CLIMATE RISK VULNERABILITY ASSESSMENT

SURIGAO DEL NORTE

DEPARTMENT OF AGRICULTURE
REGIONAL FIELD OFFICE XIII

Message

We live in a world where we enjoy the pleasures of nature. We are provided with resources that are abundant and free. But as years pass and human activities are changing, tremendous effects of climate change are dominantly present affecting the availability of resources and poses dramatic loss to the economy.

As we face this very challenging times brought about by the climate change, the Department of Agriculture continues to provide interventions that will develop adaptation and mitigation skills of our farmers and fishers – helping them battle the effects of climate adversities.

I commend the Research Division for producing a comprehensive and holistic analysis of the Climate Risk Vulnerability Assessment (CRVA) in the region. In this report, the vulnerability index in terms of the adaptive capacity, exposure, and sensitivity are presented in details, as well as the factors affecting it.

The CRVA is very relevant for it serves two purposes: (1) as basis in the establishment of AMIA Villages where Climate-Resilient Agriculture (CRA) practices are showcased and (2) as guide in implementing programs and interventions of the Department. Similarly, this also serves as reference for policy-makers, farmers, research institutions, academe, organizations, and interested groups.

May this output further promote the crucial role that R&D plays in developing innovations and enhancing agricultural productivity as well as income of our farmers and fishers in Caraga.

Thank you and Mabuhay! Larga Caraga, Larga!

ABEL JAMES I. MONTEAGUDO
Regional Executive Director

Message

As climate change continues to exert pressure on the livelihoods and agricultural productivity of our farmers, the need to understand the vulnerability of the community is very timely and necessary.
Cognizant of the fact that there have been various programs and interventions geared towards adaptation and mitigation initiatives of our farmers and fishers in Caraga, having this comprehensive CRVA report is in the right direction.

This CRVA output will serve as benchmark of future programs and interventions we will be implementing the region. Considering the present situation and the existing resources available, we can make a huge impact in helping our farmers combat the negative effects of climate change in the future.

Through the AMIA project, the Department of Agriculture envisioned of enabling local communities manage climate risks while pursuing sustainable livelihoods. The information presented in this CRVA will help us determine the highly vulnerable municipality where appropriate climate-smart technologies and practices will be introduced.

I commend the Research Division and everyone behind the completion of this CRVA output deserves applause for their extraordinary effort. I am looking forward to seeing a bright R&D future ahead of us.

Congratulations everyone!

NICANDRO M. NAVIA, JR.
Regional Technical Director for

Research, Regulations & ILD/ AMIA Focal Person

Message

I take pride in supporting this printed work, a first of its kind in the area of climate and vulnerability assessment. As Project Leader CRVA Chief of the Research Division, it's kind of fulfilling to come-up with this comprehensive analysis of all the municipalities in Caraga.

this Considering all the information presented in this comprehensive CRVA output, we hope that will be used as reference by our Banner Programs and LGUs in their future interventions, target-setting, and prioritization.

As for the AMIA project, this output will be used as basis in developing and promoting climate-resilient agriculture (CRA) through implementing technologies and practices, introducing institutional and social innovations, and accessing climate-relevant support services.

I am grateful to the Climate Resilient Agriculture Office for initiating projects directed towards increasing climate-change resiliency of our farmers.

To our researchers and collaborating LGUs, thank you very much and congratulations. May this output be an important and significant reference for everyone.

ABEL F. WAGAS
Chief, Research Division/

AMIA Project Leader

Acknowledgement

The AMIA Team would like to express its heartfelt gratitude to those personalities behind the success of this CRVA analysis that provides appropriate strategies to responding to the challenging call of climate change.

This book would not be possible without the contribution and commitment of the following departments and personnel:

We are thankful to the Department of Agriculture-Climate Resilient Agriculture Office (CRAO) for designing and funding this project with enormous budget allocation.

To the Department of Agriculture- Regional Office for the unwavering support in implementing this result-based project.

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To the focal person, RTD Nicandro M. Navia Jr. who endlessly provides inputs to this paper.

To the project leader, Chief Abel F. Wagas who consistently monitored the implementation of the project.

To the members of the Technical Working Group (TWG) per special order # 11 who untiringly spare their time in attending and supporting AMIA Activities.

To the AMIA Technical Staff who perform the data collection, consolidation, and validation to ensure conducive output as a tool for decision-making.

To all the Senior Staff for their continued guidance and supervision in the implementation of all CRVA-related undertakings.

To the concerned LGU's of the province of Surigao del Norte who undoubtedly provide the data's needed for the creation of CRVA.

It's a wonderful experience to work with you all, you imparted a huge contribution in the success of this project. Thank you and God Bless us all.

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Abstract

This paper provides information on the most vulnerable municipalities to climate change impacts in the Province of Surigao del Norte in Caraga region. The assessment was carried out by overlaying climate hazard maps, sensitivity maps, and adaptive capacity maps following the vulnerability assessment framework of the United Nations' Intergovernmental Panel on Climate Change (IPCC).Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001) or a function of sensitivity, exposure and adaptive capacity. This three (3) key dimensions of vulnerability namely: sensitivity, exposure (hazard) and adaptive capacity were used in this study as a major contributor to the assessment of climate risk vulnerability. The study used geo-spatial data of various climate-related hazards in the province of Surigao del Norte, Philippines. Based on this CRVA, San Francisco in mainland and Del Carmen in Siargao Island are among the highly vulnerable municipalities in the province due to its high exposure to climate hazards as well as their low adaptive capacity and the decreasing suitability of crops to climate variability in the aforementioned municipalities. Considering other factors constant, investing for banana, corn, rice, root crops and vegetables will be less favorable in the future. However, such potential impacts could be negated if the LGUs will continue investing in climate-change related programs and interventions that will improve farming practices and those that will facilitate agri-related coping mechanisms and strategies. Several climate resilient farming technologies require further verification. A Community Participatory Action Research (CPAR) is highly recommended in coming up with location specific-climate resilient adaptation options.

Keywords: climate risk vulnerability, sensitivity index, hazard index, adaptive capacity

INTRODUCTION

The Philippines is now facing the very real impacts of climate change, which threaten to undermine our development prospects and exacerbate the vulnerability of our poorer communities. With projected changes in precipitation, temperature, intensity of tropical cyclones and frequency of extreme weather events, considerable efforts would be required to prepare the Philippines in dealing with the impacts of climate change on the different climate-sensitive sectors (Servando, N.T. in PAGASA, 2011). In addition, extreme weather events such as typhoons, drought, heavy rains, regularly visit the country and many have led to disasters costing the country billions in pesos every year. Of the 20 typhoons that enter the Philippine area of responsibility annually, nine (9) make landfall. Heavy rains from the annual monsoons also cause floods that lead to small and large disasters. El Nino, with its associated drought and floods, visit the country in 2-7 years interval.

The country's agri-fisheries sector is a perennial casualty of these climate-related risks. In the period of 2010 - 2014, loss and damages from climate/weather-induced disasters (FPOPD-DA, 2015) reached a total of Php136 billion or an average of PhP27 billion annually. The increased vulnerability of agri-fisheries communities to climate risks pose as a key challenge in enabling them to pursue more resilient and productive livelihoods, and ultimately rise out of poverty.

In response, the Department of Agriculture has launched the Adaptation and Mitigation Initiative in Agriculture (AMIA) in 2014, with an overall vision of a Philippine agri-fisheries sector that enables local communities to manage climate risks while pursuing sustainable livelihoods. As its overall approach, AMIA develops and promotes climate-resilient agriculture (CRA) through implementing technologies and practices, introducing institutional and social innovations, and accessing climate-relevant support services.

The initial phases of AMIA identified key climate risks and geographic targets across the country through Climate Risk Vulnerability Assessment (CRVA). This is purposely done to assess exposure, sensitivity, and adaptive capacity of the agri-fisheries sector to climate risks in the AMIA target regions; identify and prioritize province-specific climate risks that threaten the resilience of agri-fishery communities; and to plan and design climate-risk responsive research and development interventions to build resilience among agri-fishery communities.

Outputs of CRVA serves as basis in developing CRA-related decision-support tools, preliminary models for community action research, and recommended guidelines for provision of climate information services.

Objectives

The general objective of this study is to identify which municipalities in the Province of Surigao del Norte are the most vulnerable to climate change. It is expected that this information will be useful to policy-makers of the province and the region as well as stakeholders in better targeting their support towards climate change efforts. The specific objectives are as follows:

- To assess exposure, sensitivity, and adaptive capacity of the municipalities to climate risks in the province of Surigao del Norte;

- To show these vulnerable areas in a map for ease of reference of interested parties; and

- To plan and design climate-risk responsive research and development interventions to build resilience among agri-fishery communities.

METHODOLOGY

Study Area

This report highlights the CRVA Output for the Province of Surigao del Norte.

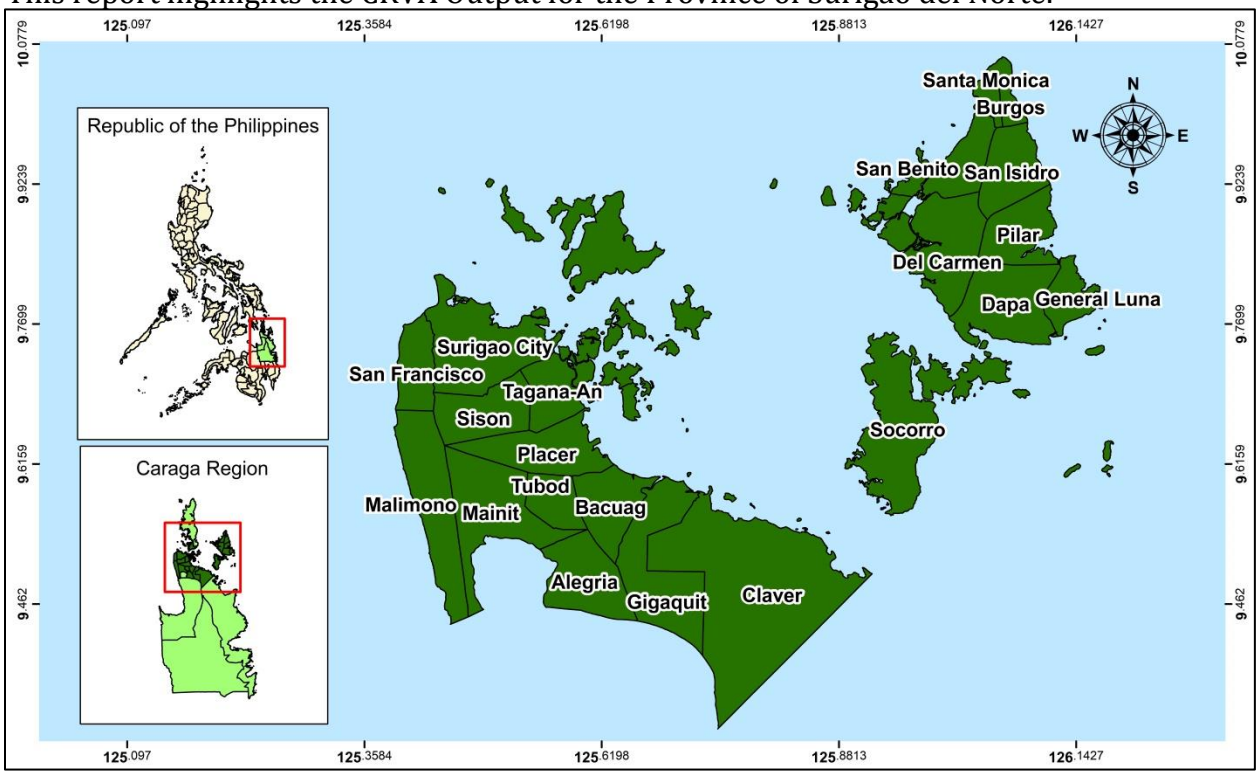


Figure 1. Geographical location of the study area

Surigao del Norte is located at the Northeastern part of Mindanao between 125˚ 15' to 126˚ 15' east longitude and 9˚ 18' to 10˚ 30' north latitude. It is bounded on the North and East by the Pacific Ocean, on the South by the Provinces of Agusan del Norte and Surigao del Sur and on the West by the Surigao Strait (Figure 1).

(Source: Factbook Surigao del Norte, 2018)

The CRVA Framework

Climate risk vulnerability is the degree to which an area is susceptible to the adverse effects of climate change, specifically as manifested in increasing weather variability and projected long-term shift in the occurrence of extreme weather events. Analysis is based on the vulnerability assessment framework from the Intergovernmental Panel on Climate Change (IPCC) which define vulnerability as a function of 3 key dimensions namely, sensitivity, exposure, and adaptive capacity as shown in Figure 2. Each key dimension has weighted impact factor depending on the importance attributed to the system. The weighted impact factor used in this particular analysis was patterned from that
of CIAT which measures CRVA as follows:

$$Vulnerability = (Exposure * 0.15) + (Sensitivity * 0.15) + ((1 - Adaptive\ Capacity) * 0.70) \quad \text{Eq (1)}$$

Integrated analysis is done through GIS overlay mapping, which is used to assess spatial patterns and to identify "hotspots" or sensitive areas with significant exposure to climate hazards and low adaptive capacity (Eq 1).

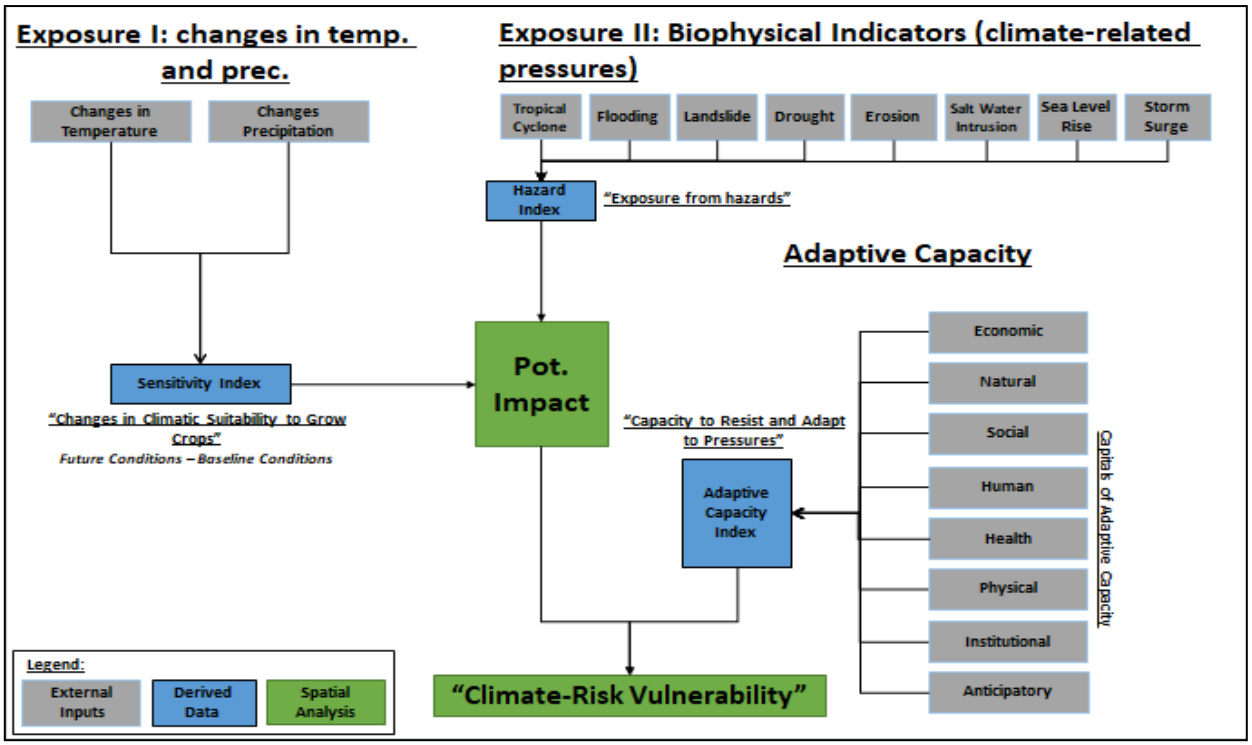


Figure 2. Framework of Climate Risk Vulnerability Assessment

Adaptive Capacity Estimation

The IPCC defined adaptive capacity (AC) as the ability or potential of a system to respond successfully to climate variability and change and includes adjustments in both behavior and in resources and technologies. Literatures provided different versions of adaptive capacity definition however, most of them emphasized on similar idea- "to cope with the consequences". Adaptive capacity focuses on eight capital indicators namely, economic, natural, social, human, health, physical, anticipatory, and institutional. Proxy variables used for each capital were presented in Table 1.

Figure 3 displays the stages of adaptive capacity estimation which starts with data standardization or normalization of values to cancel out variability of data using the equation below:

$$Norm = \frac{x - x_{min}}{x_{max} - x_{min}} \quad \text{Eq (2)}$$

where:

x = original value
x_{min} = lowest value in the data set
x_{max} = highest value in the data set

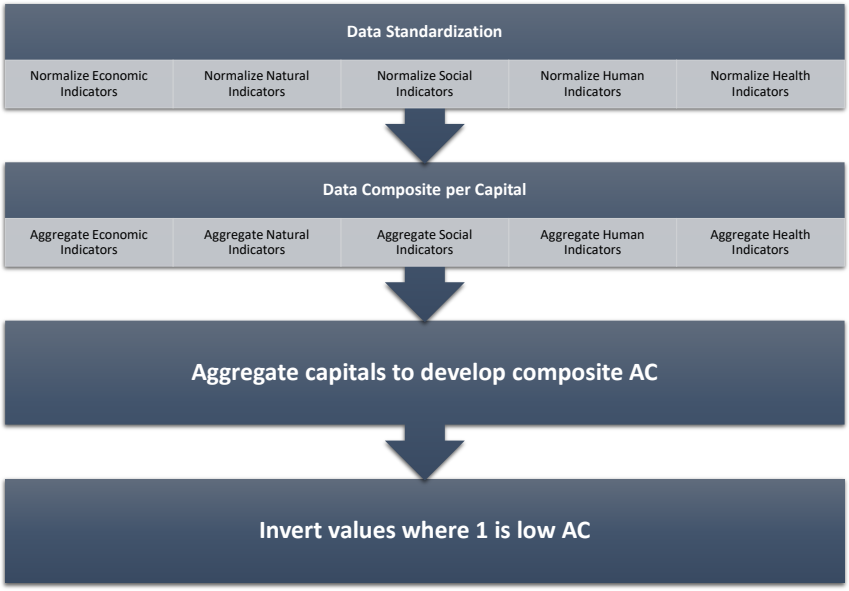


Figure 3. Simplified schematic diagram of AC processing.

Once the values are ready, composite index for each capital is then constructed by getting the average of all indicators. After computing for the composite index, the values were

Table 1. List of indicators used in measuring adaptive capacity

CAPITALS							
Economic	**Natural**	**Human**	**Physical**	**Health**	**Social**	**Anticipatory**	**Institutional**
• Total area planted (top 5 commodities)	• Total service area with irrigation	• Literacy rate	• % of farmers owning agricultural land	• Nutrition rate	• % of women officials on government	• No. of MDRRMC registered trainings	• No. of AEWs
• Total volume of production (top 5 commodities)	• Total agricultural land area	• Ratio of school teachers to students	• Average farm size	• Total number of health services	• No. of farmer associations	• % of farmers with access to mobile phones	• % of farmers visited or consulted with AEWs
• Income class		• Total no. of secondary schools	• Total number of livestock owned	• Total number of health professionals	• % of farmers who are members of coops/unions/groups	• % of farmers with access to televisions	• % of farmers visiting or consulting the AEW of MAO
• Total no. of financial institutions		• Total no. of public and private tertiary schools	• % of agricultural area with irrigation	• % of local citizen with Philhealth		• % of farmers with access to radio	
• Total no. of finance cooperatives		• Total no. of technical vocational schools	• Total no. of concrete roads			• % of farmers with access to internet	
• Total no. of ATMs			• % of household with water services				
• % of farmers covered with insurance			• % of household with electric services				
• % of population employed in agriculture							
• Minimum wage rate in agriculture							
• Poverty incidence							

normalized again for consistency. The composite AC is then derived using the sum function of all capital indices. To account for vulnerability, the AC index is then inverted where 1 is considered as low AC.

Crop Sensitivity Assessment

Sensitivity index is defined as the increase or decrease of climatic suitability of selected crops to changes in temperature and precipitation (Burgman 2002). The Climate Change Commission define it as the degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

Adopting the method suggested by the CIAT, the Maximum entropy (Maxent) model was used to compare crop suitability by the year 2050 vis-à-vis the baseline year. Analyzing changes in crop suitability involves a two-step process: The first step is to assess the baseline (current climate condition) crop suitability which is based on the condition that a species is predicted to occur at a particular location if it approximately matches the environmental condition where it is observed. The second step is to predict the location of a species on a particular time slice if it matches the environmental condition where it is observed in the baseline condition. Table 2 presents the 20 bioclimatic variables used to assess climate suitability of crops.

Table 2. Bioclimatic variables used in crop simulation modeling

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

PARAMETERS	DESCRIPTION
Bio_10 - Mean temperature of warmest quarter	This quarterly index approximates mean temperatures that prevail during the warmest quarter.
Bio_11 - Mean temperature of coldest quarter	This quarterly index approximates mean temperatures that prevail during the coldest quarter.
Precipitation Related	
Bio_12 - Annual precipitation	This is the sum of all total monthly precipitation values.
Bio_13 - Precipitation of wettest month	This index identifies the total precipitation that prevails during the wettest month.
Bio_14 - Precipitation of driest month	This index identifies the total precipitation that prevails during the driest month.
Bio_15 - Precipitation seasonality	This is a measure of the variation in monthly precipitation totals over the course of the year. This index is the ratio of the standard deviation of the monthly total precipitation to the mean monthly total rainfall and is expressed as a percentage.
Bio_16 - Precipitation of wettest quarter	This quarterly index approximates total precipitation that prevails during the wettest quarter.
Bio_17 - Precipitation of driest quarter	This quarterly index approximates total precipitation that prevails during the driest quarter.
Bio_18 - Precipitation of warmest quarter	This quarterly index approximates total precipitation that prevails during the warmest quarter.
Bio_19 - Precipitation of coldest quarter	This quarterly index approximates total precipitation that prevails during the coldest quarter.
Bio_20 - Number of consecutive dry days	Consistent number considered as dry days.

Sources:*(O'Donell, M and Ignizio, D., 2012)*

Generating Exposure Index

Exposure index captures the level of potential exposure to extreme climate- related events such as cyclone, drought, flooding, landslide, sea level rise, severe local storm, storm surge, and wildfire (ADB, 2015). The development of an exposure or hazard index relies on spatial analysis of the weighted combination of different historical climate-related natural hazards in the Province of Surigao del Norte. At least eight (8) hazards were identified for the said province, these are tropical cyclone (TC), flood (Fld), landslide (LS), erosion (Ero), saltwater intrusion (SWI), sea level rise (SLR), drought (DRT) and storm surge (SS). The selection of hazards were based on consultation and briefing conducted last August 2019 at Surigao City with the project partners from the LGU's of the of Province of Surigao del Norte.

Hazards Weights. The hazard weights used in this study was introduced by the lead partner of CIAT. The weights were identified through focus group

discussions conducted and were represented by the different SUCs' experts/focal persons. The qualitative assessment using the following criteria 1) probability of occurrence, 2) impact of local household income, 3) impact to key natural resources to sustain productivity (refers to how key resources such as water quality and quantity, soil fertility, and biodiversity are affected), and 4) impact to food security of the country, and 5) impact to national economy. Table 3 summarizes the different weights for each island group in the Philippines. The criteria used also reflect the impact of hazards at different scales from local, landscape, and national level. A spatially-weighted sum was used to develop the hazards index for each island group (Luzon, Visayas, and Mindanao). Thus, in the case of the Agusan del Norte province, the weights of the Mindanao cluster were adopted. For each municipality in the province, the value of the hazard index was computed and normalized.

Adopting the framework from CIAT, below is the econometric specification for computing hazard index:

$$Haz_{index} = \sum (TC * 16.95) + (Fld * 15.25) + (LS * 14.41) + (Ero * 12.71) + (Drt * 16.95) + (SWI * 10.17) + (SLR * 5.08) + (SS * 8.48) \quad \text{Eq (3)}$$

where:

TC= Tropical cyclone	LS= Landslide	Drt= Drought
Fld= Flood	Ero= Erosion	SWI= Salt water intrusion
SLR= Sea level rise	SS= Storm surge	

Five equal breaks were used to geo-visualize the map, and it was classified into 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High) and 0.80-1.0 (Very High).

Table 3. Hazard weights

	ISLAND GROUP		
Hazards	Luzon, %	Visayas, %	Mindanao, %
1 Tropical cyclone	20.00	18.21	16.95
2 Flood	19.05	16.40	15.25
3 Landslide	8.27	10.72	14.41
4 Erosion	11.43	12.57	12.71
5 Drought	14.25	16.17	16.95
6 Saltwater intrusion	11.43	7.21	10.17
7 Sea Level Rise	5.71	8.33	5.08
8 Storm Surge	9.52	10.39	8.48

Source: CIAT

AGRO-EDAPHIC PROFILE

Land Area
The Province is composed of the mainland, Siargao and Bucas Grande Islands with a total land area of 201, 710 hectares (based on the updated DENR-GIS Generated Land Area).

Of this total, the mainland portion occupies 138,914 hectares and Siargao Island has 62,796 hectares. The biggest land area is Claver (31,534 hectares or 15.63%) and followed by Surigao City (26,117 hectares or 10.95%). Burgos, on the other hand, has the smallest area equivalent to 0.97% of the total.
(Source: Factbook Surigao del Norte, 2018)

Topography
The mainland portion of the province has a varied terrain ranging from flat, to rugged to mountainous. A mountain range located along the boundary of the municipalities of Tubod, Bacuag and Mainit is Mt. Diwata. On the north eastern part of Sison – Placer- Mainit boundary is Mt. Buhangin with an elevation of 664 meters and flanking the western side along the boundary of Mainit- San Francisco is Mt. Tendido with an elevation of 865 meters. Two common mountain range namely: Mt. Satellite having an elevation of 1,016 meters and Mt. Agudo with 1,018 meters above sea level are found in Malimono.

Adjoining the municipality of Alegria and the municipality of Kitcharao in Agusan del Norte is Mt. Kabutan with an elevation of 975 meters. At the southeastern part bordering Surigao del Sur and Municipality of Claver lies Mt. Legaspi with an elevation of 1,170 meters above sea level.

The terrain in Siargao Island is predominantly rolling to steep. The highest elevation is 291 meters above sea level located along the middle Bucas Grande Island. On the western and southern sides of the island are broad expanse of mangrove swamps and broad reef flats. The island is proximate to the Philippine Deep which is 10,700 meters below sea level and considered as the deepest part of the trench.
(Source: Factbook Surigao del Norte, 2018)

Soil Type
The soil in the province is basically clay and sandy loam type. The soil in the mainland area is generally classified as loam soil (60% Anaon-aon/Malimono clay loam, 20% kabatohan clay loam and 20% Malalag clay loam) characterized as permeable, moderately drained and highly suitable for agriculture.

The soil type in Siargao island is: 80% bolinao clay, 10% bolinao clay steep phase and 5% Jamoyaon clay loam. The island of Bucas Grande is highly acidic due to the presence of mineral ores thereby needing careful soil management.
(Source: Factbook Surigao del Norte, 2018)

Climate
The province falls under climate type II characterized by no pronounced dry season but with a very pronounced maximum rainfall period from November to January. It has a total annual rainfall of 2,911.20 mm from the 204 rainy days in 2016.Temperatute ranges from a low of 23.1˚C in February to a high 33.8˚ C in August.

(*Source: Factbook Surigao del Norte, 2018)*

Land Classification
The alienable and disposable land (A&D) is estimated at 95,969 hectares (47.58%) of which 71,632 hectares are in Surigao Mainland while the 24,337 hectares are in Siargao and Bucas Grande Islands.

