79	1.16	0.09	326.88	0.589
Zamboangita	6.23	1.45	0.09	69.76	0.296
Pamplona	6.28	2.76	0.18	29.41	0.546
Sibulan	6.61	0.89	0.1	41.76	1.040
Basay	6.80	2.18	0.13	73.44	0.257
Sta. Catalina	6.80	2.25	0.16	67.6	0.586
San Jose	6.94	2.39	0.19	8.08	0.332

Municipalities	pH	OM	Total N	Avail P	Exch K
Siaton	7.14	2.51	0.15	40.15	0.200
Amlan	7.34	1.32	0.08	85.68	0.999
Bayawan City	7.34	3.14	0.17	60.2	0.113
Bindoy	7.37	1.99	0.11	23.04	0.208
Jimalalud	7.43	2.77	0.17	20.88	0.777
Bais City	7.47	3.25	0.2	221.44	1.390
Tanjay	7.74	4.34	0.24	85.84	0.636
Bacong	7.86	1.3	0.12	423.04	0.634
Manjuyod	7.88	3.25	0.23	75.01	0.737
Guinhulngan	7.96	3.23	0.22	38.3	0.423
BISU	8.17	4.2	0.07	108.48	0.324
Vallehermoso	8.24	1.92	0.32	346.64	1.206
La Libertad	8.46	2.63	0.18	35.2	0.216

CAPACITY BUILDING ACTIVITIES

Trainings participated by staffs from DA were also conducted. The first training was conducted face-to-face while another was conducted online due to the onset of COVID-19 pandemic. The first training was conducted on February 11-13, 2020. Held as Visayas State University, the training-workshop focused on the establishment of the demo farm. Main topics were designing an experimental field and statistical analysis, and an introduction to cost-benefit analysis. The said event was participated by 16 staffs from DA offices in Cebu, Bohol, Negros Oriental, and Siquijor.

Another training conducted under the "new normal setup" was on investment appraisal of selected climate resilient agriculture (CRA) practices in Region VII. The online training-workshop was held via Google Meet in collaboration with the Philippine Root Crops Research and Training Center (Philrootcrops) and the Visayas Socio-Economic Research and Data Analytics Center (ViSERDAC). It was participated by 40 staff from DA Central Office in Cebu and its divisions in Bohol, Negros Oriental, and Siquijor. Preparation of an investment brief was discussed during the training – covering topics on cost and benefit analysis, sensitivity analysis, and externalities.

Other conducted activities are the following:

1. Presentation of initial CRVA findings to key officials of Department of Agriculture Region VII at Cebu City last November, 26-28, 2019.
2. Follow up of lacking crop occurrence data last October 15-18, 2019 at Bohol.
3. CRVA progress presentation last October 2-4, 2019 at Cebu City.

SUMMARY OF FINDINGS

The south western part of Bohol generally projects a moderate to very high sensitivity for the most crops in the year 2050 while the northern projects a low to very low vulnerability. The northern part of the Negros Oriental stretching from Manjuyod to Canlaon City generally shows a low to very low sensitivity for all crops while a high to very high sensitivity is evident on the southern part. Sensitivity for banana, cassava, corn for the most part of the Siquijor generally ranges from moderate to very low while some parts of Siquijor and San Juan projects a high to moderate sensitivity.

The hazard index indicates that most municipalities located on the north eastern part of Bohol is exposed from high to very high level of hazard while exposure gets lesser going to the south eastern part. For Negros Oriental only the City of Tanjay is exposed to a very high level hazards while Mabinay, Valencia, Bacong, Dauin and Dumaguete City are at the lowest risk. Out of the six municipalities of the Province of Siquijor, Siquijor has the highest level of risk while Enrique Villanueva and Maria has the projects the lowest risk.

On adaptive capacity index, most municipalities of Bohol projected a low to moderate scores. Its capital city, Tagbilaran scored highest while San Isidro scored the lowest. Meanwhile, most municipalities of Negros Oriental showed moderate adaptive capacity. Bais City displayed the highest index while Zamboangita shows the lowest. In the province of Siquijor, the municipality of Maria had shown the highest adaptive capacity while San Juan had projected the lowest.

For the vulnerability index, studied crops in Bohol shows a vulnerability ranging from moderate to high for the most municipalities. But vulnerability for all studied crops is very low in the City of Tagbilaran. All studied crops consistently projects a very high vulnerability in the municipality of Pamplona. A very high vulnerability for all crops is also likely in San Jose except for rice. In the province of Siquijor, San Juan displays a very high vulnerability for all crops. Meanwhile, the municipalities of Siquijor, Lazi and Enrique Villanueva projects a moderate vulnerability for all crops. All studied crops projects a very low vulnerability in the municipality of Maria.

For the CBA analysis of CRA practices, traditional rice varieties of farming for Bohol province was identified while Negros Oriental were corn and peanut intercropping, rice and watermelon switching, and organic rice farming. Furthermore, Siquijor focused on corn and peanut intercopping.

