Gubat, Sorsogon

CLIMATE AND DISASTER RISK ASSESSMENT 2018

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I. Rationale

Recent catastrophic events in the Philippines have stressed the devastating impact that natural disasters can bring on communities and ecosystems. Most remarkable is typhoon Haiyan in 2014 that caused 6033 dead, 7468 injured, and 1779 missing. The super typhoon damaged 1.14 million houses and affected 16.1 million people in 12,000 barangays in 44 provinces. The cost of the damage is estimated to reach PhP 35.5 billion affecting 1% - 2% reduction in the Philippines GDP.

In 2015, the province of Sorsogon was hit by typhoon Nona. In Gubat, the destructive typhoon affected 788 families, and its attendant hazards partially and destroyed 1,839 houses with damage to infrastructure, agriculture, fisheries, and livestock totaling to PhP 87million according to the reports of Sorsogon Provincial Disaster Risk Reduction and Management Office (SPDRRMO).

In general, disasters disproportionately affect the vulnerable, and marginalized - including women, children, the elderly, and people with disabilities. According to the World Bank, when poverty is added to the picture, it compounds situations of vulnerability in disaster. Poor people are not only more vulnerable to climate-related shocks, but they also have fewer resources to prevent, cope with, and adapt to disasters. The poor tend to receive less support from family, community, and financial systems, and even have less access to social safety nets.

Recently, many of the world's catastrophic events are brought about by changes in the earth's climate. Climate change is a change in the state of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992). It can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (e.g. by using statistical tests). Since the twentieth century, warming global temperatures have been recorded and these are mostly influenced by greenhouse gas emissions of human-induced activities. Increasing temperature of the atmosphere and ocean, changes in the global water cycle, reductions in snow and ice and sea level rise are some of the climate change impacts experienced in different parts of the globe (IPCC, 2014).

Hazard, on the other hand, is the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. It usually refers to climate-related physical events or trends or their physical impacts (IPCC, 2014). Hazards, when combined with exposed, vulnerable, and unprepared human systems may lead to disasters. Disaster is the serious disruption of the functioning of a society, causing widespread human, material or environmental losses, which exceed the ability of affected society to cope using its own resources (UNISDR, 2009).

Ecosystems, agriculture, livelihoods, and settlements are dependent on the area's climate. Climate change affects disaster risks through the likely increase in weather and climate hazards, and through increase in the vulnerability of communities to natural hazards, particularly through ecosystem degradation, reductions in water and food availability, and changes in livelihoods (UNISDR, 2008).

The Philippines, being one of the most vulnerable countries to climate change, recognized the need to mainstream climate change and disaster risk in local planning and development. The passage of the Climate Change Act of 2009 and Disaster Risk Reduction and Management Act of 2010 provided a framework for key actions in addressing challenges brought about by intensifying climate-related hazards. Understanding the potential impacts of climate change through climate projection and assessing the vulnerabilities, sensitivity, and adaptive capacity are important to determine the risk of systems, be it population, natural resources, and infrastructure. Managing risks and uncertainties are now being mainstreamed in mandated local plans.

In order to formulate risk-sensitive plans, a comprehensive Climate and Disaster Risk Assessment (CDRA) is done to examine the degree of exposure of human and natural systems to climate stimuli and hazards, assess vulnerabilities and sensitivities, and provide sound information to supplement local planning processes. Risk information coming from the assessment will form part of the basis for an informed decision in the optimum allocation of land to various uses, considering the spatial and sectoral constraints posed by natural hazards and the potential impacts of climate change (HLURB, 2014).

In light of this, women, children, other marginalized sectors, and the whole community should be central in disaster risk prevention and community resilience programs. These sectors should be involved in the preparation of the climate and disaster risks assessment. They can become the most powerful agents of change by not considering them as inherently vulnerable, rather considering them as rights holders with the impetus to participate in decision-making.

II. Methodology

The CDRA was conducted in the 42 barangays of Gubat from May - July 2018. It followed the HLURB Supplemental Guidelines on Mainstreaming Climate and Disaster Risks in the Comprehensive Land Use Plan (CLUP), and under the guidance of the UP School of Environmental Science and Management (SESAM). The CDRA process involved five main steps:

a. Collect and organize climate change and hazard information.

The first step involved the collection of climate change information and characterization of hazards that may affect the locality. Climate change information was based on the 2011 Philippine Atmospheric Geophysical and Astronomical Services Administration (PAG-ASA) “Climate Change in the Philippines”. The book contained climate projections for 2020 and 2050 under the high, medium, and low emission scenarios relative to the baseline (1971-2000) climate. The data obtained were: (1) projected changes in seasonal and annual mean temperatures; (2) projected changes in minimum and maximum temperatures; (3) projected changes in seasonal rainfall; and (4) projected frequency of extreme events. More information was gathered from the 2016 (The Physical Science Basis) and 2017 (Impacts, Vulnerabilities and Adaptation) Philippine Climate Change Assessment by The Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation Inc. and Climate Change Commission (CCC).

Hazard information based on the history of past disasters were gathered from the Sorsogon Provincial Disaster Risk Reduction Management Office (SPDRRMO), and the Municipal Disaster Risk Reduction Management Office (MDRRMO) of the municipality, as well as from the CDRA Workshop conducted in the 42 barangays of Gubat.

b. Scope the potential impacts of hazards and climate change

Through an 'impact chain diagram' done during the CDRA workshop, direct and indirect impacts in key areas affected by climate change were identified. The diagrams show the effects and long-term impacts of the projected climate variables in the major ecosystems - agriculture, urban, coastal, and upland. This method is also done to identify specific impact areas and subsequently, exposed elements. The determination of major decision areas are also be based on this analysis.

c. Develop the exposure database.

The third step in the process is the development of an 'exposure database', which involved gathering of baseline maps and attribute data on exposure, vulnerability/sensitivity and adaptive capacity of the exposed elements as the basis for the Climate Change Vulnerability Assessment (CCVA) and Disaster Risk Assessment (DRA). Exposure refers to people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses, In the case of CDRA, the system of interest is classified into five (5) exposure units:

Population Exposure– spatial location (derived from existing residential area map) and number of potentially-affected persons based on demographic characteristics.

Urban Use Area Exposure– built environment currently utilized for residential, commercial, industrial, tourism, sanitary waste management facilities, cemeteries, and other land uses unique to the locality expressed in terms of area, type of use, and replacement/ construction cost.

Natural Resource-Based Production Areas– areas used for agriculture and forest-related production expressed in terms of type of resource or by area in terms of hectares and replacement cost, including current production practices, access to infrastructure and climate/hazard information, presence or use of risk transfer instruments and access to extension services.

*Critical Point Facilities***–** facilities that provide key socio-economic support services such as schools, hospitals/rural health units, local government buildings, roads, bridges, air/seaports, communication towers, and power- and water-related facilities (can be obtained from building/structural inventories).

*Lifeline Utilities***–** _covers transportation, water distribution, drainage and power distribution networks. Municipal assets that ensure delivery of lifeline services expressed in linear kilometers exposed, construction cost or replacement values.

Information on the exposure units are derived together with their vulnerability, sensitivity and adaptive capacity:

Vulnerability is the degree to which a system is susceptible to, or unable to cope with the adverse effects of climate change, including climate variability and extremes. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited social recognition of risks and preparedness measures, and disregard for wise environmental management (UNISDR, 2009).

Sensitivity, on the other hand, is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., 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) (UNISDR, 2009).

Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

d. Conduct a Climate Change Vulnerability Assessment (CCVA).

Once the exposure database for all systems of interest was completed, the next step was the Vulnerability Assessment, which aims to identify vulnerable areas and sectors through analyzing the identification of vulnerable areas and sectors by analyzing the exposure, sensitivity, and adaptive capacity of the systems to the various climate stimuli. Impact areas affected by climate stimuli and exposure are overlaid using Geographic Information System (GIS) to identify exposed elements.

A sensitivity analysis was then conducted given the identified exposed units. Sensitivity indicators from the exposure database were analyzed to determine the important indicators that contribute to the sensitivity of the element to expected climate stimuli. The sensitivity analysis was then used as a guide to rate the degree of impact. The score is based on the parameters in Table 1.

Table 1. Degree of impact score (HLURB, 2014).

Degree of Impact	Degree of Impact Score	Description
High	3	Estimated direct impacts in terms of number of fatalities, injuries and value of property damage will be disastrous given the extent of exposure and current sensitivity of the system. Medium to long term indirect impacts will also be experienced which may affect development processes. Significant costs needed to return to pre-impact
Moderate	2	Moderate direct impacts in terms of number of fatalities, injuries and value of property damage are expected given the extent of exposure and current sensitivities of the system. Short to medium term indirect impacts will also be experienced which may affect development processes. Medium to low cost needed to return to pre-impact levels within a short to medium time period.
Low	1	Estimated direct and indirect impacts are low to negligible which can be felt within a short term period. Minimal impacts to development processes and no significant cost needed to return to pre-impact levels.

Assessing the vulnerability also includes examining various adaptive capacities of the system, whether the system/exposed elements can cope with the impacts (Table 2). Vulnerability is a function of sensitivity and adaptive capacity.

Table 2. Adaptive capacity score and description (HLURB, 2014).

Degree of Adaptive Capacity	Adaptive Capacity Rating	Description
Low	3	The system is not able to accommodate changes in the climate. Addressing the impacts will be costly. The LGU and property owners will require external assistance to address the impacts.
Moderate	2	Addressing the impacts will require significant cost but it is still within the capacity of the system to adapt to potential impacts. It can accommodate within its resources the cost for adapting and mitigating impacts.
High	1	The system is able to accommodate changes in climate. There are adaptation measures in place to address impacts.

Using the rating from the degree of impact and adaptive capacity, the vulnerability index scores are generated to indicate whether the vulnerability of the area/system is high or low (Table 3). Systems with low vulnerability can be described as systems where the impacts are considered high but adaptive capacities are also high. Results of the vulnerability assessment are inputs in producing vulnerability maps.

Table 3. Vulnerability index scores (degree of impact x adaptive capacity = vulnerability) (HLURB, 2014).

Degree of Impact Score	Adaptive Capacity Score			Vulnerability	Vulnerability Index Range
	High (1)	Moderate (2)	Low (3)		
High (3)	3	6	9	High	>6-9
Moderate (2)	2	4	6	Moderate	>3-6
Low (1)	1	2	3	Low	≤3

e. Conduct a disaster risk assessment.

The final step was the conduct of the DRA, which is the identification of risk areas by analyzing hazard, exposure and vulnerability. This was done by reviewing the technical characteristics of hazards such as location, intensity, frequency and probability, analysis of exposure and vulnerability including the physical, social, health, economic and environmental dimensions; as well as effective coping capacities in relation to likely risk scenarios were interpreted.

Identified exposed units/areas were mapped out indicating location and extent of potentially affected area for a particular climate stimulus (e.g. number of affected persons and replacement cost). Existing and previous hazards in the area are assessed based on how frequent they might occur through the likelihood of occurrence scoring (Table 4). Likelihood of occurrence of hazards is defined as the estimated period of time expressed in years a hazard event is likely to repeat itself. It also incorporates the projected changes in frequency and intensity of the hazard because of climate change.

Table 4. Indicative likelihood of occurrence matrix (HLURB, 2014).

Measure of Likelihood	Return Period (in Yrs)	Likelihood Score
Frequent	Every 1 – 3 yrs	6
Moderate	Every >3-10 years	5
Occasional	Every >10-30 years	4
Improbable	Every >30-100 years	3
Rare event	Every >100-200 years	2
Very rare event	Every > 200 yrs	1

Severity of consequence is the function of exposure and vulnerability that measures the potential direct and indirect damages/ impacts and the interplay of exposure and the vulnerability relative to the expected intensity of the hazard. This can be determined using the suggested severity of consequence score matrix (Table 5).

Table 5. Severity of consequence score matrix (HLURB, 2014).

Category	Severity of Consequence	Description				
		Population	Urban Use Areas	Natural Resource based Production Areas	Critical Point Facilities	Lifeline Utilities
Very High	4	More than 20% of the population are affected and in need of immediate assistance	≥40% of non-residential structures are severely damaged or >20% of residential structures are severely damaged	>40% of exposed production areas/means of livelihood such as fishponds, crops, poultry and livestock and other agricultural/forest products are severely damaged;	Damages may lead to the disruption of services which may last one week or more	Disruption of service by lasting one week or more (for Municipalities) and one day for Highly Urbanized Areas
High	2	>10% to 20% of affected population in need of immediate assistance	>20% to 40% of non-residential structures are severely damaged or >5 to 10% of residential structures are severely damaged	20% to <40% of exposed production areas/means of livelihood such as fishponds, crops, poultry and livestock and other agricultural/forest products are severely damaged;	Damages may lead to the disruption of service lasting for one day to less than three days	Disruption of service by approximately three days for municipalities and less than six hour disruption for highly urbanized areas
Moderate	2	>5%-10% of affected population in need of immediate assistance	>10 to 20% of non-residential structures are severely damaged or >5 to 10% of residential structures are severely damaged	>20 to <40% of exposed production areas/means of livelihood such as fishponds, crops, poultry and livestock and other agricultural/forest products are severely damaged;	Damages may lead to the disruption of service lasting for one day to less than three days	Disruption of service by approximately three days for municipalities and less than six hour disruption for highly urbanized areas
Low	1	≤5% of the affected population in need of immediate assistance	≤10% of non-residential structures are severely damaged or ≤5% of residential structures are severely damaged	<10% and below of exposed production areas/means of livelihood such as fishponds, crops, poultry and livestock and other agricultural/forest products are severely damaged	Damages may lead to the disruption of service lasting less than one day	Disruption of service by approximately one day for municipalities and less than six hours disruption for highly urbanized areas

Provided with the scores of the likelihood of occurrence and severity of consequence, risk can be estimated. Risk is defined as the combination of the probability of an event (likelihood of occurrence) and its potential negative consequence for a given area and reference period.

Risk scores give way to the risk classifications of an area: High Risk, Moderate Risk, and Low Risk, as shown in Table 6.

Table 6. Risk score matrix (risk = likelihood of occurrence X severity of occurrence) (HLURB, 2014).

Risk Score Matrix					
Indicative Likelihood of Occurrence	**Likelihood of Occurrence Score**	Very High	High	Moderate	Low
		4	3	2	1
Frequent (1-3 Years)	6	24	18	12	6
Moderate (4-10 Years)	5	20	15	10	5
Occasional Slight Chance (11-30 Years)	4	16	12	8	4
Improbable (31-100 Years)	3	12	9	6	3
Rare (101-200 Years)	2	8	6	4	2
Very rare (>200 years)	1	4	3	2	1

f. Summarize findings.

Finally, findings are summarized and priority decision areas/sectors are identified based on the combined level of risks and vulnerabilities, identification of risk management options, climate change adaptation and mitigation options. Priority decision areas are integrated in Comprehensive Land Use Plans for a more risk-sensitive land use promoting efficient use of resources to enhance adaptive capacities and reduce vulnerability as well as other municipal development and sectoral plans towards a safer and more secure community.

III. LGU Profile

A. Physical and Environmental Profile

Geographic Location and Land Area

The Municipality of Gubat is located on the east coast of the Province of Sorsogon. It is the third largest municipality in Sorsogon Province bounded on the North by the Municipality of Prieto Diaz and Bacon District of Sorsogon City, on the South by the Municipality of Barcelona, on the West by Sorsogon City and the Municipality of Casiguran, and on the East by the vast Pacific Ocean (see Figure 2).

It is nineteen (19) kilometers from the provincial capital Sorsogon City, eighty-one (81) kilometers from the regional center of Legazpi City, and six hundred twenty-one (621) kilometers from Manila. The Municipality lies on the coordinates 12° 55’ 15.63” north latitude, and 124° 07’ 28.66” east longitude.

It has 11,485.62 hectares total land area, and a total of 18,980 hectares of municipal waters and coral reef.

Gubat comprises forty-two (42) barangays, eight (8) of which are classified as urban and located in the poblacion area, while the rest are classified as rural.

Figure 1. Coconut production area in Barangay Buenavista.

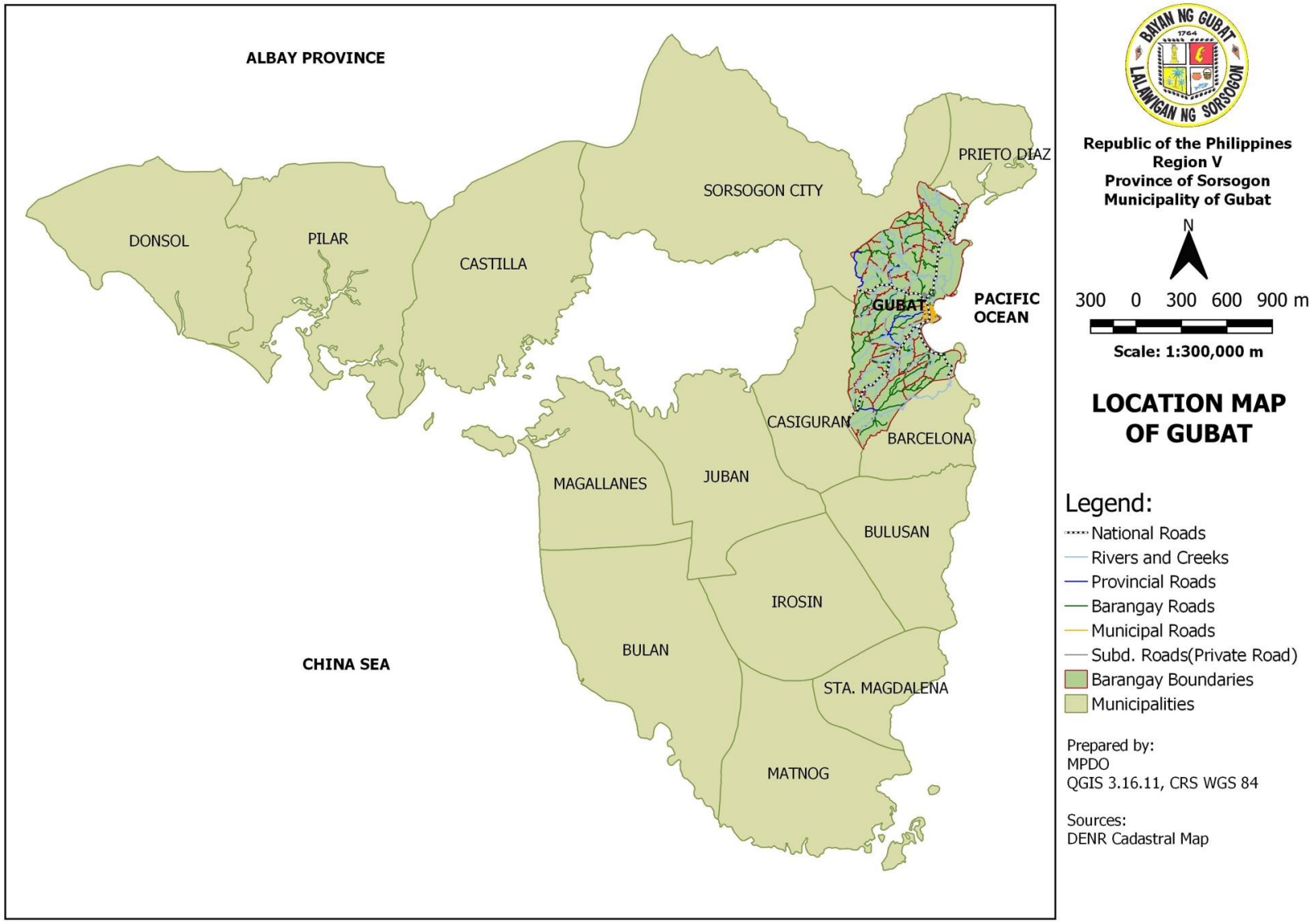


Figure 2. Map of Gubat (MPDO, 2021).

Topography

Gubat is interspersed by creeks and rivulets that are mostly tributaries of the three main rivers called the *Bulacao, Basiao* and *Tingting* (see Figure 3). The *Bulacao* River has two sources: one originates from Ariman in Barangay Bentuco flowing through Anibong, Malidlid and Calumpit, all sitios of Barangay Bulacao, to Barangay Tabi and Ariman where it meets the sea. The other source originates from Liyang, Sitio Patong in Bentuco, to Lucha in Bulacao and merges at Calumpit. The *Basiao* River starts from the numerous springs in Barangay Cabigaan, to Pandan in Bulacao, to Arasiang in Barangay Union, to Tanke in Barangay Sta.Ana, to Aropag in Barangay Ariman and into the sea.

The Tingting River serves the northwestern part of the municipality. From a small brook in Manapao, it flows to Caragti in Barangay Carriedo, to Carriedo proper, then to Maroc-baroc and Tingting in Barangay San Ignacio, then to the southern part of Barangay Tiris and flows out to the sea. Another source originates from Barangay Casili to Barangay Payawin, to Barangay Jupi and then merges at Tingting. From Tingting, rivulets and creeks traverse the outlying plains of the different sitios of Barangay Dita and barangays Lapinig and Patag. All rivers in the municipality empty to the Pacific Ocean.

The town is predominantly level to nearly level to very gently sloping (0-9%) spread over 7,350 hectares that represent 70.4 percent of the total land area (see Figure 4). The town has an average coastal elevation of no higher than 10 meters above sea level, which makes it susceptible to storm surges. The gently sloping (9-18%) is 857 hectares or 8.3 percent of the total land area widely scattered over the whole municipality. Moderately sloping or rolling to strongly sloping or strongly rolling has an area of 2,032 hectares (19.6 percent of the total land area). This type is situated in the northern part of the municipality. The strongly hilly to mountainous portion of more than 30 percent and located on the southwest side of the municipality has a total land area of 181 hectares (1.7 percent of the total land area). Unchecked spot elevations in the municipality are found in Bentuco at 115 meters; Togawe at 95 meters; Naagtan at 87 meters; and parts of Cabigaan and Bagacay at 73 meters. The highest point in Gubat is 166 meters above sea level at Tigkiw, at the southernmost part of the municipality. The other barangays have an average elevation of 24 meters.

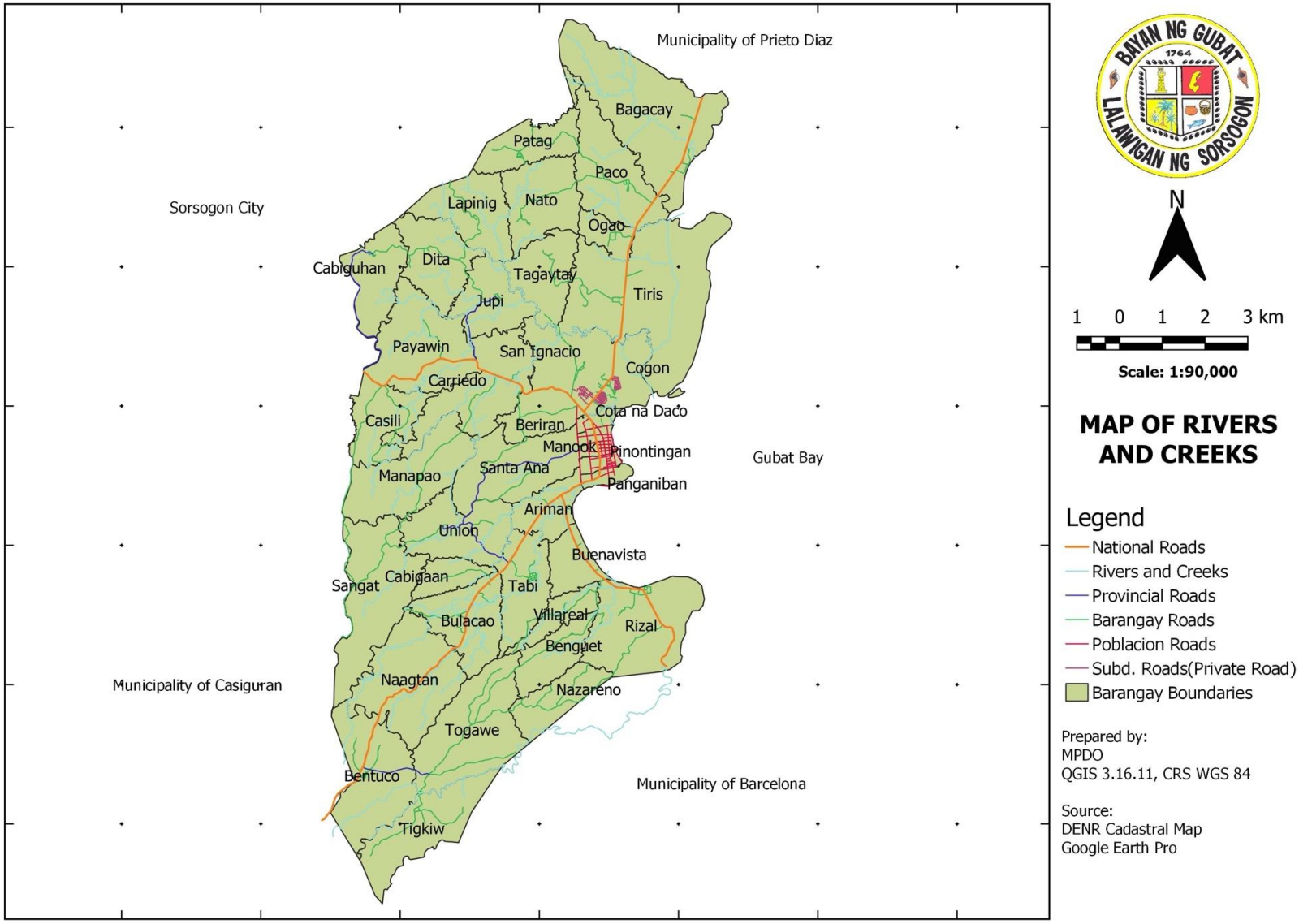


Figure 3. Maps of Rivers and Creeks.