Of the total land area, 11,123 hectares has been utilized for settlement areas, 97,640 hectares are agricultural areas, fishpond has 1,341 hectares, production forest is 17,427 hectares while other forest areas categorized as open and closed forest total to 30,175 hectares, 8,235 hectares for mining and industrial use, 765 hectares are tourism areas, 14,162 hectares are mangrove areas while only 41 hectares are utilized as military reservations. A total of 20,801 hectares are for other land uses, of which 6,530 hectares are shrub land, 5,384 hectares are grassland, 8,531 hectares are brush land and 356 hectares are considered barren.
(Source: Factbook Surigao del Norte, 2018)

SOCIO-ECONOMIC PROFILE

Language and Dialects
Surigaonon, Cebuano, Boholano, Tagalog and English are the major languages, dialects spoken in the province.
(Source: Factbook Surigao del Norte, 2018)

Population and Growth Rate
Based on 2015 NSO survey, the province has a total population of 485,088 with an annual growth rate of 1.76% (Table 4).

Table 4. Population and growth rate

Particulars	2010			2015		
	District I	District II	Province	District I	District II	Province
Population	110,653	331,935	442,588	116,587	368,501	485,088
Growth Rate (1995-2000 2007-2010)	3.33	2.48	2.69	1.07	2.20	1.92
Population Density (per sq.km.)	176	239	219	185	265	240
No. of Households	21,626	67,579	89,205	24,289	79,077	103,366
Sex Ratio (no. of males per 100 females)	103	103	103	103	103	103

Source: NSO and PPDO

Total Population refers to all persons in the territory at a specified time. Coverage includes both national and aliens; native and foreign born persons; internees, refugees, and any other group physically present within the borders of a country within a specified time. Table 5 shows the total population, total land area (has) and income class in 2015. The province of Surigao del Norte recorded a total population of 485,088 in the 2015 Census of Population. Among 21 municipalities, Claver is the only 2nd class in terms of its income.

Table 5. Population and land area profile

MUNICIPALITY/CITY	POPULATION as of AUGUST 1, 2015	TOTAL LAND AREA (has)	INCOME CLASS
DISTRICT I (Siargao Island)	**116,587**	**62,796**	
Burgos	4,034	1,948	6th class
Dapa	23,787	8,934	4th class
Del Carmen	18,392	15,191	5th class
General Luna	16,771	5,551	5th class
Pilar	9,752	5,837	5th class
San Benito	5,404	4,429	6th class
San Isidro	7,325	4,538	5th class
Santa Monica	8,808	3,691	5th class
Socorro	22,314	12,677	4th class
DISTRICT II (Mainland)	**368,501**	**138,914**	
Alegria	16,011	6,752	5th class
Bacuag	14,486	8,461	5th class
Claver	32,773	31,534	2nd class
Gigaquit	20,864	13,764	4th class
Mainit	26,741	11,425	4th class
Malimono	18,054	8,120	5th class
Placer	27,094	6,664	4th class
San Francisco	14,552	5,341	5th class
Sison	13,155	8,247	5th class
Tagana-an	16,428	7,917	5th class
Tubod	14,206	4,572	5th class
Surigao City	154,137	26,117	3rd class
SURIGAO DEL NORTE	**485,088**	**201,710**	2nd class

Source: NSO and DENR

Agriculture

Based on production statistics Calendar year 2017, Coconut has a high production with 199,839.71 mt with an area harvested of 60,729.00 ha. followed by Palay (Rice) with 49, 608.00 mt with area harvested recorded of 18,869.00 ha (Table 6).

Table 6. Crop production statistics CY 2017

CROP	HARVEST AREA (HA.)	PRODUCTION (MT)
Palay	18,869.00	49,608.00
Corn	595.00	983.00
Coconut (Copra)	60,729.00	199,839.71
Banana	1,360.00	6,410.00
Abaca	81.00	5.00
Coffee	12.00	3.00
Cacao	70.00	7.00

Vegetables (All kinds)	119.17	760.69
Rootcrops (All kinds)	584.00	4,362.20
Fruits (All kinds)	1076.00	1,693.12
Watermelon	135.00	1,314.00

Source: Philippine Statistics Authority (PSA)

Crop Occurrence Markings. The top 5 commodity of the Province of SDN were pinned through google earth and ground validated with the partnered LGU in the province to verify its occurrence in the given location. Figure 4 shows the crop occurrence markings of banana, corn, rice root crops and vegetable. Rice is mostly grown in all the municipalities as it is the main crop produce in the Province.

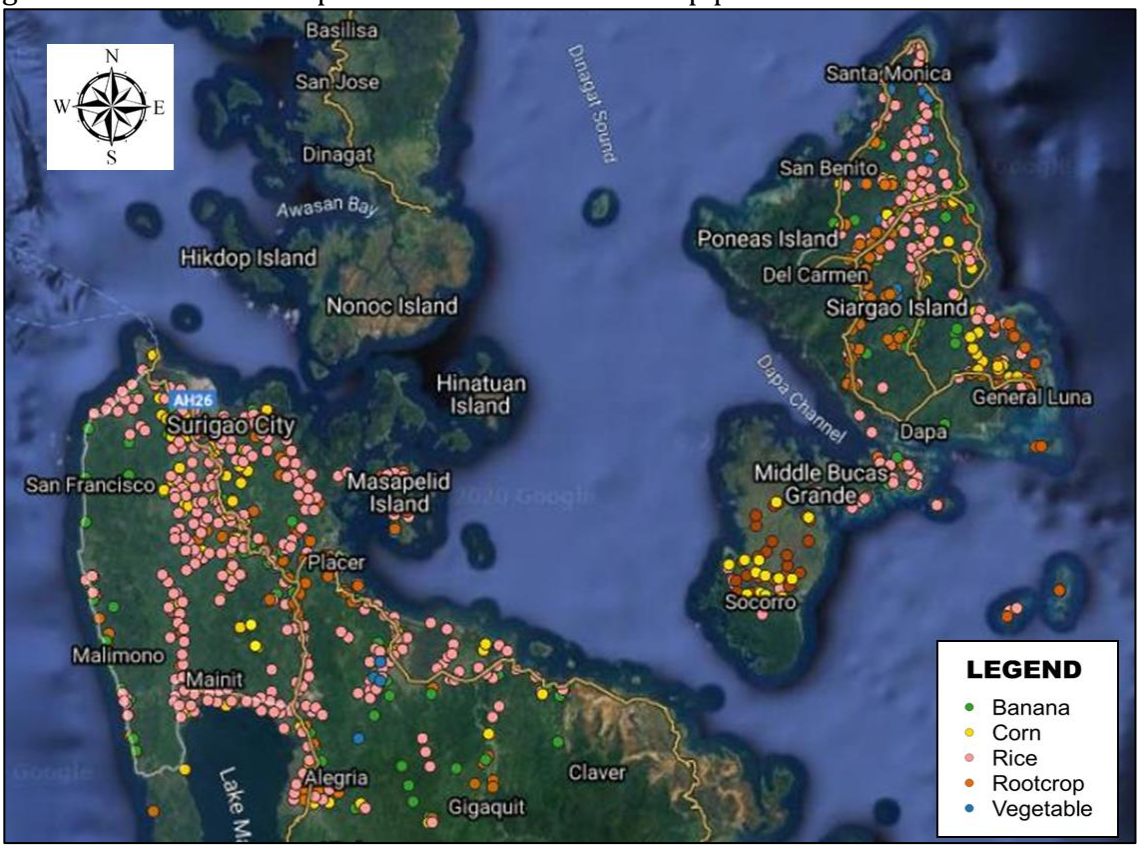


Figure 4. Crop occurrence markings of banana, corn, rice, root crops and vegetable

R.A. 8550 defines fisheries as all activities relating to the act of business of fishing, culturing, preserving, processing, marketing, developing, conserving and managing aquatic resources and the fishery areas. Fishing is the activity of taking fishery species from their wild state. This may include catching or harvesting aquatic animals other than fish. In the province, municipal marine sector has the highest production with 23, 977.27 mt. (Table 7).

Table 7. Fish production by sector CY 2016

SECTOR	PRODUCTION (MT)
Commercial	2,891.13
Municipal Marine	23,977.27
Municipal Inland	1,075.21
Aqua-Culture	413.64
Seaweeds	501.84

Source: Philippine Statistics Authority (PSA)

Livestock is commonly defined as domesticated animals raised in an agricultural setting to produce labor and commodities. The term is sometimes used to refer solely to those that are bred for consumption, while other times it refers only to farmed ruminants, such as cattle and goats. In the province, there were four (4) types of livestock raised. These include Carabao, Cattle, Goat/Sheep and Hog/Swine. Among the livestock, Hog/Swine has the highest no. of heads raised that accounted to 50,089 heads.

Poultry are domesticated birds kept by humans for their eggs, their meat or their feathers. Among the poultry products, native chicken has the highest no. of heads raised that reached to 211, 714 heads (Table 8).

Table 8. Livestock and poultry population CY 2016

ANIMAL TYPE	NO. OF HEADS		TOTAL
	Backyard	Commercial	
Carabao	17,060	no data	17,060
Cattle	2,380	15	2,395
Goat	5,150	no data	5,150
Hog	48,832	1,257	50,089
Chicken			
-Broiler	780	no data	780
-Layer	no data	20,665	20,665
-Native	211,714	no data	211,714
Duck	15,145	3,460	18,605

Source: Philippine Statistics Authority (PSA)

Education

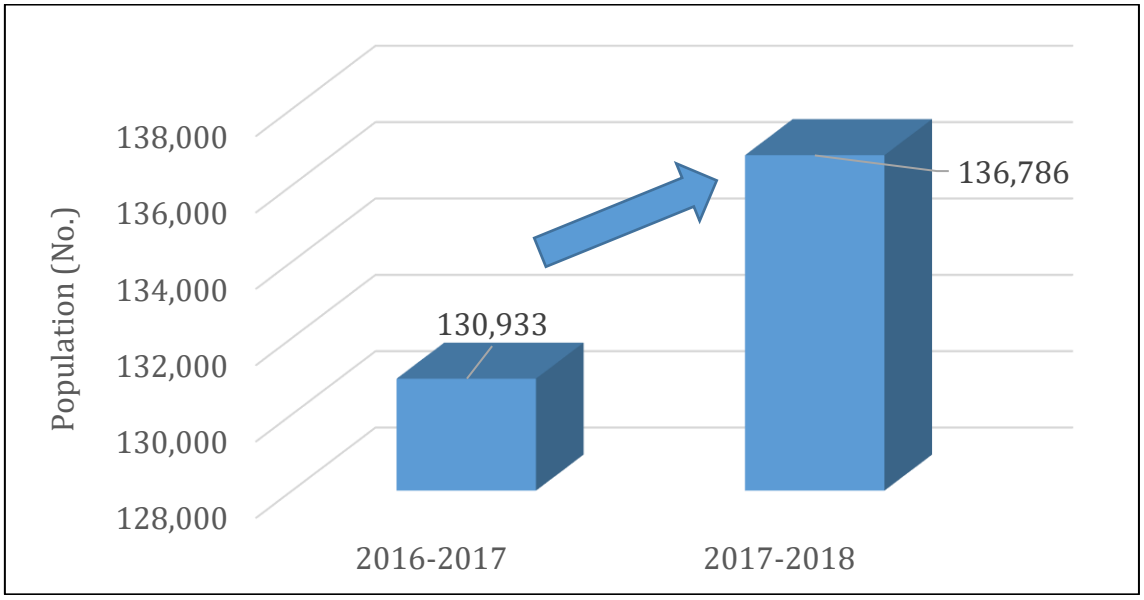


Figure 5. Total enrollment (Public & Private Schools)

In School year 2017-2018, the total enrollment for both public and private schools is 136,786 or an increase of 5,853 from the preceding school year (Figure 5).
Source: DepEd- Surigaodel Norte, Siargao and Surigao City Divisions

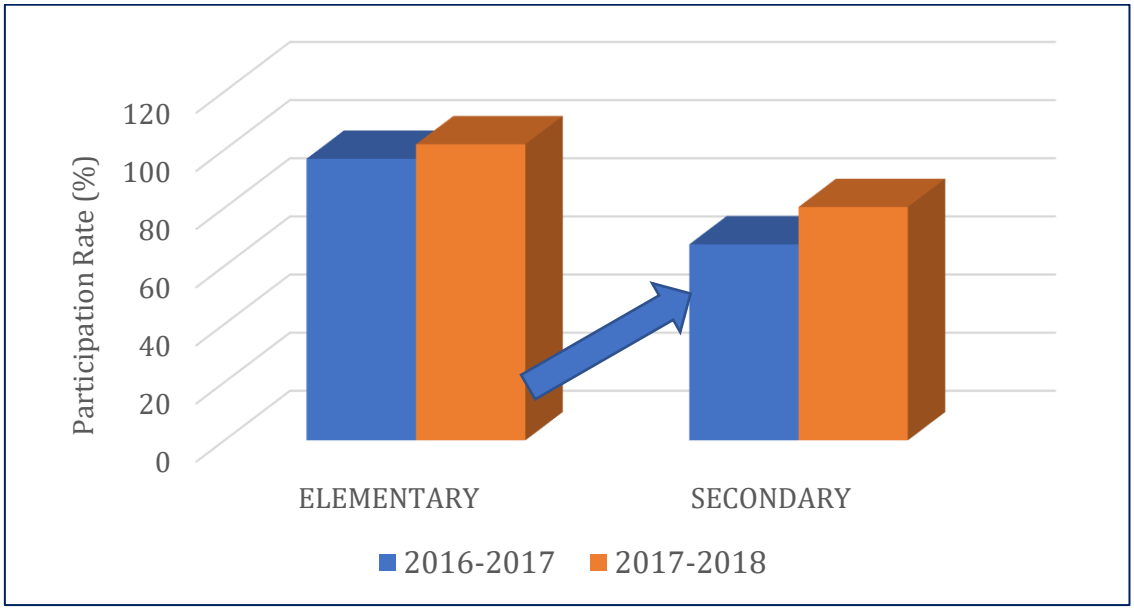


Figure 6. Average participation rate (%)

In 2016, the DepEd Divisions have an average participation rate of 96.86% and 67.43% for the elementary and secondary levels respectively, which have slightly increased from 96.37% and 66.09% from 2015 (Figure 6).
Source: DepEd- Surigao del Norte, Siargao and Surigao City Divisions

Health

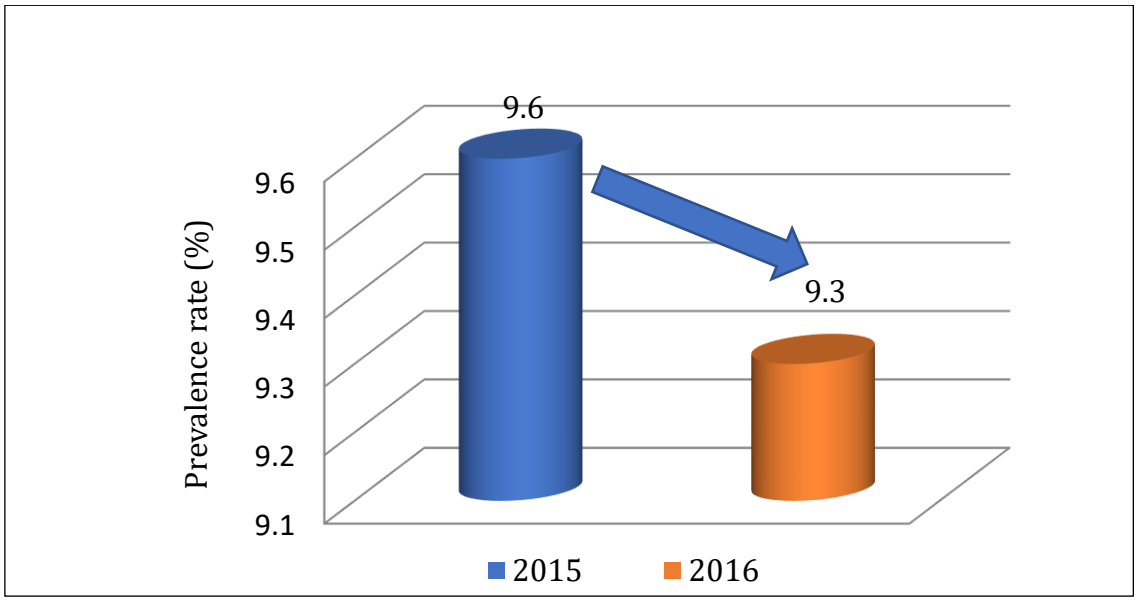


Figure 7. Malnutrition prevalence rate (%)

The Operation Timbang resulted to the decreased of underweight and severely underweight pre-schoolers from 9.6% or 3,316 of the total 34,466 in 2015, to 9.3%

in 2016 or 3,699 of the 39,626 weighed children. The normal weighing children consists 89% which is the same from 89% in 2015 (Figure 7).
Source: Provincial Health Office

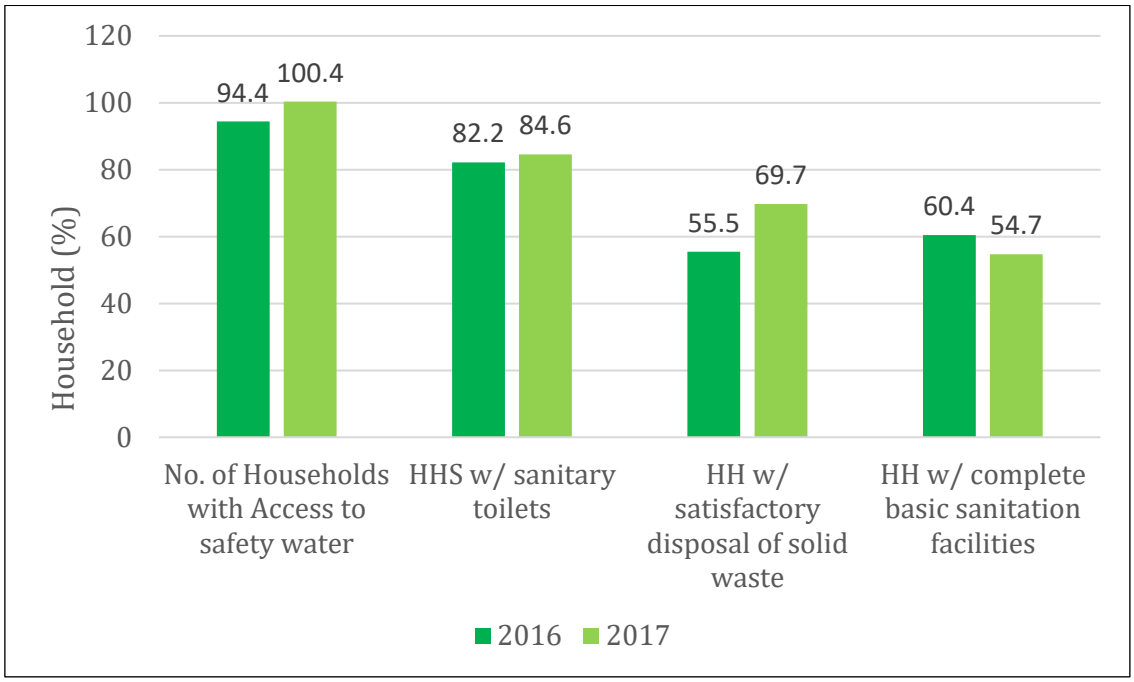


Figure 8. No. of households with basic sanitations

There was a slight decreased in the percentage of household with access to safe water and a decrease in the percentage of those with sanitary toilets, satisfactory disposal of solid wastes and household with complete basic sanitation facilities (Figure 8).
Source: Provincial Health Office

Economic

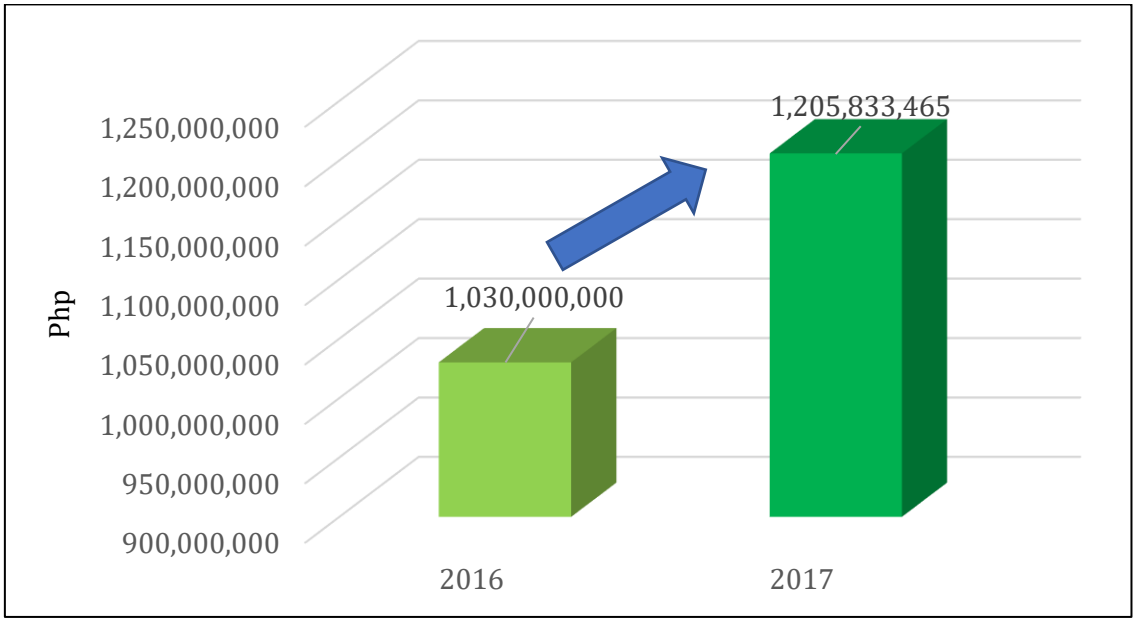


Figure 9. Sources of income

The income of the province has increase by 14.58% with Php 1,205,833,465.87 in 2017 from Php 1,030,000,000.00 in 2016 (Figure 9).
Source: Provincial Accounting Office

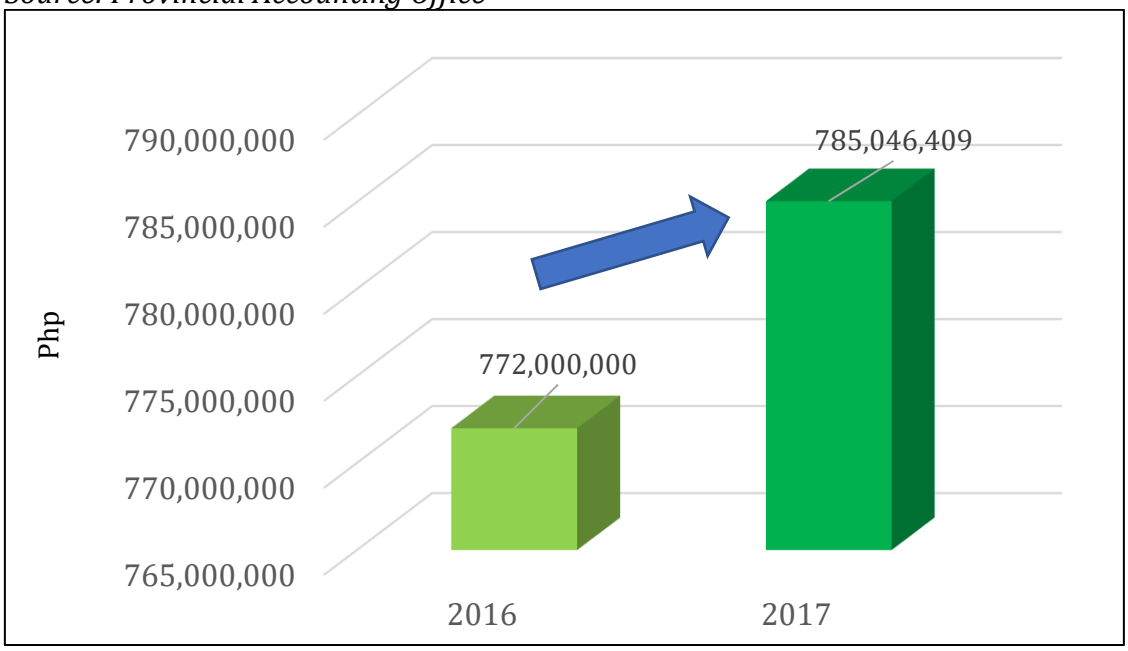


Figure 10. Expenditures

The province's 2017 expenditures gained an increase of Php 13,046,409.24 more than Php 772M in 2016 having a total of more than Php 785M in 2017 (Figure 10).
Source: Provincial Accounting Office

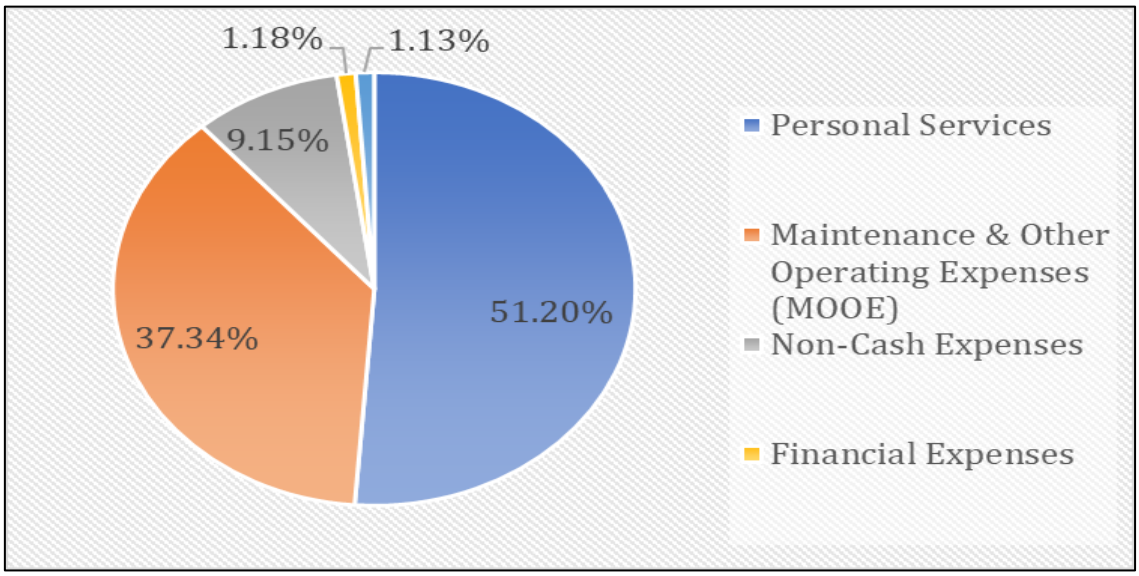


Figure 11.Expenditure (2017)

Highest utilization of 51.20% went to Personal Services, 37.34% to Maintenance & Other Operating Expenses (MOOE), 9.15% for Non-Cash Expenses, 1.18% Financial Expenses and 1.13% for the Subsidies (Figure 11).
Source: Provincial Accounting Office

Roads and Bridges

The infrastructure and utilities sector presents the current state of roads and bridges as one of the vital infrastructure that has contribution to the province's economic and social growth. Roads and bridges would aid in providing access to employment, human capital development and a crucial contributor in fighting against poverty. Table 9 shows that Province of Surigao del Norte has a total road network of 640.783 kilometers as of 2018. Approximately, 49 percent is classified as national road and 51 percent is under provincial road.

Table 9.Type of pavements

TYPE OF	NATIONAL		
PAVEMENT	MAINLAND[1]	SIARGAO ISLAND[2]	PROVINCIAL[3]
A. ROADS (In Kms)	**156.040**	**160.254**	**330.489**
Concrete	87.180	158.220	202.404
Gravel	68.860	1.814	97.459
Earth	no data	no data	28.166
Asphalt	no data	0.220	0.479
Bridge Length	no data	no data	1.930
Road Gaps	no data	no data	0.051
B. BRIDGES (In L.M.)	**3,801.650**	**0.000**	**1,929.740**
Concrete	2,208.870	no data	1,173.030
Steel (Deck Girders)	637.520	no data	351.700
RCBC	955.260	no data	no data
Spillway	no data	no data	no data
Timber	no data	no data	188.210
Bailey	no data	no data	216.800
FVR	no data	no data	no data

Source: 1st District DPWH SDN, 2nd District DPWH Dapa SDN, PEO SDN

[1] 1st District DPWH SDN
[2] 2nd District DPWH Dapa
[3] PEO, SDN

RESULTS AND DISCUSSION

Adaptive Capacity

Adaptive Capacity (AC) is the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability, or future climate conditions. In practical terms, adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards. The adaptation process requires the capacity to learn from previous experiences to cope with current climate, and to apply these lessons to cope with future climate, including surprises. The AC indicators were clustered into eight (8) capitals such as Economic, Natural, Social, Human, Health, Physical, Anticipatory and Institutional.