Growing traditional rice varieties helps in providing healthy options among consumers. Though it offers a relatively lower yield, its profitability in terms of gross margin could go higher from 126% to 233 % compared to inbred rice varieties. Traditional varieties are tolerant to water variations, resistant to pests and diseases, and could compete with weeds. This desirable traits reduces the usage of synthetic chemicals that harms that environment and exacerbates the impacts of climate change. Apart from that, growing traditional varieties helps in preserving Filipino culture and traditions that are intertwined with its cultivation.

Corn yield from corn-peanut intercropping is higher compared to monoculture due to the increased kernel per ear or KNE. Other than crop diversity, adoption of this climate-resilient agricultural practice (CRA) increases land utilization, reduces weed and insect infestations, and lowers the risk of climate change due to the reduced nitrogen usage.

Watermelon in rice and watermelon switching acts as a break-up crop. It does not necessarily replace rice for the entire cropping season. The crop is planted once a year - around March right after the harvest of rice in February. While it optimizes land usage, it provides additional profit that covers unpredictable losses from rice cultivation. The practice also improves soil quality and nutrient pools. Apart from that, water retention is also improved leading to crops capable of withstanding drought stress. It also prevents crop disease transmission and improves weed control resulting to a reduced input cost and reduced greenhouse gas emission.

Organic rice farming requires lesser input cost particularly on fertilizers and pesticides. Due to reduced chemical usage, it results to a lower greenhouse emissions and enhanced carbon sequestration. The CRA provides a toxic-free and high quality farm produce that commands higher price in the market.

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ANNEX

Annex 1 Adaptive Capacity and Capital Assets Indices of Bohol Province

‘	Economic		Natural		Social		Human		Health		Anticipatory		Physical		Institutional		Adaptive Capacity		Remarks
	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	
Alburquerque	0.22	0.16	0.22	0.59	0.28	0.53	0.25	0.13	0.11	0.07	0.27	0.28	0.49	0.55	0.17	0.21	0.31	0.15	Very Low
Alicia	0.21	0.14	0.12	0.29	0.24	0.44	0.39	0.31	0.11	0.07	0.67	0.70	0.35	0.17	0.45	0.62	0.34	0.21	Low
Anda	0.22	0.15	0.35	1.00	0.19	0.35	0.28	0.16	0.15	0.14	0.56	0.59	0.46	0.45	0.29	0.40	0.41	0.34	Low
Antequera	0.28	0.26	0.03	0.00	0.47	0.91	0.16	0.00	0.14	0.13	0.53	0.56	0.51	0.60	0.38	0.51	0.37	0.27	Low
Baclayon	0.15	0.04	0.12	0.31	0.47	0.91	0.34	0.25	0.14	0.13	0.01	0.00	0.33	0.11	0.34	0.46	0.28	0.07	Very Low
Balilihan	0.24	0.19	0.11	0.26	0.44	0.85	0.30	0.20	0.12	0.09	0.43	0.45	0.59	0.81	0.37	0.51	0.42	0.37	Low
Batuan	0.17	0.08	0.07	0.14	0.23	0.44	0.33	0.23	0.11	0.07	0.49	0.52	0.34	0.15	0.33	0.45	0.26	0.04	Very Low
Bien Unido	0.30	0.29	0.10	0.24	0.11	0.19	0.18	0.02	0.13	0.11	0.63	0.66	0.40	0.31	0.39	0.53	0.29	0.11	Very Low
Bilar	0.26	0.22	0.25	0.68	0.29	0.55	0.24	0.11	0.10	0.07	0.65	0.68	0.47	0.48	0.45	0.62	0.42	0.38	Low
Buenavista	0.15	0.04	0.09	0.21	0.23	0.44	0.21	0.06	0.20	0.22	0.47	0.49	0.33	0.12	0.43	0.58	0.27	0.06	Very Low
Calape	0.19	0.11	0.22	0.60	0.28	0.54	0.43	0.37	0.22	0.25	0.65	0.68	0.42	0.35	0.46	0.63	0.44	0.41	Moderate
Candijay	0.22	0.15	0.33	0.93	0.18	0.34	0.39	0.31	0.11	0.08	0.59	0.62	0.51	0.59	0.30	0.40	0.43	0.38	Low
Carmen	0.32	0.32	0.04	0.04	0.43	0.84	0.41	0.34	0.28	0.34	0.53	0.56	0.46	0.47	0.38	0.52	0.43	0.38	Low
Catigbian	0.23	0.17	0.05	0.09	0.18	0.32	0.35	0.26	0.19	0.20	0.13	0.14	0.40	0.29	0.61	0.84	0.29	0.10	Very Low
Clarin	0.16	0.05	0.21	0.56	0.41	0.80	0.38	0.31	0.18	0.19	0.67	0.71	0.63	0.90	0.40	0.54	0.51	0.55	Moderate
Corella	0.28	0.26	0.13	0.31	0.01	0.00	0.29	0.17	0.12	0.09	0.62	0.65	0.36	0.20	0.36	0.50	0.27	0.07	Very Low
Cortes	0.26	0.23	0.18	0.47	0.38	0.74	0.33	0.23	0.13	0.11	0.40	0.42	0.52	0.61	0.32	0.43	0.40	0.33	Low
Dagohoy	0.21	0.14	0.23	0.64	0.39	0.75	0.24	0.11	0.08	0.03	0.66	0.70	0.62	0.90	0.46	0.63	0.49	0.50	Moderate
Danao	0.19	0.11	0.13	0.33	0.36	0.69	0.23	0.09	0.08	0.03	0.69	0.72	0.40	0.30	0.49	0.67	0.37	0.26	Low
Dauis	0.25	0.21	0.09	0.20	0.19	0.34	0.37	0.29	0.14	0.13	0.43	0.45	0.55	0.70	0.49	0.67	0.37	0.27	Low
Dimiao	0.24	0.19	0.10	0.25	0.21	0.38	0.24	0.11	0.11	0.08	0.52	0.54	0.37	0.22	0.30	0.40	0.27	0.06	Very Low
Duero	0.21	0.13	0.27	0.75	0.24	0.44	0.34	0.25	0.10	0.06	0.33	0.35	0.66	1.00	0.40	0.54	0.44	0.41	Moderate
Garcia-Hernandez	0.21	0.14	0.16	0.42	0.43	0.83	0.37	0.29	0.14	0.12	0.52	0.55	0.51	0.58	0.45	0.62	0.44	0.41	Moderate