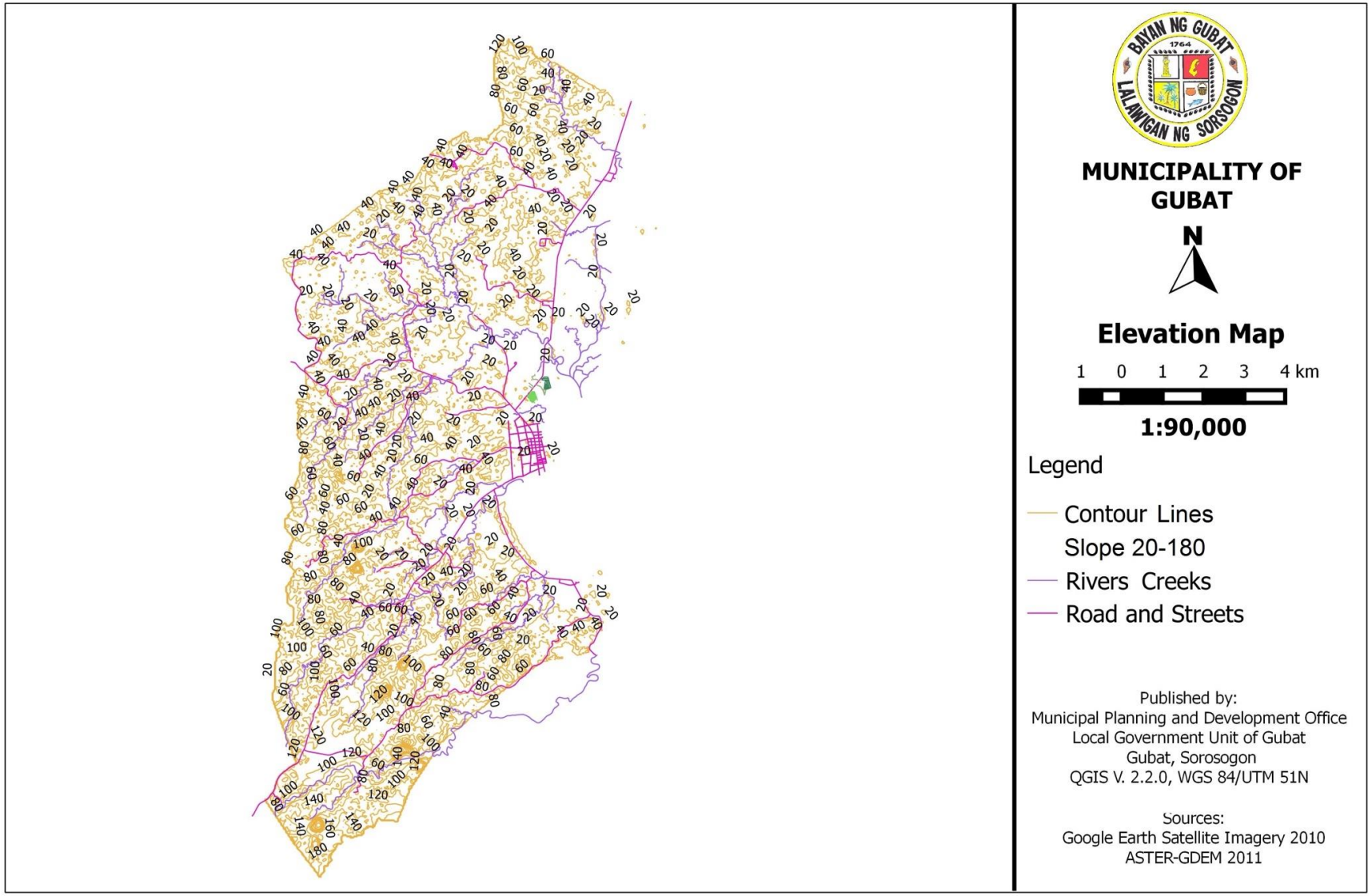


Figure 4. Elevation Map.

Soil

Different soil types characterize the terrestrial territory of the Municipality of Gubat. These are Bascaran clay, comprising 2,834 hectares; clay loam, 4,877 hectares; sandy loam, 240 hectares; hydrosoil, 354 hectares; fine sandy loam, 406 hectares; and fine clay loam, 1,709 hectares. The coastal barangays are the hydrosoil type or the beach type of soil.

The clay loam, fine clay loam and the Bascaran clay are the primary medium of agriculture in the municipality. The clay loam, which has the biggest area coverage, is found in the lowlands while the Bascaran clay is found exclusively in the highlands.

Soil Characteristics

Clay Loam

Depth	Characteristics
0-40 cm	Surface soil, clay loam, dark brown to brick reddish brown; coarse granular to blocky; highly plastic when wet, but becomes brittle upon drying. It has a fair organic matter content and is well penetrated by roots. Boundary to the subsoil is wavy and diffused.
40-110 cm	Subsoil, clay, reddish brown, dark brown to brown; coarse granular to columnar. It is mottled black and gray, highly plastic and sticky when wet, and brittle and hard when dry. It is moderately compact. Boulders are present in some places in this layer. It has a wavy boundary to the lower layer.
110-170	Lower subsoil, clay, dark brown to reddish brown; blocky to columnar. Presence of gray and bluish streaks and concretions. Boundary to the substratum is clear.
170-200	Substratum, clay, dark brown to reddish brown; moderately compact and columnar with plenty of concretions. Underneath is reddish orange and gray and highly weathered parent material.

Bascaran Clay

0-40	Surface soil, clay, brownish gray to grayish brown and light reddish brown; moderately compact; blocky structure; slightly plastic when wet; fair amount of organic matter. Gravel is present.
40-65	Subsoil, silty clay to clay, grayish brown to dark brown with abundant brick red streaks; plastic when wet and brittle when dry; coarse columnar. Weathered yellowish gravel is present in this layer. Boundary is diffused and smooth to the lower horizon.
65-115	Lower subsoil, clay, brownish gray splotched with red; columnar and contains yellowish orange gravel. Boundary is smooth and diffused.
115-150	Substratum, clay, yellowish brown, grayish brown to brownish gray, massive. Compact.

Hydrosoil

The hydrosoil in the Municipality of Gubat comprises the areas of swamps and marshes. The areas are under water practically the whole year round and are extensive along the Gubat coastline. The hydrosoil is generally characterized by a brackish aqueous horizon that is about 100 centimeters deep or more depending upon the rise and fall of the tide. Underneath the aqueous layer is the sub-aqueous horizon. It is slimy, brownish gray to grayish brown to light gray, fine to coarse sandy clay to silty clay with plenty of plant remains. The depth ranges from 35 to 80 centimeters. The basal horizon is also slimy, ashy gray sandy clay. The depth ranges from 80 to 150 centimeters or more from the sub-aqueous surface.

Fine Sandy Loam

0-15	Surface soil, fine sandy loam, black to grayish black; friable; fine granular; loose and mellow in all moisture conditions. Fair in organic content and no stones. boundary to the subsoil is smooth and clear.
30-60	Lower subsoil, silt loam, brown to grayish brown and mottled brown; structureless; very compact in dry and wet conditions. Boundary to the substratum is smooth and diffused.
60-150	Substratum, sandy loam, light gray and compact. Below the substratum is a layer of dark gray clay.

Clay Loam

0-60	Surface soil, clay loam; grayish black to reddish brown; coarse granular and moderately compact; slightly sticky and plastic when wet and very crumbly when dry. Contain good amount of organic matter and coarse skeleton is present on areas along rivers. Boundary to the subsoil is clear and wavy.
60-80	Subsoil, clay; reddish brown to strong brown; coarse granular to columnar; moderately compact; very sticky and plastic when wet. In some places, stones are present. Boundary to the lower layer is diffused and wavy.
80-120	Lower subsoil, clay; dark brown to reddish brown with bluish black mottling; coarse columnar. Free from stones. Boundary to the substratum is clear and smooth.
120-below	Substratum, clay; arrange brown to reddish brown speckled yellow and black; coarse granular. This layer rests on highly weathered sandstone and tuff.

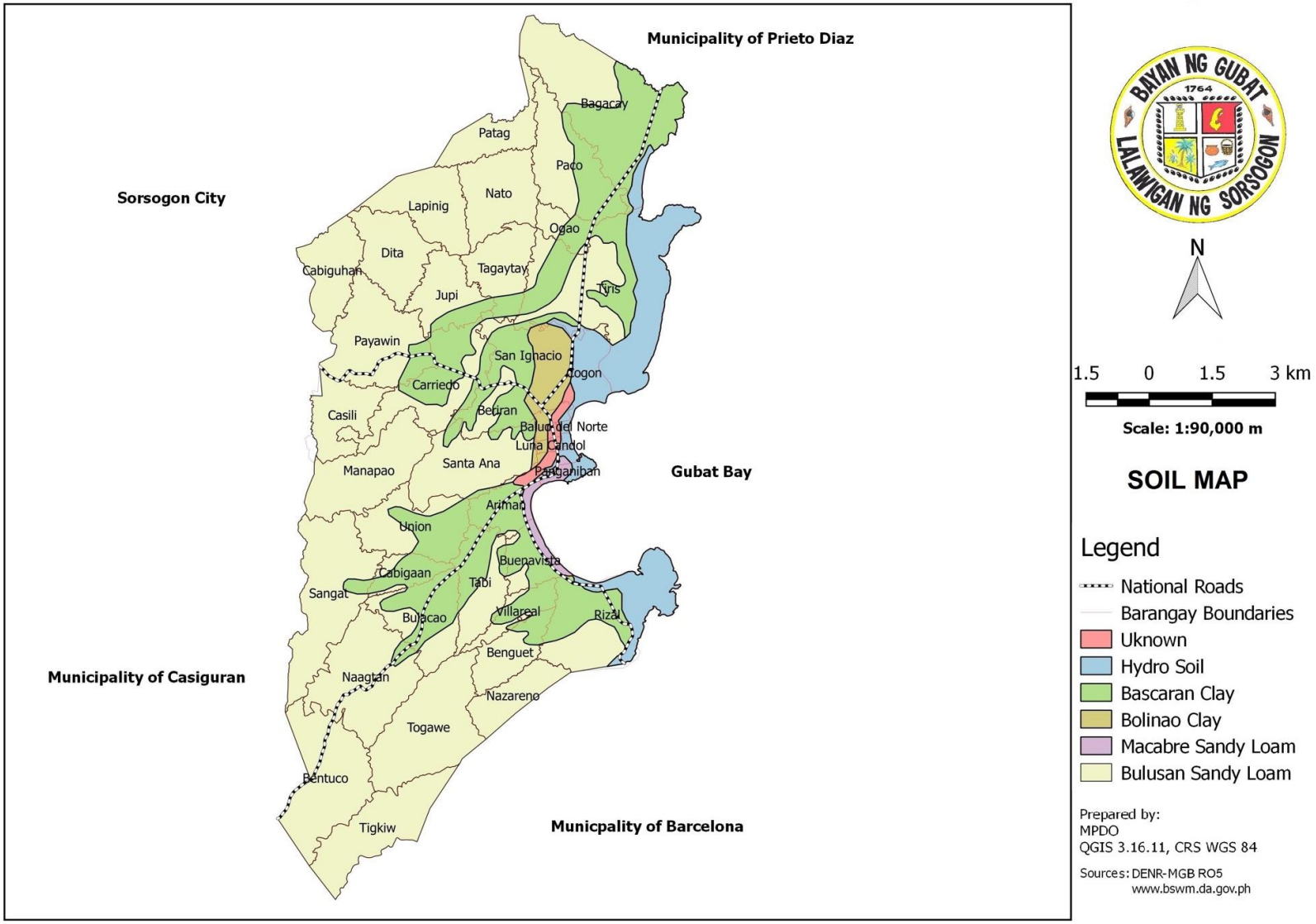


Figure 5. Soil Map of Gubat.

Climate

The municipality experiences a Type II climate based on the Modified Coronas Classification characterized by no dry season with a very pronounced maximum rainfall from December to February during the Northeast Monsoon (*Amihan*).

There are 2 seasonal winds passing the municipality at different times of the year (Figure 6) namely Northeast monsoon or “Amihan” and Southwest Monsoon or “Habagat”. Amihan is a seasonal wind blowing from the northeast direction and is characterized by dry and cold air. It causes cloud development and rainfall at the eastern section of the country where Sorsogon Province is situated. It normally occurs during the months of November up to the middle of March each year. While the southwest monsoon, locally known as “Habagat” is a seasonal wind blowing from the southwest direction and characterized by warm and humid/moist air and causes extensive cloud development and rainfall at the western section of the country. It may reach Sorsogon province during strong surge or when it is enhanced by a Tropical Cyclone. It usually occurs during the months of May to September.

The municipality is mostly visited by tropical cyclones by the last quarter of the year as shown in Figure 7 based on the data of PAG-ASA on Sorsogon Province. Based on the seventy-two (72)-year data record, a total of thirty-eight (38) tropical cyclones directly hit the province, twenty (20) of which are under typhoon category, twelve (12) are tropical storms, while six (6) are tropical depression. Most occurrences fall on the month of November, while there was no direct passage for the months of February, March and April. Although most of these tropical cyclones significantly affected the province and brought about tremendous amount of rainfall even without directly crossing the land.

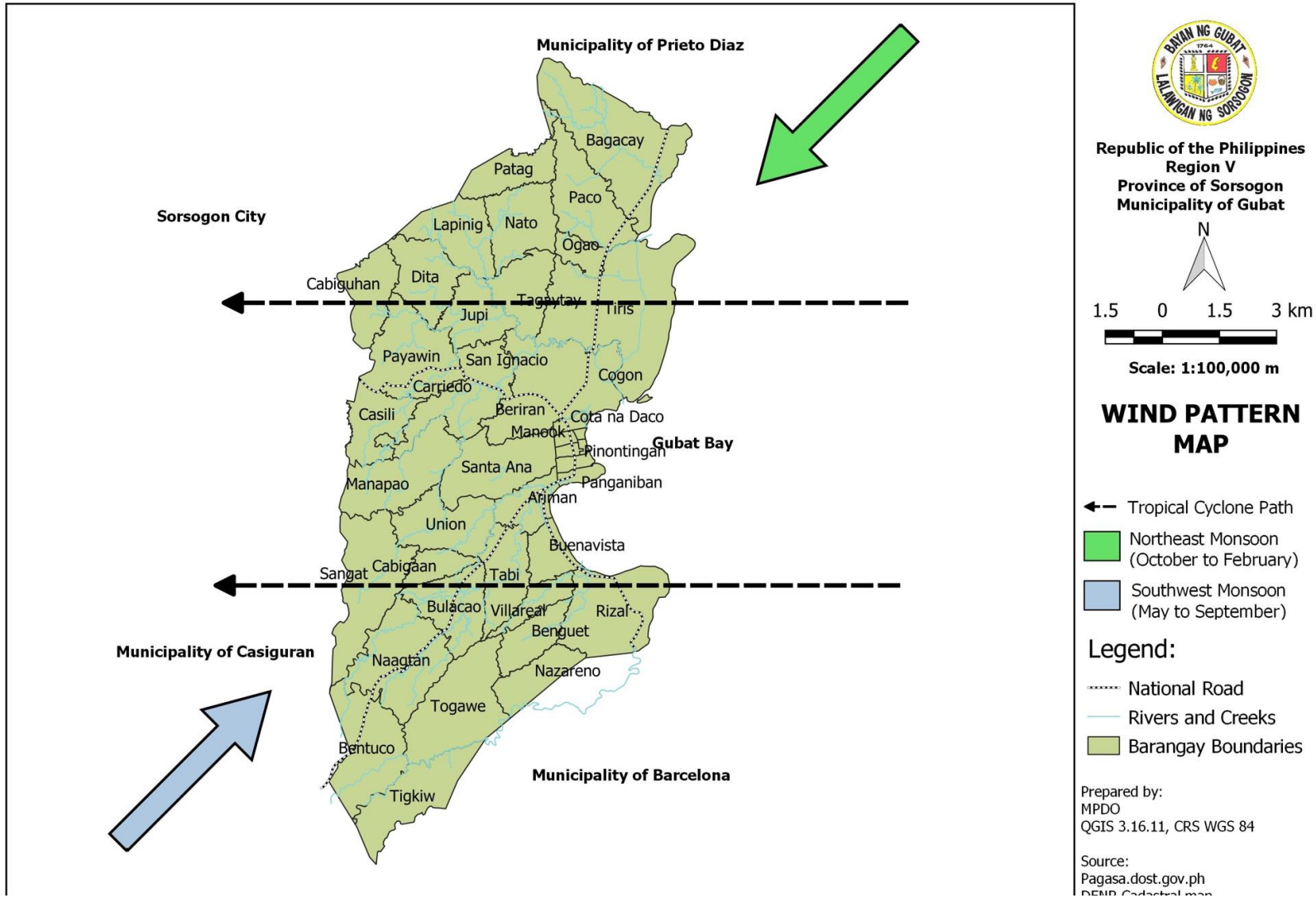
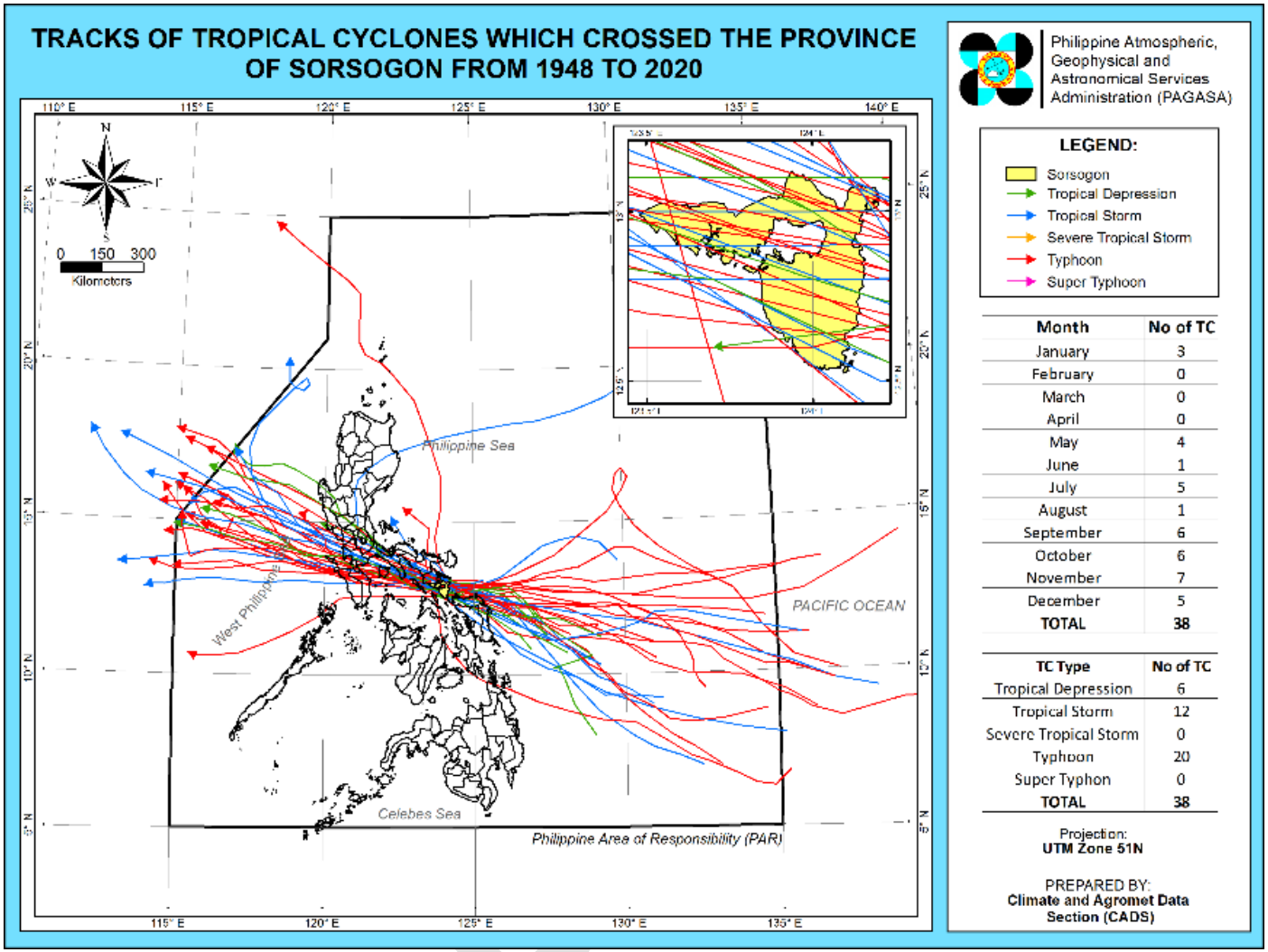


Figure 6. Wind Pattern Map (MPDO, 2021).

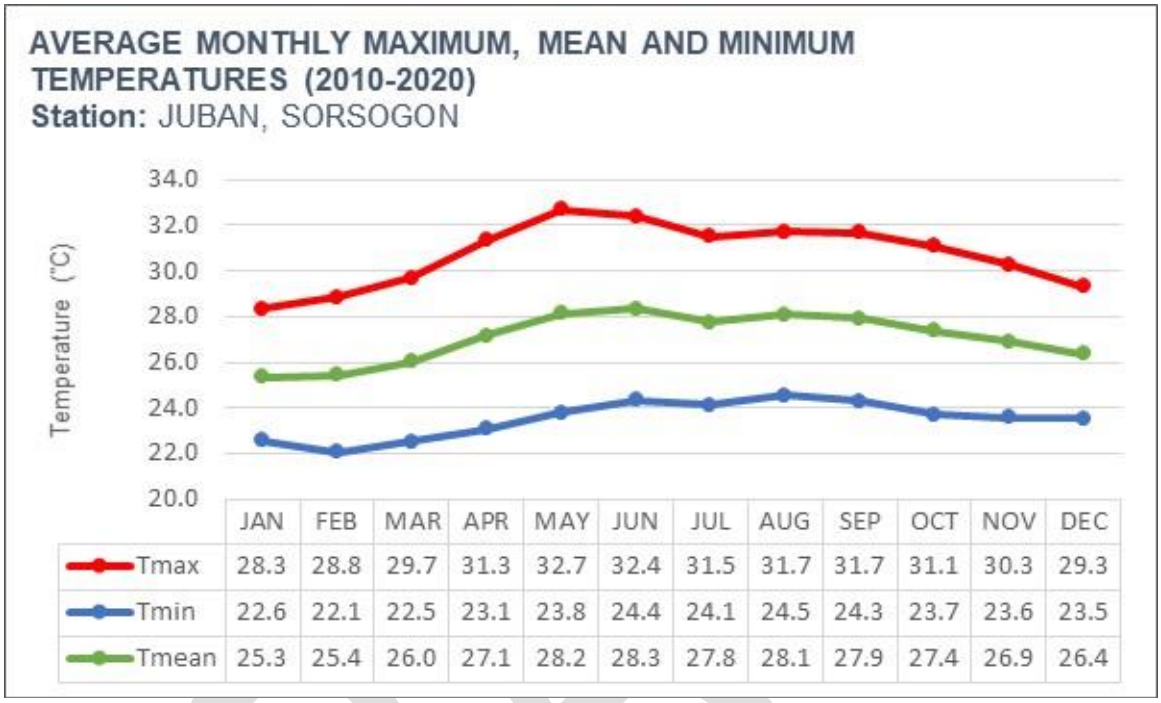


Month	No of TC
January	3
February	0
March	0
April	0
May	4
June	1
July	5
August	1
September	6
October	6
November	7
December	5
TOTAL	**38**

TC Type	No of TC
Tropical Depression	6
Tropical Storm	12
Severe Tropical Storm	0
Typhoon	20
Super Typhon	0
TOTAL	**38**

Figure 7. Tracks of Tropical Cyclones Which Crossed the Province of Sorsogon from 1948 to 2020 (PAG-ASA, 2021).

Figure 8 shows the observed average monthly maximum, mean, and minimum temperatures in Sorsogon Province from 2010 to 2020 based on PAG-ASA Sorsogon Synoptic Station. The average mean temperature ranges from 25.3°C and 28.3°C. The warmest occurs during the months of May and June at 32.7°C and 32.4°C respectively, while the coolest month falls on February at 22.1°C.



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Tmax	28.3	28.8	29.7	31.3	32.7	32.4	31.5	31.7	31.7	31.1	30.3	29.3
Tmin	22.6	22.1	22.5	23.1	23.8	24.4	24.1	24.5	24.3	23.7	23.6	23.5
Tmean	25.3	25.4	26.0	27.1	28.2	28.3	27.8	28.1	27.9	27.4	26.9	26.4

Figure 8. Average Monthly Maximum, Mean, and Minimum Temperatures from 2010 to 2020 in Sorsogon Province (PAG-ASA, 2021).

In terms of rainfall, pronounced maximum precipitation occurs in the months of November, December, and January, at 537.9 mm, 907.5 mm, and 630.5 mm, respectively (Figure 9). This happens during the Northeast (Amihan) monsoon. While there is no dry month, April and May receive the least amount of rainfall at 123.77 mm and 172.9 mm, respectively (PAG-ASA, 2021).