Figure 12 presents the spatial analysis of all capitals as well as the aggregated adaptive capacity index for the province of Surigao del Norte. Data indicated that Surigao City was a highly adaptive municipality within the province concerning economic, natural, social, health, human, physical, anticipatory and institutional capitals. This information implies that this municipality has had great coping mechanisms or strategies to respond to climate-related hazards. The municipality of Burgos was found to have the weakest adaptive capacity in terms of economic (0.00), natural (0.00), health (0.00) and anticipatory (0.08) capital while Sta. Monica, San Isidro and Bacuag were the most vulnerable in terms of social resources with 0.00, 0.07 and 0.09 social capital index respectively. In terms of human capital, municipalities of Tagana-an (0.00), Gigaquit (0.02), Alegria (0.04), San Isidro (0.06), Claver (0.08), Santa Monica and Sison (0.09), Del Camen (0.10), Tubod (0.12), San Francisco (0.15), General Luna and Pilar (0.16), Bacuag (0.17) and Placer (0.20) were very low in adaptive capacity. Municipalities of San Benito (0.00), San Francisco (0.03), Tagana-an (0.07), Dapa (0.08) and Alegria (0.09) were weakest in terms of physical while Tubod (0.00), Mainit (0.08), San Francisco (0.17) and General Luna (0.17) were weakest in terms of institutional. Overall, results show the need for the respective local government units (LGUs) to focus on improving their coping mechanisms by adding or improving their services and interventions in their respective communities affected by climate-related pressures.

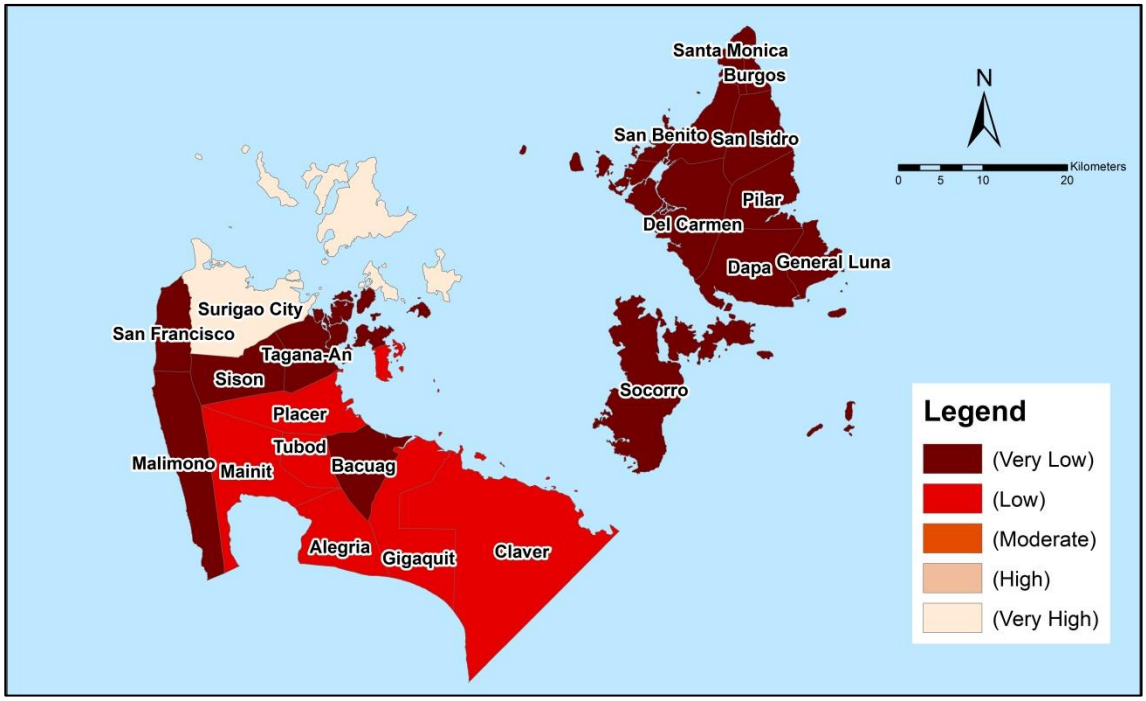


Figure 12. Adaptive capacity index

Economic capital. Economic capital apprehends for greater financial asset means that it has greater ability to recover from potential damage/calamities. It is typically defined as the difference between the given percentile of a loss distribution and the expected loss. In the case of Surigao del Norte, most municipalities of Siargao Island including San Francisco, Malimono, Sison, Placer, Tagana-an and Gigaquit were observed to be the most vulnerable to climate change in terms of economic resources while Surigao City was observed to be the most adaptable with 1.00 economic capital index (Figure 13a). The vulnerability of these municipalities is likely due to total area planted and total volume of production, there is also no presence of financial institutions/cooperatives as well as ATM machine, low agriculture minimum wage (Figure 13b). High poverty incidence implies that the community in general lacks availability and access to appropriate resources that may significantly limit the ability of a system to cope with the effects of climate change and wider development pressures (Jone, et.al., 2010).

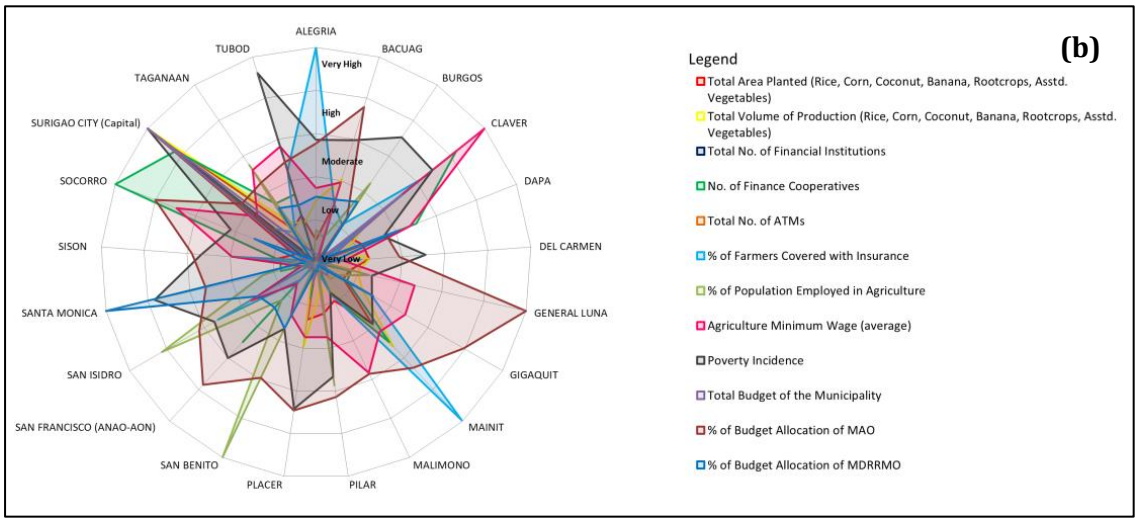


Figure 13. Economic capital map (a) and radar graph (b)

Natural capital. Natural capital includes the land, water and biological resources that farm households use to generate livelihoods (Ellis, 2000). This includes water source and total agricultural land area. The productivity of land is a direct measure of one of the most immediate dimensions of natural capital contributing to the adaptive capacity. It can be measured as the biological productivity of land, availability of water. This is further supported with the trend observed in SDN where all municipalities of Siargao including San Francisco, Tagana-an, Placer and Tubod were found to have the lowest natural capital index. Meanwhile, Gigaquit and Surigao City were observed to have better adaptability in terms of natural capital with 1.00 and 0.84 capital index, respectively (Figure 14a). This is because Gigaquit and Surigao City were both have better irrigation system and larger agricultural area. It is a common knowledge that access to irrigation system facilitated good productivity thus, enabling the ability of a system to cope with the effects of climate change (Figure 14b).

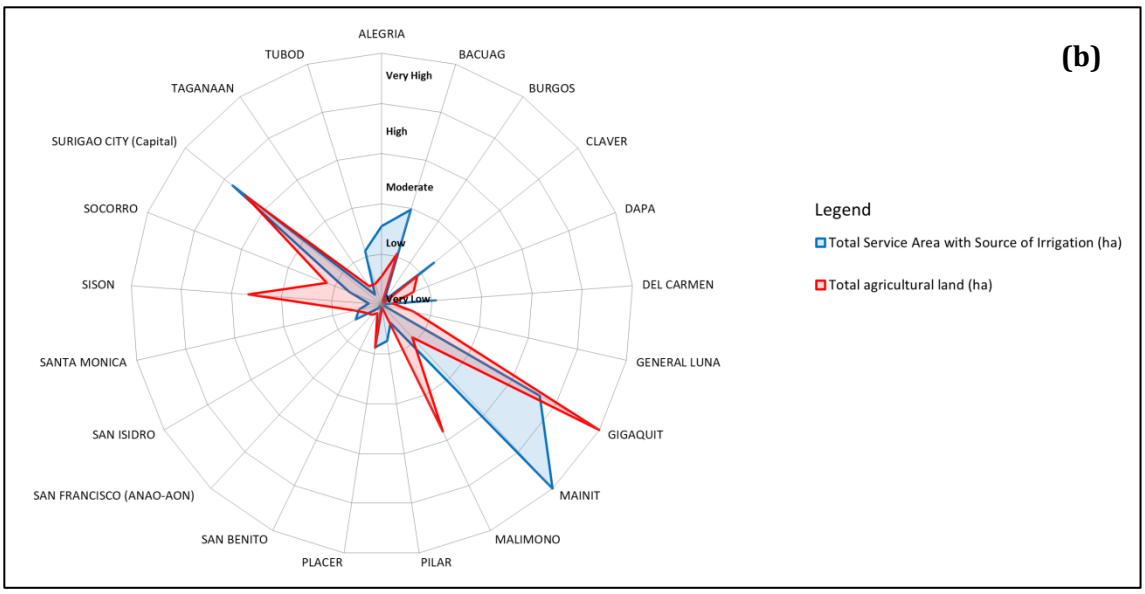


Figure 14. Natural capital map (a) and radar graph (b)

Social capital. Social capital is the collaboration and social relationship in the community and relationships between individuals. Social assets are claims on others which individuals and households can draw on by virtue of belonging to social groups. In general, stocks of social capital refer to the varying degrees of inclusiveness in society at large. There is growing recognition of the untapped capacity and talents of women and women's leadership (Pepera, 2018). Women and farmer groups play important role in enhancing the community's adaptive capacity to climate change. The study of Muthoni and Wangui (2013) indicated that the role of women extends from family units to the community level where they contribute in all the major spontaneous and planned strategies that the village has taken up in response to a changing climate among other drivers. Membership to a farmers' organization is another sub-indicator of information resource. Affiliations to social groups provide farmers access to useful information for climate change adaptation that may be exclusively available only to group members. Group membership can also be a significant avenue for knowledge sharing among farmers about effective adaptation practices. These indicators are the very reason why Dapa (1.00), Placer

and Tubod (0.95), Surigao City (0.92) and Alegria (0.67) have better social capital index over all other municipalities especially Mainit (0.18), General Luna (0.13), Bacuag (0.09), San Isidro (0.07) and Santa Monica (0.00) (Figure 15a). This is likely due to the fact that involvement of women in the government decision-makings as well as presence of more farmer associations in their locality and higher percentage of farmers who are member of groups and/or associations are consistently observe in these municipalities (Figure 15b).

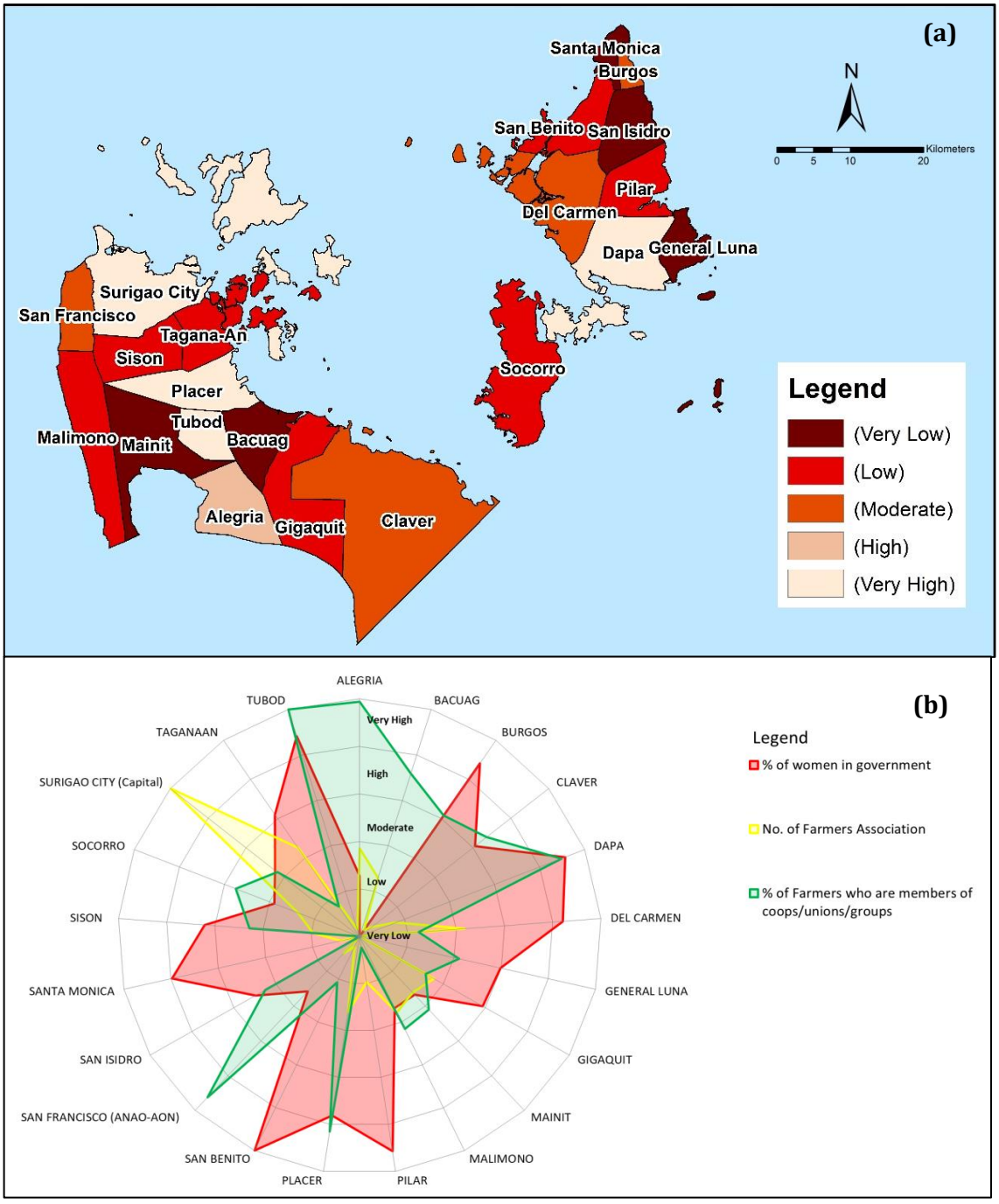
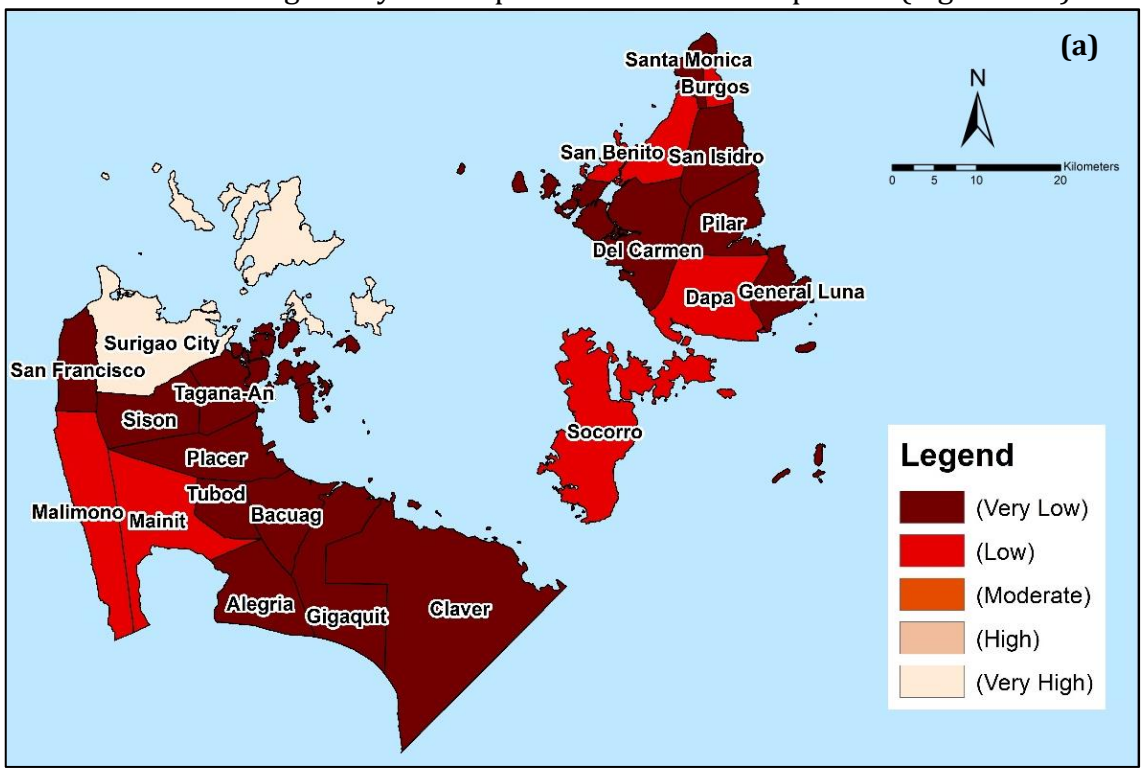


Figure 15. Social capital map (a) and radar graph (b)

Human capital. Human capital has also been identified as a critical determinant of adaptive capacity and behavior as it captures the inherent adaptive

capacity of the vulnerable population. Generally, it is viewed that more educated households have better access to information and technologies and are better able to exploit these resources in adapting to climate change. The study of Wamsler et al. (2012) which assessed the role of schooling for increasing societies' adaptive capacities found that respondents with lower education were more likely to see their surroundings as risk free, whereas those with higher education were more aware of existing risks. According to the book of Kumar et al. on "Globalization and the Poor in Asia: Can Shared Growth be Sustained?" an entity's vulnerability decreases with increase in both literacy levels and expenditure on education. Variables that contributed to human capital strength of a community such as literacy rate, ratio of school teacher to students, total number of secondary schools, total number of tertiary schools, and total number of technical vocational schools were considered in this analysis. Results indicated that Surigao City being the capital was found to have high human capital index on the other end all the rest of the municipalities were in low and very low range (Figure 16a). Surigao City had the most number of technical vocational schools, tertiary school, has high ratio of teachers to students, and has good literacy rate hence, found to be highly adaptable in terms of human capital since overall investment in education is mostly concentrated in Surigao City as compared to other municipalities (Figure 16b).



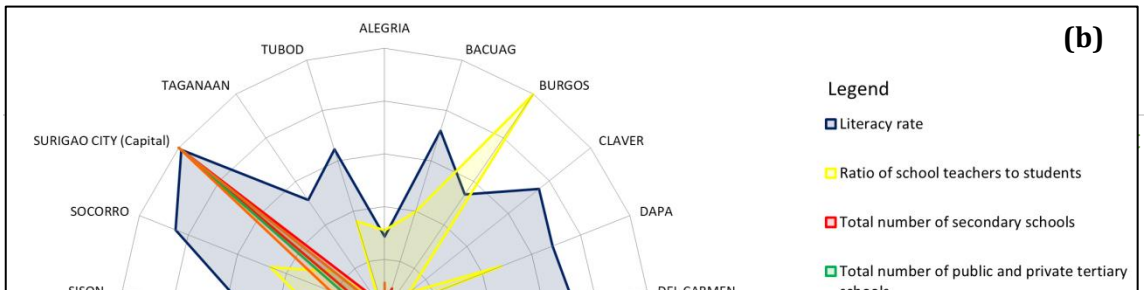
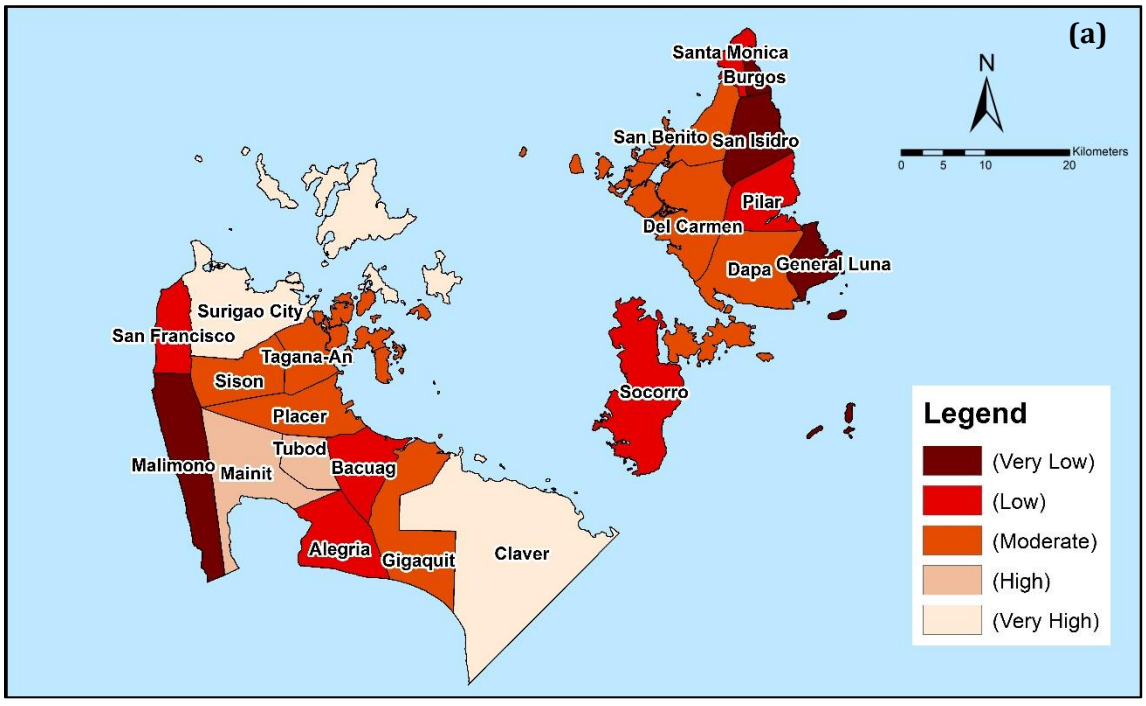


Figure 16. Human capital map (a) and radar graph (b)

Health capital. Health capital and adaptive capacity are interlinked. High nutrition status and overall health of the population is a main determining factor of climate vulnerability. Poor nutrition can result in diminished productivity, which in turns lowers the adaptive capacity of the entire community. The same case was observed in SDN as those municipalities with high nutrition rate are generally the ones who are highly adaptable in terms of health resources. For example, the municipalities of Surigao City (1.00), Claver (0.83), Tubod (0.78) and Mainit (0.75) were observed to have high nutrition, given the fact that they were also the ones with most number of health services and health professionals. As a result, these municipalities turned out to be the top four adaptable municipalities in terms of health resources while General Luna (0.16), San Isidro and Malimono (0.12) and



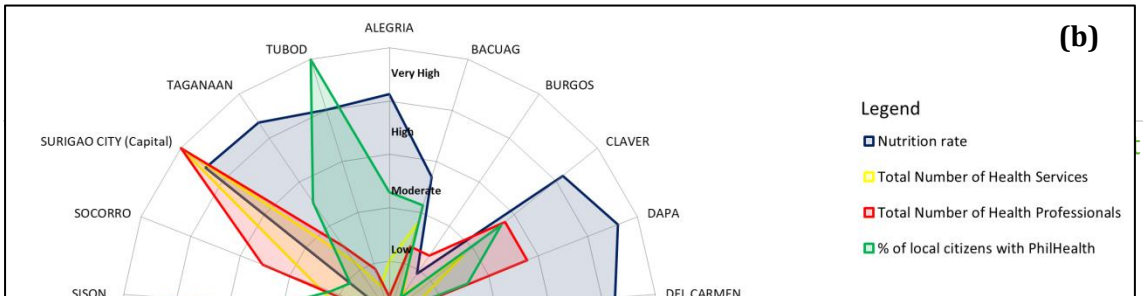


Figure 17. Health capital map (a) and radar graph (b)

Burgos (0.00) were the weakest municipalities when it comes to adaptability with respect to health resources (Figure 17a). Enabling wide access to healthy and nutritious food as well as access to health insurance and services makes the population more resilient to climate change. Thus, accounting for health capital in measuring the adaptive capacity of a system is significant and necessary (Figure 17b).

Physical capital. Physical resources refer to capital created by economic production processes, such as roads, machinery, and tools (Ellis, 2000).The physical resources sub-indicators such as farm size, farm ownership, irrigation source, and number of farm implements and livestock owned, household water and electric services are considered to have significant role in the adaptive capacity of a system or community. For instance, farm ownership allows owners some privileges to farm infrastructure such as construction of shallow tube wells which is not allowed for non-owners (Eakin and Bojorquez-Tapia, 2008). This enables farm owners to combine a set of physical resources such as irrigation and farm tenure to carry out strategies to adapt to climate change. Thus, it is assumed that adaptive capacity increases with increase number of the aforementioned resources. Data gathered in SDN indicated that Surigao City (1.00) is highly adaptable to climate change in terms of physical capital followed by Mainit (0.87). It was observed that the municipalities of Del Carmen (0.20), Placer, Gigaquit and Socorro (0.15), Santa Monica (0.13), Alegria (0.09), Dapa and Claver (0.08), Tagana-an (0.07), San Francisco (0.03) and San Benito (0.00) were the most vulnerable to climate change with respect to physical resources (Figure 18a). This is likely since these municipalities has the least number of livestock owned, least percentage of households with potable water services, has least total length of concrete roads, and low percentage of irrigated agricultural area (Figure 18b).