‘	Economic		Natural		Social		Human		Health		Anticipatory		Physical		Institutional		Adaptive Capacity		Remarks
	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	
Guindulman	0.22	0.15	0.06	0.10	0.51	1.00	0.35	0.25	0.16	0.15	0.55	0.58	0.58	0.79	0.45	0.62	0.45	0.44	Moderate
Inabanga	0.34	0.35	0.30	0.83	0.26	0.49	0.35	0.26	0.12	0.09	0.63	0.66	0.29	0.00	0.48	0.65	0.42	0.36	Low
Jagna	0.30	0.29	0.15	0.38	0.36	0.69	0.46	0.41	0.25	0.28	0.52	0.55	0.53	0.63	0.31	0.41	0.46	0.44	Moderate
Getafe	0.24	0.18	0.17	0.45	0.09	0.15	0.20	0.05	0.10	0.06	0.51	0.53	0.47	0.49	0.01	0.00	0.24	0.00	Very Low
Lila	0.13	0.00	0.30	0.84	0.45	0.87	0.24	0.10	0.17	0.18	0.60	0.63	0.59	0.81	0.69	0.95	0.55	0.63	High
Loay	0.22	0.16	0.22	0.60	0.43	0.83	0.29	0.18	0.16	0.15	0.53	0.55	0.56	0.72	0.44	0.61	0.47	0.48	Moderate
Loboc	0.21	0.15	0.16	0.41	0.29	0.55	0.36	0.27	0.14	0.13	0.64	0.67	0.52	0.63	0.37	0.50	0.41	0.35	Low
Loon	0.31	0.31	0.11	0.27	0.44	0.85	0.38	0.30	0.16	0.15	0.59	0.62	0.50	0.57	0.58	0.79	0.48	0.50	Moderate
Mabini	0.24	0.19	0.15	0.39	0.40	0.78	0.32	0.21	0.12	0.10	0.67	0.70	0.55	0.71	0.41	0.56	0.46	0.44	Moderate
Maribojoc	0.28	0.26	0.29	0.81	0.27	0.51	0.35	0.26	0.14	0.12	0.68	0.71	0.56	0.72	0.50	0.68	0.51	0.55	Moderate
Panglao	0.25	0.21	0.12	0.30	0.15	0.27	0.34	0.24	0.18	0.18	0.62	0.65	0.44	0.40	0.46	0.63	0.36	0.24	Low
Pilar	0.24	0.19	0.29	0.81	0.33	0.63	0.22	0.07	0.12	0.10	0.58	0.61	0.46	0.47	0.26	0.35	0.40	0.33	Low
President Garcia	0.14	0.03	0.12	0.29	0.27	0.52	0.38	0.30	0.08	0.03	0.47	0.49	0.39	0.28	0.39	0.53	0.31	0.14	Very Low
Sagbayan	0.14	0.02	0.03	0.03	0.27	0.50	0.30	0.20	0.12	0.10	0.47	0.49	0.50	0.56	0.26	0.34	0.28	0.08	Very Low
San Isidro	0.21	0.15	0.05	0.07	0.43	0.82	0.21	0.06	0.11	0.07	0.60	0.63	0.37	0.21	0.39	0.53	0.32	0.16	Very Low
San Miguel	0.26	0.23	0.25	0.68	0.29	0.55	0.26	0.14	0.07	0.02	0.65	0.68	0.57	0.76	0.33	0.44	0.44	0.40	Moderate
Sevilla	0.27	0.24	0.03	0.01	0.43	0.83	0.37	0.29	0.11	0.08	0.55	0.58	0.44	0.40	0.32	0.43	0.36	0.24	Low
Sierra Bullones	0.24	0.20	0.17	0.43	0.30	0.57	0.29	0.18	0.07	0.01	0.34	0.36	0.47	0.49	0.38	0.51	0.34	0.21	Low
Sikatuna	0.24	0.18	0.06	0.11	0.24	0.45	0.33	0.23	0.14	0.13	0.68	0.71	0.54	0.68	0.50	0.69	0.40	0.32	Low
Tagbilaran City	0.72	1.00	0.20	0.54	0.13	0.24	0.88	1.00	0.71	1.00	0.68	0.71	0.42	0.36	0.72	1.00	0.73	1.00	Very High
Talibon	0.27	0.24	0.26	0.72	0.40	0.77	0.40	0.32	0.20	0.21	0.55	0.58	0.37	0.21	0.56	0.78	0.48	0.49	Moderate
Trinidad	0.19	0.10	0.02	0.00	0.08	0.14	0.31	0.20	0.06	0.00	0.57	0.59	0.43	0.37	0.43	0.59	0.25	0.02	Very Low
Tubigon	0.34	0.36	0.35	0.99	0.45	0.87	0.36	0.27	0.22	0.25	0.73	0.76	0.49	0.54	0.42	0.57	0.58	0.69	High
Ubay	0.41	0.48	0.16	0.42	0.27	0.51	0.54	0.52	0.26	0.31	0.95	1.00	0.66	0.98	0.46	0.63	0.61	0.75	High
Valencia	0.29	0.27	0.19	0.51	0.43	0.84	0.29	0.17	0.15	0.14	0.58	0.61	0.51	0.61	0.38	0.52	0.46	0.44	Moderate