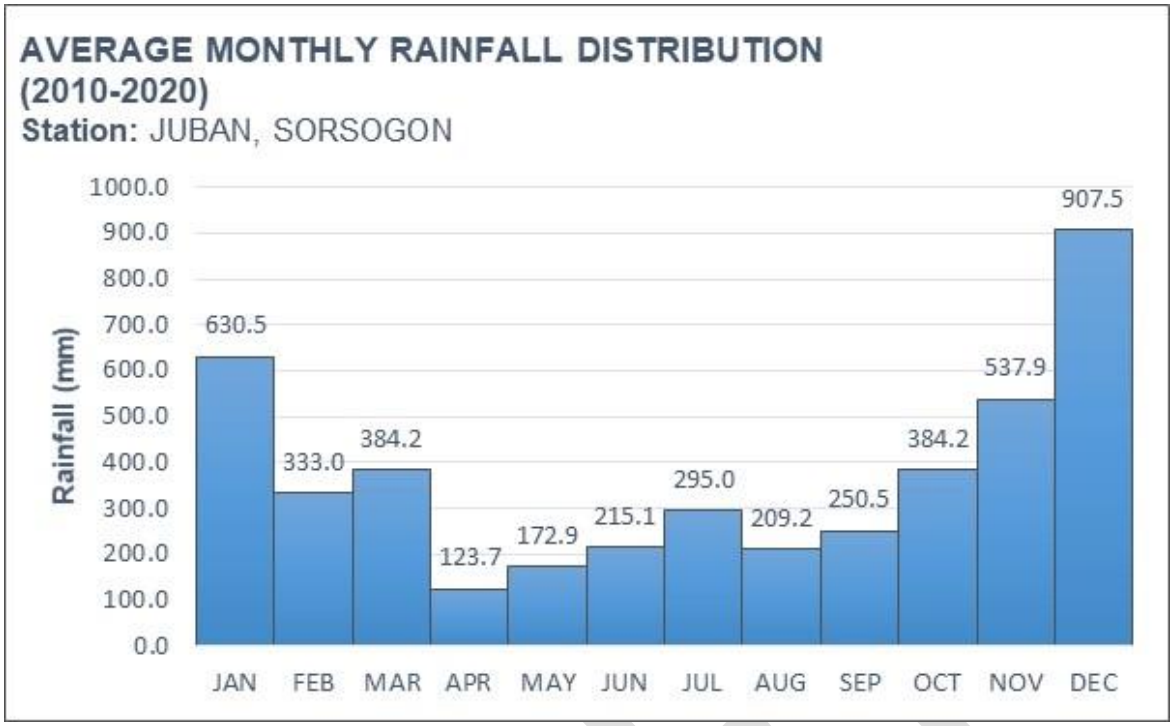


Figure 9. Average Monthly Rainfall Distribution in Sorsogon Province (PAG-ASA, 2021).

Due to high temperature and presence of surrounding bodies of water, Gubat is relatively humid. The most humid months in Sorsogon Province are November, December and January that ranges from 89% - 90%, while the least humid days occurs during the month of May at 83% (Figure 10). The annual mean relative humidity is 86% (PAG-ASA, 2021).

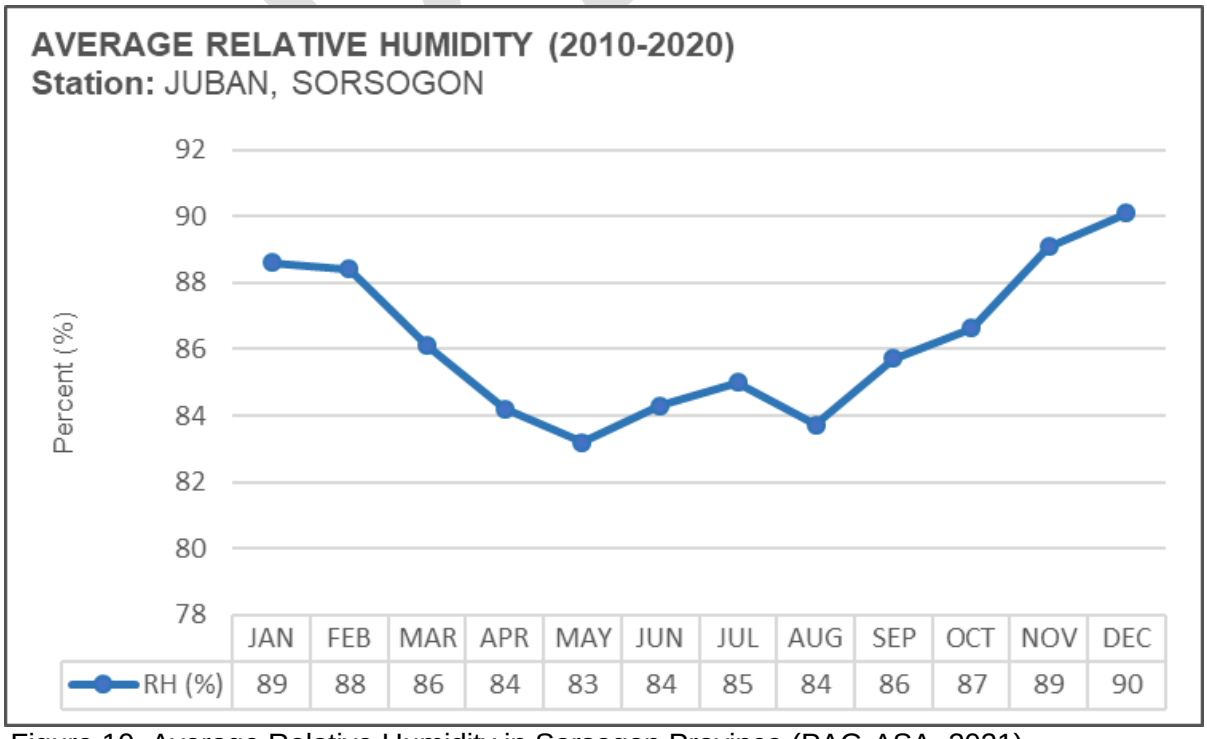


Figure 10. Average Relative Humidity in Sorsogon Province (PAG-ASA, 2021).

B. Population and Demographic Profile

Total Population

The result of the CY 2015 census showed that the municipality had already reached 59,534 counts compared to the recorded population of 57,327 in 2010 (see Table 7). The current population of the municipality accounts for 7.51 percent of the total population of the Province of Sorsogon. This shows that the municipality has a lower growth rate of 0.72 percent compared to the 1.31 percent growth rate of the province.

Table 7. Population, 1960 - 2015 (PSA, 2015).

Year	Population
1960	31,028
1970	38,412
1980	43,866
1990	43,296
1995	49,716
2000	52,707
2007	55,457
2010	57,327
2015	59,534

Determined at 1.2 percent, the annual household growth rate of the municipality is slightly higher than its population growth rate. From this figure, it is expected that households in Gubat will increase from 14,303 households in 2021 to 15,735 households in 2029 or 1,432 additional households in a nine-year period projection (see Table 8).

Table 8. Population and Household Projection, 2021-2029 (PSA, 2020).

Year	Population	Household
2021	62,153	14,303
2022	62,600	14,474
2023	63,051	14,648
2024	63,505	14,824
2025	63,962	15,002
2026	64,423	15,182
2027	64,886	15,364
2028	65,354	15,548
2029	65,824	15,735

Annual Population Growth Rate: 0.72%
Household Growth Rate: 1.2%

Urban-Rural Population

In 2015, the level of urbanization or the percentage of population residing in urban barangays of the municipality was 22.49 percent. This means that a total of 13,388 persons reside in the eight (8) barangays classified as urban. It also shows a decrease in the level of urbanization from 1995, which was 25.15 percent.

The rural population in 2015 comprises 77.51 percent or accounts for 46,146 persons. This figure is 2.66 percent higher than the rural population in 1995 which is 74.85 percent or 37,211 persons.

While previous records in 1995 census showed that the urbanity movement in the municipality is slow, there was a significant increase of rural population or decrease in urbanity movement in the municipality in the year 2015 (see Table 9). This could be attributed to the development of new subdivisions in barangays Cogon and San Ignacio, which are both classified as rural barangays.

Table 9. Urban-Rural Population,1995 and 2015 (PSA, 2015).

Barangay	1995		2015	
	Household	Population	Household	Population
Urban				
Balud del Norte	349	1,664	444	1,961
Balud del Sur	240	1,176	270	1,192
Cota na Daco	270	1,259	386	1,707
Luna Candol	491	2,297	533	2,356
Manook	302	1,462	317	1,401
Panganiban	438	2,036	500	2,211
Paradijon	275	1,265	293	1,295
Pinontingan	298	1,346	286	1,265
Sub-Total	**2,663**	**12,505**	**3,029**	**13,388**
Rural				
Ariman	261	1,309	375	1,657
Bagacay	548	2,825	753	3,328
Benguet	116	560	123	543
Bentuco	273	1,417	379	1,676
Beriran	145	701	228	1,007
Buenavista	143	804	226	997
Bulacao	324	1,481	458	2,024
Cabigaan	161	926	253	1,116
Cabiguhan	143	786	174	771
Carriedo	379	1,848	508	2,244
Casili	177	940	249	1,101
Cogon	201	1,013	518	2,289
Dita	100	546	110	488
Jupi	197	1,062	248	1,095
Lapinig	70	364	110	485
Manapao	155	742	219	968
Naagtan	194	978	221	975
Nato	182	986	255	1,129
Nazareno	75	349	118	522
Ogao	207	991	300	1,327
Paco	243	1,367	351	1,552
Patag	100	522	134	593
Payawin	243	1,228	365	1,611
Rizal	510	2,566	609	2,690
San Ignacio	216	1,121	508	2,244
Sangat	152	845	188	832
Sta. Ana	262	1,225	456	2,015
Tabi	328	1,672	380	1,681
Tagaytay	142	737	233	1,031
Tigkiw	207	1,028	231	1,019
Tiris	323	1,518	465	2,053
Togawe	192	907	286	1,265
Union	239	1,197	270	1,193
Villareal	112	650	141	625
Sub-Total	**7,320**	**37,211**	**10,442**	**46,146**
TOTAL (Urban + Rural)	**9,983**	**49,716**	**13,471**	**59,534**

The average household size dropped from 4.98 in 1995 to 4.39 household size in 2015. The average household size in rural barangays in 1995 is higher than urban while the values are the same in 2015, with Barangay Dita having the largest household size at 4.43 (see Table 10).

Table 10. Household Distribution by Barangay, 1995 and 2015 (PSA, 2015).

Barangay	1995	2015
	Average Household Size	**Average Household Size**
Urban		
Balud del Norte	4.77	4.38
Balud del Sur	4.90	4.39
Cota na Daco	4.66	4.39
Luna Candol	4.68	4.38
Manook	4.84	4.40
Panganiban	4.65	4.39
Paradijon	4.60	4.40
Pinontingan	4.52	4.40
Sub-Total Average	**4.70**	**4.39**
Rural		
Ariman	5.02	4.39
Bagacay	5.16	4.36
Benguet	4.83	4.41
Bentuco	5.19	4.39
Beriran	4.83	4.40
Buenavista	5.62	4.39
Bulacao	4.57	4.39
Cabigaan	5.75	4.39
Cabiguhan	5.50	4.42
Carriedo	4.88	4.38
Casili	5.31	4.40
Cogon	5.04	4.38
Dita	5.46	4.43
Jupi	5.39	4.40
Lapinig	5.20	4.40
Manapao	4.79	4.40
Naagtan	5.04	4.40
Nato	5.42	4.41
Nazareno	4.65	4.41
Ogao	4.79	4.40
Paco	5.63	4.40
Patag	5.22	4.42
Payawin	5.05	4.39
Rizal	5.03	4.37
San Ignacio	5.19	4.38
Sangat	5.56	4.41
Sta. Ana	4.68	4.39
Tabi	5.10	4.40
Tagaytay	5.19	4.41
Tigkiw	4.97	4.39
Tiris	4.70	4.38
Togawe	4.72	4.40
Union	5.01	4.40
Villareal	5.80	4.42
Sub-Total Average	**5.08**	**4.39**
TOTAL (Urban + Rural) Average	**4.98**	**4.39**

As per result of the census conducted in 2015, the largest age group population is age group 10-14, which accounts for 11.54 percent followed by age group 15-19 making up 10.84 percent of the total population (see Table 11). Of the total population, 60.16 percent belongs to the working-age population (15 to 64 years). Children below 15 years of age comprises 32.09 percent while older persons with age 65 years and over accounts for 7.75 percent. Data also shows that male slightly outnumbered the females. Of the total population, 50.67 percent is male while 49.33 percent is female (see Figure 11).

Table 11. Population Distribution by Age Group and Sex, 2010 and 2015 (PSA, 2015).

Population Distribution by Age Group and Sex CY 2015 and 2010						
Age Group	Censal Year 2 (2015)			Censal Year 1 (2010)		
	Male	Female	Total	Male	Female	Total
0 - 4	3,024	2,839	5,863	3,624	3,570	7,194
5 - 9	3,359	3,012	6,371	3,916	3,587	7,503
10 - 14	3,524	3,349	6,873	3,997	3,780	7,777
15 - 19	3,410	3,041	6,451	2,976	2,464	5,440
20 - 24	2,574	2,297	4,871	1,766	1,510	3,276
25 - 29	1,932	1,788	3,720	1,619	1,554	3,173
30 - 34	1,722	1,649	3,371	1,590	1,589	3,179
35 - 39	1,793	1,692	3,485	1,768	1,757	3,525
40 - 44	1,612	1,563	3,175	1,664	1,622	3,286
45 - 49	1,725	1,709	3,434	1,462	1,327	2,789
50 - 54	1,451	1,397	2,848	1,244	1,172	2,416
55 - 59	1,220	1,249	2,469	974	1,021	1,995
60 - 64	915	1,074	1,989	854	902	1,756
65 and over	1,907	2,707	4,614	1,724	2,294	4,018
Total	**30,168**	**29,366**	**59,534**	**29,178**	**28,149**	**57,327**

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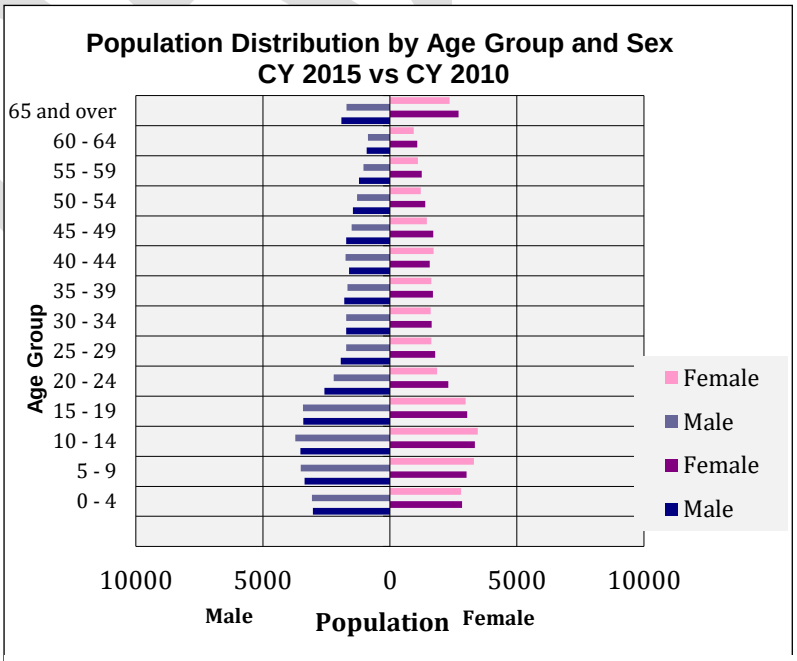


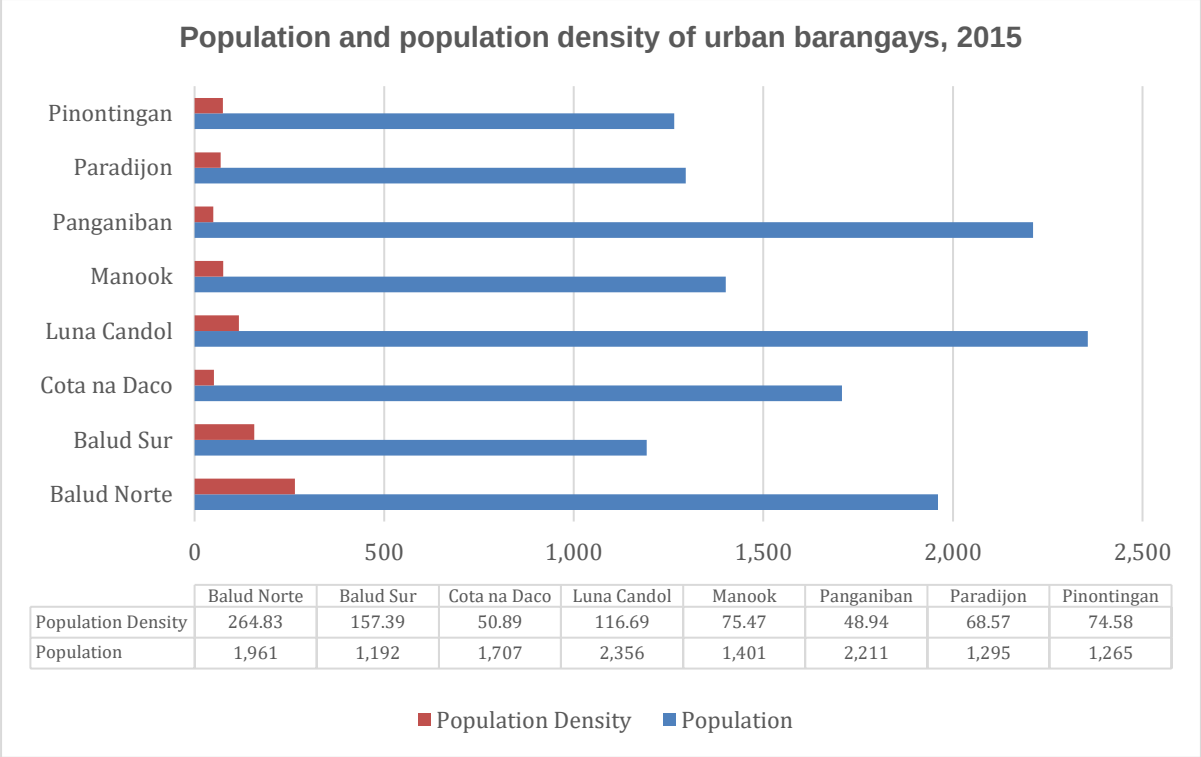
Figure 11. Population Distribution by Age Group and Sex, 2015 and 2010 (PSA, 2015).

Population Density

Based on the total land area of 11,485.62 hectares, the population density of the municipality in 2015 stands at 5.18 per hectare, while urban or población barangays remain to have the highest population density with barangay Balud del Norte posting the highest figure with 264.33 per hectare population density (see Table 12 and Figure 12).

Table 12. Population, Land Area and Population Density per Barangay, 2015 (PSA, 2015).

Barangay	Population	Land Area (in has)	Population Density
Ariman	1,657	153.18	10.82
Bagacay	3,328	750.70	4.43
Balud Norte	1,961	7.40	264.83
Balud Sur	1,192	7.57	157.39
Benguet	543	193.29	2.81
Bentuco	1,676	463.18	3.62
Beriran	1,007	185.98	5.41
Buenavista	997	142.06	7.02
Bulacao	2,024	310.50	6.52
Cabigaan	1,116	47.06	23.72
Cabiguhan	771	285.47	2.70
Carriedo	2,244	412.89	5.43
Casili	1,101	283.16	3.89
Cogon	2,289	160.50	14.26
Cota na Daco	1,707	33.54	50.89
Dita	488	250.12	1.95
Jupi	1,095	235.61	4.65
Lapinig	485	267.48	1.81
Luna Candol	2,356	20.19	116.69
Manapao	968	421.76	2.30
Manook	1,401	18.56	75.47
Naagtan	975	523.33	1.86
Nato	1,129	360.93	3.13
Nazareno	522	204.71	2.55
Ogao	1,327	93.99	14.12
Paco	1,552	386.60	4.01
Panganiban	2,211	45.18	48.94
Paradijon	1,295	18.89	68.57
Patag	593	236.26	2.51
Payawin	1,611	449.26	3.59
Pinontingan	1,265	16.96	74.58
Rizal	2,690	509.70	5.28
San Ignacio	2,244	302.32	7.42
Sangat	832	514.28	1.62
Sta. Ana	2,015	395.87	5.09
Tabi	1,681	263.45	6.38
Tagaytay	1,031	255.30	4.04
Tigkiw	1,019	368.89	2.76
Tiris	2,053	942.80	2.18
Togawe	1,265	496.10	2.55
Union	1,193	326.45	3.65
Villareal	625	124.15	5.03
Total	**59,534**	**11,485.62**	**Ave. 5.18**



	Balud Norte	Balud Sur	Cota na Daco	Luna Candol	Manook	Panganiban	Paradijon	Pinontingan
Population Density	264.83	157.39	50.89	116.69	75.47	48.94	68.57	74.58
Population	1,961	1,192	1,707	2,356	1,401	2,211	1,295	1,265

Figure 12. Population and Population Density of Urban Barangays, 2015 (PSA, 2015).

Among the 34 rural barangays, only four barangays (Ariman, Cabigaan, Cogon, Ogao) posted a double-digit population density of which Cabigaan is the most densely populated rural barangay with 23.72 population density per hectare (see Table 8). The remaining barangays have single-digit densities (see Figure 13) with the following four barangays having the lowest population densities: Dita (1.95), Naagtan (1.86), Lapinig (1.81), and Sangat (1.62) (see Table 8).

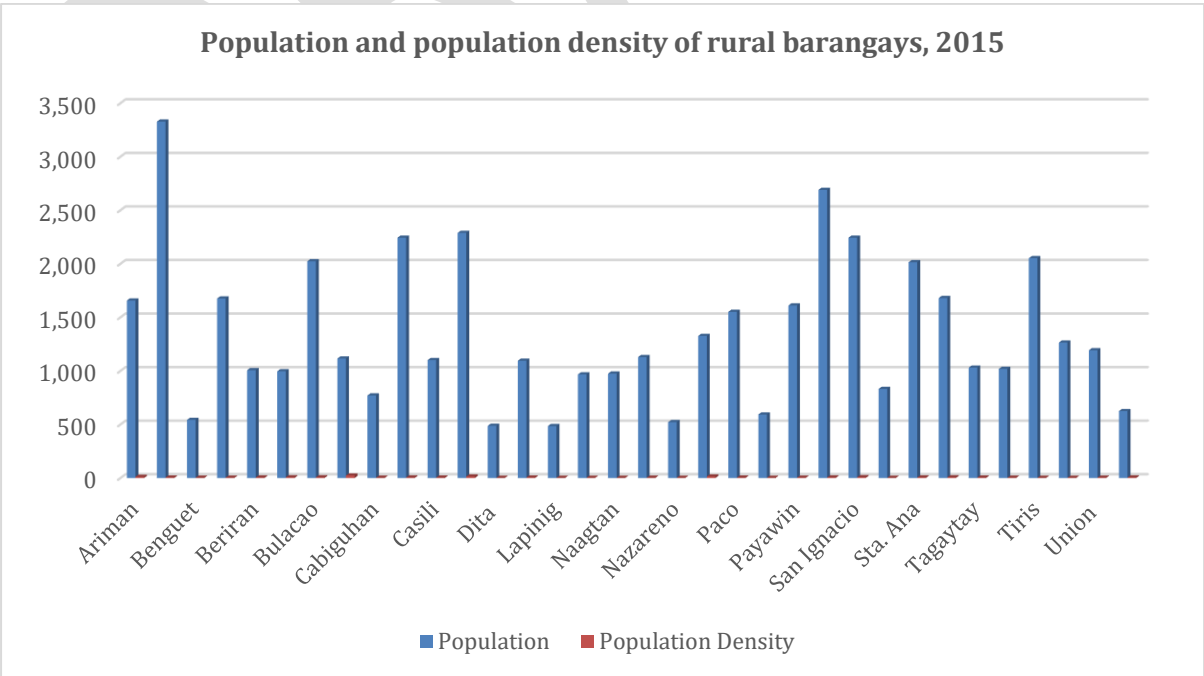


Figure 13. Population and Population Density of Rural Barangays, 2015 (PSA, 2015).

Ethnicity*

Close to 97 percent of the household population in the whole province of Sorsogon are Bicolanos. Other ethnic groups include Tagalog (0.38%), Kankanaey (0.22%), Bisaya (0.17%), and Masbateño (0.13%).

*Source: https://psa.gov.ph/content/five-persons-every-household-sorsogon
http://directory.ucanews.com/dioceses/philippines-sorsogon/409

Poverty Incidence

As per 2015 PSA record, the poverty incidence among families in the municipality was at 30.5 percent (see Table 13), which was significantly lower than the provincial rate of 46.20 percent and regional rate of 45.10 percent, but higher than the national incidence of 21.60 percent. On the other hand, poverty incidence among individuals based on the estimates by the 2015 Family Income and Expenditure Survey (FIES) was 36 percent, lower than the 41.1 percent in 2012.

Table 13. Poverty incidence in Gubat, 2006, 2009, 2012, and 2015 (PSA, 2015).

Year	Poverty Incidence
2006	31.7
2009	33.6
2012	25.6
2015	30.5

However, as per RCBMS 2016 results, there were 7,979 households below the poverty threshold, nearly 59 percent of the total households, and 42 percent of households had income below the food threshold.

Based on the June 2015 data from the Department of Social Welfare and Development (DSWD) Region V, there were 4,042 family beneficiaries of the Pantawid Pamilyang Pilipino Program (4Ps) in Gubat. Barangay Bagacay accounted for the greatest number with 243 families while Barangay Paradijon had the least number of beneficiaries with 17 families. By 2019, 4Ps beneficiaries decreased to 3,833.

* In 2018, a Filipino family of five (5) needed P 7,337.00 average monthly income to buy their Minimum Basic Food Needs and P 10,481.00 monthly to include Other Minimum Basic Needs. In 2009, the food threshold was at PhP 4,869 and poverty threshold was at PhP 7,017.00.