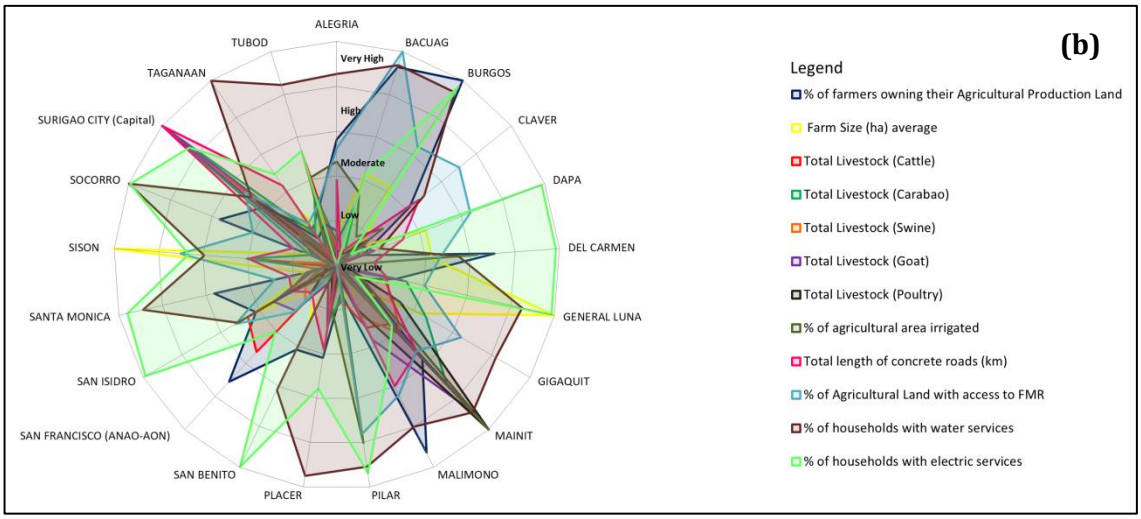


Figure 18. Physical capital map (a) and radar graph (b)

Anticipatory capital. Kellet and Peters (2014) define anticipatory capacity as the ability of social system to anticipate and reduce the impact of climate variability and extremes through preparedness and planning. It is seen in proactive action before foreseen event to avoid upheaval, either by avoiding or reducing exposure or by minimizing vulnerability to specific hazards. The sub-indicators of information resources include training on farming, technical assistance from the government, participation in farmers' organization, and number of sources of climate information. These are the avenues by which farmer can derive pertinent information that strengthen their ability to adapt to climate change, either directly from training, sources of climate information, or indirectly through interactions and knowledge-sharing with other farmers. As for the data gathered in SDN, it was observed that Surigao City (1.00) was the most adaptable

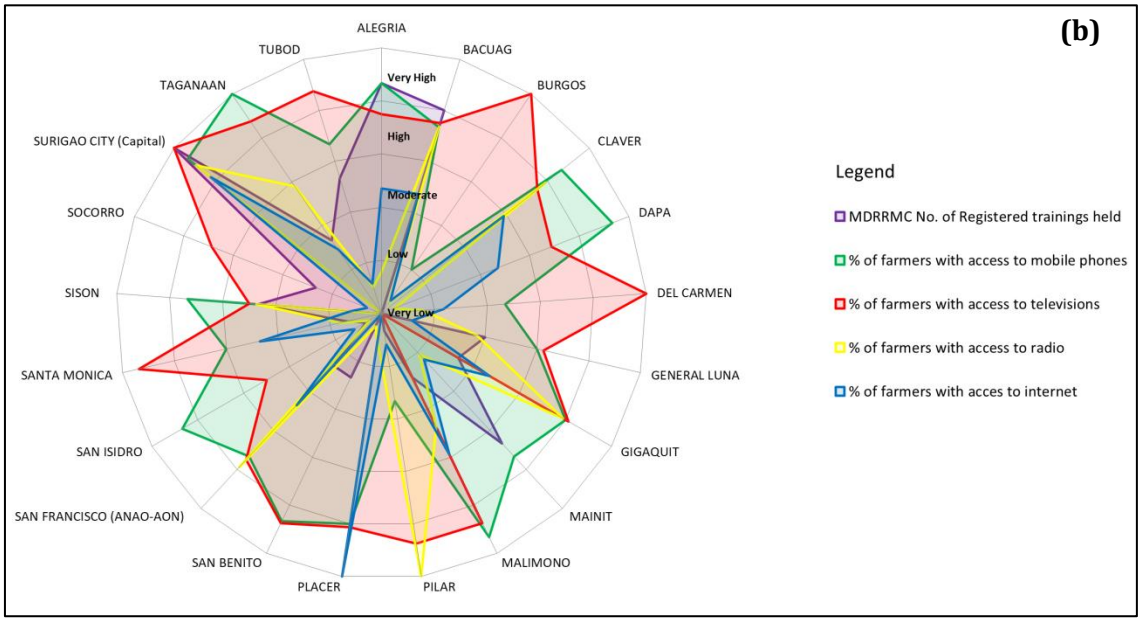
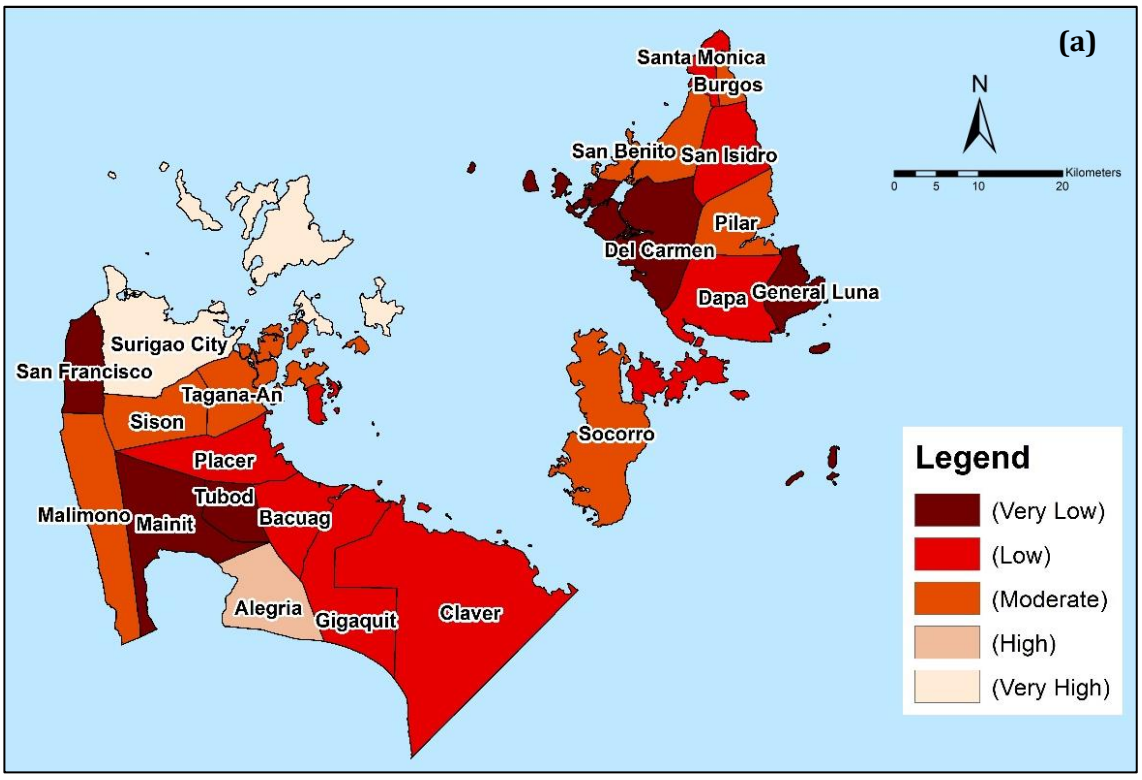


Figure 19.Anticipatory capital map (a) and radar graph (b), 2019

to climate change in terms of anticipatory resources followed by Bacuag with 0.68 anticipatory index (Figure 19a). This is expected since being the capital municipality, it is the number one recipient of climate-change related trainings and 100% their population already have access to information modalities such as mobile phones, televisions, radio, and internet. Municipalities of San Isidro (0.16), Burgos (0.08) and Socorro (0.00) on the other hand were found to have the lowest adaptive capacity in terms of anticipatory resources due to quite low number of registered MDRRMC trainings and low percentage of population with access to mobile phones, televisions, radio and internet (Figure 19b).

Institutional capital. An area with well-developed social institutions is typically better able to respond to changing environment than those with less effective social institutions. For instance, those municipalities with more number of AEWs will have better services of providing technical assistance to the community in terms of farming practices that are adaptable to climate change. Equally, this will translate to better frequency of consultation between AEW's and farmers, thus, resulting to enhanced overall adaptive capacity of the farmers. Surigao City (1.00) and Alegria (0.67) were found to have the strongest adaptive capacity in terms of institutional capital while San Francisco and General Luna (0.17), Mainit (0.08) and Tubod (0.00) were the weakest (Figure 20a). Poor adaptive capacity of these municipalities when it comes to institutional capital is mainly due to their low number of AEWs relative to the other municipalities as well as low percentage of farmers visiting to the Municipal Agriculture Office (MAO) or consulting with the technician. Strong networks with the AEW's suggests better adaptive capacity of the system to respond to the challenges of changing circumstances. However, weak links among these institutions implies poor adoption of climate-smart practices thus, constrain adaptive capacity and increase vulnerability (Figure 20b).



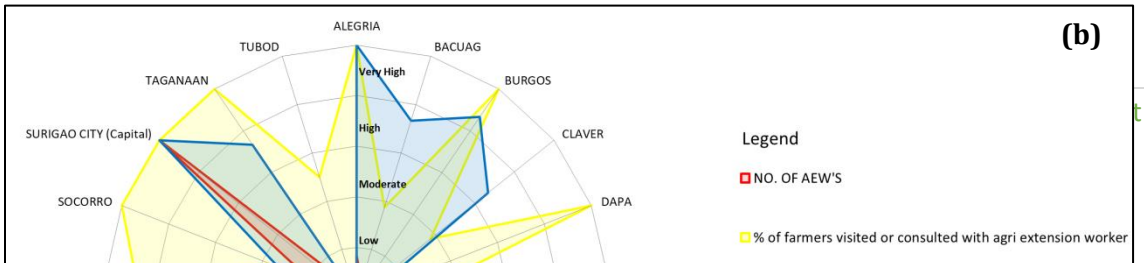


Figure 20. Institutional capital map (a) and radar graph (b)

Sensitivity Index

This section presents the climatic suitability of the selected priority crops in the province of Surigao del Norte (i.e. rice, corn, banana, vegetable, and root crops) by the year 2050 through climate modeling and use of species distribution. Change in suitability of crops of future and present will also be evaluated to five priority commodity of Surigao del Norte namely; Banana, Corn, Rice, Rootcrops and Vegetable crop. Thorough analysis of the results revealed that this crop losses its suitablity in Placer, Tubod, Bacuag as well as Alegria, Gigaquit, and Claver. In contrast, the neighboring areas of the said municipalities losses its suitability among 21 areas of Surigao del Norte.

Rice. The adverse effect of climate change was mainly on the municipalities of Siargao Islands. Present situation shows (Figure 21a) that municipalities in Siargao are highly suitable but losses its climatic suitability in the year 2050. Surigao City maintains its suitability of rice in the upcoming years (Figure 21b). As a whole it implies that suitability of rice losses in the municipalities of Santa Monica, Burgos, San Benito, San Isidro & Pilar (Figure 21c).

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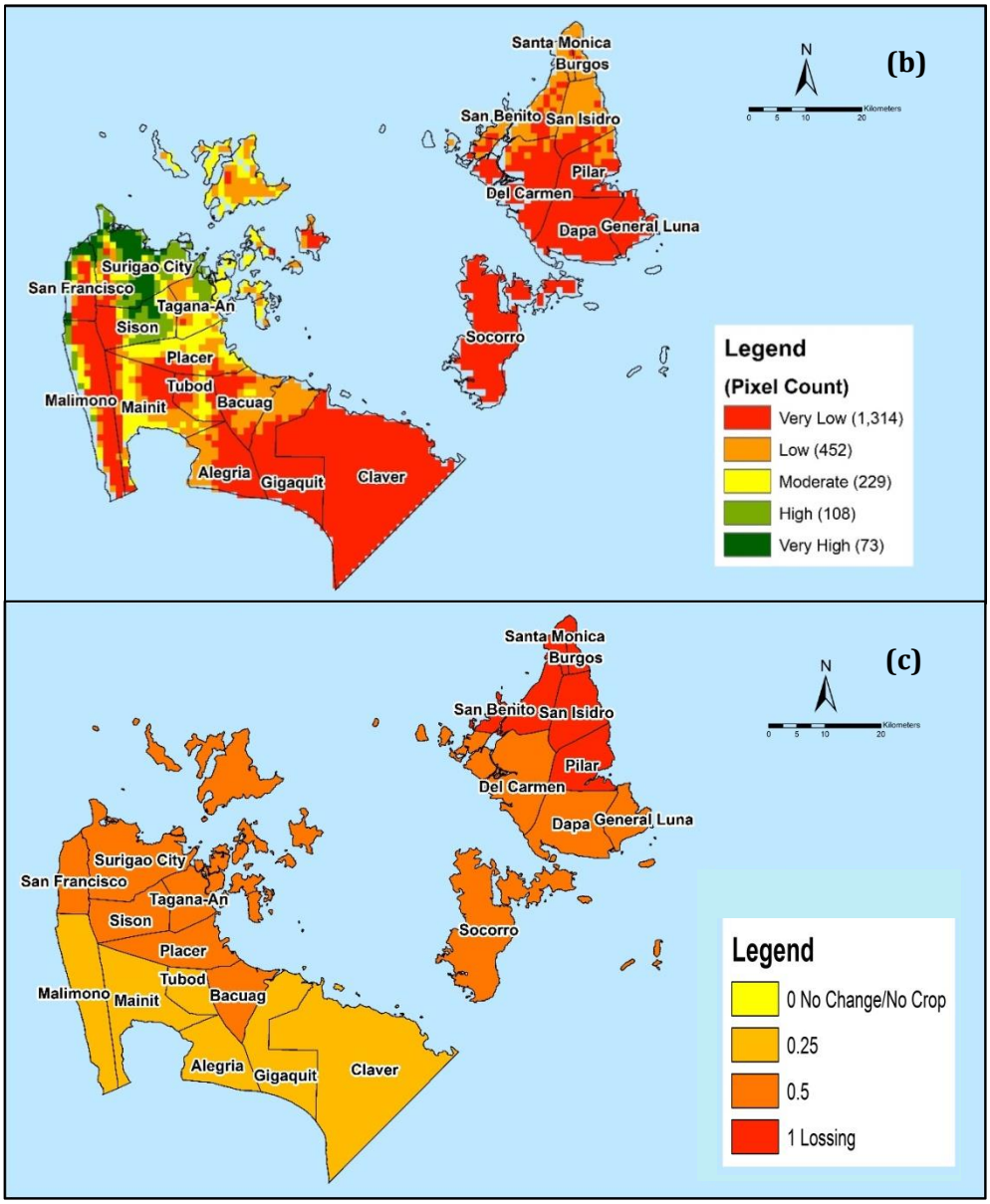


Figure 21. Sensitivity index map of rice in present 2019 (a) and future 2050 (b) and sensitivity index (c)

Corn. Corn is another important cereal crop in the Philippines. It is one of the primary commodity of Surigao del Norte Province as well other regions of Caraga.

The Islands of Siargao and the north western part of Surigao del Norte particularly Surigao City and Sison have high suitability for corn currently (Figure 22a).

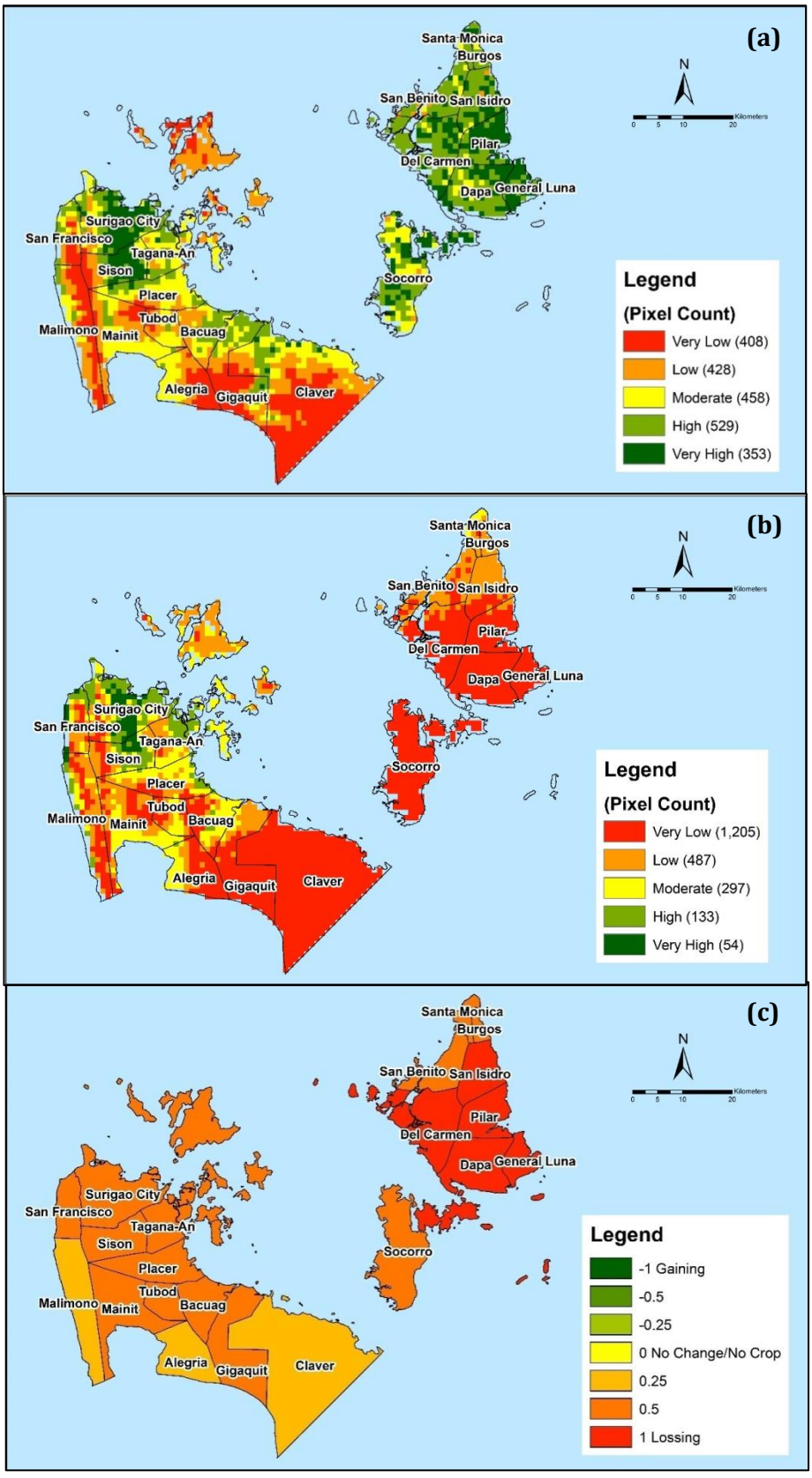
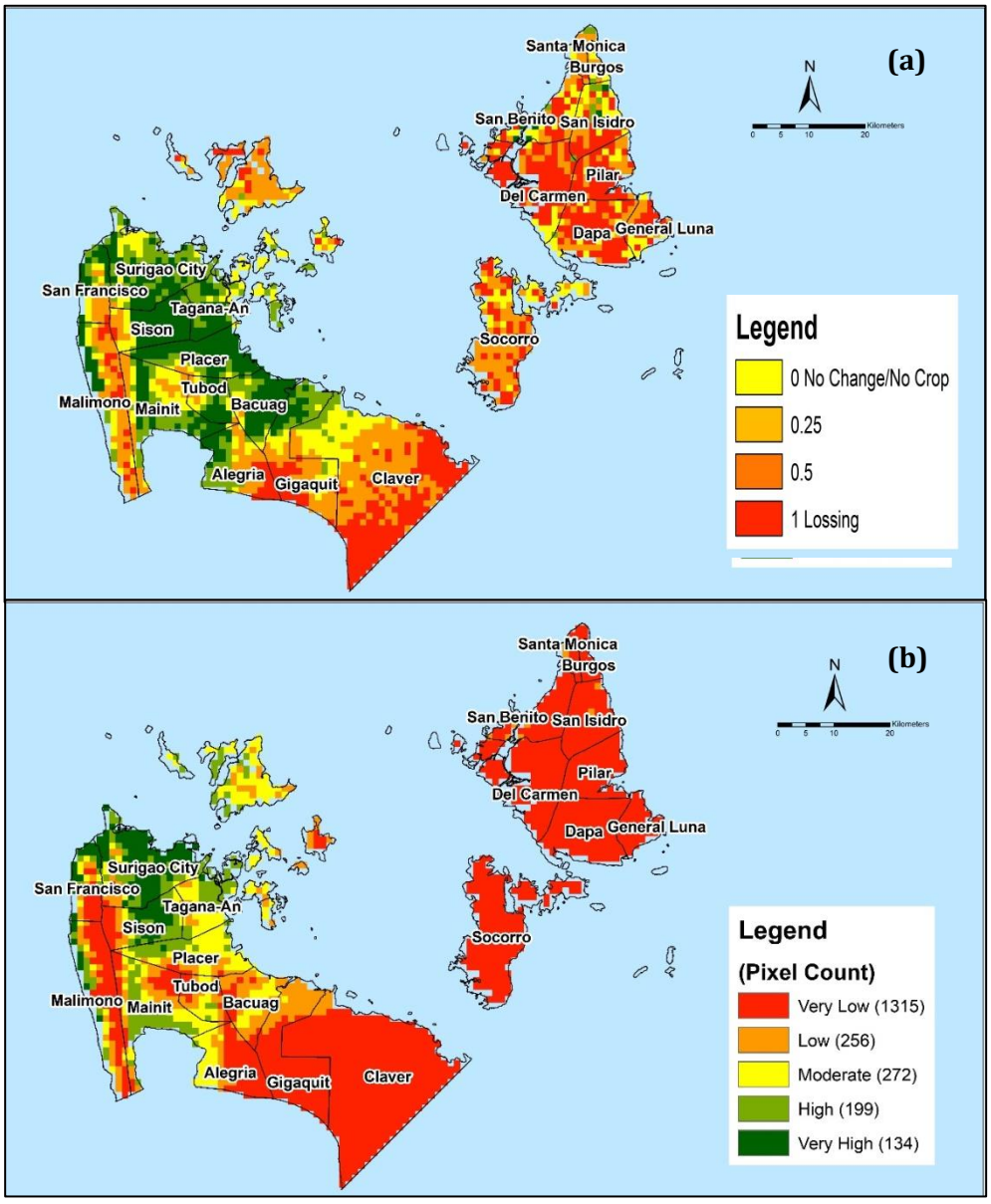


Figure 22. Sensitivity index map of corn in present 2019 (a) and future 2050 (b) and sensitivity index (c)

The north eastern part of Surigao del Norte, particularly in Siargao Islands were highly affected to sensitivity for corn in the year 2050.While in the north western part of Surigao del Norte, particularly in upper part of Surigao City have gaining

climatic suitability for corn in the year 2050 (Figure 22b). As a whole the map shows that the province of Surigao del Norte especially in the municipalities of San Isidro, Del Carmen, Pilar, Dapa and General Luna of Siargao Islands losses its climatic suitability of corn (Figure 22c) in the upcoming years.

Banana. Suitability of banana is high in the north western and north eastern part of Surigao del Norte (Figure 23a). Siargao Islands and in Claver, Gigaquit and Alegria have great influence to sensitivity (not suitable) for banana in the year 2050. While in the north western part of Surigao del Norte, particularly in upper part of Surigao City have gaining climatic suitability for banana in the year 2050 (Figure 23b). As a whole the map shows that the province of Surigao del Norte is losing the climatic suitability particularly in the municipalities of Placer, Tubod, Bacuag, Alegria and Gigaquit (Figure 23c).



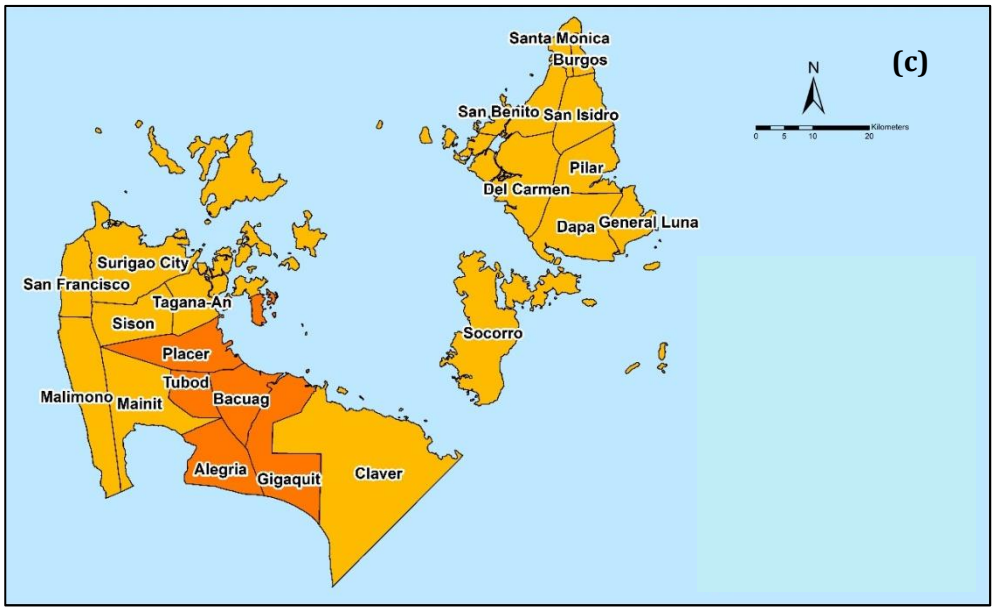
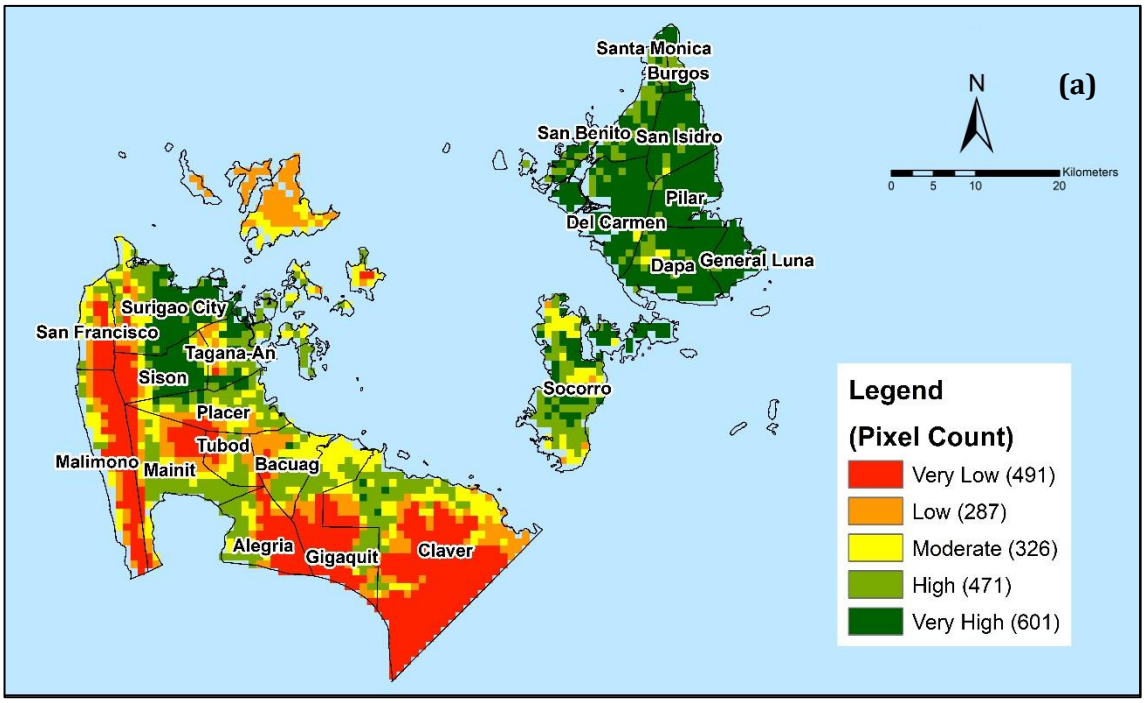


Figure 23. Sensitivity index map of banana in present 2019 (a) and future 2050 (b) and sensitivity index (c)

Root crops. The north western and southern part of Surigao del Norte and Siargao Islands have a high climatic suitability of root crops (Figure 24a) but have great influence to sensitivity (not suitable) in the year 2050. Surigao City and some parts of Sison maintained its suitability for root crops in the future (Figure 24b). As a whole the map shows that the province of Surigao del Norte especially in Siargao Island is losing the climatic suitability for root crops in the year 2050 (Figure 24c).