Annex 2 Adaptive Capacity and Capital Asset Indices of Negros Oriental Province

Municipalities	Economic		Natural		Social		Human		Health		Anticipatory		Physical		Institutional		Adaptive Capacity		Remarks
	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	
Amlan	0.14	0.07	0.43	0.69	0.44	0.63	0.39	0.48	0.17	0.07	0.63	0.76	0.72	1.00	0.23	0.24	0.49	0.49	Moderate
Ayungon	0.26	0.24	0.61	1.00	0.21	0.16	0.24	0.25	0.16	0.06	0.50	0.58	0.48	0.49	0.26	0.28	0.38	0.29	Low
Bacong	0.18	0.12	0.01	0.00	0.26	0.26	0.22	0.22	0.24	0.22	0.44	0.50	0.62	0.80	0.31	0.33	0.31	0.15	Very Low
Bais City	0.57	0.69	0.35	0.57	0.19	0.12	0.52	0.68	0.58	0.94	0.56	0.67	0.41	0.33	0.52	0.58	0.57	0.63	High
Basay	0.14	0.06	0.43	0.70	0.37	0.49	0.25	0.27	0.14	0.01	0.57	0.68	0.48	0.49	0.29	0.31	0.38	0.27	Low
Bayawan City	0.65	0.81	0.53	0.86	0.63	1.00	0.62	0.82	0.50	0.77	0.66	0.80	0.31	0.12	0.87	1.00	0.77	1.00	Very High
Bindoy	0.09	0.00	0.60	0.97	0.43	0.60	0.07	0.00	0.21	0.15	0.42	0.47	0.64	0.83	0.13	0.13	0.39	0.31	Low
Canlaon City	0.42	0.47	0.32	0.52	0.50	0.75	0.16	0.14	0.29	0.34	0.55	0.65	0.28	0.06	0.53	0.60	0.44	0.39	Low
Dauin	0.21	0.16	0.29	0.45	0.14	0.03	0.43	0.55	0.24	0.23	0.52	0.61	0.46	0.44	0.24	0.25	0.34	0.21	Low
Dumaguete City	0.78	1.00	0.04	0.05	0.37	0.49	0.74	1.00	0.61	1.00	0.69	0.85	0.37	0.25	0.48	0.54	0.65	0.77	High
Guihulngan City	0.42	0.47	0.42	0.68	0.39	0.53	0.29	0.33	0.34	0.44	0.81	1.00	0.41	0.35	0.20	0.21	0.50	0.50	Moderate
Jimalalud	0.12	0.04	0.27	0.43	0.14	0.03	0.23	0.24	0.27	0.28	0.45	0.52	0.42	0.35	0.13	0.13	0.25	0.04	Very Low
La Libertad	0.12	0.04	0.22	0.35	0.28	0.31	0.21	0.21	0.21	0.15	0.57	0.68	0.40	0.31	0.48	0.54	0.32	0.18	Very Low
Mabinay	0.34	0.35	0.18	0.28	0.46	0.67	0.43	0.55	0.26	0.26	0.55	0.65	0.40	0.33	0.30	0.32	0.43	0.37	Low
Manjuyod	0.20	0.16	0.31	0.50	0.13	0.00	0.21	0.21	0.28	0.30	0.53	0.63	0.37	0.25	0.22	0.23	0.29	0.11	Very Low
Pamplona	0.13	0.05	0.33	0.53	0.30	0.35	0.37	0.44	0.13	0.00	0.37	0.41	0.37	0.25	0.13	0.12	0.27	0.08	Very Low
San Jose	0.23	0.20	0.13	0.20	0.52	0.78	0.36	0.44	0.21	0.17	0.53	0.63	0.40	0.32	0.36	0.39	0.39	0.30	Low
Santa Catalina	0.41	0.47	0.37	0.59	0.34	0.43	0.42	0.53	0.37	0.49	0.47	0.55	0.40	0.31	0.38	0.42	0.47	0.45	Moderate
Siaton	0.35	0.38	0.33	0.53	0.25	0.24	0.46	0.59	0.37	0.50	0.07	0.00	0.53	0.60	0.27	0.29	0.39	0.30	Low
Sibulan	0.26	0.24	0.32	0.52	0.28	0.30	0.49	0.62	0.25	0.25	0.70	0.86	0.25	0.00	0.13	0.12	0.36	0.25	Low
Tanjay City	0.36	0.39	0.37	0.59	0.27	0.29	0.46	0.58	0.25	0.25	0.57	0.68	0.43	0.38	0.53	0.60	0.47	0.44	Moderate
Tayasan	0.20	0.15	0.20	0.31	0.31	0.36	0.25	0.26	0.23	0.20	0.65	0.78	0.45	0.42	0.23	0.24	0.34	0.21	Low
Valencia	0.32	0.33	0.28	0.44	0.44	0.62	0.36	0.44	0.31	0.37	0.70	0.86	0.52	0.58	0.53	0.60	0.53	0.56	Moderate
Vallehermoso	0.14	0.07	0.20	0.32	0.14	0.03	0.12	0.07	0.28	0.31	0.40	0.45	0.49	0.50	0.09	0.07	0.23	0.00	Very Low
Zamboanguita	0.17	0.11	0.21	0.32	0.14	0.02	0.35	0.42	0.14	0.00	0.55	0.66	0.45	0.43	0.03	0.00	0.25	0.04	Very Low