Meanwhile, the labor force participation for ages 15 to 24 years (the proportion of the population ages 15 to 24 that was economically active; all the people who supply labor force for the production of goods and services during a specific period) was at 45.5 percent, while the youth unemployment rate of the labor force ages 15 to 24 year without work but available for and seeking employment was at 54.5 percent (see Table 14).

Table 14. Labor Force, 2018 (PSA, 2018).

	Population 15 Years and Over	Employed	%	Unemployed	%
Male	20,261	13,764	67.9	6,497	32.1
Female	20,166	4,615	22.9	15,551	77.1
Both Sexes	40,427	18,379	45.5	22,048	54.5

C. Commerce, Trade, and Industry

Major Economic Activities

Agriculture is the main economic resource of Gubat where the majority of the population is engaged in farming, livestock production and fishing. According to the Office of the Municipal Agriculturist (OMAg), there were 6,756 households enrolled in the Registry System for Basic Sectors in Agriculture (RSBSA) in 2020. This number comprised almost 50percent of the 13,471 total number of households in the municipality (See Figure 14).

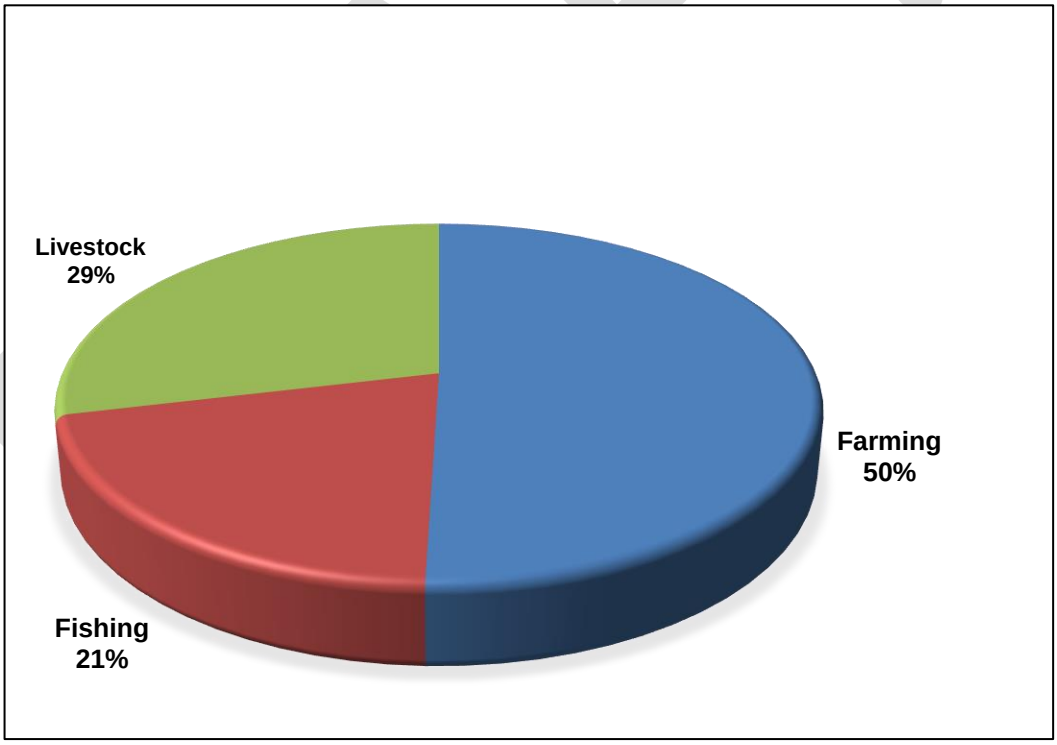


Figure 14. Household Engaged in Farming, Fishing, and Livestock Production, 2020 (RSBSA, 2016).

Data from Business Process and Licensing Office (BPLO) shows a substantial decline of business registrations and employment generation from 2019 to 2020. Gubat recorded a 35 percent decline in registrations by commercial establishments from 1172 in 2019 to 759 in 2020. A direct impact of the COVID-19 pandemic, closures of several establishments evidently affected the sector's employment generation with a 26 percent drop in 2020(See Table 15).

Table 15. Inventory of Registered Commercial Establishments by Economic Activities, 2019-2020.

Economic Activities	2019		2020	
	Number of Establishments	Number of Employees	Number of Establishments	Number of Employees
Wholesale and Retail Trade	836	1633	501	1120
Personal Services (Restaurants, Food Service, Hotel, Recreation and Accommodation)	86	208	56	176
Transport, Storage and Communication	14	180	11	131
Financial Intermediation	24	111	23	108
Health, Education and Social Work	14	74	11	67
Construction	3	13	2	2
Real Estate, Renting and Business Activities	119	138	102	122
Other community, social and personal service activities	76	153	53	131
Total	**1172**	**2510**	**759**	**1857**

Data Source: Business Permit and Licensing Office (BPLO)

Moreover, the results of the assessment of the LGU competitiveness and business-friendliness from the National Competitiveness Council and Philippine Chamber of Commerce and Industry's Business-Friendly LGU Awards Program show that in 2018, Gubat was at the bottom of overall ranking of all municipalities at 1,064 out of 1,368 entries. Among 1st and 2nd class municipalities, it ranked at 430 among 490 entries, an improvement of 50 places from its ranking in 2016.

Consequently, recent reforms on annual targets, management, and overall fiscal effort led to the improvement in the collection of income from local sources of the municipality. Data from Municipal Treasurer's Office (MTO) showed an annual growth rate of four percent from 2016-2020. Except for 2017, there was a general trend of increasing collections from local sources from 2016 to 2020 (See Figure 15).

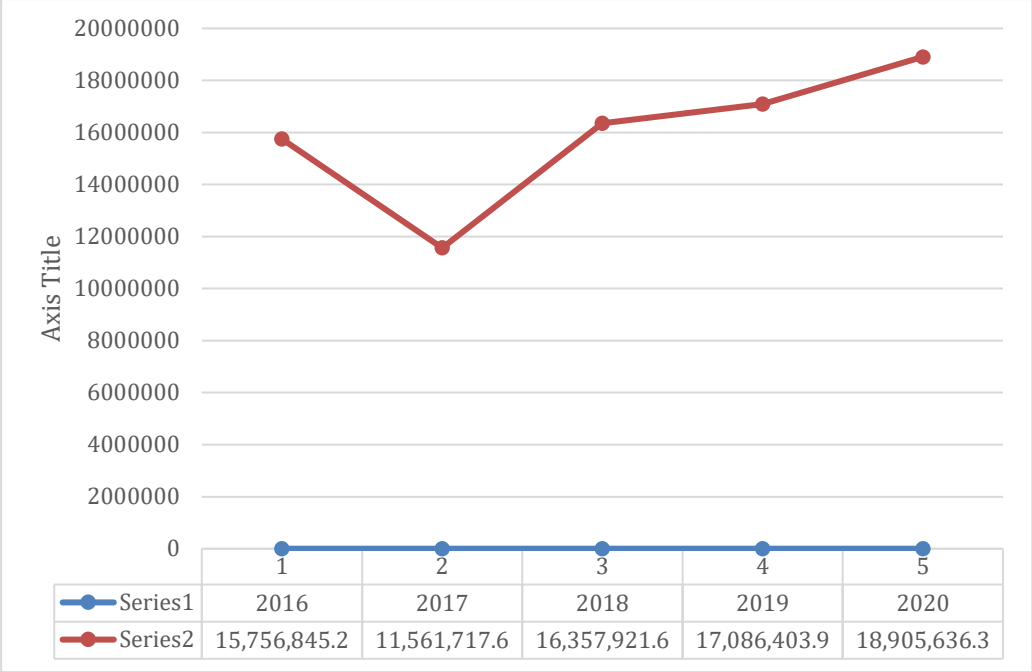


Figure 15. Income from Local Sources, 2016-2020 (MTO, 2020).

D. Current Land Use

The major categories of land classification of the municipality are alienable and disposable land, and the mangrove that grows on coastal barangays. Agricultural, urban and rural land use and recreation are the major capabilities of land in the municipality.

Agricultural lands occupy the major part of the municipality's landscape, with a total area of 9,119.71 hectares or 79.40 percent of the total land area. Agricultural lands can be found in all barangays and small portions in the urban barangays of Luna-Candol, Paradijon, and Panganiban. These are primarily devoted to permanent crops like palay, coconut, and other crops. High value crops like vegetables, citrus, fruit trees, banana, and root crops are found in areas not planted to permanent crops or intercropped on coconut lands.

General residential areas cover 848.30 hectares, while 60.04 hectares is allotted for socialized housing. Commercial and institutional areas sprawl over 109.37 hectares and 103.26 hectares, respectively. There are 48.38 hectares devoted for tourism purposes, 14.90 hectares for industrial, 17.55 hectares for agri-industrial purpose, 16.21 hectares for cemeteries and 37.58 hectares for parks, sports, and recreation. The controlled dumpsite located at Tagaytay has an area of 5.25 hectares. Mangrove forests are spread over an area of 551.49 hectares.

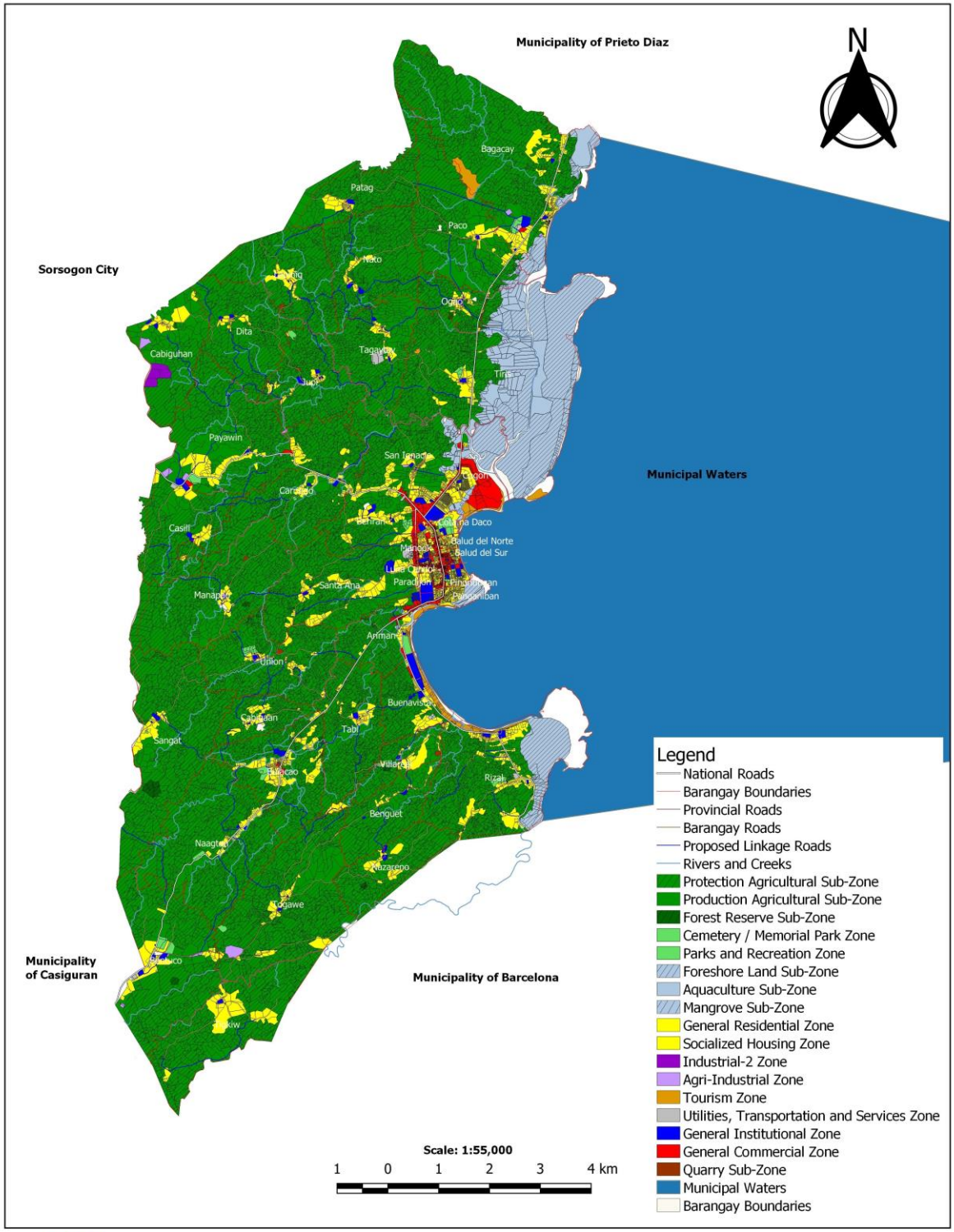


Figure 16. Land Use Map of Gubat .

IV. Climate Projections

Located on the eastern side of Sorsogon facing the Pacific Ocean, Gubat is directly in the path of typhoons and has suffered several destructive ones. Gubat was identified at high risk to climate change events because of its location, its coastal topography (narrow low-lying plains bordered by the ocean and the volcanoes), and the population (largest population center facing the Pacific in the province of Sorsogon). Additionally, because of the presence of rivers, the town is potentially at risk of additional climate stresses, i.e., extreme weather events, changes in precipitation and increase in temperature. Figure 17 shows the projection of sea level rise based on different models and indicates various municipalities of Sorsogon that are prone to this hazard. The projected sea level rise by the year 2100 is more than 0.7 meter, 3 to 5 percent higher than the projected global average.

The climate projections for Gubat were based on the projected changes on temperature and precipitation. The Philippine Climate Extremes Report 2020 of PAG-ASA was analyzed using the Climate Extremes Risk Analysis Matrix (CERAM) tool. The moderate scenario RCP4.5 was used in early (2020-2039), mid (2046-2065), and late (2080-2099) projections as presented in Table 16.

Based on this climate projection, the municipality will experience an increase in temperature across all magnitude by an average of 1.2 °C and increase of more than 50 days of hot days and warm nights by end of 2099. There will be a significant decrease of 137.6 mm from the 2801 mm baseline in total wet-day rainfall but slight increase in the maximum 1-day and 5-day rainfall. Longest wet spell will decrease by 2 days but there will be only minimal change on the longest dry spell. Overall, it is expected to have hotter and drier days in the future and while the total rainfall amount will decrease, more intense rainfall events will be observed.

Inherent with the climate stresses are the increased exposures to various hazards like sea level rise, riverine and coastal flooding, rain-induced landslides, prolonged dry spells and strong winds. Projected impacts of climate change on agriculture include decrease in crop yield, increase in post-harvest losses, increase in crop pests and diseases and decrease in livestock production, thereby negatively affecting food security.

The environment and biodiversity will also be impacted, resulting in extinction of certain species of flora and fauna in a fragile environment. Water use will likewise be affected, including siltation of water bodies, declining water quality, reduction of potable water supply and increased demand in water for use in irrigation. Health impacts include increase in incidence of water- and vector-borne diseases. Extreme weather events will damage social and economic support infrastructures like schools, hospitals, lifelines and other utilities. Human settlements are projected to have increased property damages due to flooding, landslide and storm surge, resulting in increased number of climate-induced casualties and displaced individuals.

Based on marine geological study, Gubat has lost about 70 meters of its shore land to erosion over the past 50years (World Bank, 2012). Recent results of the Climate and Disaster Risks Assessment show that flooding and landslides in some barangays also affect the town. Natural flooding caused by overflow of adjacent rivers combined with the area's physical characteristics affecting five barangays located on the north-western side of the municipality. It must be noted that the low portions of the *población* experience drainage overflow. Depths of these overflows measure less than one meter and usually subside within an hour. Although these cannot entirely be

categorized as flooding, they still pose an obstacle to the normal functions of the affected sections.

In 2008, the World Bank carried out an *insitu* vulnerability assessment to establish which of Gubat's 13 coastal villages were at highest risk and to establish areas of engagement. Adopting the UNDP formula for risk, i.e., Risk = Hazard x Exposure x Vulnerability, the villages of Bagacay and Rizal were found to rank highest in the risk index. Bagacay, with a population of 3,181 in 2007, had a third of its population living within 500 meters of the shoreline. In Rizal, one-fifth of the 2007 population of 2,580was similarly situated. Villagers living directly behind the seawall were found to be at highest risk. Most of them were fishers whose houses would not withstand strong typhoons, with or without climate change. Found to be at high risk of flooding, in addition to the fishing village, were the elementary school, the village hall, and the health center in Bagacay, which were situated a few meters from the seawall.

The state of physical infrastructure in Bacagay and Rizal also presented potential hazards. The main roads and public buildings lacked drainage that worsened the extent and magnitude of rain-induced flooding. The studies concluded that, given the projected increase in frequency and intensity of typhoons, inaction would exacerbate flooding in these communities.

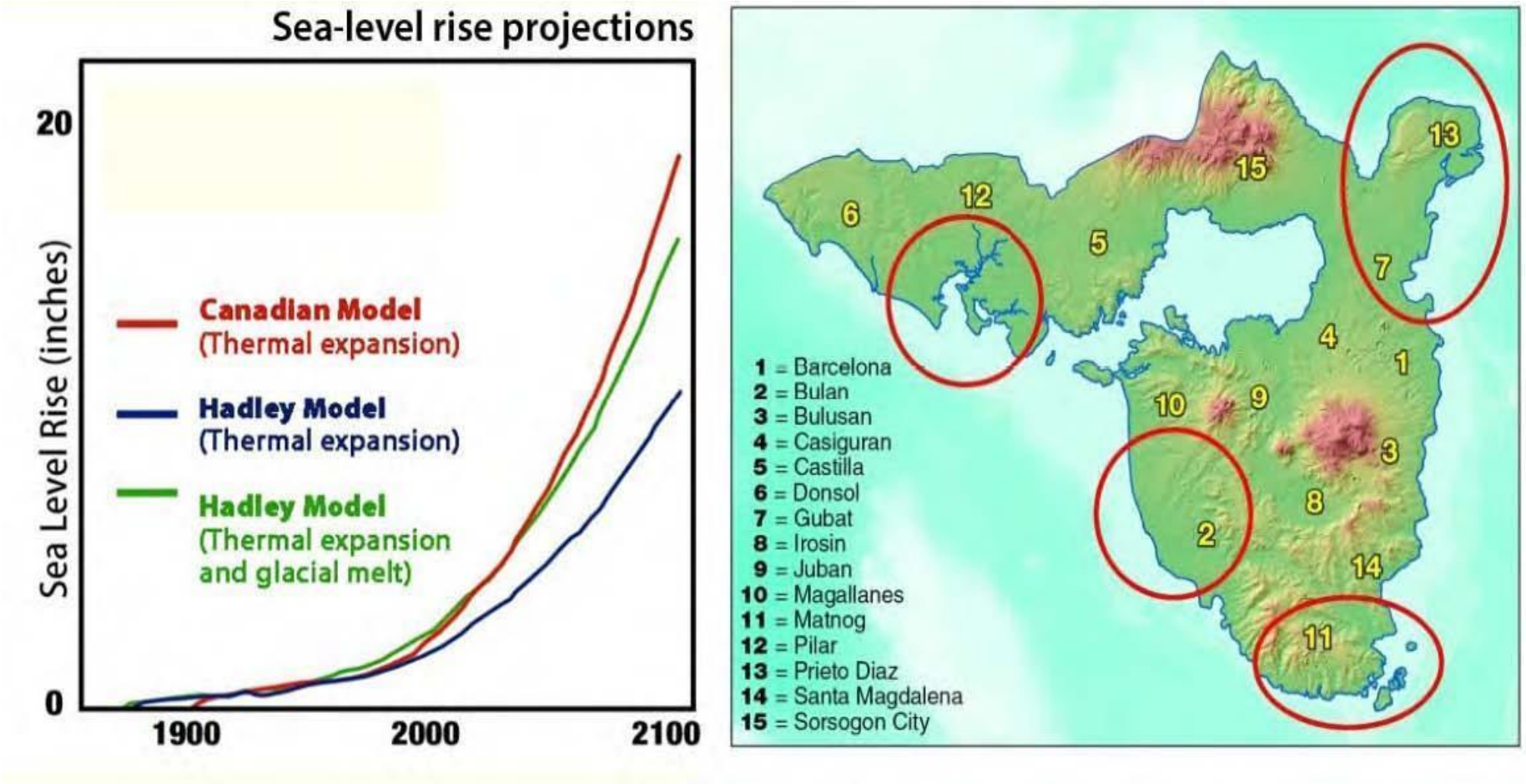


Figure 17. Sea level rise projection.

Table 16. Provincial-scale Observed and Projected Climate Extremes in Sorsogon (PAG-ASA, 2020).

	Climate Extreme Indices	Description	Base line	Scenario	EARLY (2020-2039)		MID (2046-2065)		LATE (2080-2099)		Historical Impacts	Projected Changes in Extremes (LATE)	Potential Impacts of Changes in Extremes	Adaptation Option
					Projected Change		Projected Change		Projected Change					
	CODE				Projected Value	Amount of Change	Projected Value	Amount of Change	Projected Value	Amount of Change				
TEMPERATURE	Magnitude													
	TNn	Coldest night time temperature (°C)	19.8	Moderate Emission (RCP4.5)	20.5	0.7	21	1.2	21.3	1.5	Coldest night temperature is 19.8 °C	1.5 °C increase in coldest night temperature	Drought, dry spell leading to yield reduction, water shortage, heat-driven human and animal diseases, increased morbidity and mortality	Use of heat-resistant crop varieties; utilize solar energy for power source; expansion of irrigaation system coverage; technology support on climate change
	TNm	Average night time temperature (°C)	23.5	Moderate Emission (RCP4.5)	24.1	0.6	24.6	1.1	24.8	1.3	Average night time temperature us 23.5 °C	1.3 °C increase in average night time temperature		
	TNx	Warmest night time temperature (°C)	26	Moderate Emission (RCP4.5)	26.7	0.7	27.1	1.1	27.4	1.4	Warmest night time temperature is 26 °C	1.4 °C increase in warmest night time temperature		

	TXn	Coldest day time temperature (°C)	25.7	Moderate Emission (RCP4.5)	26.4	0.7	26.8	1.1	26.9	1.2	Coldest day time temperature us 25.7 °C	1.2 °C incease in coldest day time temperature		adaptation from the government; Establishment of early warning system; declaration of no build zones; construction of flood preventive and protective structures; use of flood-resistant varieties
	TXm	Average day time temperature (°C)	31	Moderate Emission (RCP4.5)	31.6	0.6	32.2	1.2	32.4	1.4	Average day time temperature is 31 °C	1.4 °C increase in average day time temperature		
	TXx	Warmest day time temperature (°C)	34.4	Moderate Emission (RCP4.5)	35	0.6	35.6	1.2	36	1.6	Warmest day time temperature is 34.4 °C	1.6 °C increase in warmest day time temperature		
	DTR	Daily temperature range (°C)	7.5	Moderate Emission (RCP4.5)	7.5	0	7.6	0.1	7.6	0.1	Daily temperature range is 7.5 °C	Minimal change on daily temperature		
	Frequency													
	TN10p	Fraction of cold nights (%)	11.4	Moderate Emission (RCP4.5)	3.1	-8.3	1.4	-10	0.7	-10.7	Cold nights occur from 41 to 42 days	10 to 11 days decrease in number of cold nights	Flooding, rain-induced landslide resulting to agriculture loss, damages on	
	TN90p	Fraction of warm nights (%)	11.4	Moderate Emission (RCP4.5)	35.4	24	58	46.6	70.3	58.9	Warm nights occur	58 to 59 days		

											from 41 to 42 days	increase in number of warm nights	structures, disruption in mobility of goods and services, increased water-borne diseases	
	TX10p	Fractin of cool days (%)	11.3	Moderate Emission (RCP4.5)	3.5	-7.8	1.6	-9.7	1.1	-10.2	Cool days occur from 41 to 42 days	10 to 11 days decrease in number of cool days		
	TX90p	Fraction of hot days (%)	11.3	Moderate Emission (RCP4.5)	30.1	18.8	56.7	45.4	68.5	57.2	Hot days occur from 41 to 42 days	57 to 58 days increase in number of hot days		
	Duration													
	WSDI	Warm Spell Duration Index (days)	3.9	Moderate Emission (RCP4.5)	66.3	62.4	203.3	199.4	284.1	280.2	The number of days contributing to warm periods is 66 to 67 days.	280 days increase in number of days contributing to warm period		
PR	Magnitude													