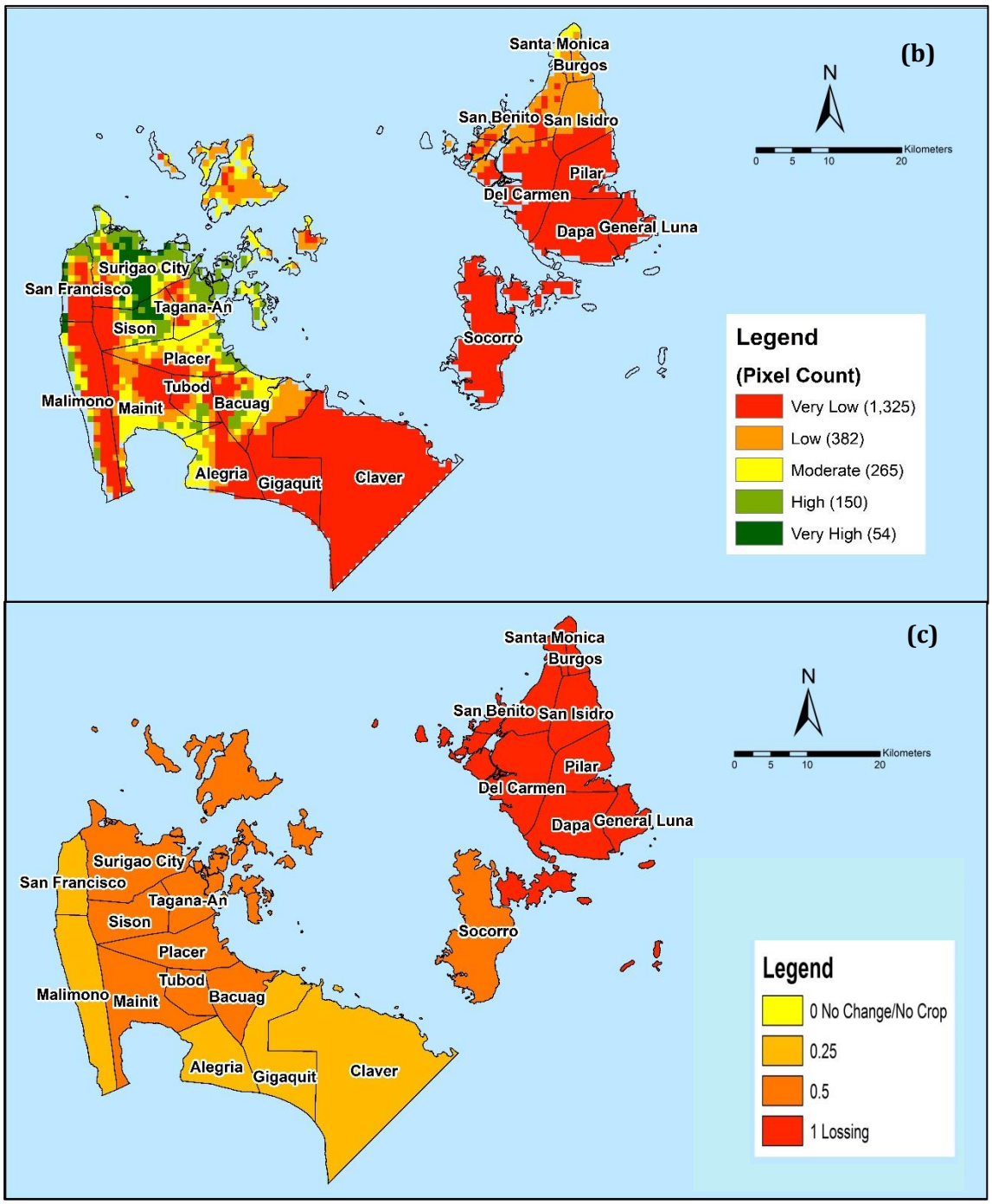


Figure 24. Sensitivity index map of root crops in present 2019 (a) and future 2050 (b) and sensitivity index(c)

Vegetables. The north eastern part of Surigao del Norte and northern part of Siargao Island are highly suitable for vegetables (Figure 25a). The south eastern part of Surigao del Norte, particularly in Socorro, Dapa, Gigaquit and Claver were highly affected to sensitivity for vegetable but Surigao City and some part of Sison and Tagana-an have a gaining suitability of vegetables in the year 2050. As a whole it implies that the province of Surigao del Norte losses the climatic suitability in all municipalities of Siargao Islands including Tagana-an & Bacuag (Figure 25c).

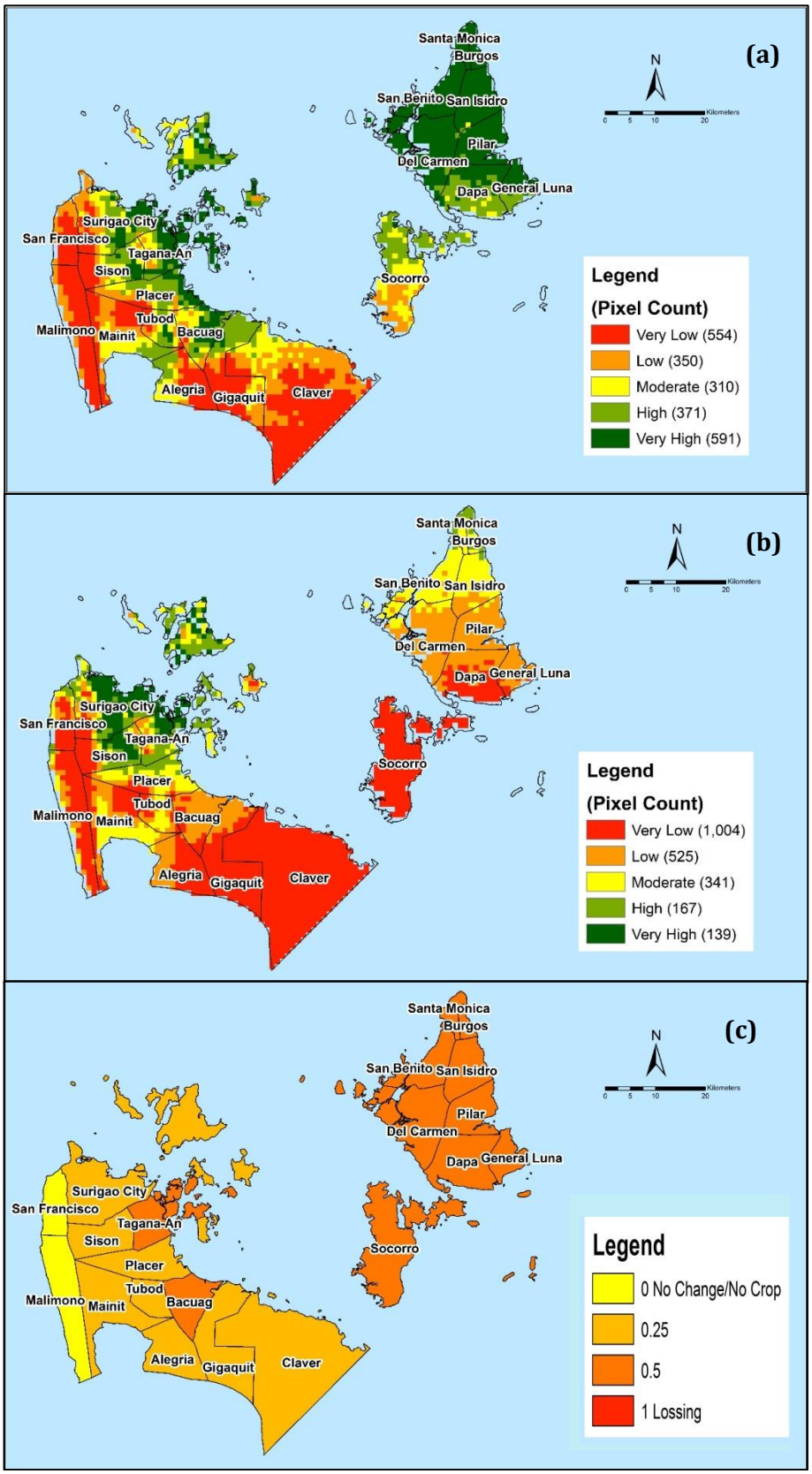
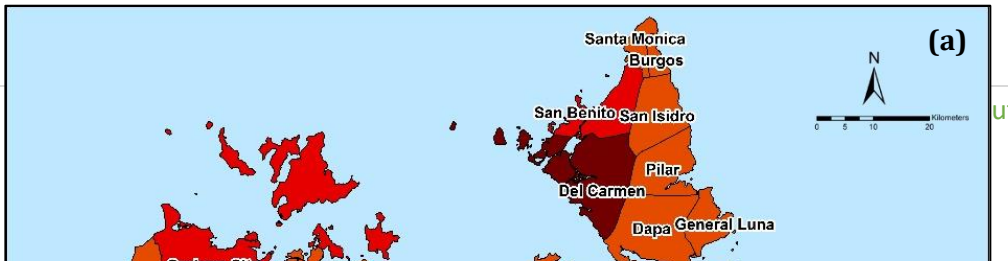


Figure 25. Sensitivity index map of vegetables in present 2019 (a) and future 2050 (b) and sensitivity index (c)

Hazard Index

Hazard is a source or a situation with the potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or combination of these (dmp.wa.gov.au). Based on consultation and briefing conducted last August 2019 at Surigao City with the project partners from the LGU's of the of Province of Surigao del Norte, eight (8) hazards were identified for the said province, these are tropical cyclone (TC), flood (Fld), landslide (LS), erosion (Ero), saltwater intrusion (SWI), sea level rise (SLR), drought (DRT) and storm surge (SS) (Figure 42). All hazard data were sourced-out from the International Center for Tropical Agriculture (CIAT), an authorized data provider. The combination of these all natural hazards had been used to estimate the extent each municipality of the said province by using its hazard weights (Arief & Francisco; 2009).

Hazard weights were generated through group discussion represented by the experts from the different State Universities and Colleges (SUC's). During the group discussion the following criteria were identified: (1) probability of occurrence; (2) impact to National Economy; (3) impact to food security of the Country; (4) impact of local household income; and (5) impact to key natural resources to sustain productivity (i.e., water quality & quantity, biodiversity, soil fertility). The hazard-weighted sum was used to develop the hazard index for each island group (Luzon, Visayas and Mindanao). Among the twenty one municipalities/city, only Del Carmen (Figure 26) has a very high exposure to hazards. Four hazards in the said municipality were identified namely: tropical cyclone (Figure 27), salt water intrusion (Figure 28a), storm surge (Figure 28b) and sea level rise (Figure 28c). In the same manner, in the north eastern part of Surigao del Norte, particularly the municipalities of Siargao Islands including Socorro and Surigao City have a very high incidence to tropical cyclone as these municipalities are facing the open sea. In the western part, San Francisco and Malimono have high exposure to land slide (Figure 29a) including Claver in the southern part of the province. In terms of the risk of soil erosion (Figure 29b), the following municipalities namely: Alegria, Claver, San Francisco and Socorro have high incidence of soil erosion. On the other hand, Tubod, San Benito, San Isidro, Pilar, Del Carmen, Dapa and General Luna are among the municipalities that have low exposure to the aforementioned hazards. Municipality of Del Carmen have moderate incidence to flood (Figure 29c). Map of Drought Hazard Index in Surigao del Norte, shows that all municipalities have a very low incidence to drought (Figure 30).



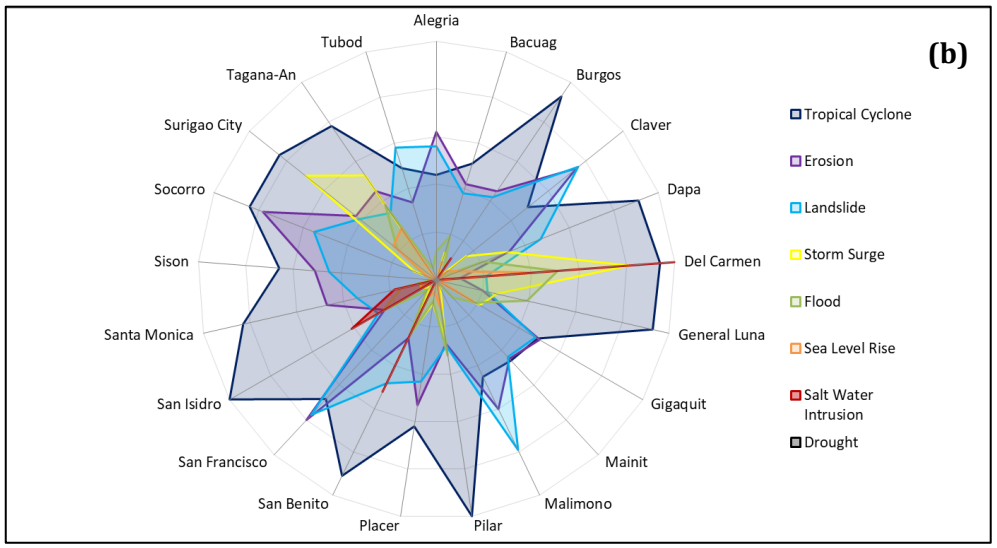


Figure 26. Hazard index map (a) and radar graph (b)

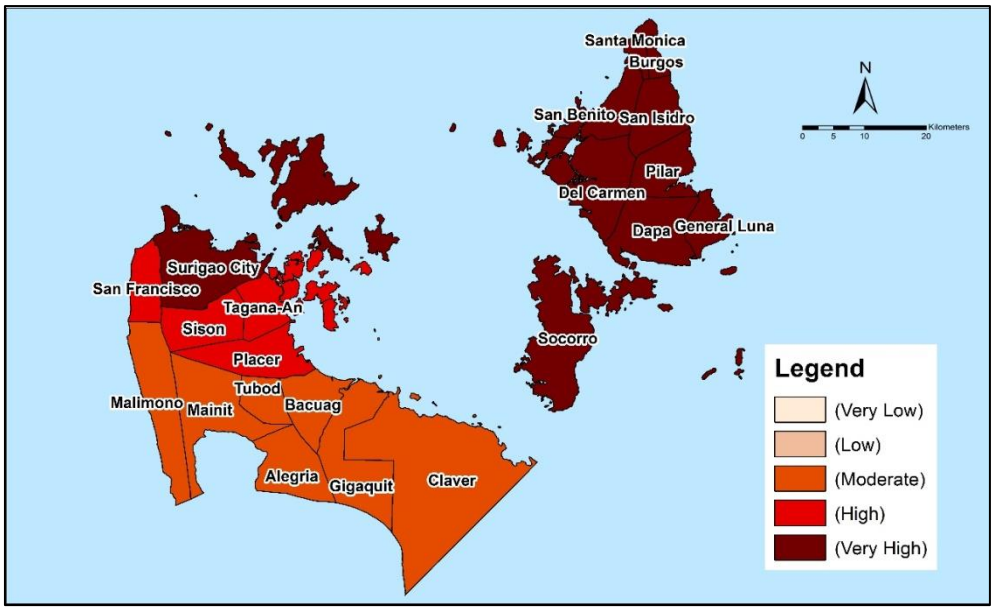
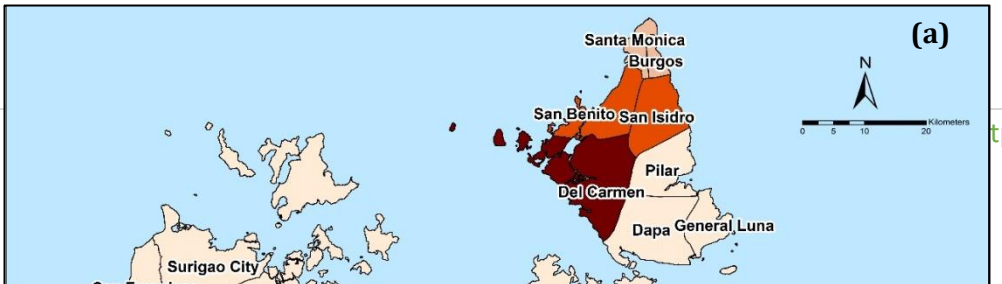


Figure 27. Hazard index map of tropical cyclone



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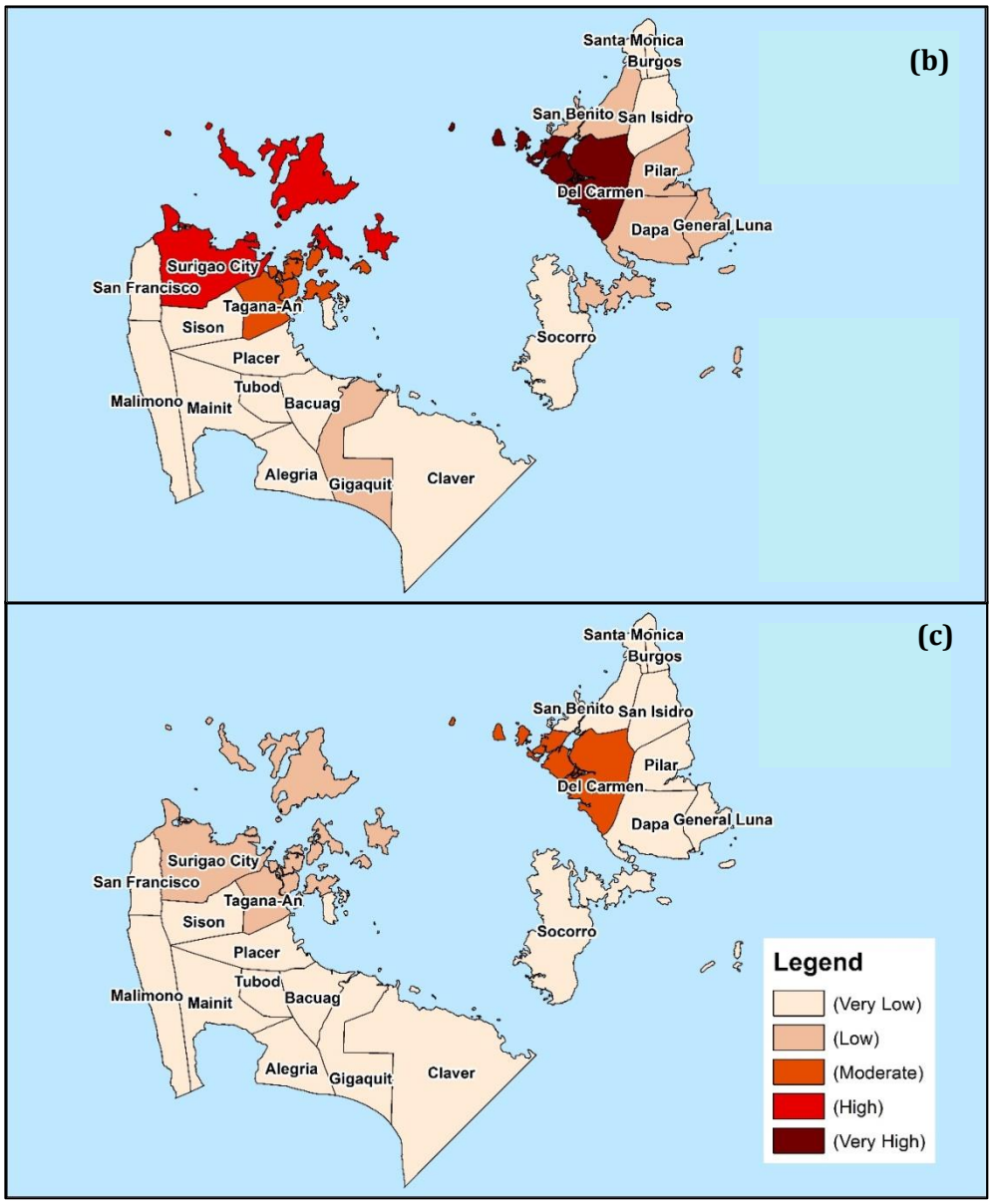

Figure 28. Hazard index map of salt water intrusion (a), storm surge (b) and sea sea level rise (c)

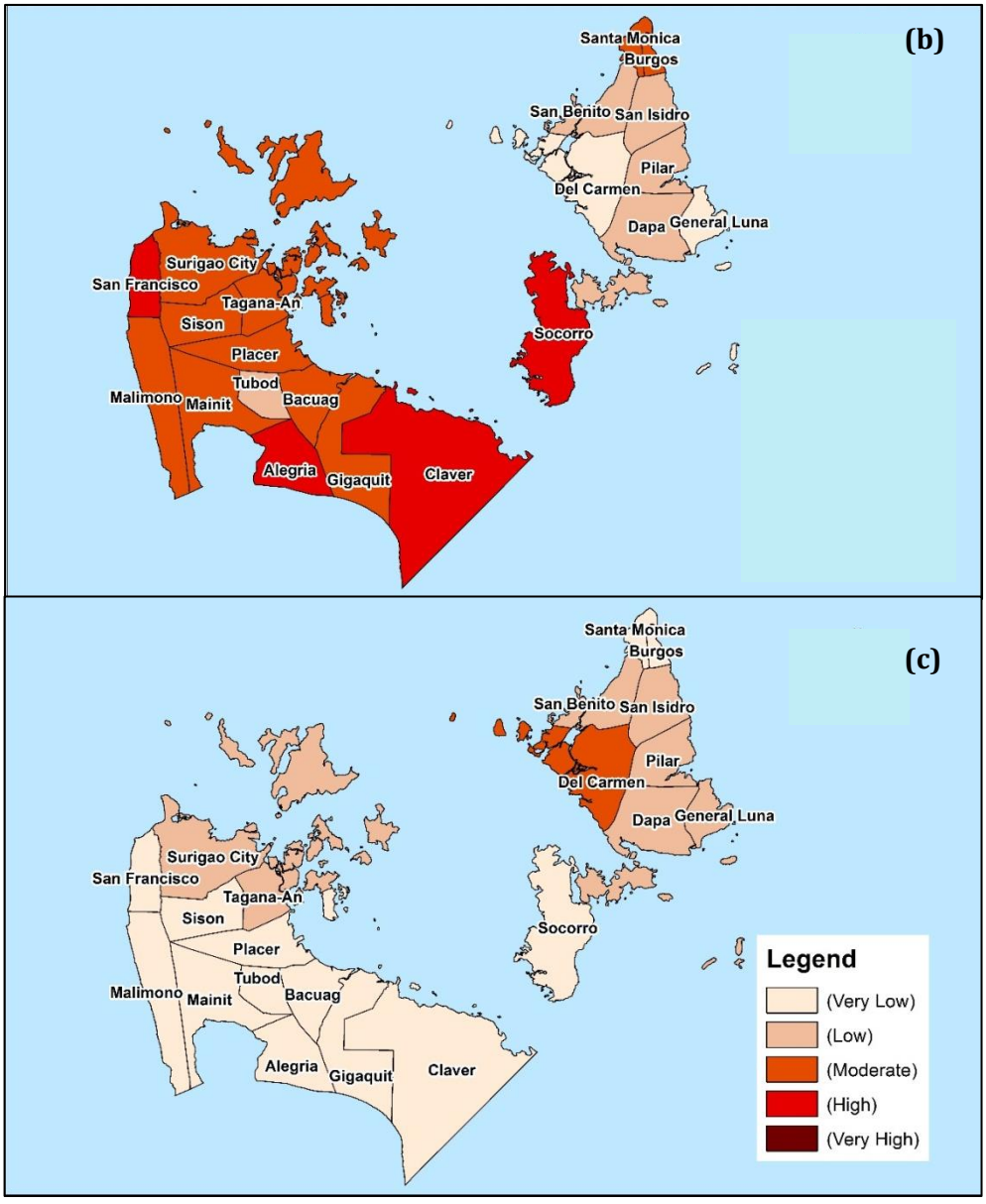

Figure 29. Hazard index map of landslide (a) and soil erosion (b) and flood (c)

Figure 30. Hazard index map of drought

Vulnerability Index

The vulnerability model was constructed using the GIS platform for the three components namely, sensitivity, exposure, and adaptive capacity. Among the 21 municipalities, only Surigao City showed a very low vulnerability of these three components while all municipalities of Siargao Islands and the municipalities of San Francisco and Tagana-an were very highly vulnerable(Figure 31).

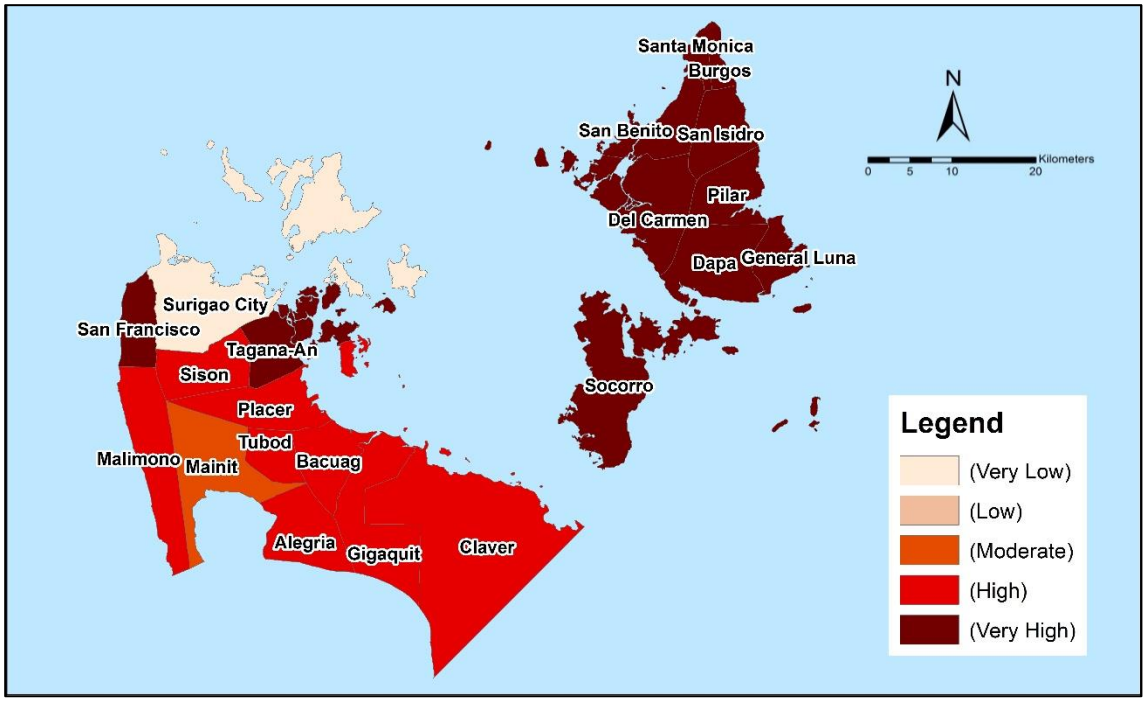

Figure 31. Climate Risk Vulnerability Assessment Map

Rice. Rice commodity is also indicated in the map (Figure 32) as vulnerable except Surigao city with highly adaptable community while most of the vulnerable

areas were identified in the Siargao Islands and in the Municipality of San Francisco for the mainland area of the Province which has a very low adaptive capacity and moderately exposed to hazard.

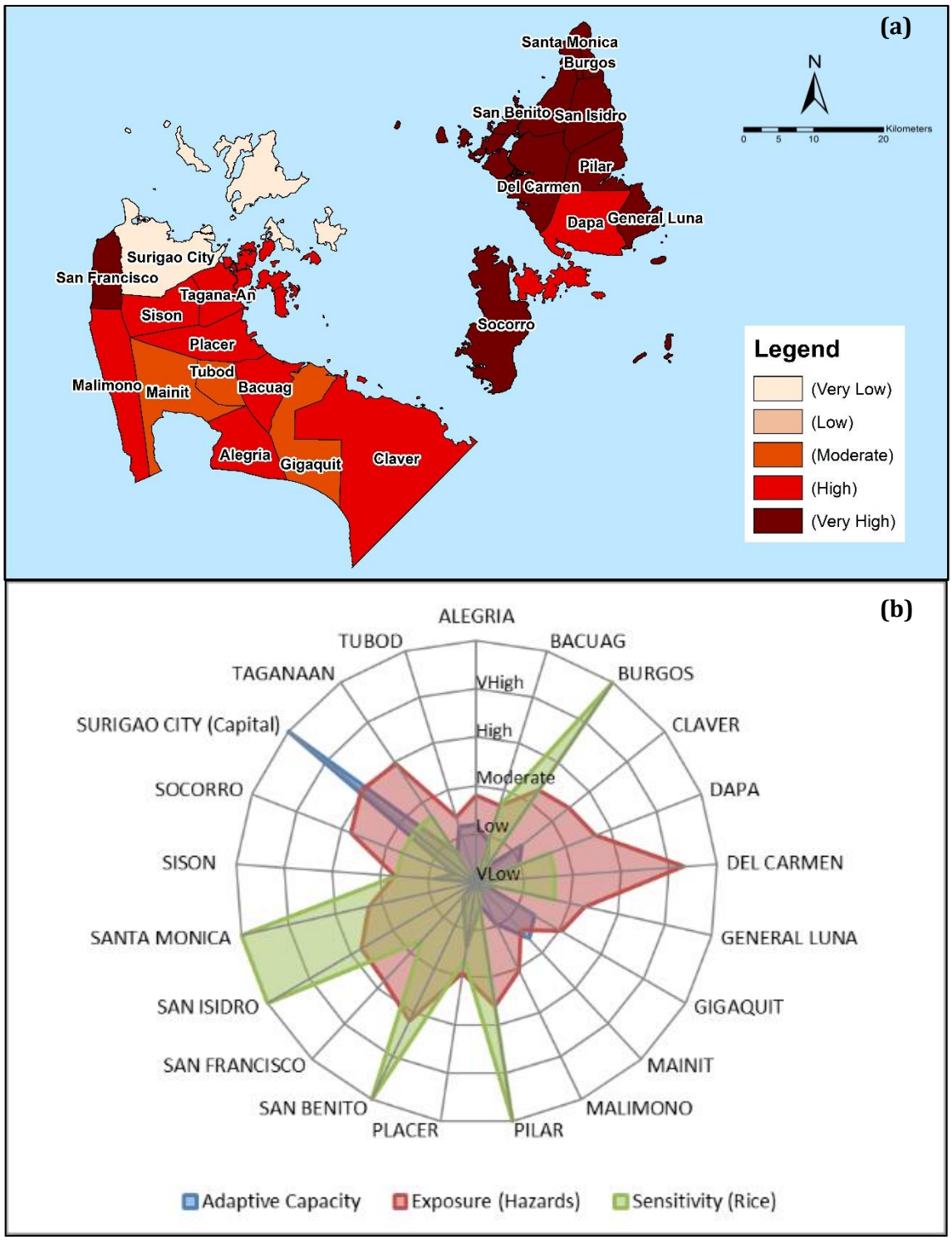

Figure 32. Vulnerability index map (a) and radar graph (b) of rice

Corn. The Vulnerability map of the Corn commodity (Figure 33) also shows that it is highly vulnerable in the areas of Siargao Islands with very low adaptive capacity and not suitable to corn commodity. Radar graph indicates that most of the

municipalities in Siargao Islands are highly exposed to hazards. For the mainland, only the Municipality of San Francisco indicates the very high vulnerability, very low adaptive capacity and highly not suitable for corn production.