Annex 3. Adaptive Capacity and Capital Asset Indices of Siquijor Province

Municipalities	Economic		Natural		Social		Human		Health		Anticipatory		Physical		Institutional		Adaptive Capacity		Remarks
	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	Mean	Norm	
Siquijor	0.85	1.00	0.22	0.25	0.26	0.28	0.82	1.00	0.43	0.51	0.30	0.26	0.45	0.32	0.00	0.00	0.45	0.48	Moderate
San Juan	0.30	0.21	0.20	0.22	0.25	0.27	0.53	0.56	0.31	0.00	0.67	0.84	0.36	0.00	0.19	0.27	0.30	0.00	Very Low
Larena	0.75	0.85	0.57	0.69	0.35	0.50	0.19	0.01	0.38	0.30	0.13	0.00	0.48	0.43	0.26	0.37	0.40	0.30	Low
Maria	0.29	0.20	0.82	1.00	0.56	1.00	0.18	0.00	0.49	0.76	0.26	0.21	0.52	0.57	0.31	0.45	0.52	0.69	High
Enrique Villanueva	0.15	0.00	0.35	0.42	0.49	0.83	0.38	0.31	0.43	0.50	0.77	1.00	0.63	1.00	0.67	0.95	0.63	1.00	Very High
Lazi	0.53	0.54	0.02	0.00	0.14	0.00	0.46	0.44	0.54	1.00	0.38	0.39	0.46	0.37	0.70	1.00	0.47	0.52	Moderate

Annex 4. Hazard Exposure Index of Bohol Province

Municipality	TP_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	Haz_norm
Alburquerque	0.000	0.230	0.220	0.870	0.000	0.000	0.030	0.040	17.730	0.240
Alicia	0.740	0.370	0.220	0.620	0.320	0.000	0.020	0.000	35.040	0.620
Anda	0.700	0.060	0.700	0.640	0.000	0.000	0.100	0.110	31.260	0.540
Antequera	0.150	0.120	0.510	0.780	0.040	0.000	0.010	0.000	20.700	0.310
Baclayon	0.000	0.170	0.280	0.710	0.000	0.000	0.000	0.010	14.820	0.180
Balilihan	0.150	0.080	0.360	0.760	0.050	0.000	0.000	0.000	18.260	0.250
Batuan	0.150	0.140	0.740	0.580	0.060	0.000	0.000	0.000	21.220	0.320
Bien Unido	0.860	0.610	0.050	0.000	1.000	0.640	0.090	0.430	52.200	1.000
Bilar	0.140	0.170	0.870	0.710	0.040	0.000	0.000	0.000	24.240	0.380
Buenavista	0.830	0.250	0.290	0.810	0.670	0.000	0.290	0.260	48.460	0.920
Calape	0.140	0.490	0.500	0.450	0.100	0.000	0.590	0.590	34.260	0.600
Candijay	0.690	0.860	0.290	0.490	0.000	0.000	0.590	0.450	45.530	0.850
Carmen	0.220	0.190	0.380	0.710	0.000	0.000	0.000	0.000	20.120	0.290
Catigbian	0.150	0.060	0.420	0.520	0.000	0.000	0.000	0.000	14.750	0.180
Clarin	0.260	0.000	0.280	0.350	0.000	0.000	0.150	0.160	15.050	0.180