	PRCPTOT	Total wet-day rainfall (mm)	2801	Moderate Emission (RCP4.5)	2712.2	-88.8	2783.5	-17.5	2663.4	-137.6	Total wet-day rainfall of 2801 mm is mostly due to occurences of tropical cyclones, tail end of the cold front, thunderstorms, ITCZs, and first half of Amihan season. These events trigger flooding in foodplains mostly ricefields.	137.6 mm decrease in total wet-day rainfall	Water shortage in irrigation and domestic consumption, reduced agricultural yield	
	SDII	Average daily rainfall intensity (mm/day)	12.8	Moderate Emission (RCP4.5)	12.5	-0.3	12.7	-0.1	12.2	-0.6	Average daily rainfall is 12.8 mm/day. Short duration rainfalls pose flooding and landslid	0.6 mm decrease in average daily rainfall		

										e hazards to low-lying and catchment areas.			
	Rx1day	Maximum 1-day rainfall total (mm)	121.8	Moderate Emission (RCP4.5)	125.8	4	132.3	10.5	130.7	8.9	Maximum 1-day rainfall is 121.8 mm and reached or might even be surpassed in the event of tropical cyclones and continuous heavy rainfall during the tail end of the cold front, causing river overflows and agricultural losses.	8.9 mm increase in maximum 1-day rainfall	Flooding, rain-induced landslide resulting to agriculture loss, damages on structures, disruption in mobility of goods and services, increased water-borne diseases
	Rx5day	Maximum 5-day rainfall total (mm)	264	Moderate Emission (RCP4.5)	270.7	6.7	300.5	36.5	264.6	0.6	Maximum 5-day rainfall is 264 mm. Recent prologed	0.6 mm increase in maximum 5-	

											floodings were triggered by TECF and submerged portions of roads and hiways, rice paddies, fish ponds, and few housing units.	day rainfall	
	P95	Rainfall on very wet days (mm)	41.7	Moderate Emission (RCP4.5)	41.5	-0.2	42.5	0.8	40.9	-0.8	Rainfall on very wet days totals to 41.7 mm. This triggers flooding in low-lying areas.	0.8 mm decrease in amount of rainfall on very wet days	Water shortage in irrigation and domestic consumption, reduced agricultural yield
	P99	Rainfall on extremely wet days (mm)	86.9	Moderate Emission (RCP4.5)	85.6	-1.3	85.2	-1.7	87.2	0.3	Rainfall on extremely wet days reaches 86.9 mm and flooded slightly elevated	0.3 mm increase in rainfall on extremely wet days	Flooding, rain-induced landslide resulting to agriculture loss, damag

										areas near river channels.		es on structures, disruption in mobility of goods and services, increased water-borne diseases	
	R95p	Total rainfall from very wet days (mm)	751.3	Moderate Emission (RCP4.5)	752.8	1.5	784.7	33.4	758	6.7	Total rainfall from very wet days is at 751.3mm which are mostly due to typhoons, TECF, and monsoon events causing agricultural damages due to flooding.	6.7 mm increase in total rainfall from very wet days	
	R99p	Total rainfall from extremely wet days (mm)	247.2	Moderate Emission (RCP4.5)	260.1	12.9	262.8	15.6	255.8	8.6	Total rainfall from extremely wet days is at 247.2mm and mostly due to typhoons, monsoon rains, and	8.6 mm increase in total rainfall from extremely wet days	

											TECF continuous heavy rainfall.			
	Frequency													
	P95d	Number of very wet days (days)	10.8	Moderate Emission (RCP4.5)	10.6	-0.2	11.1	0.3	10	-0.8	The number of very wet days is 10 to 11 which is characterized by flooding in low-lying areas and disrupts mobility of goods and services and leads to agricultural losses.	1 day decrease in the number of wet days	Same risks at present may continue in the future.	
	P99d	Number of extremely wet days (days)	2.2	Moderate Emission (RCP4.5)	2.2	0	2.1	-0.1	2.2	0	There are 2 to 3 extremely wet days which caused flooding in low-lying areas.	No change in the number of extremely wet days		
	Duration													

	CWD	Longest wet spell (days)	20.5	Moderate Emission (RCP4.5)	20.3	-0.2	19.4	-1.1	18.4	-2.1	The longest wet spell is 20 to 21 days ausing flooding in low-lying areas.	2 to 3 days decrease in the longest wet spell		
	CDD	Longest dry spell (days)	15.2	Moderate Emission (RCP4.5)	15.2	0.4	15	-0.2	14.4	-0.8	The longest dry spell is 15 to 16 days which leads to drying up of natural springs and difficulty in sourcing irrigation water.	1 day decrease in the longer dry spell		

V. Climate Change Impacts

A. Climate Chain Impact Summary

Gubat, Sorsogon was identified at high risk to climate change events because of their location, their coastal topography (narrow low-lying plains bordered by the ocean and the volcanoes), and the population (largest population center facing the Pacific in the province of Sorsogon) (Integrative Analysis of the Vulnerability of the SEA Region with respect to Food, Health and Coastal Industry, 2008)

Located on the eastern side of Sorsogon facing the Pacific Ocean, Gubat is directly in the path of typhoons and had suffered several destructive typhoons. In 2015, typhoon Nona hit the province of Sorsogon affecting the whole municipality of Gubat. The Sorsogon Provincial Disaster Risk Reduction and Management Office (SPDRMMO) reported a total of 788 families affected in Gubat. The destructive typhoon and its attendant hazards partially and destroyed 1,839 houses with damage to infrastructure, agriculture fisheries and livestock totaling to PhP 87 million.

In 2006, when super typhoons Milenyo (September 2006) and Reming (November 2006) struck, both typhoons were measured to have sustained maximum winds of more than 200 kilometers per hour. In the whole province of Sorsogon, more than 10,000 houses (33%) were destroyed and an estimated PhP 208 million damage to infrastructure was recorded due to typhoon Milenyo. While still in the state of calamity and while recovery was just starting, Typhoon Reming again caused destruction and further affected the already damaged structures and disrupted the urban system thus prolonging the town's recovery. Vital lifelines such as power and water services were impaired, and the former was only fully restored after three months. The impacts gravely affected the poor households in the municipality because their structures sustained severe damage as they are built with materials and technologies that could not sustain stronger typhoon winds, their livelihood implements were destroyed, and their sources of income were halted.

Moreover, given the projected increase in rainfall, the municipality is continually exposed to flooding events. In 2009, during the tail end of the summer season, typhoon Dante, which by the Philippine Atmospheric, Geophysical and Astronomical Services Administration storm warning was only signal number 1, brought extremely heavy rains to the town. According to local records, "Dante" poured more than 300 millimeters of rain within a short period of time and caused major destruction to infrastructure and agricultural land amounting to PhP 200 million worth in Sorsogon city alone (UN Habitat, 2009).

In 2019, Typhoon Tisoy resulted in significant damages in the municipality. An estimated production loss of PhP 223,194,923.70 for crops, PhP 462,500.00 for livestock, and PhP 3,657,000.00 for damages on fishery equipment were recorded. A total of 7,249 houses were affected, of which 656 were totally damaged. Barangays Jupi, Carriedo, San Ignacio, Ariman, and Bulacao were the most heavily flooded due to the overflowing of major river systems.

Based on marine geological study, Gubat has lost about seventy meters of its shore land to erosion over the past fifty years. Recent results of the Climate and Disaster Risks Assessment show that flooding and landslides in some barangays also affect the town.

B. Climate Impact Chain Diagram

The Philippines relies heavily on the coast and coastal resources as settlement areas, economic zones, and food resources. As such there is much concern on the fate of the coast under the climate change lens.

Based on the projected patterns of change in the climate considering the identified climate variables in Table 16, a workshop was conducted to explore the possible impact areas or sectors in Gubat. Representatives from various barangays took part in the exercise providing insights based on their knowledge and experience,

In summary, negative effects in the municipality's ecosystem and the economy were found to be most concerning about the changing climate. With an increased temperature and greater volume of rain, the agriculture sector is the most affected. While worsening the quality of soil, drought can likewise affect the town's water supply – including its irrigation water. Higher temperature also reduces the growth rate of trees and the effect on the quality of produce and may well affect the overall health of the population. Meanwhile, an increased number of hot days means increase in demand for water, both for domestic and agricultural purposes. Intensifying competition among sectors and a rise in demand for water increases production costs, which potentially affects agricultural production and normal functions of businesses and households. A decrease in the amount of rainfall during the Amihan season is crucial to the agriculture sector. Drought, pest multiplication, and reduced recharging rate of the water reservoir shape unfavorable conditions for food production. The said factors may diminish the food supply of Gubat.

With this, food security issue is a perceived exacerbating feature since limited resources has led to the compromise of both agricultural lands and coastal habitat health, A study made in 2008 (Climate Change in Coastal Areas: A Community-Based Adaptation Approach) in Barangay Bagacay found out that cost of climate-related hazard can result to damage to private property (houses and assets) amounting to PhP 10,000,000; damage to barangay public property (e.g. barangay hall), PhP 5,000,000; declining productivity of coastal resources, PhP 650,000 based on incremental loss of PhP 2,800 due to drop of catch from 5 kilos per day to 3 kilos per day; and damage to assets (e.g. fishing boat/gear) may cost as much as PhP 15,000. Loss of such assets in an economy where capital infusion is meager is rather serious.

Extreme events such as excessive rainfall was found to cause flooding in many of the barangays. Although often below one meter and usually subsides within an hour, the normal flow of networks, services, and businesses might be disrupted. This has adverse effects on the barangay's economy and everyday living.

Meanwhile, in the upland areas, frequent tropical cyclones and excessive rains may induce soil erosion and landslides, which can lead to damage on agriculture, properties, livelihoods, and tourism amenities. Equally sensitive is the tourism industry. Overlay of MPAs, resort establishments and transportation infrastructure highlight sites that are becoming vulnerable to climate change.

Finally, it should be noted that non-climate related natural disasters such tsunamis, volcanic eruptions from nearby Mt. Bulusan, and earthquakes continue to be a threat to parts of the municipality. Figure 18 shows the summary of impact chain diagram of all stimuli across all sectors while specific climate change impacts per sector are presented in Figures 19 to 33 of this report.

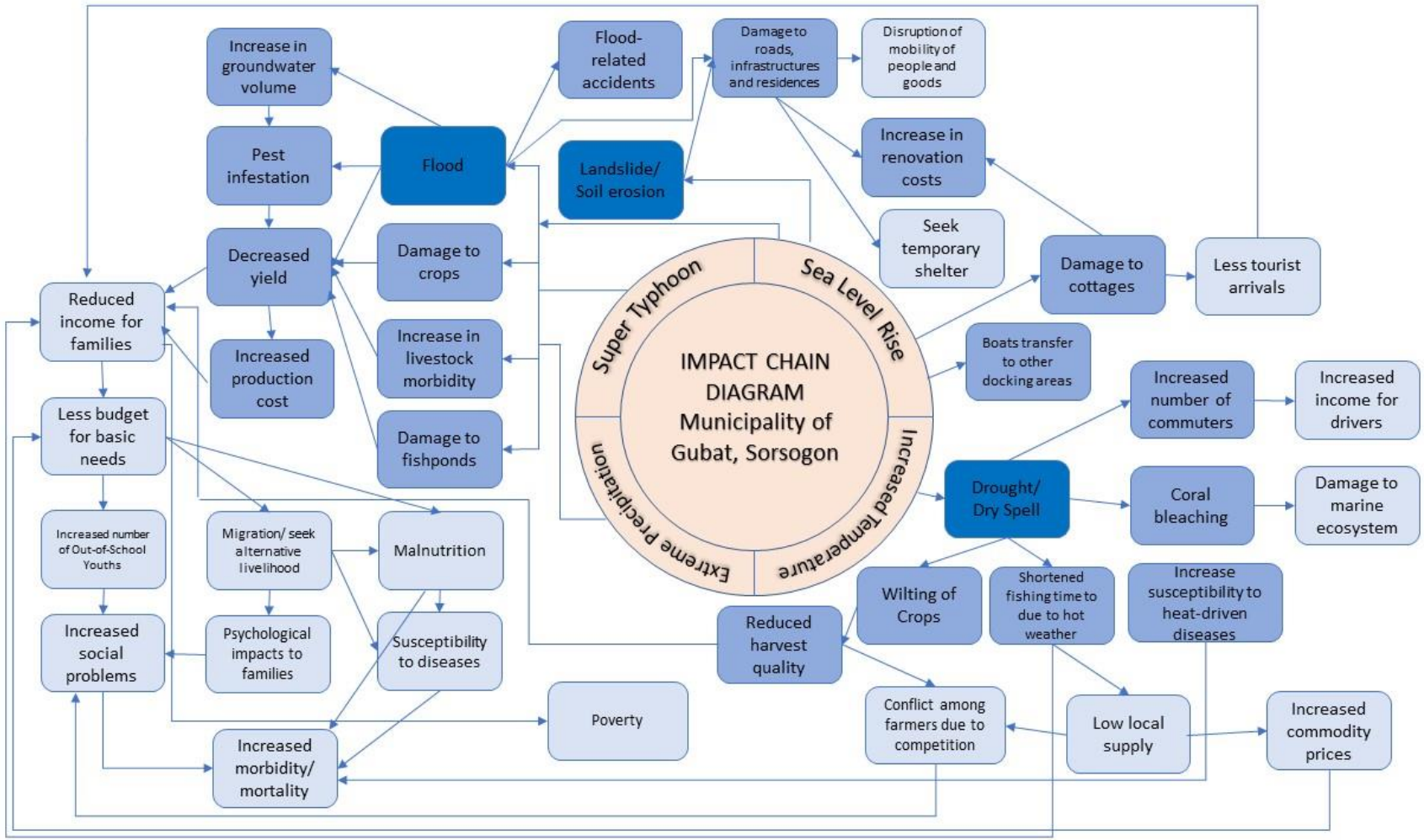


Figure 18. Summary of Impact Chain Diagram (CDRA, 2018).

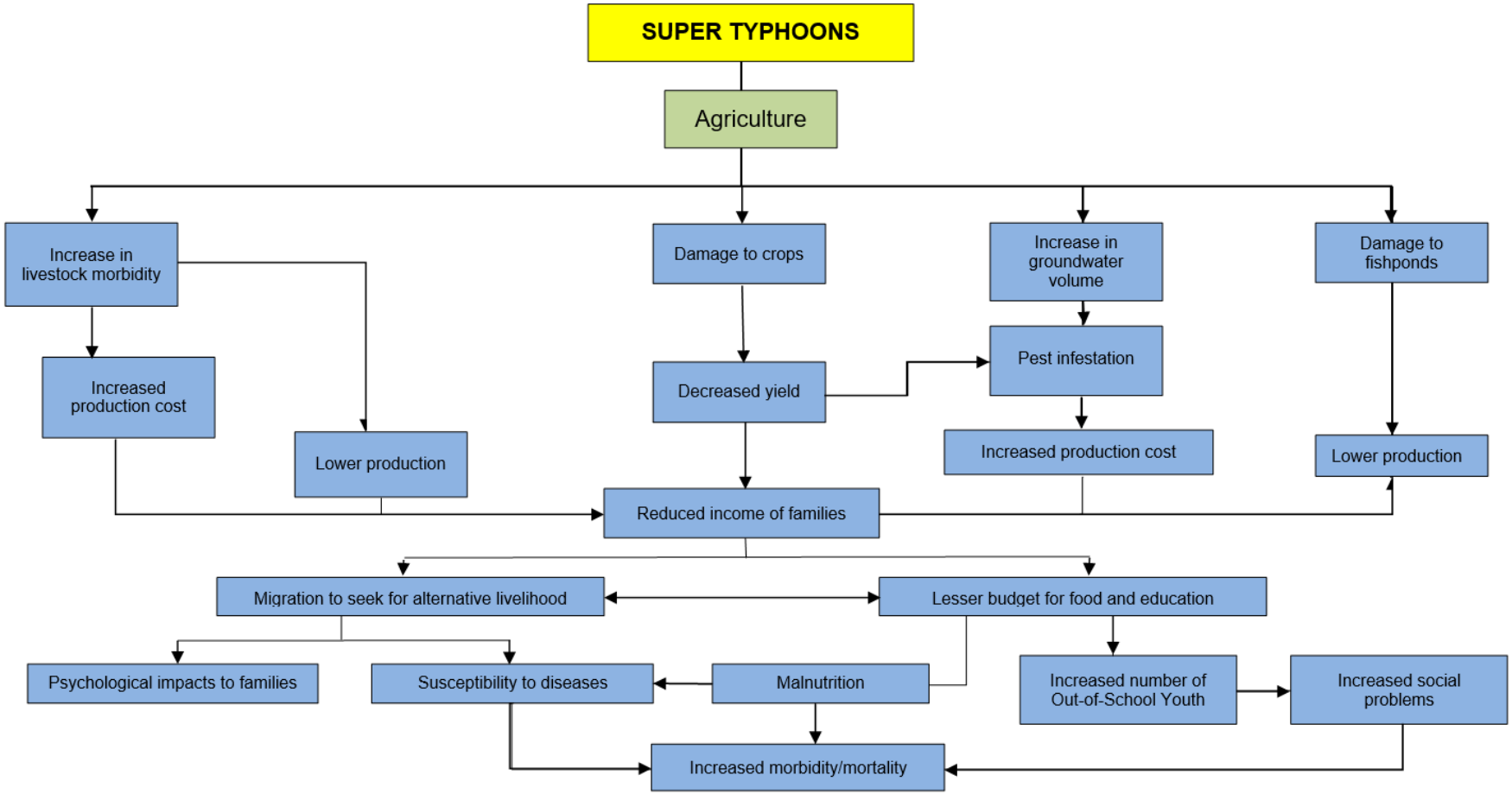


Figure 19. Impact Chain Diagram of Super Typhoons in Agriculture (CDRA, 2018).

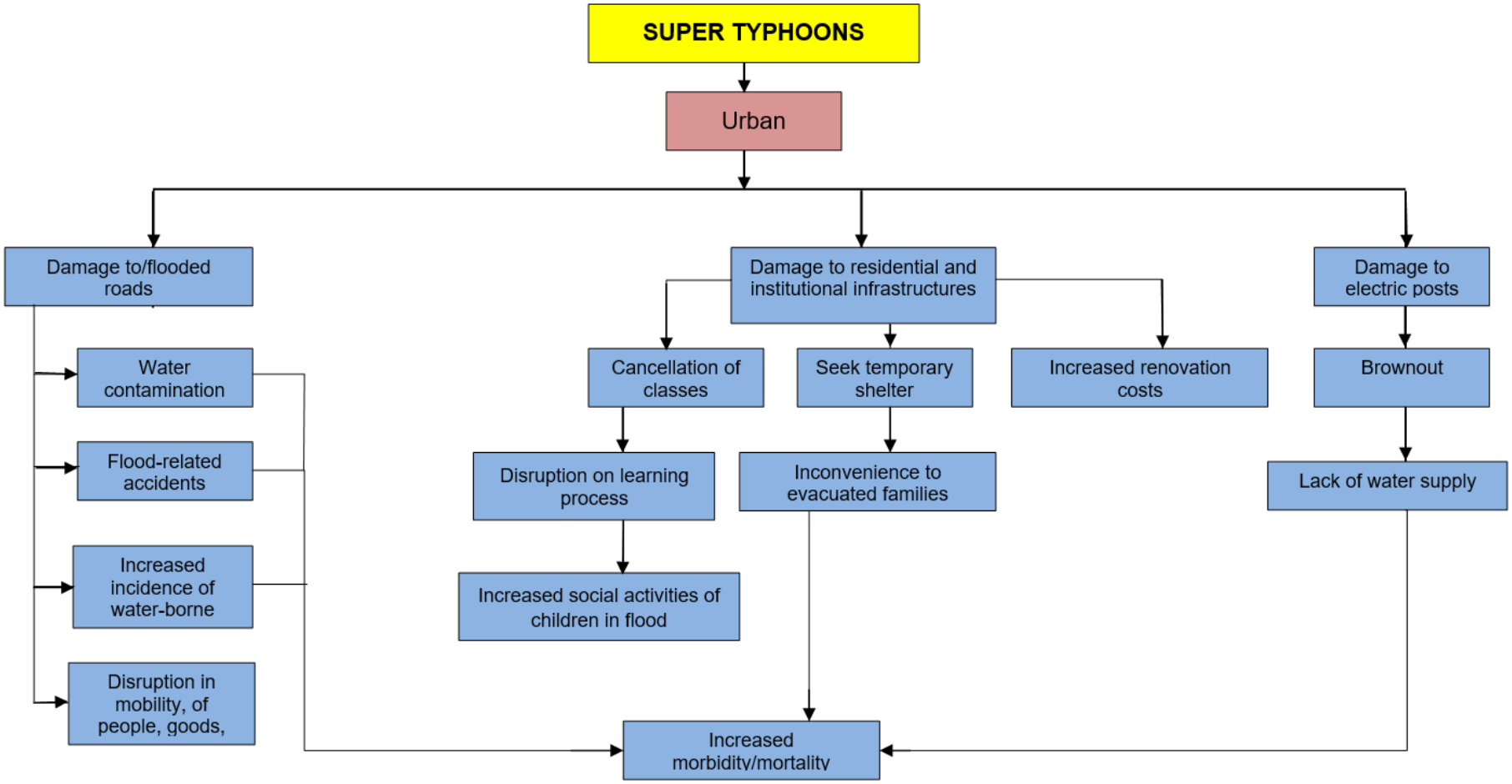


Figure 20. Impact Chain Diagram of Super Typhoons in Urban Use Areas (CDRA, 2018).

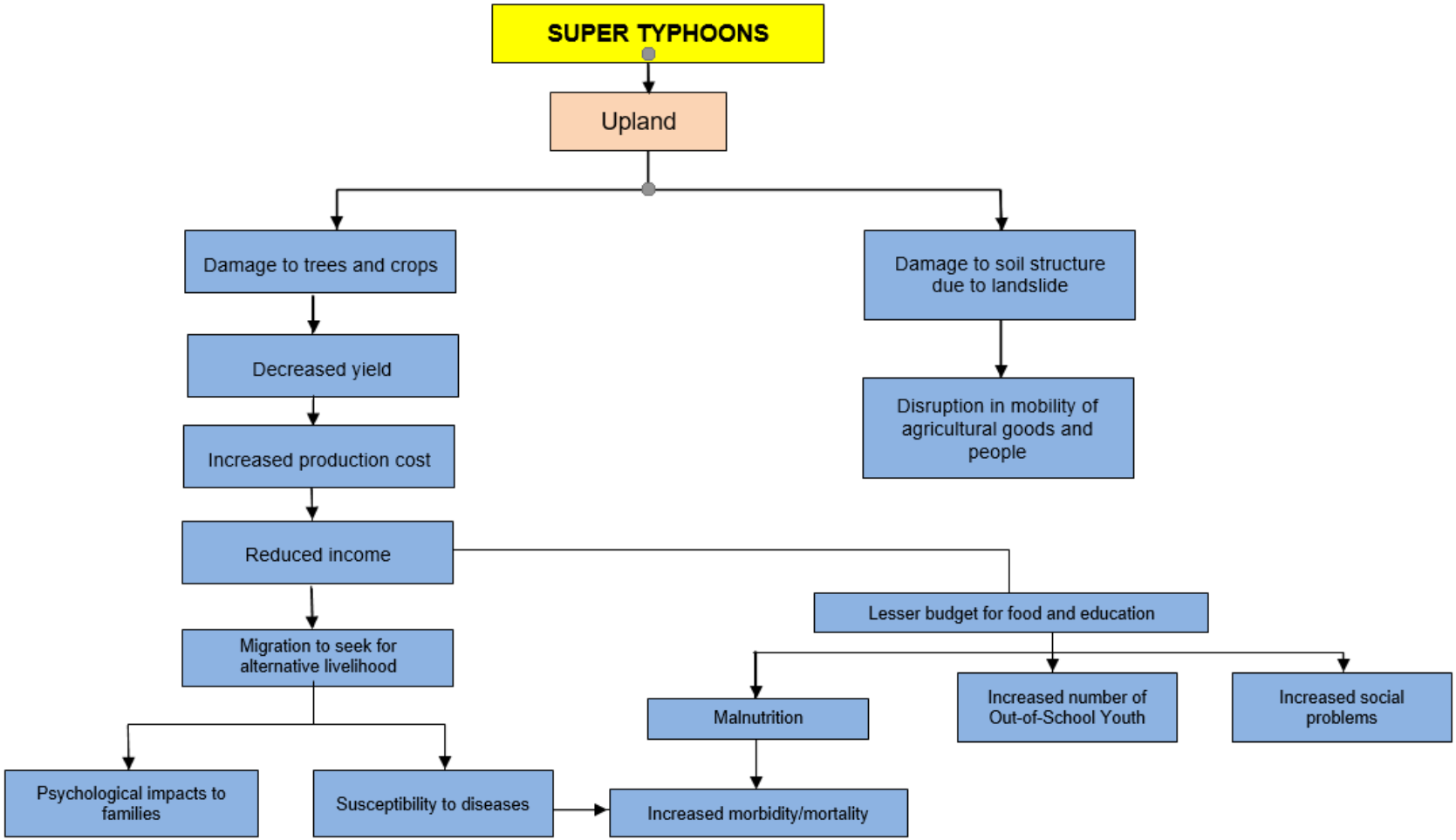


Figure 21. Impact Chain Diagram of Super Typhoons in Upland (CDRA, 2018).