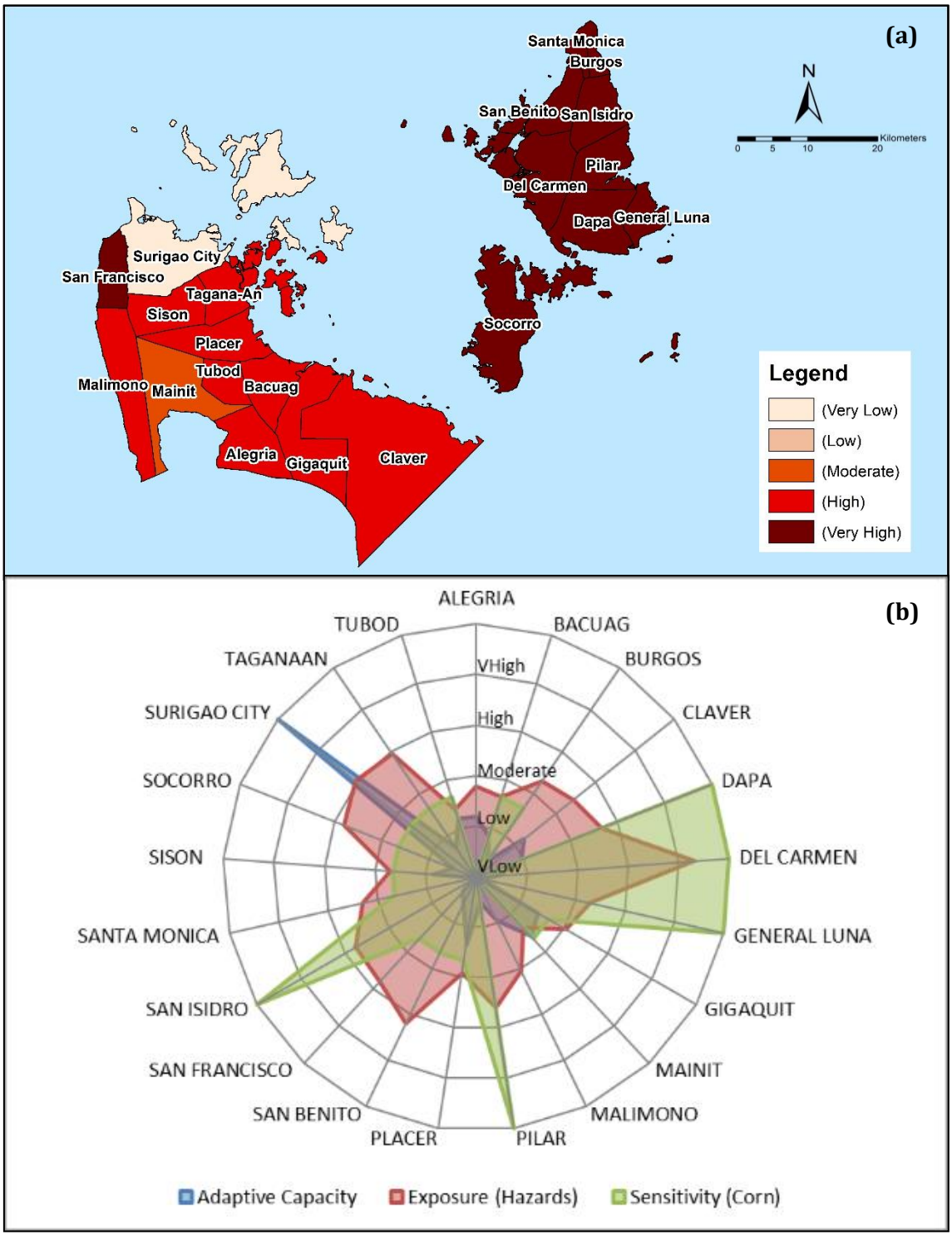

Figure 33. Vulnerability index map (a) and radar graph (b) of corn

Root crops. The same with Rice commodity, the vulnerability map (Figure 34) of root crops shows high vulnerability in Siargao Islands with very low adaptive capacity and highly not suitable in the area and moderately exposed to hazards. The city of Surigao have high level of adaptive capacity.

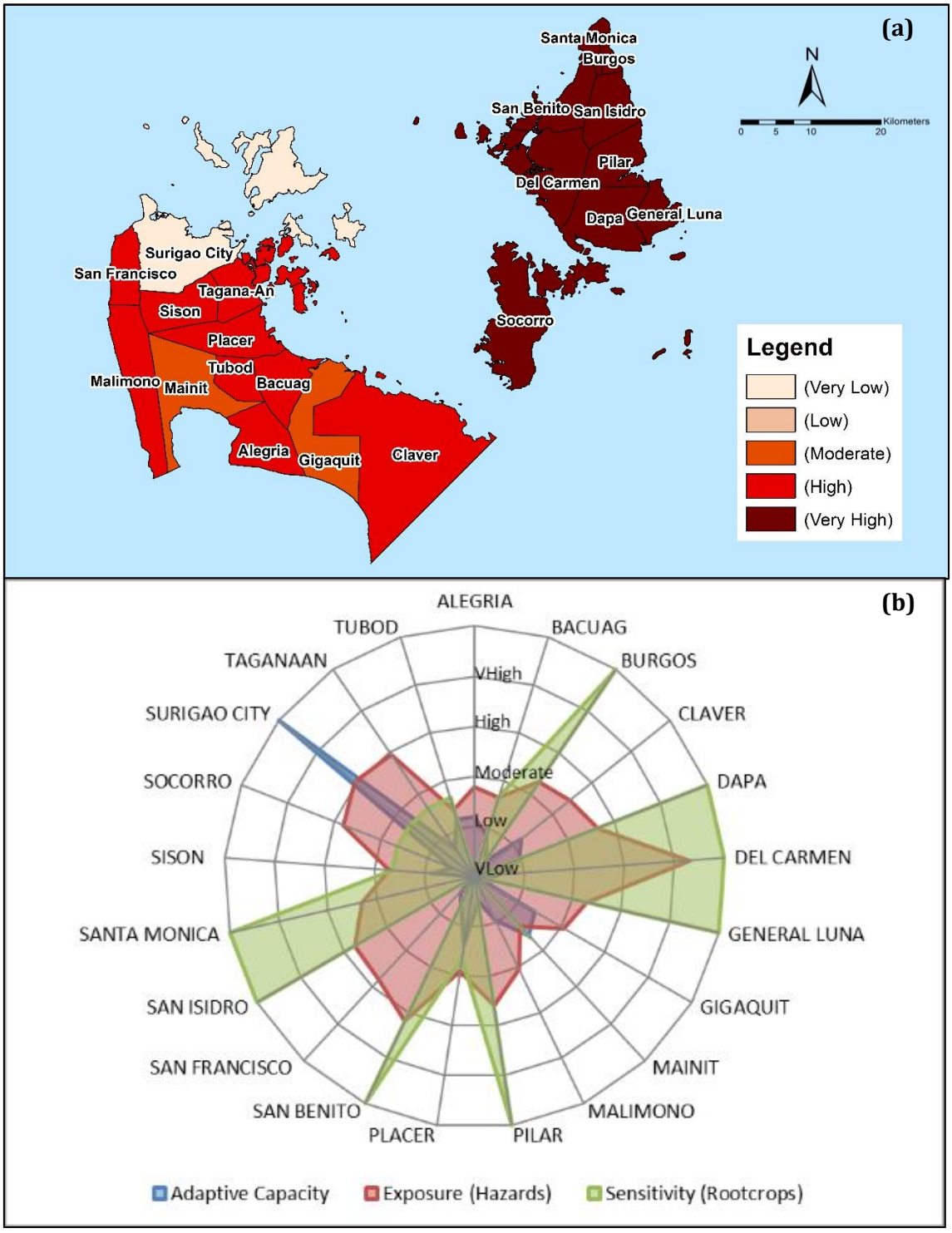

Figure 34. Vulnerability index map (a) and radar graph (b) of root crops

Banana. The total CRVA Map of banana commodity (Figure 35) shows that all of the Municipalities in Siargao Islands are highly vulnerable. On the other hand, in the mainland, municipalities of San Francisco, Tagana-an, and Bacuag were identified as most highly vulnerable areas with very low adaptive capacity and moderately exposed to hazards.

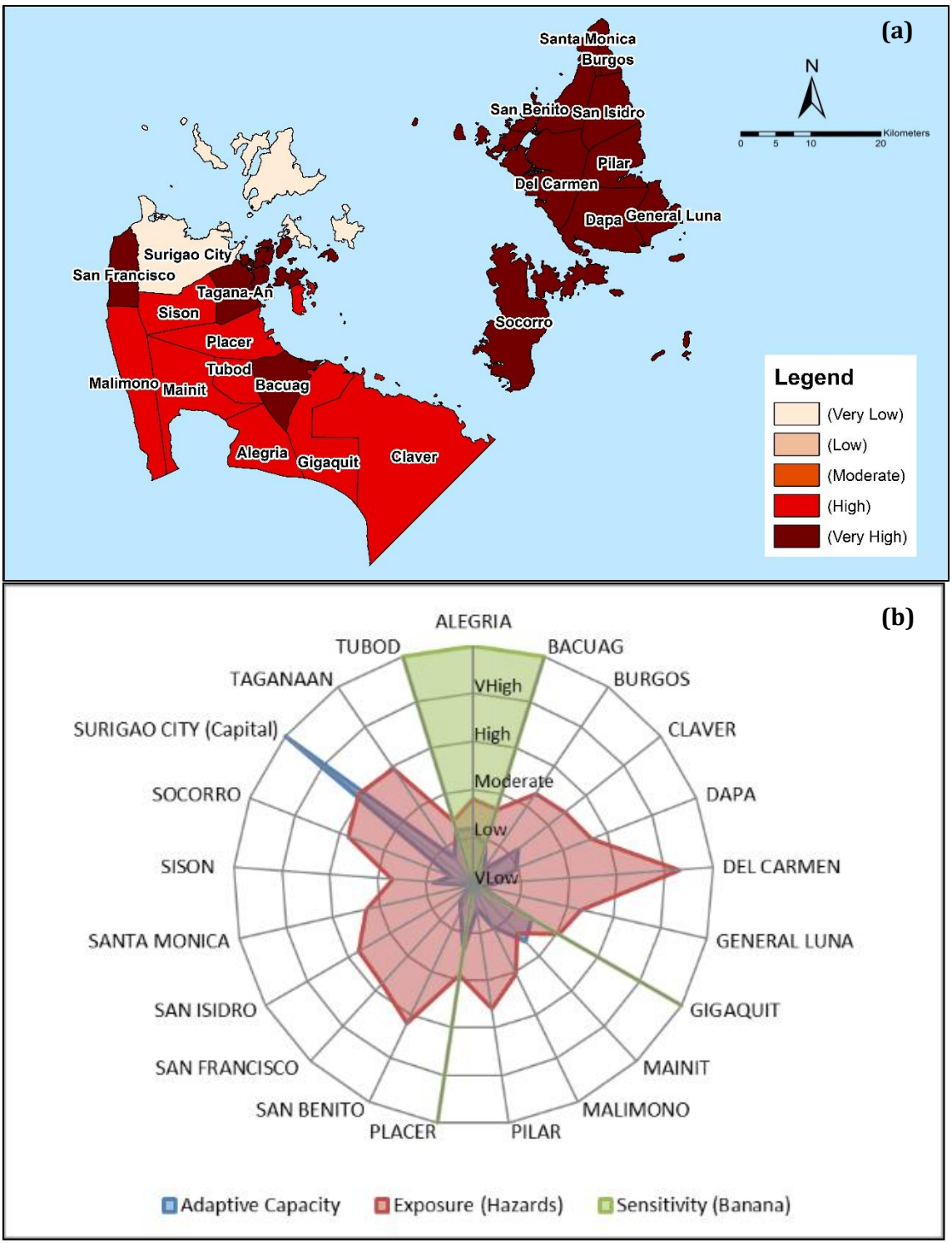

Figure 35.Vulnerability index map (a) and radar graph (b) of banana

Vegetables. Vegetable is also selected as one of the major crops in the Province of Surigao del Norte because it appears to have a presence in all of the Municipalities covered by the Province but it only has a small scale production. Vegetables are suitable in the city of Surigao, but totally not suitable in Siargao Islands with medium exposure to hazards due to climatic variations (Figure 36).

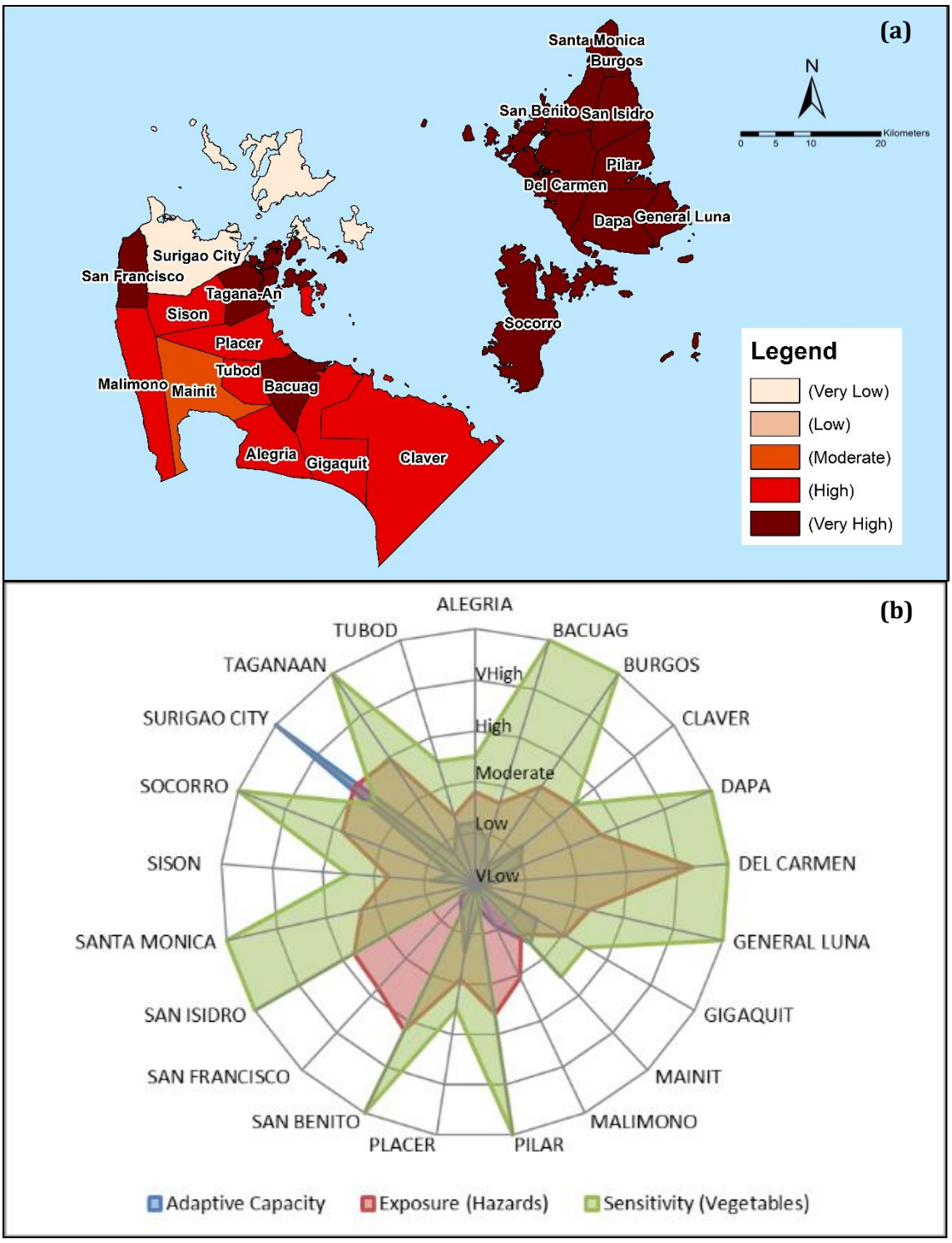

Figure 36. Vulnerability index map (a) and radar graph (b) of vegetables

The identification of the area's most vulnerable to climate change risks in Caraga

vulnerable to climate change and producing a map to show climate change vulnerability in the province. Gathered data at regional, provincial and municipal

levels from various sources were integrated in a consistent and meaningful manner to produce a map indicating the area's most vulnerable to climate change. Despite data limitations, it is expected that the output of this analysis will be useful to policy-makers and stakeholders in better targeting programs and interventions towards adaptation measures undertaken in the region particularly in Surigao del Norte.

Based on this CRVA, in the mainland of Surigao del Norte the municipality of San Francisco and the municipality of Del Carmen in Siargao Island were among the highly vulnerable municipalities in the province due to its high exposure to climate hazards particularly low adaptive capacity and the decreasing suitability of crops to climate variability in the aforementioned municipalities. Considering other factors constant, investing for rice, corn, root crops, banana and vegetables will be less favorable in the future. However, such potential impacts could be negated if the LGUs and other government institutions will continue investing in climate-change related programs and interventions that will improve farming practices and those that will facilitate agri-related coping mechanisms and strategies.

Climate Resilient practices are recommended for these municipalities. These practices will be adapted in AMIA Villages that will be established after this CRVA. Several practices such as alternate wetting and drying (i.e., controlled irrigation rather than standard continuous flooding of rice fields), adoption of water-saving technologies (e.g. drainage, drip irrigation), use of traditional and new varieties, plowing techniques, compost application, moderate fertilizer application and planting at moderate density can be applied. According to the article published by Chandra, A. et al. (2017) adaptation of organic farming such as use of rice hull as soil cover improved water use, soil moisture and soil infiltration during dry seasons. Vegetables survived the long drought seasons because grass cover in the topsoil retains moisture. Mitigation and adaptation options were also influenced by farmer knowledge of growing seasons and local climate conditions. By scheduling planting with real-time climate information via seasonal calendars, smallholder farmers were able to coincide with the early or late rainy seasons or avoid disasters. Farmers also reported seasonal calendar better tools for planting under organic agriculture compared to relying on fertilizers and chemicals to mitigate drought effects on high value crops (Table 10 is the cropping calendar of top 5 commodities of the Province of SDN). Use of Site-Specific Nutrient Management (SSNM), Integrated Pest Management (IPM) and use of early maturing and stress-tolerant varieties are best practices for Corn. To further validate these farming practices, Community Participatory Action Research (CPAR) is recommended.

Table10. Cropping Calendar of top 5 commodities in the Province of SDN

Top 5 commodity of SDN	**Months**
1.Rice	
Lowland	October to December
Palagad	May to July

Upland	June to August and September to November
2.Corn	
Dry season	March to May
Rainy season	January to February and August to September
3.Banana	whole year
4.Vegetables	
Leafy vegetables	
Cabbage	January to March
Cauliflower	January to March
Celery	January to March
Lettuce	March to June
Mustard	January to March
Pechay	January to March
Fruit vegetables	
Ampalaya	June to August and November to February
Cucumber	March to April
Eggplant	January to April and August to September
Okra	whole year
Patola	March to September
Squash	whole year
Tomato	January to April and August to September
Upo	November to March
Beans	
Batao	February to April
Bountiful Bean	January to May
Cowpea	January to March and May to June
Cadius	February to March
Mungo	February to June
Seguidillas	February to April
Sitao	May to June
Soybean	January to March
Tapilan	January to March and August to October
5.Rootcrops	
Sweet potato	Year round
Gabi	Year round
Ube	Year round
Cassava	Year round

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Appendix Table 1. Economic capital indicator by rice and corn production, Surigao del Norte 2019.

Municipality	RICE PRODUCTION		CORN PRODUCTION	
	Area Harvested (ha)	Total Volume of Production (kg)	Area Harvested (ha)	Total Volume of Production (kg)
ALEGRIA	1,005.25	3,166,537.50	58.45	67,802.00
BACUAG	965.30	3,040,695.00	no data	no data
BURGOS	227.00	715,050.00	no data	no data
CLAVER	639.20	2,013,480.00	15.00	17,400.00
DAPA	277.75	874,912.50	no data	no data
DEL CARMEN	1,044.00	3,288,600.00	no data	no data
GENERAL LUNA	496.00	1,562,400.00	5.25	6,090.00
GIGAQUIT	1,288.29	4,058,113.50	22.85	26,506.00
MAINIT	2,291.25	7,217,437.50	76.00	88,160.00
MALIMONO	96.15	302,872.50	no data	no data
PILAR	369.00	1,162,350.00	6.50	7,540.00
PLACER	798.15	2,514,172.50	no data	no data
SAN BENITO	7.00	22,050.00	no data	no data
SAN FRANCISCO	328.00	1,033,200.00	no data	no data
SAN ISIDRO	510.00	1,606,500.00	no data	no data
SANTA MONICA	381.25	1,200,937.50	4.00	4,640.00
SISON	617.50	1,945,125.00	14.85	17,226.00
SOCORRO	1,080.25	3,402,787.50	4.00	4,640.00
SURIGAO CITY	6,441.00	20,289,150.00	44.80	51,968.00
TAGANAAN	391.55	1,233,382.50	4.50	5,220.00
TUBOD	754.00	2,375,100.00	no data	no data

note: yield (t/ha) for Rice =3.15 data from the Province (SDN)
yield (t/ha) for Corn=1.61 data from the Province (SDN)

Source: Philippine Statistics Authority (for the yield t/ha data)
Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 2. Economic capital indicator by coconut production, Surigao del Norte 2019.

Municipality	COCONUT PRODUCTION		
	Total Coconut Area (ha)	Total Nut Production (pieces)	Total volume of nut production (kg)
ALEGRIA	3,165.00	18,948,462.00	11,369,077.20
BACUAG	6,013.00	25,818,169.00	15,490,901.40
BURGOS	2,568.00	7,704,747.00	4,622,848.20
CLAVER	4,905.00	22,288,417.00	13,373,050.20
DAPA	5,901.00	15,312,242.00	9,187,345.20
DEL CARMEN	5,404.00	16,709,562.00	10,025,737.20
GENERAL LUNA	4,532.00	16,873,339.00	10,124,003.40
GIGAQUIT	3,520.00	15,431,742.00	9,259,045.20
MAINIT	5,680.00	21,842,643.00	13,105,585.80
MALIMONO	5,417.00	15,145,548.00	9,087,328.80
PILAR	5,901.00	13,938,152.00	8,362,891.20
PLACER	5,847.00	25,494,609.00	15,296,765.40
SAN BENITO	2,588.00	10,658,929.00	6,395,357.40
SAN FRANCISCO	2,686.00	9,505,146.00	5,703,087.60
SAN ISIDRO	2,079.00	6,780,587.00	4,068,352.20
SANTA MONICA	2,198.00	11,690,653.00	7,014,391.80
SISON	4,770.00	12,645,201.00	7,587,120.60
SOCORRO	3,058.00	5,107,631.00	3,064,578.60
SURIGAO CITY	11,565.00	28,719,366.00	17,231,619.60
TAGANAAN	5,142.00	19,190,092.00	11,514,055.20
TUBOD	5,417.00	15,145,548.00	9,087,328.80

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 3. Economic capital indicator by banana production, Surigao del Norte 2019.

Municipality	Banana (Area Planted) ha			Total Area Planted (Banana)	Total Volume of Production (kg)
	Lakatan	Latundan	Saba / Cardava		
ALEGRIA	2.00	2.30	21.00	25.30	107,950.04
BACUAG	no data	2.50	3.00	5.50	23,467.40
BURGOS	no data	no data	no data	no data	no data
CLAVER	no data	no data	40.50	40.50	172,805.39
DAPA	6.00	0.75	4.00	10.75	45,868.10
DEL CARMEN	no data	no data	no data	no data	no data
GENERAL LUNA	4.50	no data	17.00	21.50	91,736.20
GIGAQUIT	0.50	0.50	10.00	11.00	46,934.80
MAINIT	12.25	7.50	138.50	158.25	675,221.08
MALIMONO	8.00	4.25	52.50	64.75	276,275.29
PILAR	no data	no data	no data	no data	no data
PLACER	46.00	17.00	27.50	90.50	386,145.39
SAN BENITO	4.00	4.00	11.00	19.00	81,069.20
SAN FRANCISCO	18.20	no data	80.00	98.20	418,999.75
SAN ISIDRO	16.00	13.00	32.34	61.34	261,725.50
SANTA MONICA	8.00	16.20	24.80	49.00	209,073.19
SISON	no data	no data	no data	no data	no data
SOCORRO	38.70	40.00	41.60	120.30	513,296.02
SURIGAO CITY	6.25	10.46	12.27	28.97	123,611.33
TAGANAAN	20.50	15.50	10.25	46.25	197,339.49
TUBOD	no data	no data	20.00	20.00	85,336.00

Note: yield (t/ha) =4.27 data from the province (SDN)
Source: Philippine Statistics Authority (for the yield t/ha data)
Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 4. Economic capital indicator by root crops production, Surigao del Norte 2019.

Municipality	Root Crops			
	Cassava		Sweet Potato	
	Area Planted (ha)	Total Volume of Production (Ton)	Area Planted (ha)	Total Volume of Production (Ton)
ALEGRIA	9.25	44.50	2.50	0.00
BACUAG	0.00	0.00	1.00	0.00
BURGOS	0.00	0.00	0.00	0.00
CLAVER	0.00	0.00	21.00	0.00
DAPA	0.00	0.00	8.63	0.00
DEL CARMEN	0.00	0.00	0.00	0.00
GENERAL LUNA	11.50	27.00	7.00	0.00
GIGAQUIT	6.67	45.00	17.00	0.00
MAINIT	207.75	1421.50	40.50	0.00
MALIMONO	12.38	74.00	49.00	56.40
PILAR	0.00	0.00	0.00	0.00
PLACER	6.38	47.40	0.00	0.00
SAN BENITO	0.00	0.00	9.00	24.00
SAN FRANCISCO	0.00	0.00	30.80	10.90
SAN ISIDRO	0.00	0.00	4.00	2.05
SANTA MONICA	6.16	56.15	2.60	0.26
SISON	92.00	307.30	200.01	0.00
SOCORRO	0.00	0.00	3.50	23.00
SURIGAO CITY	9.25	35.00	0.00	0.00
TAGANAAN	3.50	9.20	6.00	0.00
TUBOD	0.00	0.00	0.00	0.00

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 5. Economic capital indicator by root crops production, total area planted and total volume of production Surigao del Norte 2019.

Municipality	Root Crops			
	Taro		Total Area Planted (ha)	Total Volume of Production (kg)
	Area Planted (ha)	Volume of Production (Ton)		
ALEGRIA	1.00	0.00	12.8	44,500.0
BACUAG	0.50	0.00	1.5	no data
BURGOS	0.00	0.00	no data	no data
CLAVER	0.00	0.00	21.0	no data
DAPA	0.25	0.00	8.9	no data
DEL CARMEN	0.00	0.00	no data	no data
GENERAL LUNA	0.00	0.00	18.5	27,000.0
GIGAQUIT	0.00	0.00	23.7	45,000.0
MAINIT	14.00	0.00	262.3	1,421,500.0
MALIMONO	0.00	0.00	61.4	130,400.0
PILAR	0.00	0.00	no data	no data
PLACER	0.00	0.00	6.4	47,400.0
SAN BENITO	0.00	0.00	9.0	24,000.0
SAN FRANCISCO	0.00	0.00	30.8	10,900.0
SAN ISIDRO	0.00	0.00	4.0	2,050.0
SANTA MONICA	0.00	0.00	8.8	56,410.0
SISON	0.00	0.00	292.0	307,300.0
SOCORRO	0.00	0.00	3.5	23,000.0
SURIGAO CITY	0.00	0.00	9.3	35,000.0
TAGANAAN	0.00	0.00	9.5	9,200.0
TUBOD	0.00	0.00	no data	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 6. Economic capital indicator by vegetables (tomato and eggplant) production, Surigao del Norte 2019.