Municipality	TP_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	Haz_norm
Corella	0.030	0.070	0.250	0.690	0.000	0.000	0.000	0.000	13.050	0.140
Cortes	0.050	0.730	0.110	0.370	0.000	0.000	0.110	0.060	20.250	0.300
Dagohoy	0.560	0.480	0.300	0.750	0.240	0.000	0.000	0.000	34.590	0.610
Danao	0.620	0.390	0.520	1.000	0.200	0.000	0.000	0.000	39.060	0.710
Dauis	0.000	0.010	0.170	0.460	0.000	0.840	0.020	0.010	14.100	0.160
Dimiao	0.150	0.040	0.440	0.870	0.000	0.000	0.020	0.020	19.410	0.280
Duero	0.270	0.140	0.520	0.870	0.000	0.060	0.030	0.050	24.930	0.400
Garcia Hernandez	0.150	0.100	0.730	0.650	0.030	0.000	0.010	0.040	21.350	0.320
Getafe	0.880	0.150	0.180	0.560	0.680	0.000	0.660	0.630	50.490	0.960
Guindulman	0.540	0.230	0.610	0.740	0.000	0.000	0.170	0.170	32.630	0.570
Inabanga	0.530	1.000	0.130	0.400	0.000	0.000	0.580	0.530	42.810	0.790
Jagna	0.150	0.100	0.670	0.810	0.100	0.000	0.030	0.040	24.020	0.380
Lila	0.040	0.290	0.430	0.810	0.000	0.000	0.000	0.020	20.480	0.300
Loay	0.000	0.920	0.520	0.480	0.000	0.000	0.120	0.130	29.050	0.490
Loboc	0.040	0.420	0.570	0.840	0.000	0.000	0.100	0.030	25.430	0.410
Loon	0.120	0.250	0.570	0.540	0.000	0.000	0.140	0.140	21.800	0.330
Mabini	0.820	0.550	0.240	0.640	0.080	0.000	0.280	0.330	41.620	0.770
Maribojoc	0.070	0.320	0.470	0.590	0.000	0.000	0.130	0.130	21.410	0.320
Panglao	0.000	0.000	0.170	0.400	0.000	1.000	0.050	0.050	15.000	0.180
Pilar	0.510	0.150	0.360	0.600	0.000	0.000	0.000	0.000	23.150	0.360
Pres. Carlos P. Garcia	0.930	0.940	0.000	0.400	0.000	0.000	1.000	0.450	50.380	0.960
Sagbayan	0.250	0.020	0.320	0.690	0.070	0.000	0.000	0.000	18.120	0.250
San Isidro	0.150	0.040	1.000	0.880	0.000	0.000	0.000	0.000	25.170	0.400
San Miguel	0.870	0.590	0.120	0.590	0.000	0.000	0.000	0.000	34.220	0.600
Sevilla	0.150	0.260	0.420	0.780	0.000	0.000	0.000	0.000	21.300	0.320
Sierra Bullones	0.200	0.190	0.460	0.650	0.000	0.000	0.000	0.000	19.860	0.290
Sikatuna	0.100	0.020	0.430	0.850	0.000	0.000	0.000	0.000	17.440	0.230

Municipality	TP_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	Haz_norm
Tagbilaran City	0.000	0.050	0.150	0.340	0.000	0.000	0.010	0.000	6.790	0.000
Talibon	0.940	0.330	0.130	0.530	0.000	0.470	0.530	0.700	45.660	0.860
Trinidad	0.990	0.730	0.140	0.520	0.040	0.850	0.000	0.190	46.790	0.880
Tubigon	0.150	0.130	0.400	0.540	0.000	0.000	0.220	0.220	20.060	0.290
Ubay	1.000	0.740	0.050	0.320	0.000	0.570	0.030	1.000	49.650	0.940
Valencia	0.150	0.170	0.750	0.820	0.000	0.000	0.030	0.040	24.530	0.390

Annex 5. Hazard Exposure Index of Negros Oriental Province

Municipality	TC_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	HazIn_norm
Amlan	0.000	0.650	0.610	0.690	0.080	0.000	0.220	0.230	31.390	0.440
Ayungon	0.000	0.070	0.820	0.760	0.140	0.000	0.140	0.150	24.480	0.260
Bacong	0.000	0.630	0.220	0.490	0.030	0.000	0.010	0.030	19.730	0.140
Bais City	0.000	0.620	0.510	0.800	0.350	0.000	0.520	0.530	41.190	0.690
Basay	0.000	0.320	0.420	0.750	0.220	0.000	0.200	0.220	26.690	0.320
City of Bayawan	0.000	0.200	0.310	0.720	1.000	0.000	0.430	0.470	40.290	0.670
Bindoy	0.000	0.170	0.850	0.950	0.190	0.000	0.030	0.120	28.410	0.370
Canlaon City	0.960	0.000	0.480	0.550	0.000	0.000	0.000	0.000	29.540	0.390
Dauin	0.000	0.110	0.450	0.570	0.040	0.000	0.000	0.020	14.650	0.010
Dumaguete City	0.000	0.770	0.000	0.000	0.050	0.000	0.040	0.120	15.020	0.020
City of Guihulngan	0.570	0.110	0.700	0.730	0.000	0.000	0.040	0.140	30.650	0.420
Jimalalud	0.310	0.050	0.980	0.770	0.000	0.000	0.000	0.020	26.860	0.330
La Libertad	0.300	0.100	0.850	0.760	0.000	0.000	0.000	0.030	26.080	0.310
Mabinay	0.000	0.000	0.260	0.560	0.270	0.000	0.000	0.000	14.190	0.000
Manjuyod	0.000	0.380	0.670	0.910	0.180	0.000	0.150	0.180	30.880	0.430
Pamplona	0.000	0.170	0.690	1.000	0.370	0.000	0.010	0.000	28.820	0.380
San Jose	0.000	0.100	0.830	0.750	0.090	0.000	0.030	0.050	22.190	0.210