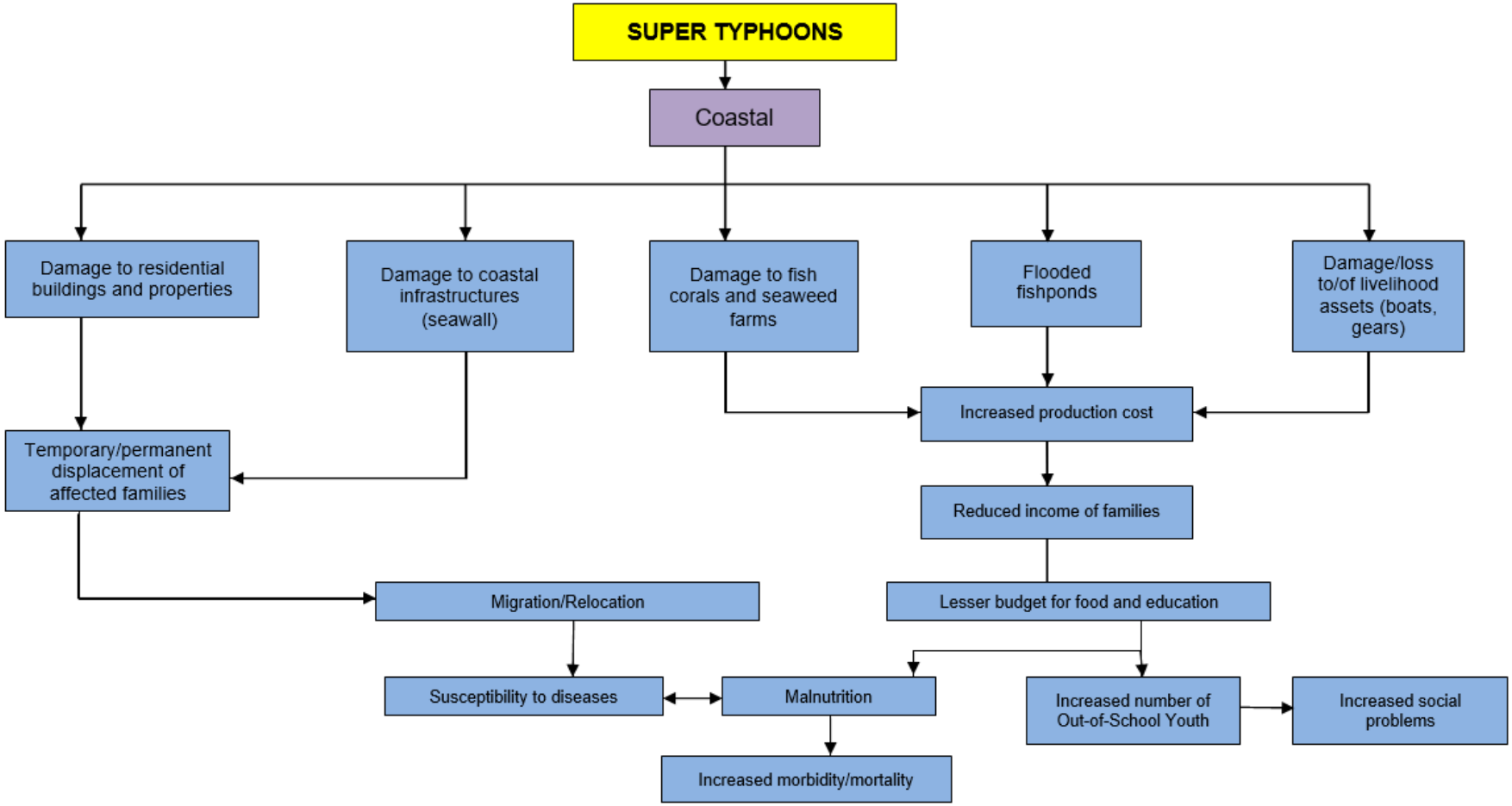


Figure 22. Impact Chain Diagram of Super Typhoons in Coastal (CDRA, 2018).

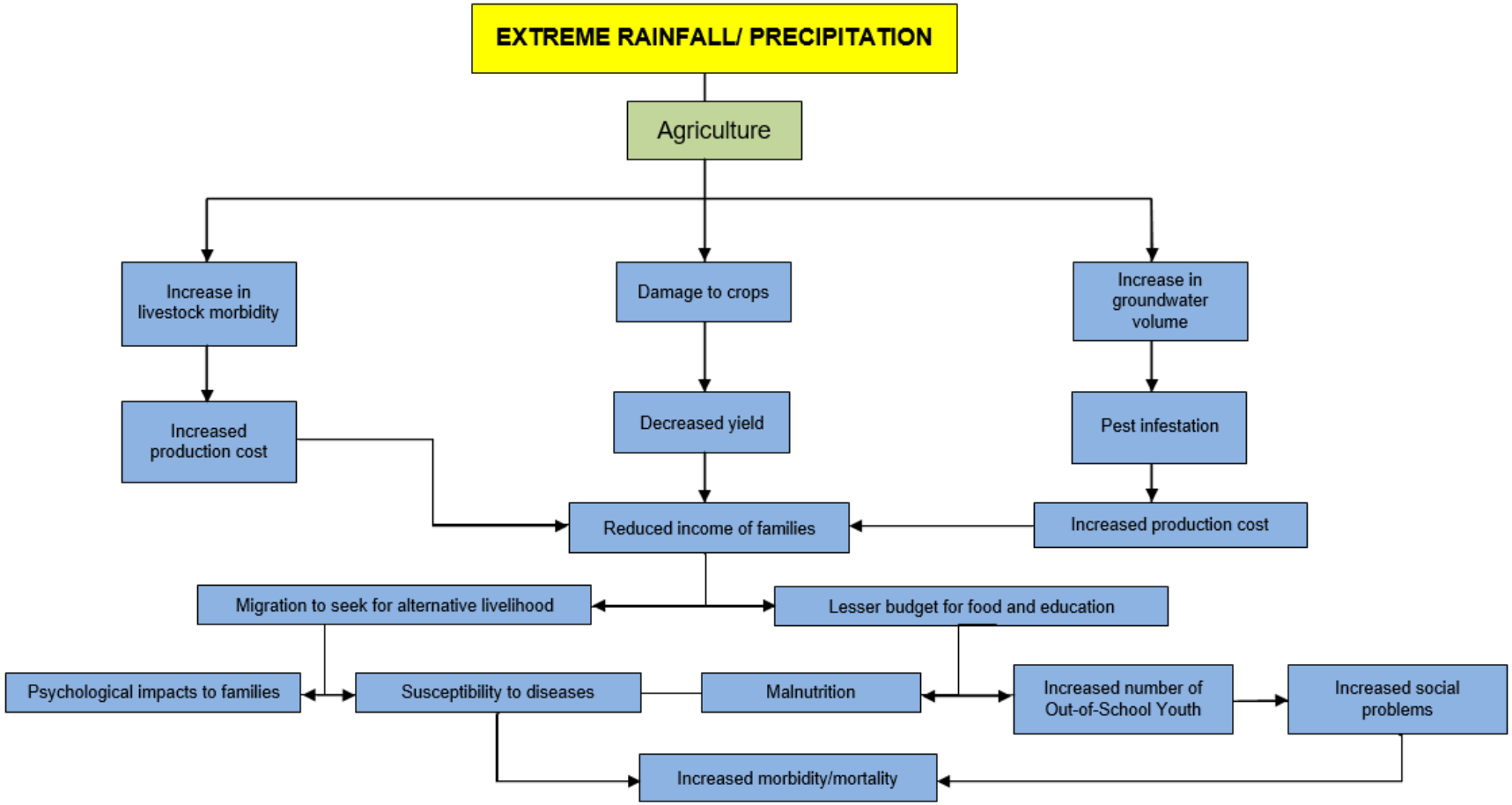


Figure 23. Impact Chain Diagram of Extreme Rainfall in Agriculture (CDRA, 2018).

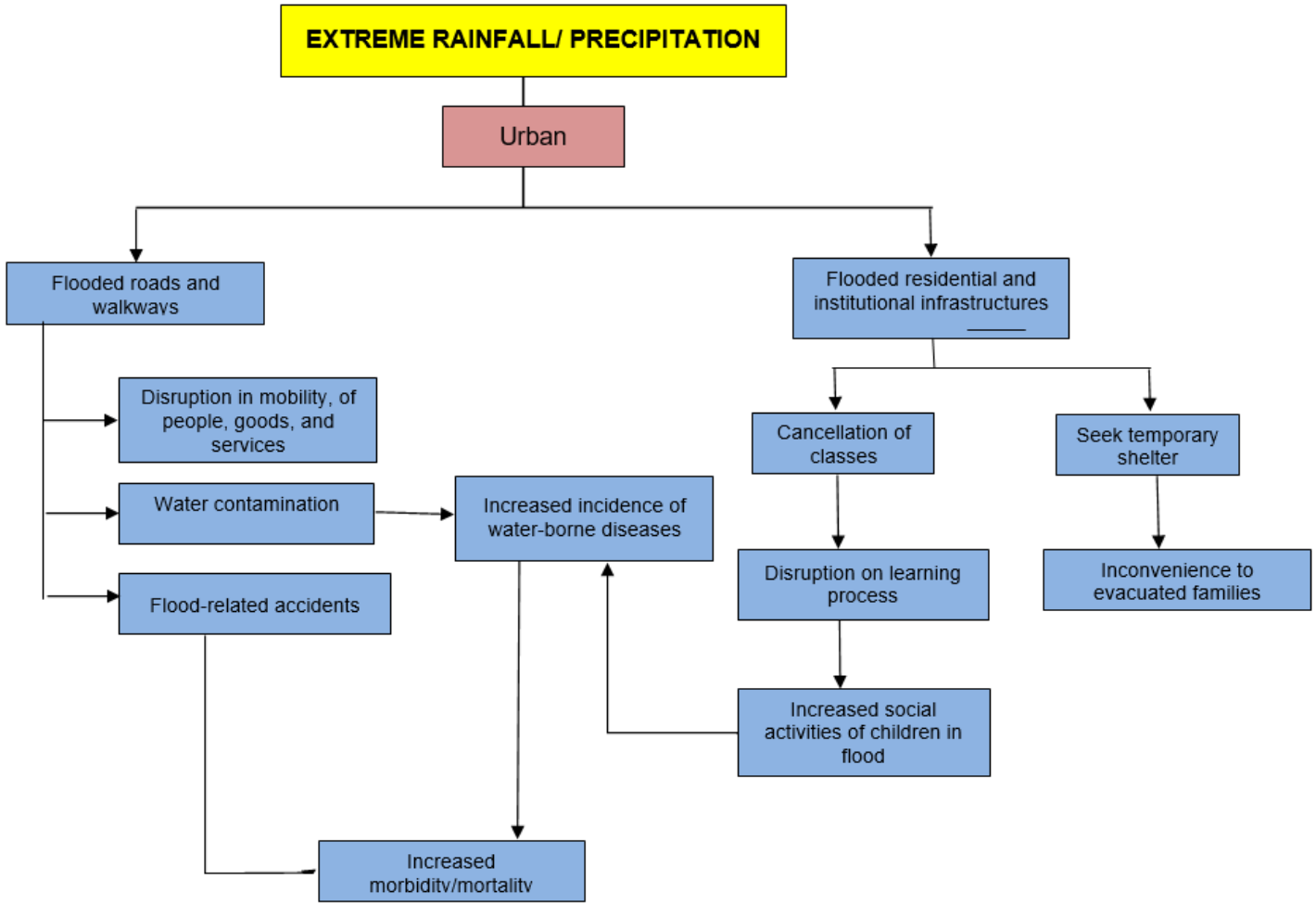


Figure 24. Impact Chain Diagram of Extreme Rainfall in Urban Areas (CDRA, 2018).

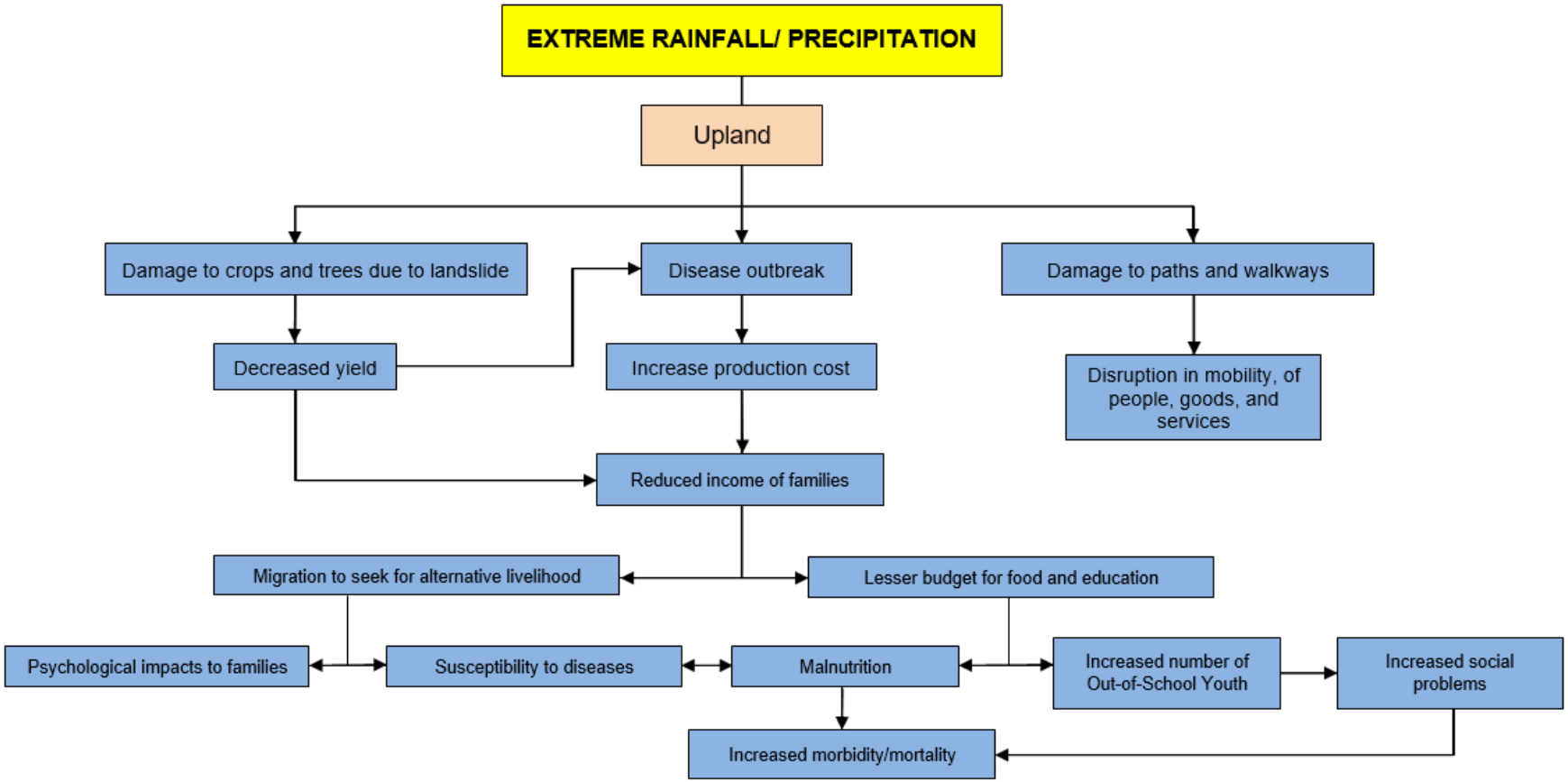


Figure 25. Impact Chain Diagram of Extreme Rainfall in Upland (CDRA, 2018).

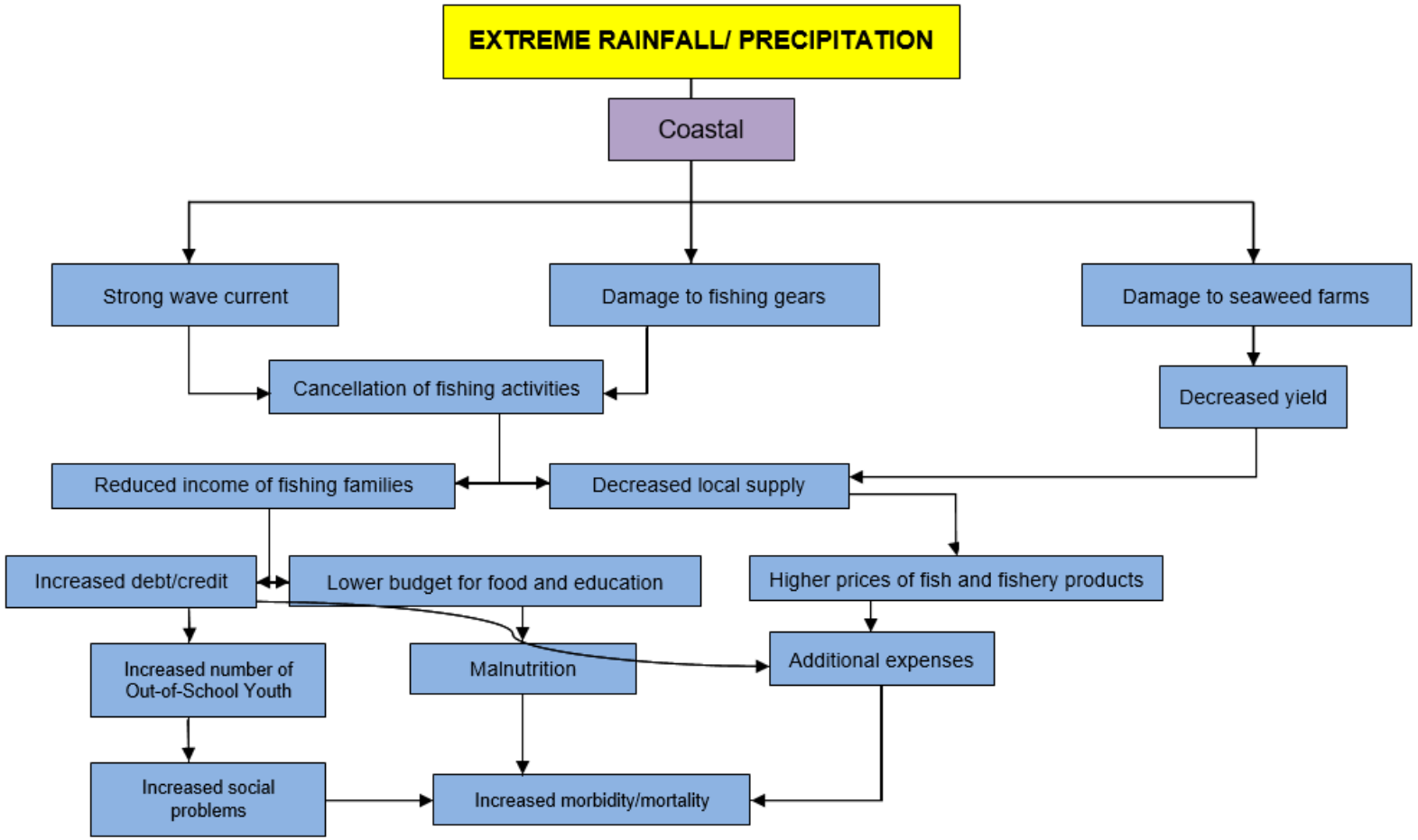


Figure 26. Impact Chain Diagram of Extreme Rainfall in Coastal (CDRA, 2018).

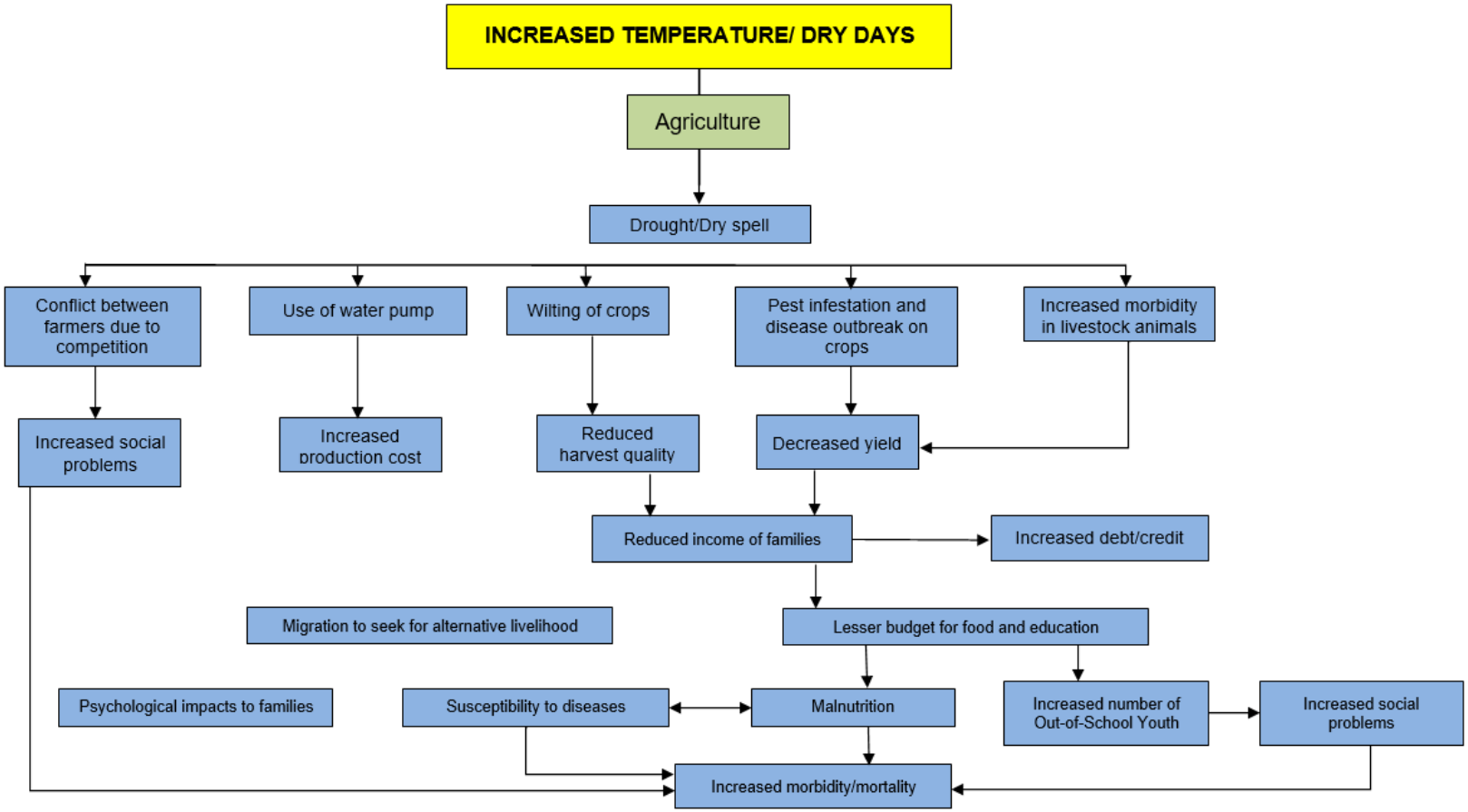


Figure 27. Impact Chain Diagram of Increased Temperature/Dry Days in Agriculture (CDRA, 2018).

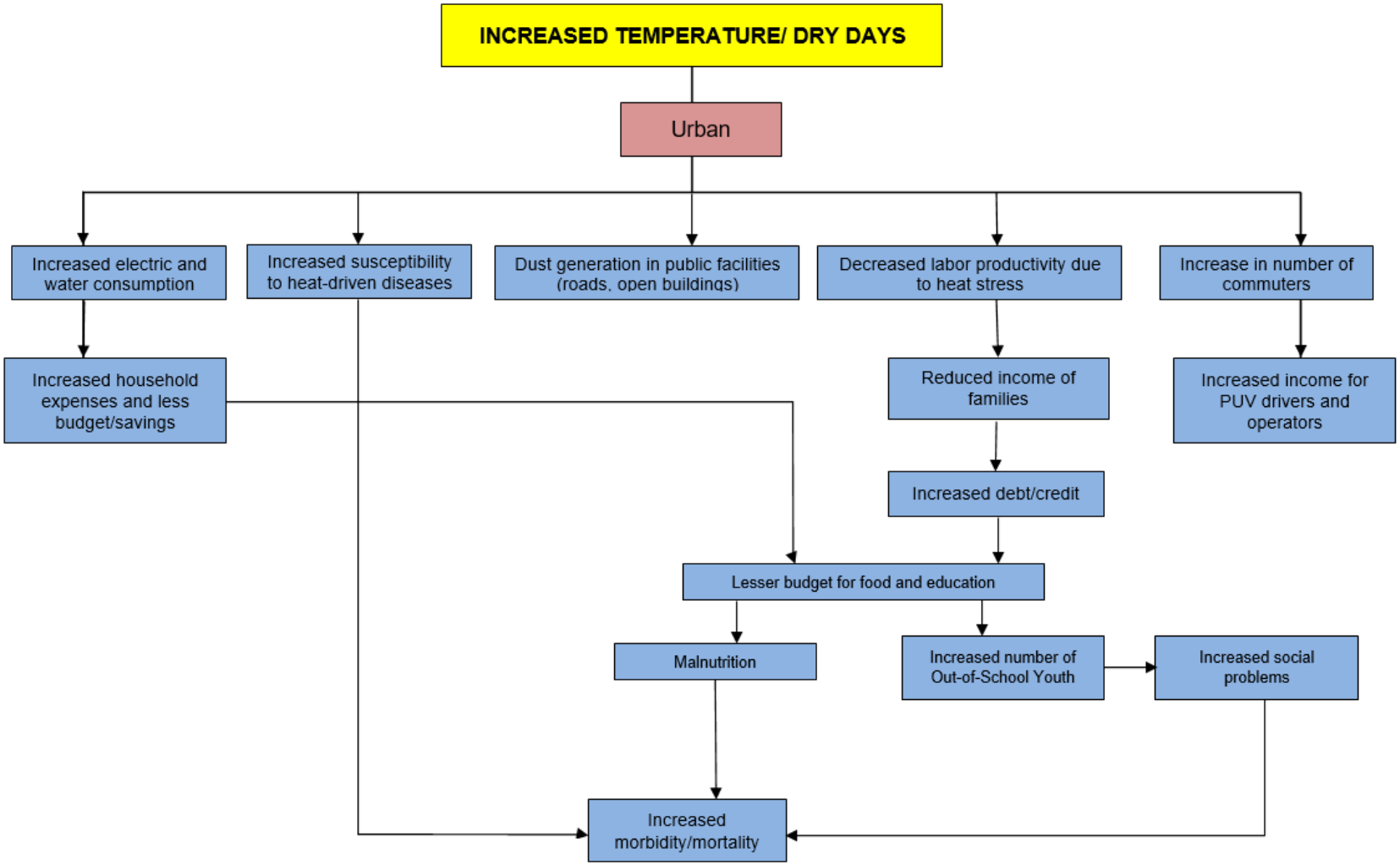


Figure 28. Impact Chain Diagram of Increased Temperature/Dry Days in Urban Areas (CDRA, 2018).