Municipality	Vegetables			
	Tomato		Eggplant	
	Area Planted (ha)	Volume of Production (kg)	Area Planted (ha)	Volume of Production (kg)
ALEGRIA	3.25	no data	5.25	no data
BACUAG	1.11	no data	1.40	no data
BURGOS	0.55	no data	1.50	no data
CLAVER	0.16	no data	1.27	360.00
DAPA	4.69	20.00	8.45	50.00
DEL CARMEN	1.50	no data	4.00	no data
GENERAL LUNA	1.40	no data	4.90	no data
GIGAQUIT	0.27	no data	9.34	4,070.00
MAINIT	2.50	200.00	12.50	2,000.00
MALIMONO	0.13	no data	0.33	no data
PILAR	no data	no data	4.75	no data
PLACER	0.11	no data	0.51	no data
SAN BENITO	0.50	no data	3.00	360.00
SAN FRANCISCO	no data	no data	1.00	no data
SAN ISIDRO	no data	no data	no data	no data
SANTA MONICA	no data	no data	no data	no data
SISON	no data	no data	2.00	no data
SOCORRO	7.00	no data	5.75	no data
SURIGAO CITY	no data	6,500.00	3.00	2,500.00
TAGANAAN	0.16	no data	0.69	no data
TUBOD	2.00	no data	2.50	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 7. Economic capital indicator by vegetables (ampalaya and pole sitaw) production, Surigao del Norte 2019.

Municipality	Vegetables			
	Ampalaya		Pole Sitaw	
	Area Planted (ha)	Volume of Production (kg)	Area Planted (ha)	Volume of Production (kg)
ALEGRIA	3.50	no data	3.50	no data
BACUAG	0.59	no data	0.30	no data
BURGOS	2.00	no data	3.00	no data
CLAVER	0.28	no data	0.56	no data
DAPA	7.75	100.00	7.65	no data
DEL CARMEN	4.00	no data	1.28	80,000.00
GENERAL LUNA	0.80	no data	2.92	no data
GIGAQUIT	2.53	1,000.00	7.06	120.00
MAINIT	9.50	150.00	10.00	100.00
MALIMONO	0.29	no data	0.79	no data
PILAR	2.75	no data	1.50	no data
PLACER	0.59	no data	0.53	no data
SAN BENITO	1.50	70.00	1.50	490.00
SAN FRANCISCO	0.50	no data	1.25	no data
SAN ISIDRO	no data	no data	no data	no data
SANTA MONICA	no data	no data	no data	no data
SISON	4.50	no data	3.50	no data
SOCORRO	2.75	no data	2.00	no data
SURIGAO CITY	1.25	1,330.00	8.50	16,200.00
TAGANAAN	0.86	no data	1.01	no data
TUBOD	4.50	no data	5.00	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 8. Economic capital indicator by vegetables (kalabasa and upo) production, Surigao del Norte 2019.

Municipality	Vegetables			
	Kalabasa		Upo	
	Area Planted (ha)	Volume of Production (kg)	Area Planted (ha)	Volume of Production (kg)
ALEGRIA	4.75	no data	2.25	no data
BACUAG	0.31	no data	0.38	no data
BURGOS	0.25	no data	1.25	no data
CLAVER	0.17	no data	0.55	no data
DAPA	1.60	no data	3.25	no data
DEL CARMEN	5.00	no data	1.20	no data
GENERAL LUNA	1.90	no data	0.20	no data
GIGAQUIT	6.41	no data	1.63	no data
MAINIT	7.50	300.00	2.00	250.00
MALIMONO	6.25	400.00	0.80	70.00
PILAR	19.50	no data	1.75	no data
PLACER	no data	no data	no data	no data
SAN BENITO	3.00	no data	no data	no data
SAN FRANCISCO	no data	no data	no data	no data
SAN ISIDRO	no data	no data	no data	no data
SANTA MONICA	no data	no data	no data	no data
SISON	6.00	no data	no data	no data
SOCORRO	6.50	no data	2.00	no data
SURIGAO CITY	18.50	108,000.00	1.25	13,500.00
TAGANAAN	0.60	no data	0.63	no data
TUBOD	1.75	no data	1.20	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 9. Economic capital indicator by vegetables production (patola and okra) Surigao del Norte 2019.

Municipality	Vegetables			
	Patola		Okra	
	Area Planted (ha)	Volume of Production (kg)	Area Planted (ha)	Volume of Production (kg)
ALEGRIA	2.50	no data	3.03	no data
BACUAG	0.58	no data	1.07	no data
BURGOS	no data	no data	2.25	no data
CLAVER	0.00	no data	0.32	160.00
DAPA	2.06	no data	5.88	260.00
DEL CARMEN	no data	no data	3.75	no data
GENERAL LUNA	0.40	no data	no data	no data
GIGAQUIT	1.47	no data	7.36	no data
MAINIT	1.75	150.00	12.50	300.00
MALIMONO	no data	no data	0.65	no data
PILAR	no data	no data	3.50	1,500.00
PLACER	no data	no data	0.52	no data
SAN BENITO	0.10	no data	2.00	440.00
SAN FRANCISCO	no data	no data	1.00	no data
SAN ISIDRO	no data	no data	no data	no data
SANTA MONICA	no data	no data	no data	no data
SISON	0.55	no data	2.23	no data
SOCORRO	0.25	no data	3.50	no data
SURIGAO CITY	0.75	2,900.00	1.50	10,000.00
TAGANAAN	0.51	no data	1.21	no data
TUBOD	2.50	no data	3.75	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 10. Economic capital indicator by vegetables (pechay and kangkong) production Surigao del Norte 2019.

Municipality	Vegetables			
	Pechay		Kangkong	
	Area Planted (ha)	Volume of Production (kg)	Area Planted (ha)	Volume of Production (kg)
ALEGRIA	5.00	no data	2.25	no data
BACUAG	1.17	no data	0.76	no data
BURGOS	0.75	no data	1.20	no data
CLAVER	0.03	no data	0.00	no data
DAPA	4.42	1,620.00	3.50	no data
DEL CARMEN	2.00	1,000.00	no data	no data
GENERAL LUNA	2.50	no data	2.06	no data
GIGAQUIT	2.87	no data	2.64	no data
MAINIT	8.50	10.00	5.20	10.00
MALIMONO	0.36	no data	0.75	10.00
PILAR	4.00	no data	no data	no data
PLACER	0.49	no data	0.25	no data
SAN BENITO	0.10	no data	0.50	no data
SAN FRANCISCO	0.75	no data	0.75	no data
SAN ISIDRO	no data	no data	no data	no data
SANTA MONICA	no data	no data	no data	no data
SISON	1.00	no data	4.80	no data
SOCORRO	4.68	no data	no data	no data
SURIGAO CITY	0.25	2,500.00	0.50	3,000.00
TAGANAAN	0.28	200.00	no data	no data
TUBOD	2.15	no data	no data	no data

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 11. Economic capital indicator asstd. vegetables and total area planted (rice, corn, coconut, banana, root crops and asstd. vegetables), Surigao del Norte 2019.

Municipality	Asstd. Vegetables		Total Area Planted (Rice, Corn, Coconut, Banana, Root crops, Asstd. Vegetables)
	Area Planted (ha)	Volume of Production (kg)	
ALEGRIA	35.28	no data	4,302.03
BACUAG	7.66	no data	6,992.96
BURGOS	12.75	no data	2,807.75
CLAVER	3.33	520.00	5,624.03
DAPA	49.26	2,050.00	6,247.63
DEL CARMEN	22.73	81,000.00	6,470.73
GENERAL LUNA	17.08	no data	5,090.33
GIGAQUIT	41.58	5,190.00	4,907.39
MAINIT	71.95	3,470.00	8,539.70
MALIMONO	10.33	480.00	5,649.61
PILAR	37.75	1,500.00	6,314.25
PLACER	3.01	no data	6,745.03
SAN BENITO	12.20	1,360.00	2,635.20
SAN FRANCISCO	5.25	no data	3,148.25
SAN ISIDRO	no data	no data	2,654.34
SANTA MONICA	no data	no data	2,641.01
SISON	24.58	no data	5,718.94
SOCORRO	34.43	no data	4,300.48
SURIGAO CITY	35.50	166,430.00	18,124.52
TAGANAAN	5.95	200.00	5,599.75
TUBOD	25.35	no data	6,216.35

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 12. Economic capital indicator by total agricultural production area and total volume of production, Surigao del Norte 2019.

Municipality	Total agricultural production area (ha) Rice, Corn, Coconut, Banana, Root crops and Asstd. Vegetables	Total Volume of Production (Rice, Corn, Coconut, Banana, Root crops, Asstd. Vegetables)
ALEGRIA	2,363.34	14,782,169.24
BACUAG	4,081.61	18,555,063.80
BURGOS	442.43	5,337,898.20
CLAVER	3,547.00	15,584,005.59
DAPA	2,785.32	10,110,175.80
DEL CARMEN	1,208.81	13,395,337.20
GENERAL LUNA	2,699.84	11,813,592.10
GIGAQUIT	17,586.36	13,451,072.00
MAINIT	3,517.94	22,545,574.38
MALIMONO	10,070.95	9,797,356.59
PILAR	644.32	9,537,206.20
PLACER	3,434.44	18,244,483.29
SAN BENITO	1,110.68	6,523,836.60
SAN FRANCISCO	1,410.32	7,166,187.35
SAN ISIDRO	1,616.18	5,938,627.70
SANTA MONICA	2,320.27	8,487,252.49
SISON	9,563.31	9,863,454.10
SOCORRO	4,467.00	7,010,102.12
SURIGAO CITY	12,369.64	37,917,938.93
TAGANAAN	1,941.70	12,961,422.19
TUBOD	1,916.00	11,547,764.80

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 13. Economic capital indicator by access to credit, total no. of financial institutions and no. of finance cooperatives, Surigao del Norte 2019.

Municipality	ACCESS TO CREDIT		Total No. of Financial Institutions	No. of Finance Cooperatives
	No. of Banks	Other Institutions		
ALEGRIA	1	5	6	no data
BACUAG	no data	10	10	no data
BURGOS	no data	no data	no data	no data
CLAVER	5	22	27	5
DAPA	6	8	14	3
DEL CARMEN	1	9	10	no data
GENERAL LUNA	1	no data	1	1
GIGAQUIT	no data	8	8	1
MAINIT	no data	11	11	3
MALIMONO	no data	5	5	1
PILAR	no data	2	2	no data
PLACER	3	39	42	1
SAN BENITO	no data	1	1	no data
SAN FRANCISCO	1	1	2	3
SAN ISIDRO	1	2	3	no data
SANTA MONICA	1	no data	1	1
SISON	no data	6	6	1
SOCORRO	no data	14	14	6
SURIGAO CITY	24	265	289	5
TAGANAAN	no data	6	6	2
TUBOD	no data	6	6	2

Source: Municipal Planning and Development Offices (MPDO) of SDN, 2019

Appendix Table 14. Economic capital indicator by total no. of ATM's, total no. of farmers and crop insurance, Surigao del Norte 2019.

Municipality	Total No. of ATMs	Total Number of Farmers	CROP INSURANCE	
			No. of Farmers Covered	% of Farmers Covered
ALEGRIA	1	836	771	92.22
BACUAG	1	798	211	26.44
BURGOS	no data	323	64	19.81
CLAVER	11	548	314	57.30
DAPA	2	820	30	3.66
DEL CARMEN	2	550	106	19.27
GENERAL LUNA	1	630	no data	no data
GIGAQUIT	no data	1,791	488	27.25
MAINIT	1	1,400	1,285	91.79
MALIMONO	no data	1,776	262	14.75
PILAR	1	2,770	91	3.29
PLACER	2	1,200	25	2.08
SAN BENITO	no data	350	3	0.86
SAN FRANCISCO	no data	1,282	128	9.98
SAN ISIDRO	2	390	189	48.46
SANTA MONICA	no data	1,741	34	1.95
SISON	no data	1,182	427	36.13
SOCORRO	1	5,500	161	2.93
SURIGAO CITY (Capital)	45	5,892	1,398	23.73
TAGANAAN	no data	1,826	287	15.72
TUBOD	no data	400	165	41.25

Source: Municipal Planning and Development Offices (MPDO) of SDN, 2019

Appendix Table 15. Economic capital indicator by population, Surigao del Norte 2019.

Municipality	Population		
	Household Population	Number of Households	Average Size/household
ALEGRIA	16,004	3,415	4.70
BACUAG	14,473	3,107	4.70
BURGOS	4,034	919	4.40
CLAVER	32,254	7,357	4.40
DAPA	23,758	5,139	4.60
DEL CARMEN	18,361	3,973	4.60
GENERAL LUNA	16,747	3,847	4.40
GIGAQUIT	20,650	4,532	4.60
MAINIT	26,655	5,975	4.50
MALIMONO	18,052	3,995	4.50
PILAR	9,748	2,401	4.10
PLACER	27,055	5,922	4.60
SAN BENITO	5,404	1,222	4.40
SAN FRANCISCO	14,429	3,256	4.40
SAN ISIDRO	7,323	1,625	4.50
SANTA MONICA	8,808	1,986	4.40
SISON	13,154	2,920	4.50
SOCORRO	22,314	4,417	5.10
SURIGAO CITY	153,105	35,784	4.30
TAGANAAN	16,422	3,799	4.30
TUBOD	14,071	3,243	4.30

Source: Municipal Planning and Development Offices (MPDO) of SDN, 2019

Appendix Table 16. Economic capital indicator by no. of employed in agriculture, Surigao del Norte 2019.

Municipality	No. of Employed in Agriculture		
	Regular	Casual	Job Order
ALEGRIA	7	1	6
BACUAG	5	no data	6
BURGOS	3	3	1
CLAVER	7	1	no data
DAPA	4	no data	4
DEL CARMEN	3	no data	5
GENERAL LUNA	5	no data	16
GIGAQUIT	10	no data	5
MAINIT	6	4	8
MALIMONO	5	1	1
PILAR	4	no data	3
PLACER	6	no data	2
SAN BENITO	3	no data	4
SAN FRANCISCO	6	no data	11
SAN ISIDRO	3	no data	5
SANTA MONICA	4	2	5
SISON	4	no data	4
SOCORRO	7	no data	5
SURIGAO CITY	34	no data	39
TAGANAAN	6	16	9
TUBOD	3	no data	3

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 17. Economic capital indicator by no. of employed in agriculture, % of population and agriculture minimum wage, Surigao del Norte 2019.

Municipality	No. of Employed in Agriculture		% of Population	Agriculture Minimum Wage (average)
	Contract of Service/ Others	Total		
ALEGRIA	no data	14	0.09	200.00
BACUAG	no data	11	0.08	210.00
BURGOS	1	8	0.20	120.00
CLAVER	5	13	0.04	350.00
DAPA	no data	8	0.03	228.00
DEL CARMEN	no data	8	0.04	150.00
GENERAL LUNA	no data	2	0.13	228.00
GIGAQUIT	no data	15	0.07	230.00
MAINIT	no data	18	0.07	220.00
MALIMONO	no data	7	0.04	250.00
PILAR	17	24	0.25	200.00
PLACER	no data	8	0.03	200.00
SAN BENITO	15	22	0.41	181.00
SAN FRANCISCO	no data	17	0.12	150.00
SAN ISIDRO	17	25	0.34	200.00
SANTA MONICA	no data	11	0.12	136.00
SISON	no data	8	0.06	210.00
SOCORRO	no data	12	0.05	280.00
SURIGAO CITY	no data	73	0.05	200.00
TAGANAAN	8	39	0.24	240.00
TUBOD	no data	6	0.04	250.00

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 18. Economic capital indicator by poverty incidence, inversed, total budget of the municipality and total allocation of MAO, Surigao del Norte 2019.

Municipality	Poverty Incidence	Inversed	Total Budget of the Municipality	Total Allocation of MAO
ALEGRIA	36.19	63.81	82,902,268.00	2,418,556.00
BACUAG	35.80	64.20	77,433,306.00	2,817,519.00
BURGOS	34.05	65.95	42,854,120.00	794,500.00
CLAVER	34.28	65.72	528,855,627.65	4,965,167.92
DAPA	39.92	60.08	115,668,089.00	2,532,842.66
DEL CARMEN	37.17	62.83	118,148,002.00	2,744,282.30
GENERAL LUNA	41.06	58.94	75,588,000.00	3,406,408.22
GIGAQUIT	40.52	59.48	100,571,981.00	3,785,016.68
MAINIT	39.12	60.88	116,975,647.77	3,865,210.60
MALIMONO	42.86	57.14	82,697,370.00	2,459,440.80
PILAR	36.80	63.20	71,617,315.00	2,277,561.34
PLACER	34.40	65.60	135,831,912.89	4,627,499.00
SAN BENITO	39.91	60.09	67,695,414.00	2,062,187.58
SAN FRANCISCO	35.71	64.29	81,486,693.24	3,005,490.80
SAN ISIDRO	36.62	63.38	56,801,159.00	1,800,373.92
SANTA MONICA	33.05	66.95	60,580,593.00	1,701,804.16
SISON	36.80	63.20	68,078,770.00	2,040,784.88
SOCORRO	38.52	61.48	121,138,588.70	4,601,663.00
SURIGAO CITY	29.36	70.64	1,000,366,075.00	25,118,022.00
TAGANAAN	45.30	54.70	132,928,934.00	3,390,738.11

TUBOD	30.60	69.40	93,995,429.37	2,523,995.65

Note: inversed= 100- poverty incidence
Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 19. Economic capital indicator by % of budget allocation of MAO, total budget allocation of MDRRMO, % of budget allocation of MDRRMO, Surigao del Norte 2019.

Municipality	% of Budget Allocation of MAO	Total Budget Allocation of MDRRMO	% of Budget Allocation of MDRRMO
ALEGRIA	2.92	4,145,113.40	5.00
BACUAG	3.64	3,872,102.00	5.00
BURGOS	1.85	2,388,672.30	5.57
CLAVER	0.94	2,656,912.65	0.50
DAPA	2.19	7,783,404.45	6.73
DEL CARMEN	2.32	1,471,546.38	1.25
GENERAL LUNA	4.51	50,000.00	0.07
GIGAQUIT	3.76	5,028,599.05	5.00
MAINIT	3.30	519,933.59	0.44
MALIMONO	2.97	220,000.00	0.27
PILAR	3.18	530,702.23	0.74
PLACER	3.41	879,870.00	0.65
SAN BENITO	3.05	3,697,835.00	5.46
SAN FRANCISCO	3.69	3,734,523.20	4.58
SAN ISIDRO	3.17	2,840,057.95	5.00
SANTA MONICA	2.81	9,752,513.72	16.10
SISON	3.00	598,708.25	0.88
SOCORRO	3.80	6,057,138.00	5.00
SURIGAO CITY	2.51	4,875,621.00	0.49
TAGANAAN	2.55	6,646,446.70	5.00
TUBOD	2.69	4,272,283.55	4.55

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 20. Natural capital indicator by presence of irrigation, total service area with source of irrigation (ha) and total agricultural production area (ha), Surigao del Norte 2019.

Municipality	Presence of Irrigation COMMUNAL IRRIGATION SYSTEM SERVICE AREA WITH SOURCE OF WATER SUPPLY			Total Service Area with Source of Irrigation (ha)	Total agricultural production area (ha)
	GRAVITY (service area)	PUMP (service area)	RESERVOIR (service area)		
ALEGRIA	399.00	no data	no data	399.00	2,363.30
BACUAG	505.00	no data	no data	505.00	4,081.60
BURGOS	25.00	no data	no data	25.00	442.40
CLAVER	341.00	no data	no data	341.00	3,547.00
DAPA	no data	no data	no data	no data	2,785.30
DEL CARMEN	244.00	33.00	no data	277.00	1,208.80
GENERAL LUNA	no data	no data	no data	no data	2,699.80
GIGAQUIT	930.00	no data	no data	930.00	17,586.40
MAINIT	1,262.00	18.00	no data	1,280.00	3,517.90
MALIMONO	105.00	no data	no data	105.00	10,071.00
PILAR	188.00	no data	no data	188.00	644.30
PLACER	221.00	no data	no data	221.00	3,434.40
SAN BENITO	no data	no data	no data	no data	1,110.70
SAN FRANCISCO	30.00	no data	no data	30.00	1,410.30
SAN ISIDRO	153.00	no data	no data	153.00	1,616.20
SANTA MONICA	115.00	3.00	no data	118.00	2,320.30
SISON	66.00	no data	no data	66.00	9,563.30
SOCORRO	180.00	no data	no data	180.00	4,467.00

SURIGAO CITY	972.00	no data	no data	972.00	12,369.60
TAGANAAN	60.00	no data	no data	60.00	1,941.70
TUBOD	285.00	no data	no data	285.00	1,916.00

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 21. Social capital indicator by number of local elected officials, Surigao del Norte 2019.

Municipality	NUMBER OF LOCAL ELECTED OFFICIALS				
	Total Number of Elected Officials	Male	Female	% of men in government	% of women in government
ALEGRIA	97	68	29	70.10	29.90
BACUAG	75	57	18	76.00	24.00
BURGOS	54	30	24	55.56	44.44
CLAVER	118	73	45	61.86	38.14
DAPA	237	130	107	54.85	45.15
DEL CARMEN	131	74	57	56.49	43.51
GENERAL LUNA	148	92	56	62.16	37.84
GIGAQUIT	117	73	44	62.39	37.61
MAINIT	189	129	60	68.25	31.75
MALIMONO	126	86	40	68.25	31.75
PILAR	135	74	61	54.81	45.19
PLACER	180	105	75	58.33	41.67
SAN BENITO	53	28	25	52.83	47.17
SAN FRANCISCO	99	68	31	68.69	31.31
SAN ISIDRO	76	49	27	64.47	35.53
SANTA MONICA	99	57	42	57.58	42.42
SISON	108	66	42	61.11	38.89
SOCORRO	119	80	39	67.23	32.77
SURIGAO CITY	486	319	167	65.64	34.36
TAGANAAN	125	77	48	61.60	38.40

TUBOD	81	45	36	55.56	44.44

Source: Municipal Planning Development Offices (MPDO) of SDN, 2019

Appendix Table 22. Social capital indicator by no. of farmers association, no. of farmers, no. of farmers association members and % of farmers who are members of coops/unions/groups, Surigao del Norte 2019.

Municipality	No. of Farmers Association	No. of farmers	No. of Farmers Association Members	% of Farmers who are members of coops/unions/groups
ALEGRIA	28	836	821	98.21
BACUAG	21	798	591	74.06
BURGOS	7	323	210	65.02
CLAVER	9	548	383	69.89
DAPA	15	820	738	90.00
DEL CARMEN	32	1,728	550	31.83
GENERAL LUNA	5	630	300	47.62
GIGAQUIT	27	1,791	683	38.14
MAINIT	25	1,400	665	47.50
MALIMONO	27	1,776	862	48.54
PILAR	17	2,770	393	14.19
PLACER	25	1,200	1,010	84.17
SAN BENITO	8	350	102	29.14
SAN FRANCISCO	11	1,282	1,186	92.51
SAN ISIDRO	5	390	196	50.26
SANTA MONICA	10	1,741	174	9.99
SISON	17	1,182	600	50.76
SOCORRO	22	5,500	3250	59.09
SURIGAO CITY	67	5,892	2876	48.81
TAGANAAN	33	1,826	431	23.60

TUBOD	7	400	397	99.25

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 23. Human capital indicator by educational level, literacy rate, no. of teachers and no. of students, Surigao del Norte 2019.

Municipality	EDUCATIONAL LEVEL (LITERACY RATE)		Literacy rate	Number of teachers	Number of students
	Literate (10 Yrs. Old & Above)	Total population (10 Yrs. Old & Above)			
ALEGRIA	11,940	12,219	97.72	62	1,481
BACUAG	11,511	11,654	98.77	60	1,380
BURGOS	3,189	3,243	98.33	15	275
CLAVER	24,304	24,588	98.84	110	2,868
DAPA	18,121	18,362	98.69	127	2,828
DEL CARMEN	14,180	14,359	98.75	46	1,272
GENERAL LUNA	12,742	12,855	99.12	70	1,719
GIGAQUIT	15,554	16,032	97.02	54	1,138
MAINIT	20,074	20,411	98.35	109	2,479
MALIMONO	13,958	14,104	98.96	83	1,593
PILAR	7,580	7,744	97.88	33	652
PLACER	20,857	20,971	99.46	95	2,484
SAN BENITO	4,131	4,170	99.06	13	247
SAN FRANCISCO	11,251	11,402	98.68	51	1,179
SAN ISIDRO	5,521	5,652	97.68	31	678
SANTA MONICA	6,894	6,996	98.54	34	833
SISON	9,965	10,130	98.37	44	1,062
SOCORRO	17,004	17,159	99.10	82	1,834
SURIGAO CITY	120,797	121,496	99.42	500	12,283

TAGANAAN	12,578	12,799	98.27	51	1,388
TUBOD	10,725	10,878	98.59	54	1,262

Source: Department of Education (DepEd)- Caraga Region, 2019

Appendix Table 24. Human capital indicator by ratio of school teachers to students, no. of private secondary schools and no. of public secondary schools, Surigao del Norte 2019.

Municipality	Ratio of school teachers to students	Number of private secondary schools	Number of public secondary schools
		Private	Public
ALEGRIA	0.04	0	2
BACUAG	0.04	1	3
BURGOS	0.05	0	1
CLAVER	0.04	0	2
DAPA	0.04	2	5
DEL CARMEN	0.04	1	4
GENERAL LUNA	0.04	0	4
GIGAQUIT	0.05	1	2
MAINIT	0.04	1	5
MALIMONO	0.05	0	7
PILAR	0.05	0	2
PLACER	0.04	1	4
SAN BENITO	0.05	0	1
SAN FRANCISCO	0.04	2	2
SAN ISIDRO	0.05	0	2
SANTA MONICA	0.04	0	3
SISON	0.04	1	3
SOCORRO	0.04	0	4
SURIGAO CITY	0.04	8	25
TAGANAAN	0.04	0	3
TUBOD	0.04	0	2

Source: Department of Education (DepEd)- Caraga Region, 2019

Appendix Table 25. Human capital indicator by total no. of secondary schools, total no. of public and private tertiary schools and no. of technical vocational schools, Surigao del Norte 2019.

Municipality	Total number of secondary schools	Total number of public and private tertiary schools	Number of technical vocational schools
ALEGRIA	2	0	1
BACUAG	4	0	0
BURGOS	1	0	0
CLAVER	2	0	0
DAPA	7	1	1
DEL CARMEN	5	1	0
GENERAL LUNA	4	0	0
GIGAQUIT	3	0	0
MAINIT	6	1	1
MALIMONO	7	1	0
PILAR	2	0	0
PLACER	5	0	1
SAN BENITO	1	0	0
SAN FRANCISCO	4	0	0
SAN ISIDRO	2	0	0
SANTA MONICA	3	0	0
SISON	4	0	0
SOCORRO	4	1	2
SURIGAO CITY	33	7	9
TAGANAAN	3	0	0
TUBOD	2	0	0

Source: Department of Education (DepEd)- Caraga Region, 2019

Appendix Table 26. Health capital indicator by malnutrition rate, nutrition rate, no. of health services and no. of health professionals, Surigao del Norte 2019.

Municipality	Malnutrition Rate		Nutrition rate	Number of Health Services	Number of Health Professionals
	No. Of Children Weighed	Normal			
ALEGRIA	2,201	2,001	90.91	8	10
BACUAG	1,880	1,586	84.36	10	19
BURGOS	648	494	76.23	8	19
CLAVER	4,057	3,695	91.08	20	32
DAPA	2,466	2,296	93.11	9	32
DEL CARMEN	737	674	91.45	17	8
GENERAL LUNA	2,102	1,781	84.73	5	15
GIGAQUIT	2,438	2,271	93.15	10	35
MAINIT	2,998	2,818	94.00	15	28
MALIMONO	1,662	1,375	82.73	8	7
PILAR	981	827	84.30	13	10
PLACER	3,451	3,275	94.90	12	27
SAN BENITO	604	570	94.37	17	16
SAN FRANCISCO	1,298	1,087	83.74	13	19
SAN ISIDRO	990	815	82.32	7	18
SANTA MONICA	792	692	87.37	8	13
SISON	1,142	1,040	91.07	12	9
SOCORRO	3,673	2,645	72.01	17	30
SURIGAO CITY	16,965	15,64	92.20	24	52
TAGANAAN	1,662	1,528	91.94	9	21

TUBOD	1,445	1,306	90.38	16	15

Source: Rural Health Units (RHU) of SDN, 2019

Appendix Table 27. Health capital indicator by local citizen with philhealth, Surigao del Norte 2019.