Municipality	TC_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	HazIn_norm
Santa Catalina	0.000	0.240	0.660	0.760	0.690	0.000	0.350	0.340	38.170	0.620
Siaton	0.000	0.350	0.650	0.660	0.610	0.000	0.280	0.350	36.840	0.580
Sibulan	0.000	0.200	0.850	0.610	0.110	0.000	0.020	0.150	23.560	0.240
City of Tanjay	0.000	1.000	0.360	0.700	0.330	0.000	1.000	1.000	53.110	1.000
Tayasan	0.230	0.060	0.830	0.660	0.090	0.000	0.010	0.040	24.320	0.260
Valencia	0.000	0.000	1.000	0.700	0.050	0.000	0.000	0.000	20.330	0.160
Vallehermoso	1.000	0.330	0.690	0.710	0.000	0.000	0.040	0.120	41.520	0.700
Zamboanguita	0.000	0.150	0.710	0.630	0.180	0.000	0.050	0.130	22.670	0.220

Annex 6. Hazard Exposure Index of Siquijor Province

Municipality	TC_norm	Fld_norm	LS_norm	Ero_norm	Drt_norm	SWI_norm	SLR_norm	SS_norm	Haz_Index	HazIn_norm
Enrique Villanueva	0.000	0.310	0.000	0.450	0.000	0.000	0.000	0.170	12.510	0.090
Larena	0.000	0.180	0.000	1.000	0.270	0.000	0.110	0.020	21.010	0.270
Lazi	0.000	0.000	0.000	0.490	0.630	0.000	0.150	0.080	18.430	0.220
Maria	0.000	0.080	0.000	0.030	0.360	0.000	0.070	0.000	8.090	0.000
San Juan	0.000	0.750	0.000	0.000	0.190	0.000	0.180	0.200	18.950	0.230
Siquijor	0.000	1.000	0.000	0.330	1.000	0.000	1.000	1.000	55.440	1.000

Annex 7. Sensitivity Index of Bohol Province

Municipality	Sensitivity Index	Municipality	Sensitivity Index
Alburquerque	0.000	Guindulman	0.500
Alicia	0.250	Inabanga	-0.500
Anda	0.500	Jagna	1.000
Antequera	-1.000	Lila	-1.000
Baclayon	-0.250	Loay	0.250
Balilihan	-1.000	Loboc	-1.000
Batuan	-1.000	Loon	-1.000

Municipality	Sensitivity Index	Municipality	Sensitivity Index
Bien Unido	0.250	Mabini	-0.500
Bilar	-0.500	Maribojoc	-1.000
Buenavista	-1.000	Panglao	0.000
Calape	-0.500	Pilar	0.250
Candijay	0.500	Pres. Carlos P. Garcia	0.500
Carmen	-0.500	Sagbayan	-1.000
Catigbian	-1.000	San Isidro	-1.000
Clarin	-0.500	San Miguel	-0.250
Corella	-0.250	Sevilla	-1.000
Cortes	-0.250	Sierra Bullones	0.500
Dagohoy	-0.250	Sikatuna	-1.000
Danao	-0.500	Tagbilaran City	0.250
Dauis	0.000	Talibon	-0.250
Dimiao	-0.500	Trinidad	-0.250
Duero	1.000	Tubigon	-0.500
Garcia Hernandez	0.500	Ubay	-0.250
Getafe	-0.500	Valencia	0.000

Annex 8. Sensitivity Index of Negros Oriental Province

Municipality	Sensitivity Index	Municipality	Sensitivity Index
Amlan	1.000	La Libertad	1.000
Ayungon	1.000	Mabinay	1.000
Bacong	1.000	Manjuyod	1.000
Bais City	1.000	Pamplona	1.000
Basay	1.000	San Jose	1.000
Bindoy	1.000	Santa Catalina	0.500
Canlaon City	1.000	Siaton	-0.500
City of Bayawan	1.000	Sibulan	1.000
City of Guihulngan	1.000	Tayasan	1.000
City of Tanjay	1.000	Valencia	0.500
Dauin	1.000	Vallehermoso	1.000
Dumaguete City	1.000	Zamboanguita	1.000
Jimalalud	1.000		

Annex 9. Sensitivity Index of Siquijor Province

Municipality	Sensitivity Index
Enrique Villanueva	1.000
Larena	1.000
Lazi	1.000
Maria	1.000
San Juan	1.000
Siquijor	1.000

Annex 10. Crop Occurrence Workshop last June 10-11, 2019 at Alta Mountain Resort, Bohol

Annex 11. Crop Occurrence Workshop at Dumaguete City last August 13, 2019

Annex 13. Crop Occurrence Workshop at Siquijor, Siquijor last August 15, 2021

Annex 12. Follow up on Crop Occurrence Data in Bohol last October 15-18, 2019.