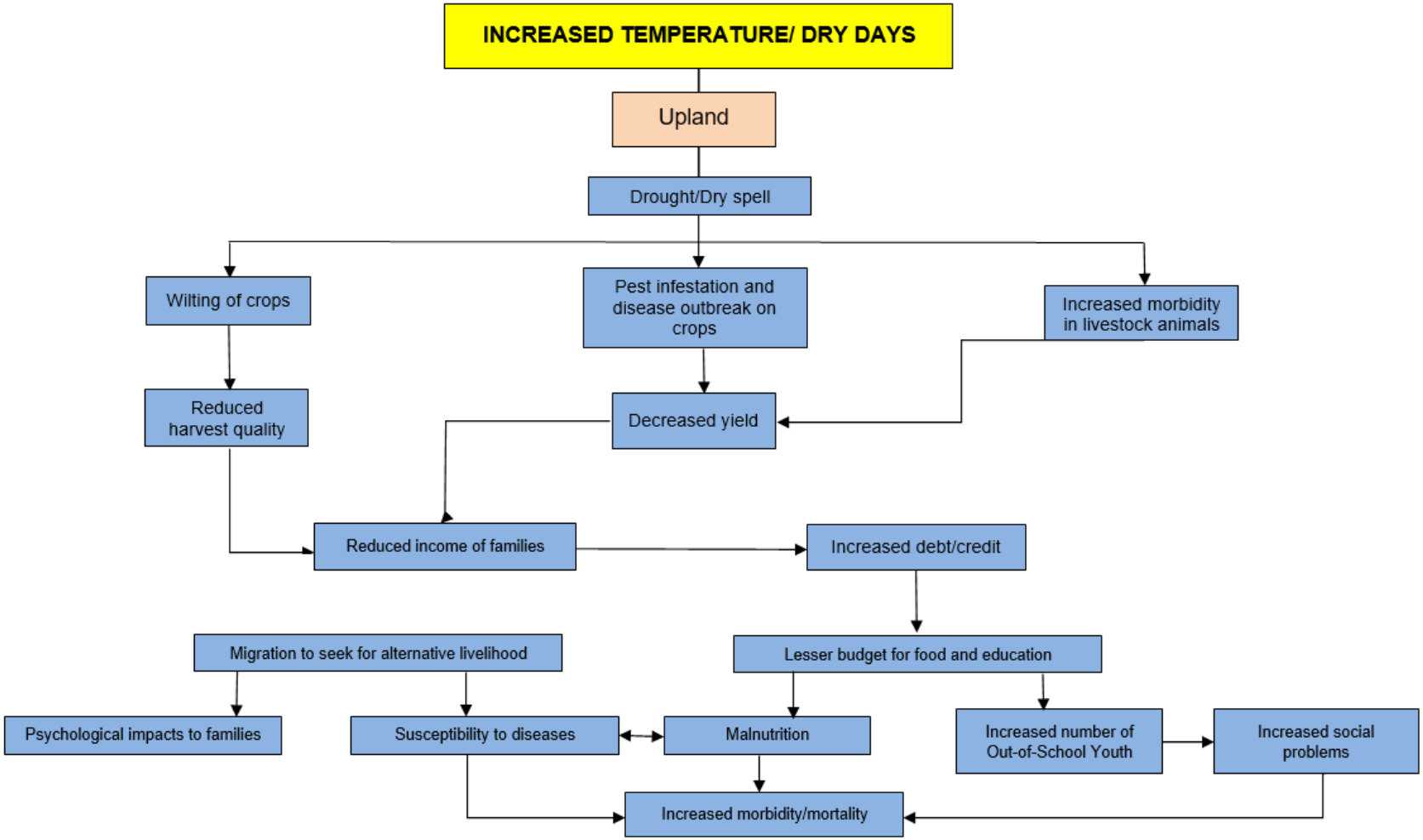


Figure 29. Impact Chain Diagram of Increased Temperature/Dry Days in Upland (CDRA, 2018).

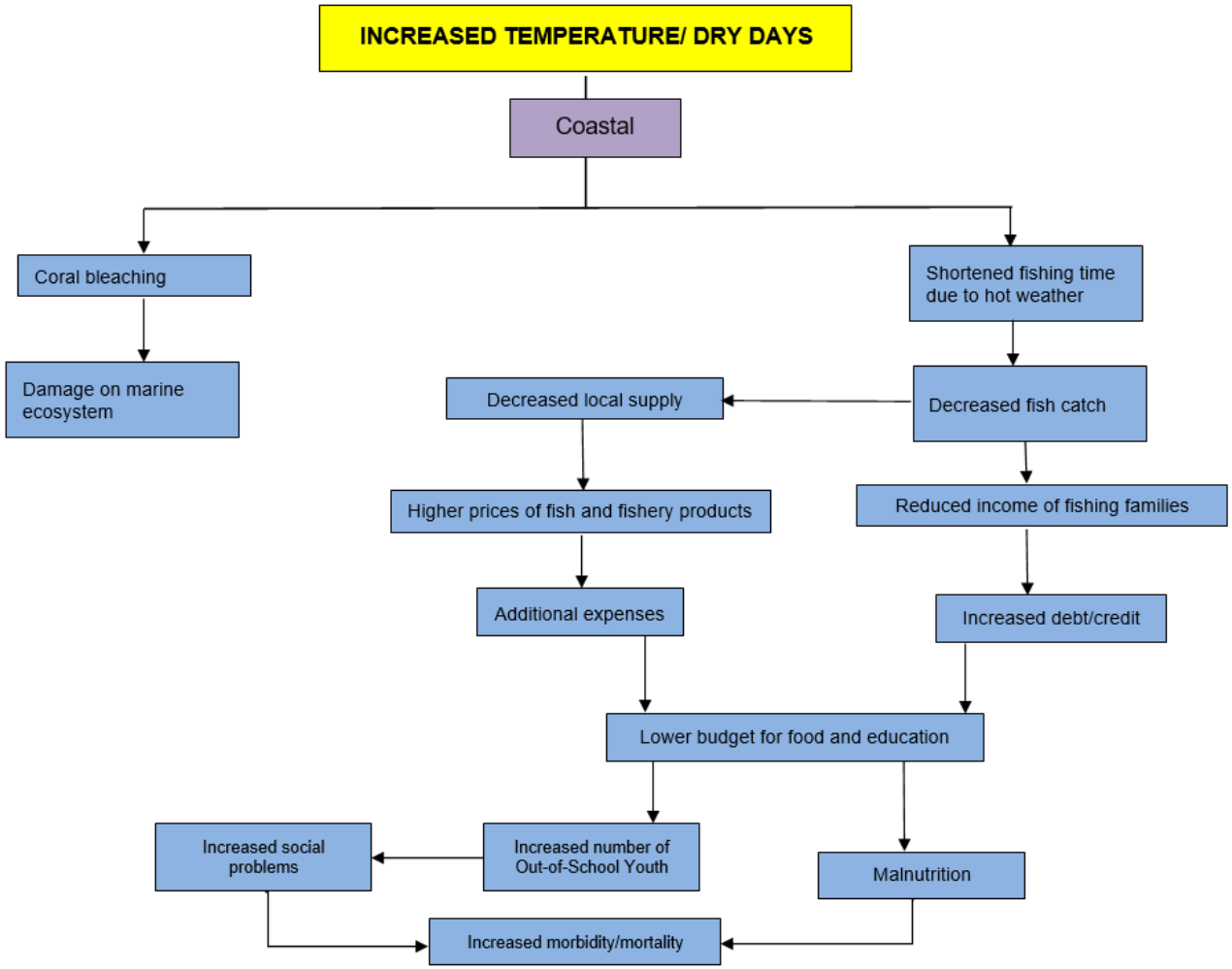


Figure 30. Impact Chain Diagram of Increased Temperature/Dry Days in Coastal (CDRA, 2018).

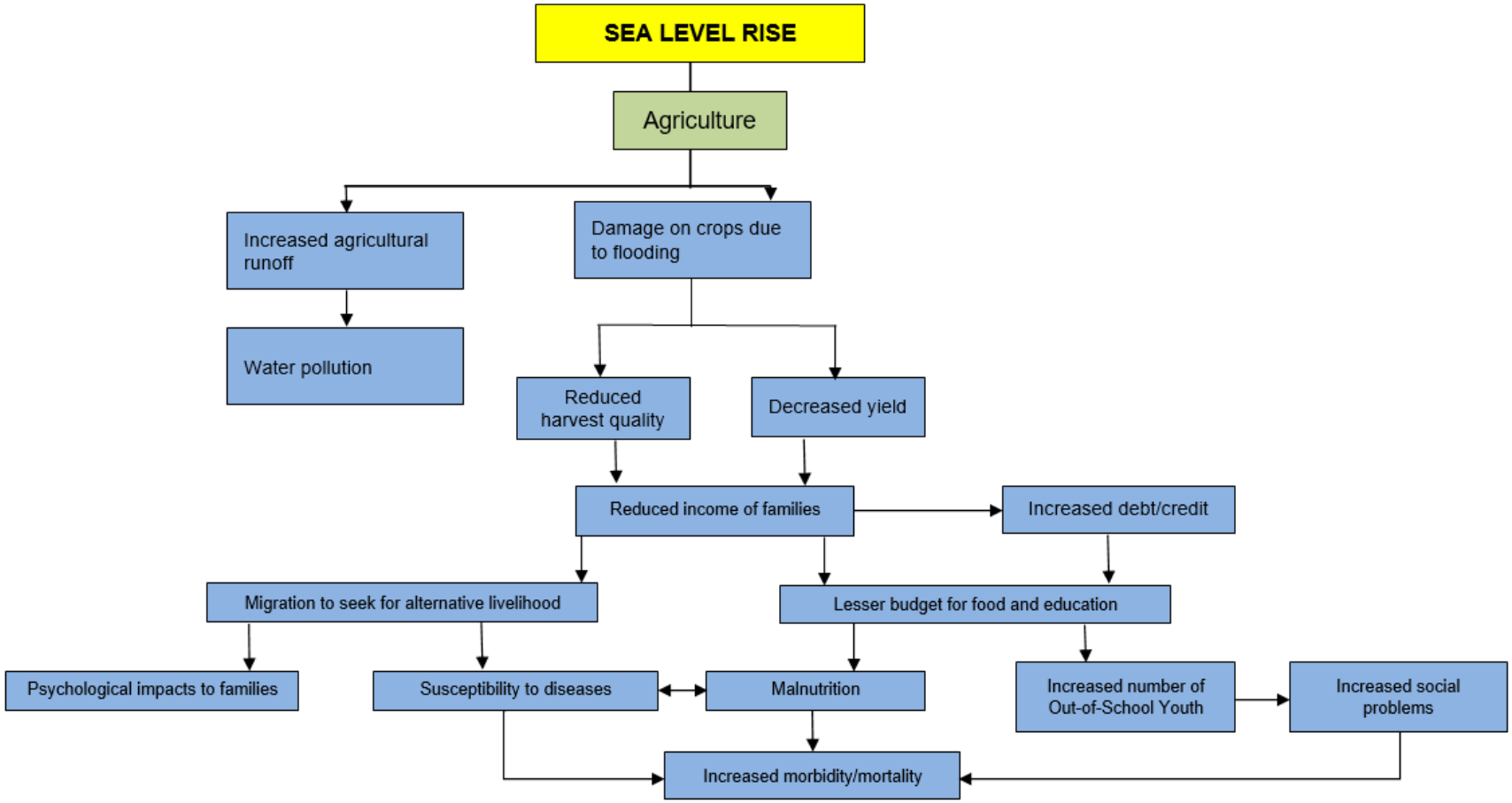


Figure 31. Impact Chain Diagram of Sea Level Rise in Agriculture (CDRA, 2018).

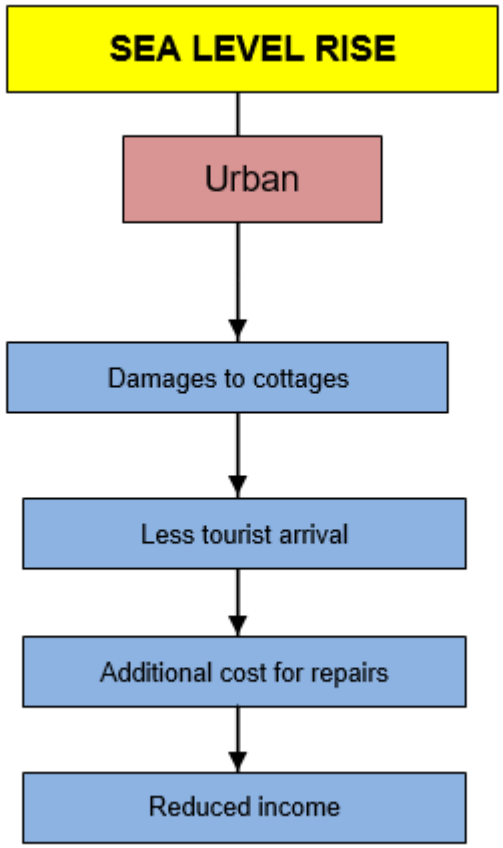


Figure 32. Impact Chain Diagram of Sea Level Rise in Urban (CDRA, 2018).

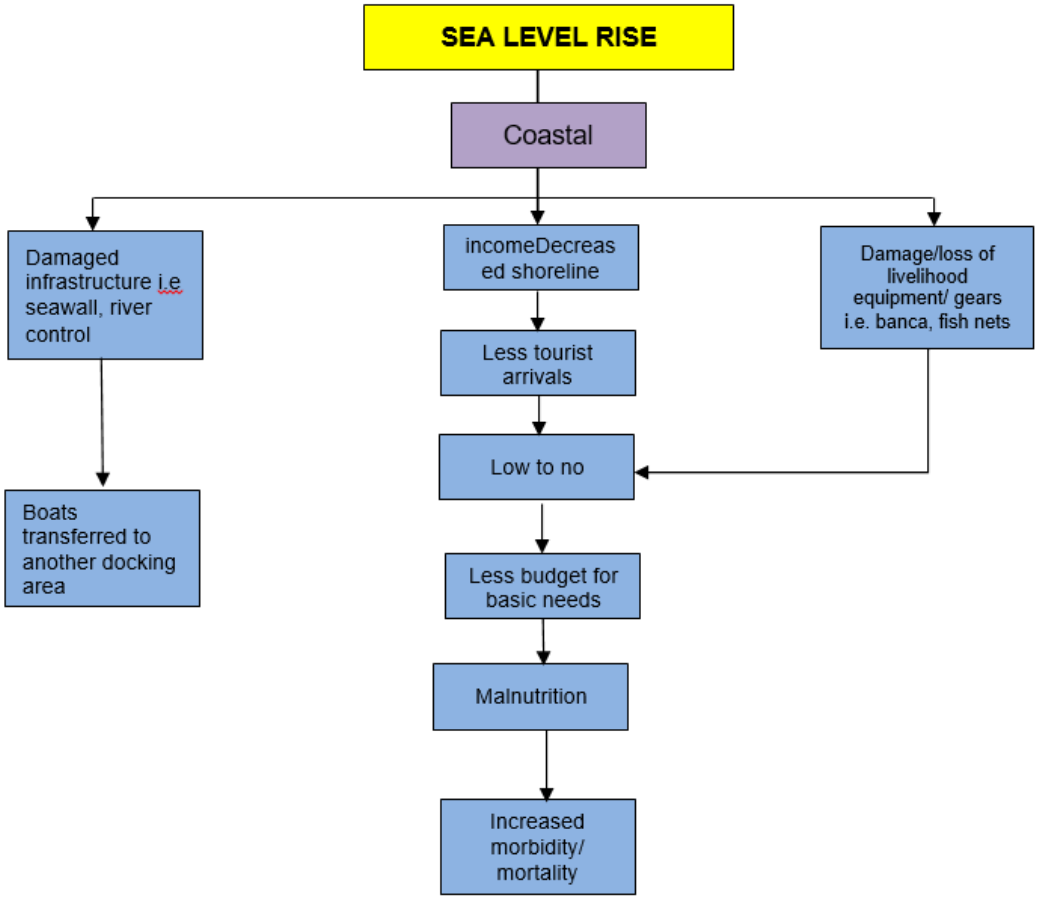


Figure 33. Impact Chain Diagram of Sea Level Rise in Coastal (CDRA, 2018).

VI. Hazard Susceptibility

A. Hazard Inventory

Gubat is exposed to various hydro-meteorological and geologic hazards due to its geographic location and characteristics. Based on the maps provided by the Mines and Geosciences Bureau (MGB), PAGASA, Philippine Institute of Volcanology and Seismology (PHIVOLCS), and Bureau of Soil and Water Management (BSWM), and the community-based risk assessment conducted, there are sixteen hazards identified that pose risks to Gubat, Sorsogon. The most frequently occurring hazards in the municipality are flooding, rain-induced landslides, and dry spells. As seen on Table 17, columns with the blue hue are hazards that are amplified by climate change and variability while the red ones are geological in nature, which may or may not be aggravated by the climate.

Figure 34. Impact of typhoon Tisoy to houses along the coastline of Gubat.

Adapted from “Typhoon Tisoy leaves trail of destruction across Bicol”, by Tin Jasareno via NASSA/ Caritas Philippines, 2019, Rappler. Retrieved from

Table 17. Hazard Susceptibility Inventory Matrix (CDRA, 2018).

Barangay	Flood	Rain-Induced Land-slide	Storm Surge	Sea Level Rise	Dry Spell/ Drought	Earthquake-induced Landslide	Liquefaction	Ground Shaking	Ground Rupture	Tsunami	Volcanic Eruption (Ash Fall)	Lahar Flow	Pyroclastic Density	Coastal Erosion	Soil Erosion	Others - Typhoon
Municipality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ariman	✓		✓	✓	✓			✓		✓	✓	✓		✓		✓
Bagacay	✓		✓	✓	✓		✓	✓		✓	✓			✓		✓
BaluddelNorte	✓		✓	✓				✓		✓	✓					✓
BaluddelSur	✓		✓	✓				✓		✓	✓					✓
Benguet	✓	✓			✓			✓			✓				✓	✓
Bentuco	✓	✓						✓			✓	✓	✓		✓	✓
Beriran	✓	✓			✓	✓		✓			✓					✓
Buenavista	✓		✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓
Bulacao	✓	✓			✓			✓			✓	✓			✓	✓
Cabigaan	✓				✓			✓			✓					✓
Cabiguhan	✓	✓			✓			✓			✓				✓	✓
Carriedo	✓	✓			✓	✓		✓			✓					✓
Casili	✓	✓						✓			✓					✓
Cogon	✓		✓	✓				✓		✓	✓					✓
CotanaDaco	✓		✓	✓	✓			✓		✓	✓			✓		✓
Dita	✓	✓			✓			✓			✓				✓	✓
Jupi	✓	✓			✓			✓	✓		✓				✓	✓
Lapinig	✓	✓			✓			✓			✓				✓	✓
LunaCandol	✓				✓			✓			✓					✓
Manapao	✓	✓			✓	✓		✓			✓				✓	✓
Manook	✓	✓			✓			✓			✓					✓
Naagtan	✓	✓			✓			✓			✓	✓			✓	✓
Nato	✓	✓			✓			✓			✓					✓
Nazareno		✓			✓			✓			✓					✓
Ogao	✓				✓			✓		✓	✓				✓	✓
Paco	✓		✓	✓	✓			✓	✓	✓	✓					✓
Panganiban	✓		✓	✓				✓		✓	✓			✓		✓
Paradijon	✓							✓		✓	✓					✓
Patag	✓	✓			✓			✓			✓				✓	✓
Payawin	✓				✓			✓			✓					✓
Pinontingan	✓		✓	✓				✓		✓	✓					✓
Rizal	✓		✓	✓	✓			✓		✓	✓			✓	✓	✓
San Ignacio	✓	✓			✓			✓			✓				✓	✓
Sangat	✓	✓			✓	✓		✓			✓				✓	✓
Sta. Ana	✓				✓			✓			✓					✓
Tabi	✓				✓			✓			✓	✓			✓	✓
Tagaytay	✓	✓			✓			✓			✓					✓
Tigkiw		✓			✓		✓	✓			✓	✓	✓			✓
Tiris	✓	✓	✓	✓	✓			✓		✓	✓					✓
Togawe		✓			✓			✓			✓	✓	✓			✓
Union	✓	✓			✓			✓	✓		✓				✓	✓
Villareal	✓	✓						✓			✓				✓	✓

B. History of Previous Disasters

The Municipality of Gubat is a relatively lowland area and its highest elevation is 166 meters above sea level. Located on the eastern Pacific coast, the municipality is also frequented by typhoons and tropical storms passing through Eastern Visayas and Bicol Region. This catalyzes events of landslides, flooding, and storm surge causing damages to the community and environment. The most at-risk and threatened sector to the impacts of typhoons is the agriculture sector. Based on the major events recalled by the participants during the FGD, the earliest account of a disaster in Gubat was observed in 1967. Typhoon Welming resulted in shoreline erosion and damages to properties along the coast. Most of the disasters recorded were typhoons and the only geologic disaster was ash fall brought about by the eruption of Mt. Bulusan. Recurring damage in agriculture and infrastructure has been cited by records. No casualty has been recorded by MDRRMO. Table 18 shows the history of disasters that struck the municipality and were observed by the community members during the focus group discussions.

Table 18. History of Previous Disasters (CDRA, 2018).

Year	Hazard	Impacts to the Community
1967	Welming	Shoreline erosion, damage on properties of coastal communities
1987	Sisang	Severe damage on agricultural crops, houses, and properties, casualties
1997-1998	El Nino	Dry spell, insufficient water supply to households and agricultural land, disease outbreak
1999	Awring	Landslide, damage on agricultural crops
2006	Milenyo	Damage on agricultural crops and properties, long-duration brownout
2006	Caloy	Damage on fishing vessels, sudden increase in prices of marine products
2007	Reming	Flooding in fishponds, damage on agricultural crops and houses
2013	Yolanda	Damage on agricultural crops and properties
2014	Glenda	Damage on seawall, properties, and agricultural crops
2014	Ruby	Damage on agricultural crops and properties
2014	El Nino	Dry spell, insufficient water supply to households and agricultural land, disease outbreak
2015	Nona	Damage on agricultural crops and properties
2018	Basyang	Flooding, damage on agricultural crops and properties, disruption in mobility of people, goods, and services

VII. Exposure Database

Natural hazards are not necessarily damaging. It may potentially harm people or the environment and becomes a disaster if that happens. This is the importance of understanding the exposure and vulnerability of elements at risk to hazards and its impacts to be able to identify necessary measures to minimize risks.

The Exposure Database provides baseline information pertaining to the elements at risk. Elements at risk refer to population, assets, structures, economic activities, and environmental resources which are located in areas exposed to potential impacts of climate

change and damaging hazard events. The exposure data provides the location, vulnerability/sensitivity and adaptive capacity attributes of the exposed elements which are necessary information when conducting a climate change vulnerability and disaster risk assessments. Each element was geo-referenced and was used to facilitate overlaying with hazard maps.

In the context of Gubat, population refers to all the residential areas; natural resources refer to agricultural land areas for crops and fruit trees, upland forests, and inland coastal waters intended for fisheries production; critical point facilities are composed of school buildings, hospitals, evacuation centers, police and fire stations, barangay halls, and telecommunication infrastructures; lifeline utilities refer to road networks including footpaths and pathways; and urban use refers to areas in the poblacion with land uses for commercial purposes, cemetery, parks, and tourism spaces.

A. Population

The total land area of Gubat is 11,520.82 hectares in which 651.27 hectares are residential. In 2015, the population density of the municipality stood at 6 persons per hectare, while población barangays remain to have the highest population density with barangay Balud del Sur posting the highest population density of 224 persons per square kilometer (Table 19). Informal settlers were composed of 4,718 individuals or 8% of the total population. All barangays have informal settlers with the majority found in Brgy. San Ignacio followed by Balud del Sur. A total of 1% equivalent to 594 individuals reside in houses made with light/salvageable materials. Barangays were observed to share a relatively equal percentage of dependent population at 36% and 8% for young and old dependents, respectively. A total of 1,537 individuals or 3% of the population are persons with disabilities while 7,979 or 59% of the total households live below the poverty threshold with the majority coming from Balud del Norte. Figures 35 to 42 illustrate the population exposure of Gubat to various hazards.

Table 19. Vulnerable Population By Barangay (RCBMS, 2016).