Municipality	Local Citizen with PhilHealth			
	Government	Private	Kasambahay	Lifetime
ALEGRIA	279	783	5	1,008
BACUAG	288	766	7	831
BURGOS	107	103	no data	147
CLAVER	493	6,888	6	1,888
DAPA	722	1,043	5	1,197
DEL CARMEN	334	463	4	653
GENERAL LUNA	299	571	16	730
GIGAQUIT	340	838	7	1,121
MAINIT	538	1,312	7	1,938
MALIMONO	302	605	1	1,137
PILAR	198	242	3	417
PLACER	529	1,892	3	1,638
SAN BENITO	97	209	no data	252
SAN FRANCISCO	273	806	6	770
SAN ISIDRO	143	164	no data	345
SANTA MONICA	233	262	1	423
SISON	211	781	3	848
SOCORRO	648	623	3	991
SURIGAO CITY	5,274	15,597	48	12,790
TAGANAAN	212	1,145	4	546
TUBOD	412	1,302	3	1,090

Source: PhilHealth Office, SDN 2019

Appendix Table 28. Health capital indicator by individually paying and sponsored program, Surigao del Norte 2019.

Municipality	Local Citizen with PhilHealth		
	Individually Paying		Sponsored Program
	OFP	IPP	
ALEGRIA	237	775	no data
BACUAG	198	600	55
BURGOS	29	92	no data
CLAVER	273	1,262	876
DAPA	169	660	no data
DEL CARMEN	171	247	132
GENERAL LUNA	96	335	no data
GIGAQUIT	212	628	201
MAINIT	377	1,388	94
MALIMONO	228	580	166
PILAR	79	121	no data
PLACER	332	1,349	163
SAN BENITO	57	116	no data
SAN FRANCISCO	195	690	no data
SAN ISIDRO	38	148	no data
SANTA MONICA	97	184	50
SISON	194	640	no data
SOCORRO	79	506	no data
SURIGAO CITY	2,532	15,669	no data
TAGANAAN	166	528	88
TUBOD	265	644	829

Source: PhilHealth Office, SDN 2019

Appendix Table 29. Health capital indicator by indigent program and 4Ps/MCCT, Surigao del Norte 2019.

Municipality	Indigent Program		4Ps/ MCCT
	Listahanan2	(L1) 4th -6th class	
ALEGRIA	2,955	1,809	1,263
BACUAG	2,629	1,746	1,045
BURGOS	653	497	399
CLAVER	5,363	no data	1,764
DAPA	4,417	2,954	1,770
DEL CARMEN	3,144	2,326	1,514
GENERAL LUNA	3,258	2,364	1,520
GIGAQUIT	3,838	1,950	1,379
MAINIT	4,989	3,092	1,902
MALIMONO	3,491	2,265	1,062
PILAR	2,031	1,301	854
PLACER	4,552	2,806	1,512
SAN BENITO	982	613	467
SAN FRANCISCO	2,714	1,475	1,079
SAN ISIDRO	1,325	968	661
SANTA MONICA	1,424	1,358	736
SISON	2,252	1,548	947
SOCORRO	4,368	2,838	1,788
SURIGAO CITY	20,882	no data	7,166
TAGANAAN	3,201	2,254	1,351
TUBOD	2,178	1,776	844

Source: PhilHealth Office, SDN 2019

Appendix Table 30. Health capital indicator by local citizens with philhealth, estimated population (2017) and % of local citizens with philhealth, Surigao del Norte 2019.

Municipality	Local citizens with PhilHealth	Estimated Population (2017)	% of local citizens with PhilHealth
ALEGRIA	9,114	16,004	57
BACUAG	8,165	14,473	56
BURGOS	2,027	4,034	50
CLAVER	18,813	32,254	58
DAPA	12,937	23,758	54
DEL CARMEN	8,988	18,361	49
GENERAL LUNA	9,189	16,747	55
GIGAQUIT	10,514	20,650	51
MAINIT	15,637	26,655	59
MALIMONO	9,837	18,052	54
PILAR	5,246	9,748	54
PLACER	14,776	27,055	55
SAN BENITO	2,793	5,404	52
SAN FRANCISCO	8,008	14,429	55
SAN ISIDRO	3,792	7,323	52
SANTA MONICA	4,768	8,808	54
SISON	7,424	13,154	56
SOCORRO	11,844	22,314	53
SURIGAO CITY	79,958	153,105	52
TAGANAAN	9,495	16,422	58
TUBOD	9,343	14,071	66

Source: PhilHealth Office, SDN 2019

Appendix Table 31. Physical capital indicator by total agricultural land (ha), % of farmers owning their agricultural production land and farm size (ha) average, Surigao del Norte 2019.

Municipality	Total agricultural land (ha)	% of farmers owning their Agricultural Production Land	Farm Size (ha) average
ALEGRIA	2,363.30	50	0.50
BACUAG	4,081.60	75	1.00
BURGOS	442.40	80	1.00
CLAVER	3,547.00	40	0.50
DAPA	2,785.30	20	1.00
DEL CARMEN	1,208.80	60	1.00
GENERAL LUNA	2,699.80	30	2.00
GIGAQUIT	17,586.40	20	1.00
MAINIT	3,517.90	50	0.50
MALIMONO	10,071.00	75	0.50
PILAR	644.30	20	0.50
PLACER	3,434.40	40	0.25
SAN BENITO	1,110.70	40	0.75
SAN FRANCISCO	1,410.30	60	0.50
SAN ISIDRO	1,616.20	40	1.00
SANTA MONICA	2,320.30	50	0.50
SISON	9,563.30	11	2.00
SOCORRO	4,467.00	50	0.50
SURIGAO CITY	12,369.60	40	0.50
TAGANAAN	1,941.70	24	0.75
TUBOD	1,916.00	30	0.50

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 32. Physical capital indicator by no. of livestock owned (cattle, carabao and swine), Surigao del Norte 2019.

Municipality	Number of livestock owned		
	Cattle	Carabao	Swine
ALEGRIA	29	291	799
BACUAG	34	685	193
BURGOS	7	192	951
CLAVER	12	450	1,719
DAPA	85	255	1,178
DEL CARMEN	0	53	0
GENERAL LUNA	51	778	2,112
GIGAQUIT	0	1,098	2,871
MAINIT	167	1,695	4,196
MALIMONO	145	112	2,529
PILAR	74	375	647
PLACER	111	661	2,361
SAN BENITO	17	62	871
SAN FRANCISCO	248	209	2,088
SAN ISIDRO	216	416	1,599
SANTA MONICA	11	221	921
SISON	167	970	2,067
SOCORRO	0	342	272
SURIGAO CITY	470	2,319	10,006
TAGANAAN	17	438	692
TUBOD	242	821	3,020

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 33. Physical capital indicator by no. of livestock owned (goat/sheep, poultry) and no. of livestock, Surigao del Norte 2019.

Municipality	Number of livestock owned		
	Goat/Sheep	Poultry	Number of livestock
ALEGRIA	158	1,046	2,323
BACUAG	11	2,944	3,867
BURGOS	31	3,445	4,626
CLAVER	144	9,751	12,076
DAPA	180	0	1,698
DEL CARMEN	0	0	53
GENERAL LUNA	307	2,575	5,823
GIGAQUIT	28	17,144	21,141
MAINIT	897	52,040	58,995
MALIMONO	374	11,551	14,711
PILAR	48	2,141	3,285
PLACER	290	7,311	10,734
SAN BENITO	91	2,799	3,840
SAN FRANCISCO	279	9,032	11,856
SAN ISIDRO	330	3,389	5,950
SANTA MONICA	114	2,429	3,696
SISON	0	1,950	5,154
SOCORRO	71	0	685
SURIGAO CITY	1,016	23,913	37,724
TAGANAAN	84	7,625	8,856
TUBOD	198	9,946	14,227

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 34. Physical capital indicator by total service area with irrigation (ha), 2018 total agricultural land (ha) and % of agricultural area irrigated, Surigao del Norte 2019.

Municipality	Total Service Area with Irrigation (ha)	2018 total agricultural land (ha)	% of agricultural area irrigated
ALEGRIA	399.00	2,363.30	16.88
BACUAG	505.00	4,081.60	12.37
BURGOS	25.00	442.40	5.65
CLAVER	341.00	3,547.00	9.61
DAPA	no data	2,785.30	no data
DEL CARMEN	277.00	1,208.80	22.92
GENERAL LUNA	no data	2,699.80	no data
GIGAQUIT	930.00	17,586.40	5.29
MAINIT	1,280.00	3,517.90	36.38
MALIMONO	105.00	10,071.00	1.04
PILAR	188.00	644.30	29.18
PLACER	221.00	3,434.40	6.43
SAN BENITO	no data	1,110.70	no data
SAN FRANCISCO	30.00	1,410.30	2.13
SAN ISIDRO	153.00	1,616.20	9.47
SANTA MONICA	118.00	2,320.30	5.09
SISON	66.00	9,563.30	0.69
SOCORRO	180.00	4,467.00	4.03
SURIGAO CITY	972.00	12,369.60	7.86
TAGANAAN	60.00	1,941.70	3.09
TUBOD	285.00	1,916.00	14.87

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 35. Physical capital indicator by reliable infrastructure (total length of concrete roads), Surigao del Norte 2019.

Municipality	Reliable infrastructure (total length of concrete roads)			
	National Road	Provincial Road	City/Municipal Road	Brgy. Road
ALEGRIA	8.00	11.50	9.75	16.69
BACUAG	no data	no data	5.33	2.22
BURGOS	9.09	no data	1.85	0.57
CLAVER	no data	no data	13.18	20.45
DAPA	23.53	no data	12.64	2.25
DEL CARMEN	no data	no data	17.95	no data
GENERAL LUNA	8.00	11.61	8.11	no data
GIGAQUIT	no data	2.15	0.81	28.76
MAINIT	5.60	30.19	8.60	10.61
MALIMONO	no data	27.09	2.70	36.52
PILAR	no data	no data	1.61	no data
PLACER	21.97	6.14	5.40	6.98
SAN BENITO	9.00	6.00	4.40	4.80
SAN FRANCISCO	no data	14.00	3.50	1.44
SAN ISIDRO	no data	no data	2.02	22.39
SANTA MONICA	8.50	5.80	5.50	6.90
SISON	no data	no data	13.46	34.37
SOCORRO	6.03	0.50	11.85	2.13
SURIGAO CITY	no data	no data	48.52	68.50
TAGANAAN	2.80	7.88	5.41	5.48
TUBOD	no data	no data	no data	no data

Source: Municipal Engineering Offices of SDN, 2019

Appendix Table 36. Physical capital indicator by FMR LGU, FMR PMED, FMR RAED and total length of concrete roads (km), Surigao del Norte 2019.

Municipality	Reliable infrastructure (total length of concrete roads)			
	FMR LGU	FMR PMED	FMR RAED	Total length of concrete roads (km)
ALEGRIA	no data	no data	no data	45.94
BACUAG	no data	no data	no data	7.55
BURGOS	no data	0.95	0.93	13.38
CLAVER	22.87	no data	no data	56.50
DAPA	no data	no data	no data	38.42
DEL CARMEN	no data	1.55	1.00	20.50
GENERAL LUNA	no data	no data	no data	27.72
GIGAQUIT	no data	0.85	0.84	33.41
MAINIT	no data	6.47	1.90	63.36
MALIMONO	5.43	no data	no data	71.74
PILAR	no data	no data	no data	1.61
PLACER	5.54	no data	no data	46.03
SAN BENITO	3.20	0.24	no data	27.64
SAN FRANCISCO	no data	0.50	0.54	19.97
SAN ISIDRO	no data	1.46	2.26	28.14
SANTA MONICA	no data	no data	no data	26.70
SISON	no data	no data	no data	47.82
SOCORRO	1.50	1.75	1.78	25.54
SURIGAO CITY	no data	1.20	1.21	119.42
TAGANAAN	30.36	no data	no data	51.92
TUBOD	no data	0.33	0.33	0.66

Source: Municipal Engineering Offices of SDN, 2019

Appendix Table 37. Physical capital indicator by % of agricultural land with access to FMR, no. of households and household with water services, Surigao del Norte 2019.

Municipality	% of Agricultural Land with access to FMR	Number of Households	Household with water services
ALEGRIA	60	3,415	3,011
BACUAG	100	3,107	2,938
BURGOS	70	919	869
CLAVER	75	7,357	4,418
DAPA	70	5,139	1,894
DEL CARMEN	55	3,973	2,530
GENERAL LUNA	50	3,847	3,380
GIGAQUIT	70	4,532	3,878
MAINIT	60	5,975	5,456
MALIMONO	70	3,995	3,344
PILAR	80	2,401	2,219
PLACER	no data	5,922	5,666
SAN BENITO	20	1,222	847
SAN FRANCISCO	40	3,256	663
SAN ISIDRO	60	1,625	990
SANTA MONICA	no data	1,986	1,805
SISON	75	2,920	1,971
SOCORRO	50	4,417	4,400
SURIGAO CITY	60	35,784	21,171
TAGANAAN	35	3,799	3,780
TUBOD	40	3,243	2,829

Source: Municipal Planning and Development Offices (MPDO) of SDN, 2019

Appendix Table 38. Physical capital indicator by % of households with water services, household with electric services and % of households with electric services, Surigao del Norte 2019.

Municipality	% of households with water services	Household with electric services	% of households with electric services
ALEGRIA	88.17	2,005	58.71
BACUAG	94.56	2,354	75.76
BURGOS	94.56	905	98.48
CLAVER	60.05	4,567	62.08
DAPA	36.86	5,100	99.24
DEL CARMEN	63.68	3,940	99.17
GENERAL LUNA	87.86	3,820	99.30
GIGAQUIT	85.57	2,846	62.80
MAINIT	91.31	4,402	73.67
MALIMONO	83.70	3,210	80.35
PILAR	92.42	2,336	97.29
PLACER	95.68	4,830	81.56
SAN BENITO	69.31	1,220	99.84
SAN FRANCISCO	20.36	2,454	75.37
SAN ISIDRO	60.92	1,615	99.38
SANTA MONICA	90.89	1,951	98.24
SISON	67.50	2,513	86.06
SOCORRO	99.62	4,400	99.62
SURIGAO CITY	59.16	33,434	93.43
TAGANAAN	99.50	3,002	79.02
TUBOD	87.23	2,618	80.73

Source: Municipal Planning Development Offices (MPDO) of SDN, 2019

Appendix Table 39. Anticipatory capital indicator by MDRRMC no. of registered trainings held, % of farmers with access to mobile phones, televisions, radio and internet, Surigao del Norte 2019.

Municipality	MDRRMC No. of Registered trainings held	% of farmers with access to mobile phones	% of farmers with access to televisions	% of farmers with access to radio	% of farmers with access to internet
ALEGRIA	13	90	80	20	40
BACUAG	12	80	80	75	40
BURGOS	0	40	100	10	5
CLAVER	0	90	80	80	50
DAPA	0	95	75	10	40
DEL CARMEN	0	60	100	20	20
GENERAL LUNA	6	70	70	40	10
GIGAQUIT	5	85	85	80	40
MAINIT	10	80	20	25	20
MALIMONO	4	95	90	50	50
PILAR	1	50	90	100	10
PLACER	0	85	85	15	85
SAN BENITO	4	90	90	10	0
SAN FRANCISCO	4	80	80	80	40
SAN ISIDRO	1	90	60	10	10
SANTA MONICA	2	70	95	20	40
SISON	7	80	60	50	10
SOCORRO	4	25	75	5	5
SURIGAO CITY	15	95	100	90	70
TAGANAAN	5	100	90	60	25
TUBOD	8	75	90	15	10

Source: Municipal Disaster Risk Reduction Management Offices (MDRRMO) of SDN 2019

Appendix Table 40. Institutional capital indicator by no. of AEW's, % of farmers visited or consulted with agri-extension worker and % of farmers visiting or consulting the AEW of municipal agriculture office, Surigao del Norte 2019.

Municipality	NO. OF AEW'S	% of farmers visited or consulted with agri extension worker	% of farmers visiting or consulting the AEW of Municipal Agriculture Office
ALEGRIA	8	100	100
BACUAG	5	75	80
BURGOS	5	100	90
CLAVER	6	75	75
DAPA	3	100	30
DEL CARMEN	7	70	70
GENERAL LUNA	6	80	50
GIGAQUIT	7	80	80
MAINIT	6	60	70
MALIMONO	5	100	85
PILAR	5	100	70
PLACER	5	80	80
SAN BENITO	3	100	80
SAN FRANCISCO	6	80	50
SAN ISIDRO	4	100	60
SANTA MONICA	4	100	30
SISON	4	95	80
SOCORRO	9	100	50
SURIGAO CITY	33	100	100
TAGANAAN	5	100	80
TUBOD	3	80	25

Source: Municipal Agriculture Offices (MAO) of SDN, 2019

Appendix Table 41. Normalized values of tropical cyclone, flood, landslide, erosion, drought and salt water intrusion, Surigao del Norte 2019.

Municipality	Tropical Cyclone	Flood	Landslide	Erosion	Drought	Saltwater Intrusion
Alegria	0.44	0.12	0.56	0.62	0.00	0.00
Bacuag	0.51	0.19	0.38	0.42	0.00	0.00
Burgos	0.93	0.06	0.42	0.45	0.00	0.11
Claver	0.49	0.02	0.76	0.75	0.00	0.00
Dapa	0.91	0.21	0.47	0.33	0.00	0.00
Del Carmen	0.94	0.51	0.21	0.10	0.00	1.00
General Luna	0.93	0.39	0.22	0.20	0.00	0.00
Gigaquit	0.49	0.19	0.48	0.50	0.00	0.00
Mainit	0.46	0.10	0.44	0.45	0.00	0.00
Malimono	0.45	0.01	0.79	0.60	0.00	0.00
Pilar	1.00	0.32	0.28	0.27	0.00	0.00
Placer	0.62	0.09	0.43	0.53	0.00	0.00
San Benito	0.91	0.26	0.48	0.27	0.00	0.52
San Francisco	0.68	0.06	0.77	0.80	0.00	0.00
San Isidro	1.00	0.26	0.28	0.25	0.00	0.41
Santa Monica	0.83	0.15	0.34	0.47	0.00	0.18
Sison	0.66	0.02	0.45	0.51	0.00	0.00
Socorro	0.84	0.05	0.55	0.78	0.00	0.00
Surigao City	0.84	0.21	0.41	0.43	0.00	0.00
Tagana-An	0.78	0.38	0.34	0.45	0.00	0.00
Tubod	0.49	0.05	0.58	0.34	0.00	0.00

Source: CIAT

Appendix Table 42. Normalized values of sea level rise, storm surge, hazard index, hazard norm and rating, Surigao del Norte 2019.

Municipality	Sea Level Rise	Storm Surge	Hazard Index	Hazard Norm	Rating
Alegria	0.00	0.00	25.24	0.36	Low
Bacuag	0.08	0.12	23.78	0.33	Low
Burgos	0.00	0.01	29.65	0.46	Medium
Claver	0.06	0.16	30.76	0.49	Medium
Dapa	0.10	0.32	32.82	0.53	Medium
Del Carmen	0.42	0.81	47.18	0.86	Very High
General Luna	0.01	0.26	29.68	0.46	Medium
Gigaquit	0.18	0.21	27.17	0.41	Medium
Mainit	0.00	0.00	21.38	0.27	Low
Malimono	0.01	0.04	27.18	0.41	Medium
Pilar	0.12	0.25	32.03	0.52	Medium
Placer	0.05	0.10	25.92	0.38	Low
San Benito	0.08	0.25	37.55	0.64	High
San Francisco	0.00	0.04	34.04	0.56	Medium
San Isidro	0.08	0.07	33.30	0.55	Medium
Santa Monica	0.02	0.07	29.75	0.46	Medium
Sison	0.00	0.00	24.46	0.34	Low
Socorro	0.04	0.10	33.89	0.56	Medium
Surigao City	0.23	0.70	35.92	0.61	High
Tagana-An	0.26	0.53	35.45	0.59	Medium
Tubod	0.00	0.00	21.75	0.28	Low

Source: CIAT

Appendix Table 43. Normalized values of economic, natural, social and human capitals, Surigao del Norte 2019.

Municipality	Economic	Natural	Social	Human
ALEGRIA	0.24	0.24	0.67	0.04
BACUAG	0.21	0.34	0.09	0.17
BURGOS	0.00	0.00	0.60	0.26
CLAVER	0.43	0.25	0.43	0.08
DAPA	0.12	0.07	1.00	0.27
DEL CARMEN	0.00	0.14	0.59	0.10
GENERAL LUNA	0.10	0.07	0.13	0.16
GIGAQUIT	0.16	1.00	0.35	0.02
MAINIT	0.36	0.68	0.18	0.21
MALIMONO	0.01	0.37	0.22	0.38
PILAR	0.10	0.08	0.25	0.16
PLACER	0.15	0.19	0.95	0.20
SAN BENITO	0.10	0.01	0.35	0.31
SAN FRANCISCO	0.13	0.04	0.42	0.15
SAN ISIDRO	0.22	0.10	0.07	0.06
SANTA MONICA	0.16	0.11	0.00	0.09
SISON	0.10	0.33	0.38	0.09
SOCORRO	0.28	0.21	0.30	0.32
SURIGAO CITY	1.00	0.84	0.92	1.00
TAGANAAN	0.15	0.07	0.32	0.00
TUBOD	0.27	0.17	0.95	0.12

Appendix Table 44. Normalized values of health, physical, anticipatory and institutional capitals, Surigao del Norte 2019.

Municipality	Health	Physical	Anticipatory	Institutional
ALEGRIA	0.35	0.09	0.58	0.67
BACUAG	0.34	0.32	0.68	0.27
BURGOS	0.00	0.31	0.08	0.57
CLAVER	0.83	0.08	0.54	0.26
DAPA	0.53	0.08	0.31	0.23
DEL CARMEN	0.43	0.20	0.23	0.19
GENERAL LUNA	0.16	0.36	0.30	0.17
GIGAQUIT	0.50	0.15	0.60	0.35
MAINIT	0.75	0.87	0.23	0.08
MALIMONO	0.12	0.38	0.58	0.55
PILAR	0.26	0.24	0.38	0.47
PLACER	0.59	0.15	0.47	0.32
SAN BENITO	0.53	0.00	0.29	0.49
SAN FRANCISCO	0.37	0.03	0.55	0.17
SAN ISIDRO	0.12	0.32	0.16	0.40
SANTA MONICA	0.24	0.13	0.35	0.24
SISON	0.42	0.29	0.35	0.46
SOCORRO	0.28	0.15	0.00	0.41
SURIGAO CITY	1.00	1.00	1.00	1.00
TAGANAAN	0.50	0.07	0.57	0.52
TUBOD	0.78	0.22	0.35	0.00

Appendix Figure 1. Validation of Crop Occurrence markings in the municipality of Alegria, SDN

Appendix Figure 2. Validation of Crop Occurrence markings in the municipality of Bacuag, SDN

Appendix Figure 3. Validation of Crop Occurrence markings in the municipality of Burgos, SDN

Appendix Figure 5. Validation of Crop Occurrence markings in the municipality of Dapa, SDN

Appendix Figure 6. Validation of Crop Occurrence markings in the municipality of Del Carmen, SDN

Appendix Figure 7. Validation of Crop Occurrence markings in the municipality of General Luna, SDN

Appendix Figure 8. Validation of Crop Occurrence markings in the municipality of Gigaquit, SDN

Appendix Figure 9. Validation of Crop Occurrence markings in the municipality of Mainit, SDN

Appendix Figure 10. Validation of Crop Occurrence markings in the municipality of Malimono, SDN

Appendix Figure 11. Validation of Crop Occurrence markings in the municipality of Pilar, SDN

Appendix Figure 12. Validation of Crop Occurrence markings in the municipality of Placer, SDN

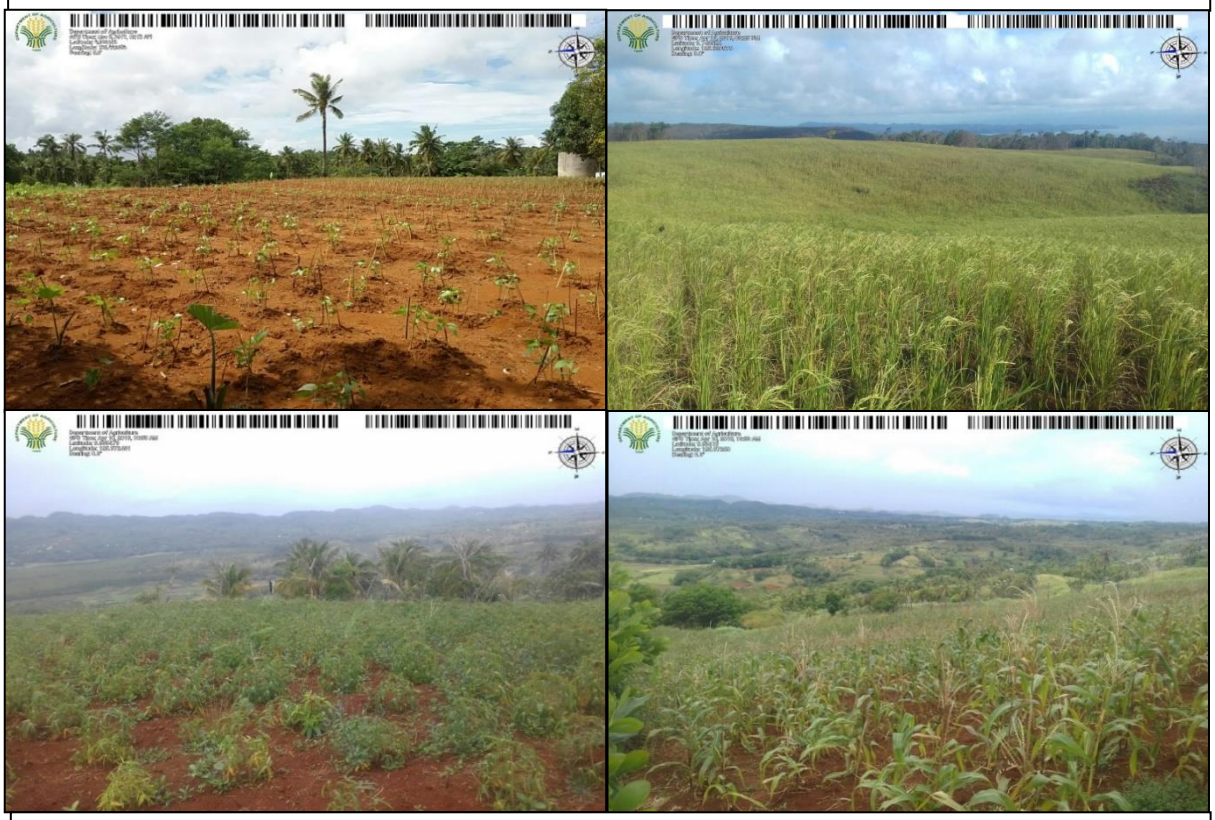
Appendix Figure 13. Validation of Crop Occurrence markings in the municipality of San Benito, SDN

Appendix Figure 14. Validation of Crop Occurrence markings in the municipality of San Francisco, SDN

Appendix Figure 15. Validation of Crop Occurrence markings in the municipality of San Isidro, SDN

Appendix Figure 16. Validation of Crop Occurrence markings in the municipality of Sison. SDN

Appendix Figure 17. Validation of Crop Occurrence markings in the municipality of Sta. Monica, SDN



Appendix Figure 18. Validation of Crop Occurrence markings in the municipality of Socorro, SDN

Appendix Figure 19. Validation of Crop Occurrence markings in the municipality of Surigao City, SDN

Appendix Figure 20. Validation of Crop Occurrence markings in the municipality of Tagana-an, SDN

Appendix Figure 21. Validation of Crop Occurrence markings in the municipality of Tubod, SDN

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