Annex 14. Soil Sample Gathering in Bohol, October 9-11, 2021

Annex 15. Soil Sample Gathering In Siquijor, October 24-24, 2019


Annex 16. Soil Sample Gathering in Negros Oriental, November 5-8, 2019


Annex 17. Famer Interview in Bohol, Jan. 15-17, 2020

Annex 18. Farmer Interview in Negros Oriental, March 3-4, 2020

Annex 19. Establishment of a Demo Farm Workshop at VSU, February 11-13, 2020

Annex 20. Training-Workshop on Investment Appraisal via Google Meet, May 26-27, 2020

Annex 21 Training Design for Demo Farm Establishment Training-Workshop

TRAINING-WORKSHOP ON THE ESTABLISHMENT OF A DEMO FARM

February 11-13, 2020
Technology Business Incubator (TBI) Building
Visayas State University, Baybay City, Leyte

Day 1. February 11, 2020

Time	Activities	Person In-Charge
8:30 – 10:00	Arrival and Registration of Participants	
10:00 – 11:30	**Opening Program** • Invocation • Singing of the National Anthem • Welcome Message • Overview of the Training • Self-introduction of Participants, Facilitators & Resource Persons	Engr. James S. Toledo Ms. Inna Sto. Tomas Dr. Moises Neil V. Seriñ Prof. Alan B. Loreto
11:30 – 12:00	Leveling-off of Expectations	Training Staff
12:00 – 1:00	Lunch Break	
1:30 – 3:30	**Topic 1. Planning an Experiment** • Overview of Scientific experiments • Things to consider • Importance of replication • Overview of the relationship between statistics, design of experiment and analysis	Dr. Norberto E. Milla Prof. Alan B. Loreto Team
3:30 – 5:00	**Topic 2: Design and Analysis of Field Experiment** • Dependent and Independent variables • Randomization process • Statistical design • Significance, Errors and Analysis of Variance	Dr. Nello Gome
6:30 – 10:00	**Welcome Dinner and Fellowship**	

Day 2. February 12, 2020

Time	Activities	Person In-Charge
8:00 – 8:30	Registration	Secretariat
8:30 – 12:00	**Topic 3. Principles of Field Lay-outing** • Important considerations (e.g. soil type, slope, no. of plants, etc) • Basic techniques in field lay-outing • Observation of a field layout	Dr. Dionesio M. Bañoc Team
12:00 – 1:00	Lunch Break	
1:00 – 5:00	**Topic 4. Statistical Analysis and Tools** • Software downloading and Installation • Familiarization of the GUI and Interface	Dr. Nello Gome Dr. Dionesio M. Bañoc Team

Day 3. February 13, 2020

Time	Activities	Person In-Charge
8:00 – 8:30	Registration	Secretariat
8:30 – 10:30	**Topic 5. Cost Benefit Analysis and its Interpretation** • Different Methods of CBA • Basic data needed for the analysis • Analysis and interpretation of data	Dr. Moises Neil V. Seriñ Mr. Jedan A. Cavero Dr. Dionesio M. Bañoc Team
10:30 – 11:30	**Closing Program** • Prayer • Impressions of Selected Participants • Message	Engr. James S. Toledo Prof. Alan B. Loreto
12:30	Homeward Bound (via Ormoc)	

Annex 22. Training Design for Investment Appraisal Workshop

PHILIPPINE ROOTCROPS RESEARCH AND TRAINING CENTER
Visayas State University, Visca, Baybay City, Leyte, Philippines 6521-A
Tel No. | Fax No.: (+63)(053)563-7229

Training-Workshop on Investment Appraisal of Selected Climate Resilient Agriculture (CRA) Practices in Region VII

May 26-27, 2020

Platform: Google Meet

Day 1: May 26, 2020

Time	Activities	Person In-charge	Training Link	Meeting Cod
9:00-11:00	Opening Lecture and Workshop 1: Cost and Benefit Analysis	Prof Alan B. Loreto Dr. Moises Neil V. Seriño Jedan A. Cavero	https://meet.google.com/yjk-icjy-gmk	yjk-icjy-gmk
2:00-3:00	Lecture and Workshop 2: Sensitivity Analysis and Externalities	Dr. Moises Neil V. Seriño Jedan A. Cavero	https://meet.google.com/dnr-xnmz-fow	dnr-xnmz-fow

Day 2: May 27, 2020

Time	Activities	Person In-charge	Training Link*	Meeting Cod
9:00-11:00	Lecture and Workshop 3: Preparing an Investment Brief	Dr. Moises Neil V. Seriño	https://meet.google.com/jhx-bbjo-gus	jhx-bbjo-gus
2:00-3:00	Presentation of outputs	Participants	https://meet.google.com/sqq-qymu-hwz	sqq-qymu-hw
4:00-5:00	Closing	Prof Alan B. Loreto		

Instructions:

1. Kindly paste the **Training Links** on your Google Chrome, Mozilla Firefox, Microsoft Edge, or Apple Safari web browsers based on the corresponding day and time slot of each sessions. Then click "**Join Now**".
2. There are instances that Google Meet will only require you to **input a name**. Do as you please then click "**Ask to join**".