Barangay	Land Area (Hectares)	Residential Area (Hectares)	Total Population	Population Density per Hectare of Residential Area	Population of Informal Settlers	Population Living in Dwelling Units with Walls Made from Light to Salvageable Materials (Households)	Population of Young and Old Dependents	Population of Persons with Disabilities	Total Number of Households Living Below the Poverty Threshold	Population of Malnourished Individuals
Ariman	170	16.99	1809	106.47	104	79	765	37	286	7
Bagacay	767	27.83	3525	126.66	192	59	1515	61	468	26
Balud del Norte (Pob.)	7.52	6.57	1977	300.91	399	52	794	82	334	8
Balud del Sur (Pob.)	7.59	3.93	1272	323.66	17	45	511	27	168	5
Benguet	187.65	35.34	537	15.20	24	1	252	13	66	4
Bentuco	477.55	5.73	1593	278.01	163	8	714	37	243	6
Beriran	168.57	17.67	1035	58.57	63	6	453	24	159	4
Buenavista	157	18.84	1263	67.04	220	7	585	36	158	4
Bulacao	304.04	17.75	2144	120.79	142	0	957	35	258	1
Cabigaan	114.64	3.53	1067	302.27	73	2	496	41	141	7
Cabiguhan	247.21	6.54	779	119.11	122	2	329	14	106	6
Carriedo	413.76	19.279	2186	113.39	21	8	954	76	291	10
Casili	223.79	23.89	1043	43.66	38	5	476	24	166	9
Cogon	173	28.18	2510	89.07	46	13	991	38	332	6
Cota na Daco (Pob.)	31.7	20.75	1823	87.86	140	57	768	26	290	8
Dita	284.48	4.63	523	112.96	41	4	238	12	79	5
Jupi	236.22	6.53	1211	185.45	53	8	524	30	168	3
Lapinig	296.6	8.29	517	62.36	71	3	253	14	68	4
Luna Candol (Pob.)	19.59	9.57	2664	278.37	177	35	1073	58	271	5
Manapao	391.32	8.8	999	113.52	42	3	463	38	167	6
Manook (Pob.)	18.11	10.58	1359	128.45	4	0	511	12	197	0
Naagtan	509.67	9.94	1098	110.46	27	9	495	37	147	2
Nato	309.47	7.85	1182	150.57	322	4	531	43	186	2
Nazareno	181.52	9.2	539	58.59	27	3	253	20	49	1
Ogao	97.05	9.08	1398	153.96	69	13	623	48	187	11
Paco	393.35	8.64	1499	173.50	155	9	650	41	194	5
Panganiban (Pob.)	51.5	16.77	1664	99.22	35	16	655	36	173	0

Barangay	Land Area (Hectares)	Residential Area (Hectares)	Total Population	Population Density per Hectare of Residential Area	Population of Informal Settlers	Population Living in Dwelling Units with Walls Made from Light to Salvageable Materials (Households)	Population of Young and Old Dependents	Population of Persons with Disabilities	Total Number of Households Living Below the Poverty Threshold	Population of Malnourished Individuals
Paradijon (Pob.)	18.33	11.006	1293	117.48	20	10	513	55	136	0
Patag	200.39	4.58	627	136.90	188	3	279	25	83	4
Payawin	443.6	18.44	1586	86.01	216	12	720	44	188	4
Pinontingan (Pob.)	16.1	8.3	1403	169.04	185	1	576	65	137	3
Rizal	573	56.16	2598	46.26	26	48	1143	52	346	9
San Ignacio	300.35	23.31	1869	80.18	415	5	742	33	227	3
Sangat	516.27	12.5	866	69.28	155	3	398	24	103	3
Sta. Ana	391.37	32.07	1549	48.30	39	8	685	33	226	6
Tabi	268.38	11.74	1440	122.66	44	4	632	43	228	1
Tagaytay	248.79	7.14	1146	160.50	221	12	556	28	166	9
Tigkiw	377.06	44.31	953	21.51	64	6	418	26	147	5
Tiris	972	22.005	2182	99.16	67	17	978	62	241	17
Togawe	510.26	17.78	1217	68.45	133	6	561	32	178	6
Union	327.87	10.24	1206	117.77	92	7	544	36	166	3
Villareal	117.15	8.99	634	70.52	66	1	282	19	55	3

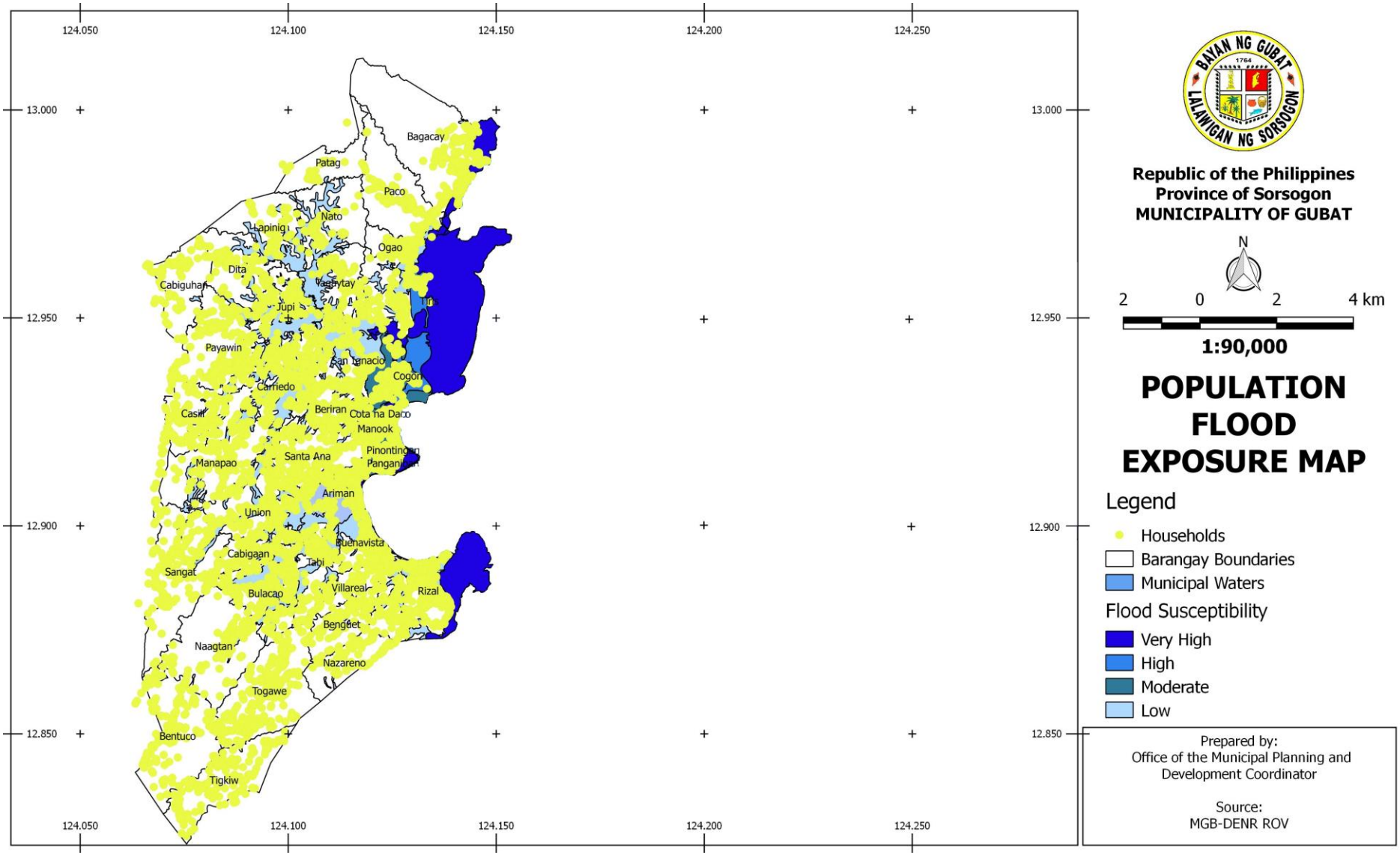


Figure 35. Population Exposure to Flooding (CDRA, 2018).

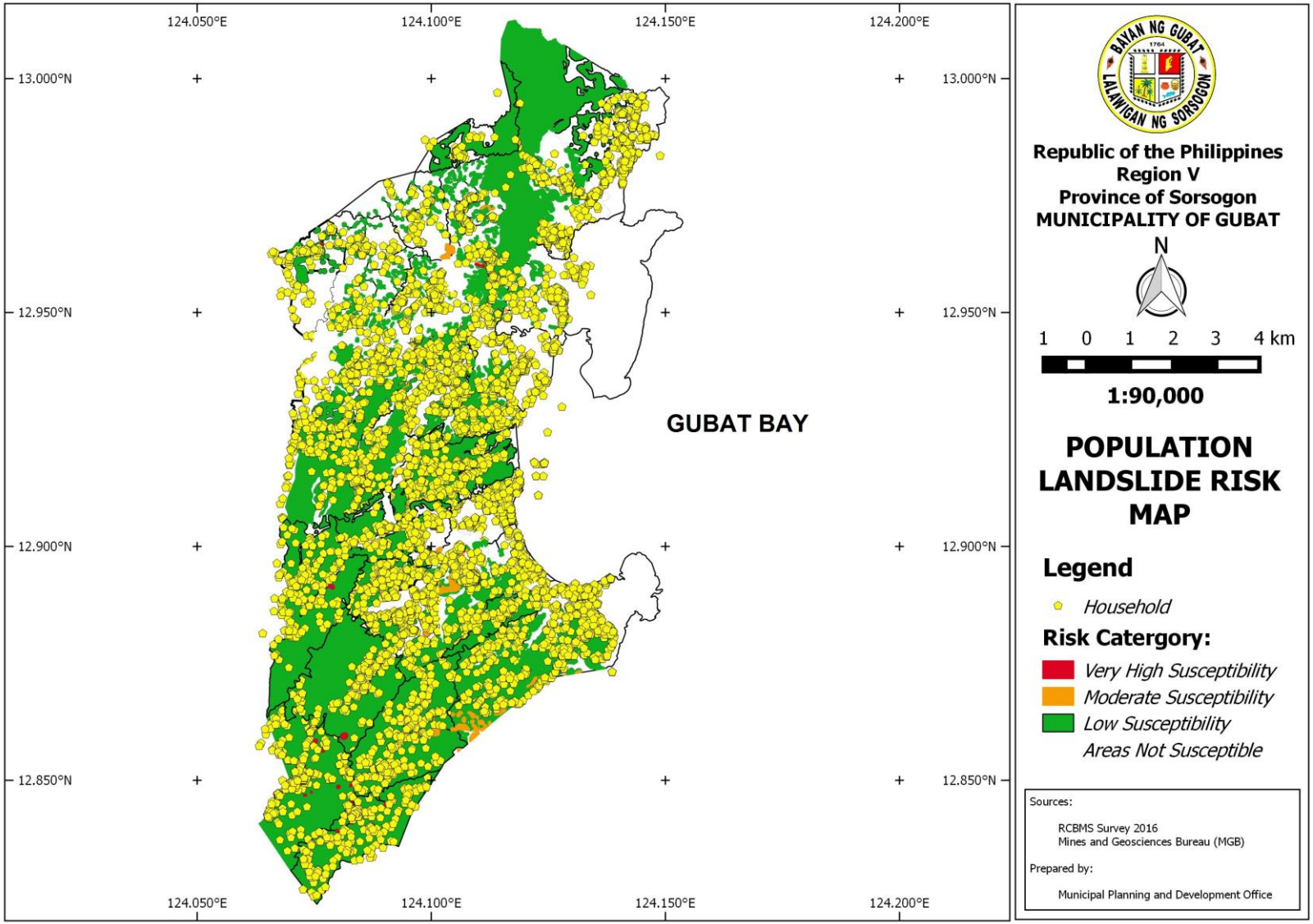


Figure 36. Population Exposure to Landslide (CDRA, 2018).

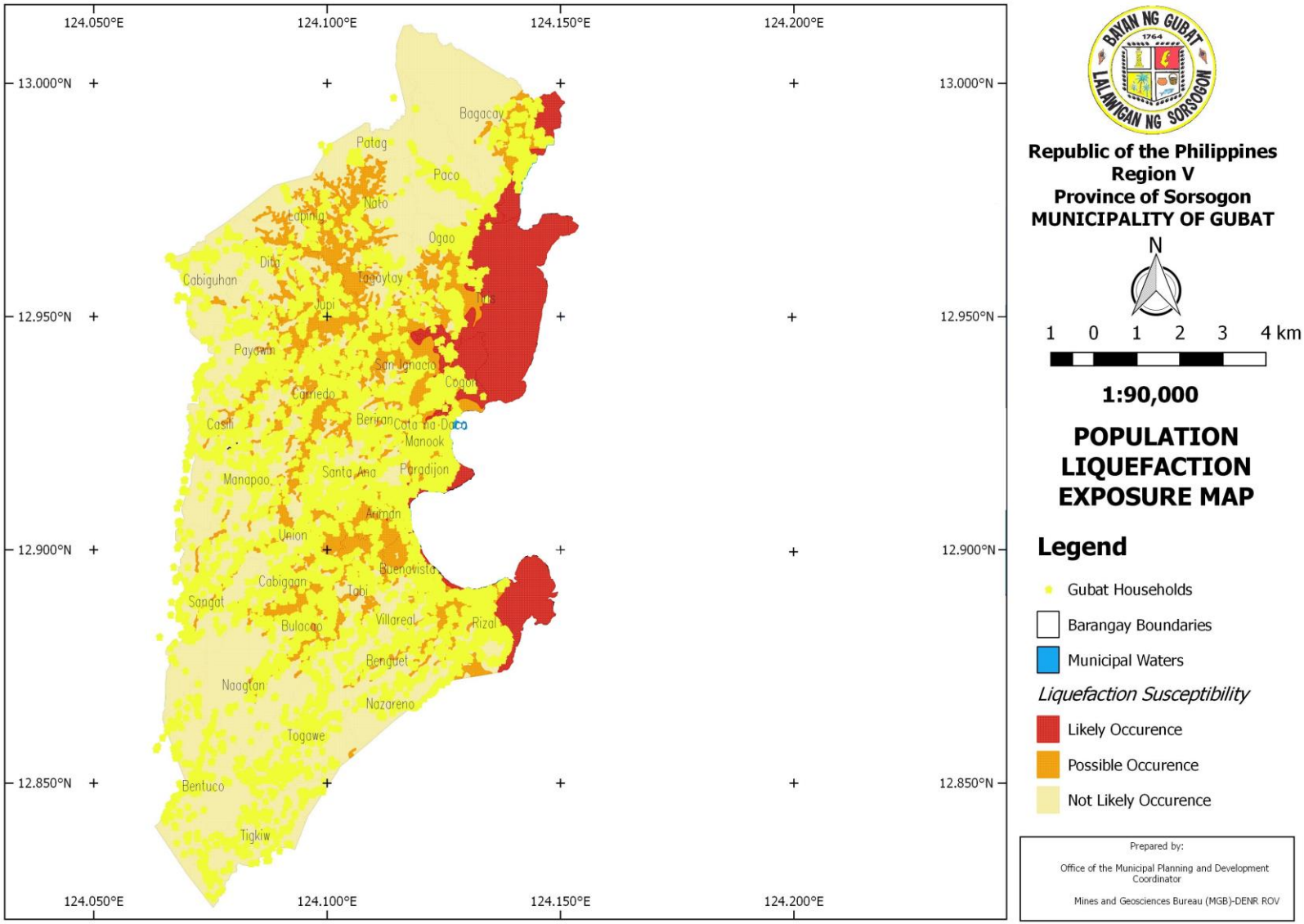


Figure 37. Population Exposure to Liquefaction (CDRA, 2018).

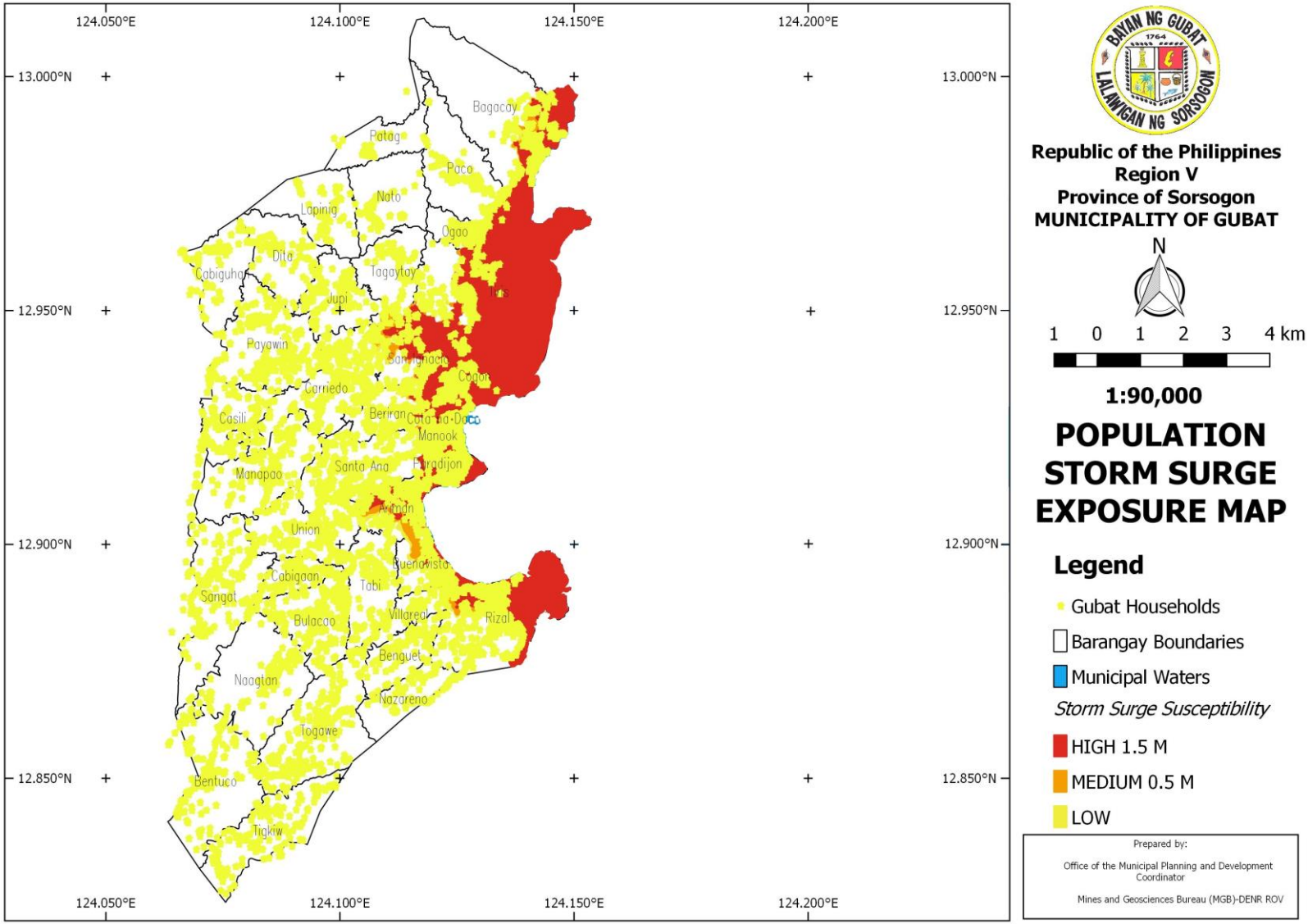


Figure 38. Population Exposure to Storm Surge (CDRA, 2018).

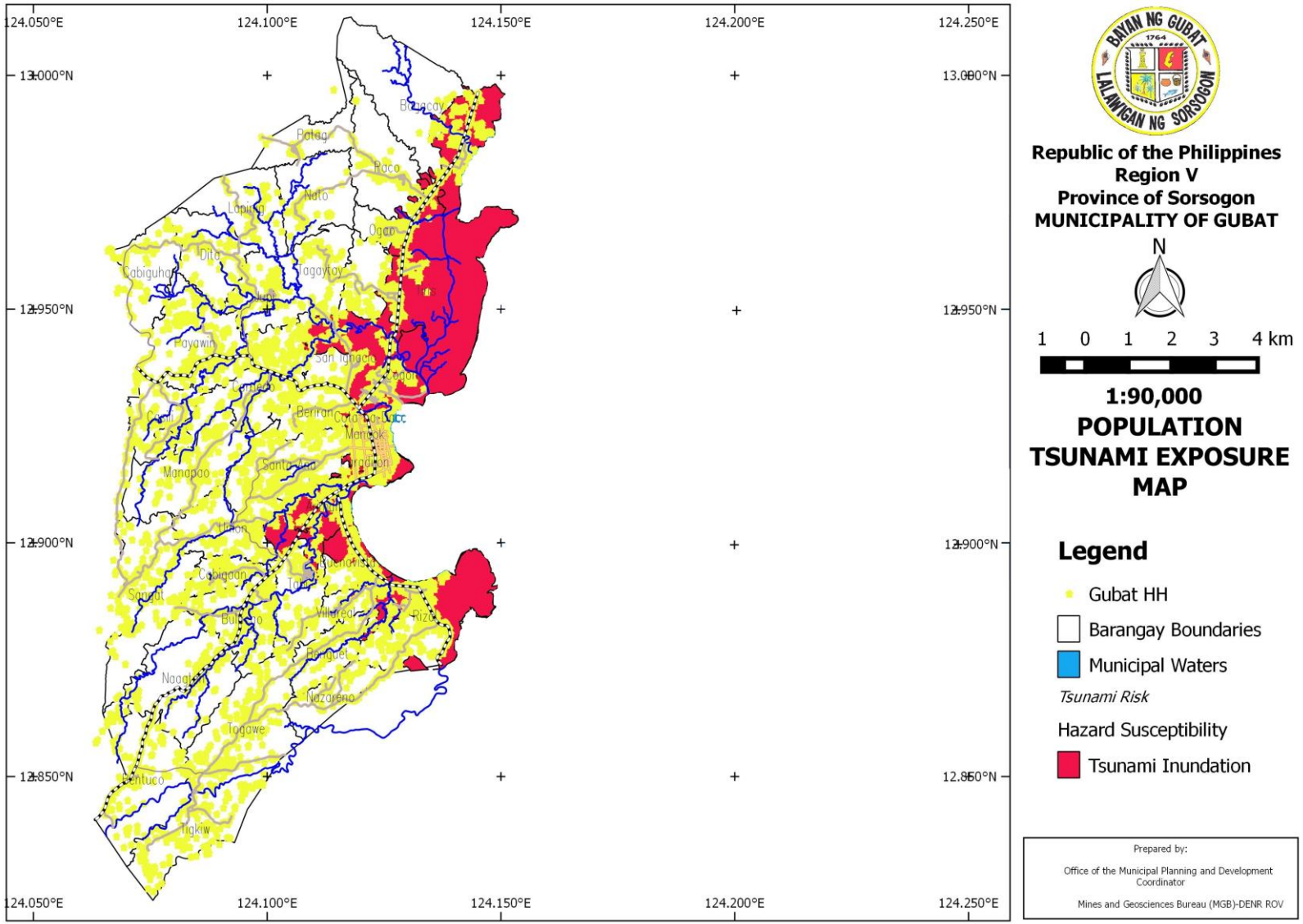


Figure 39. Population Exposure to Tsunami (CDRA, 2018).

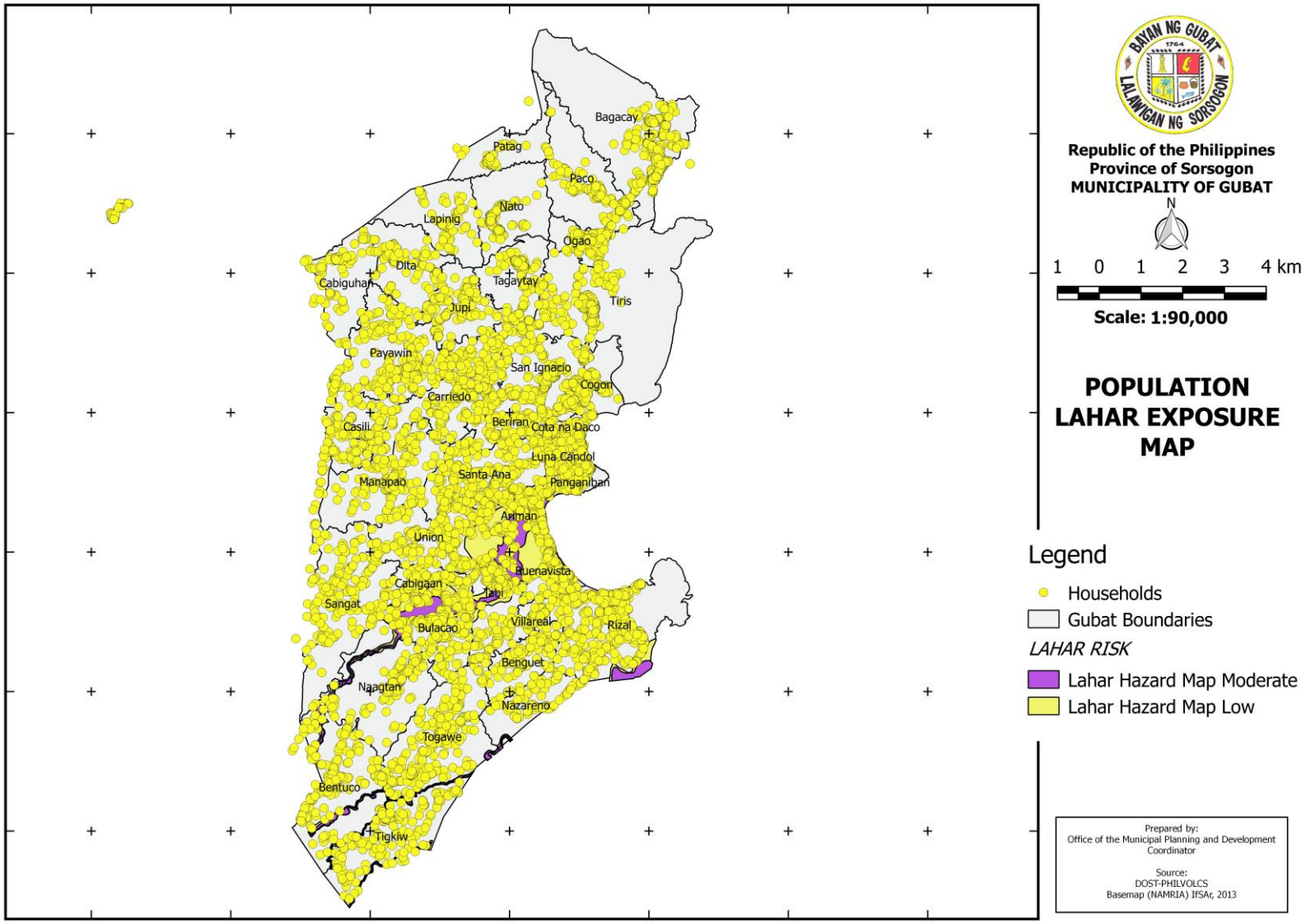


Figure 40. Population Exposure to Lahar Flow (CDRA, 2018).

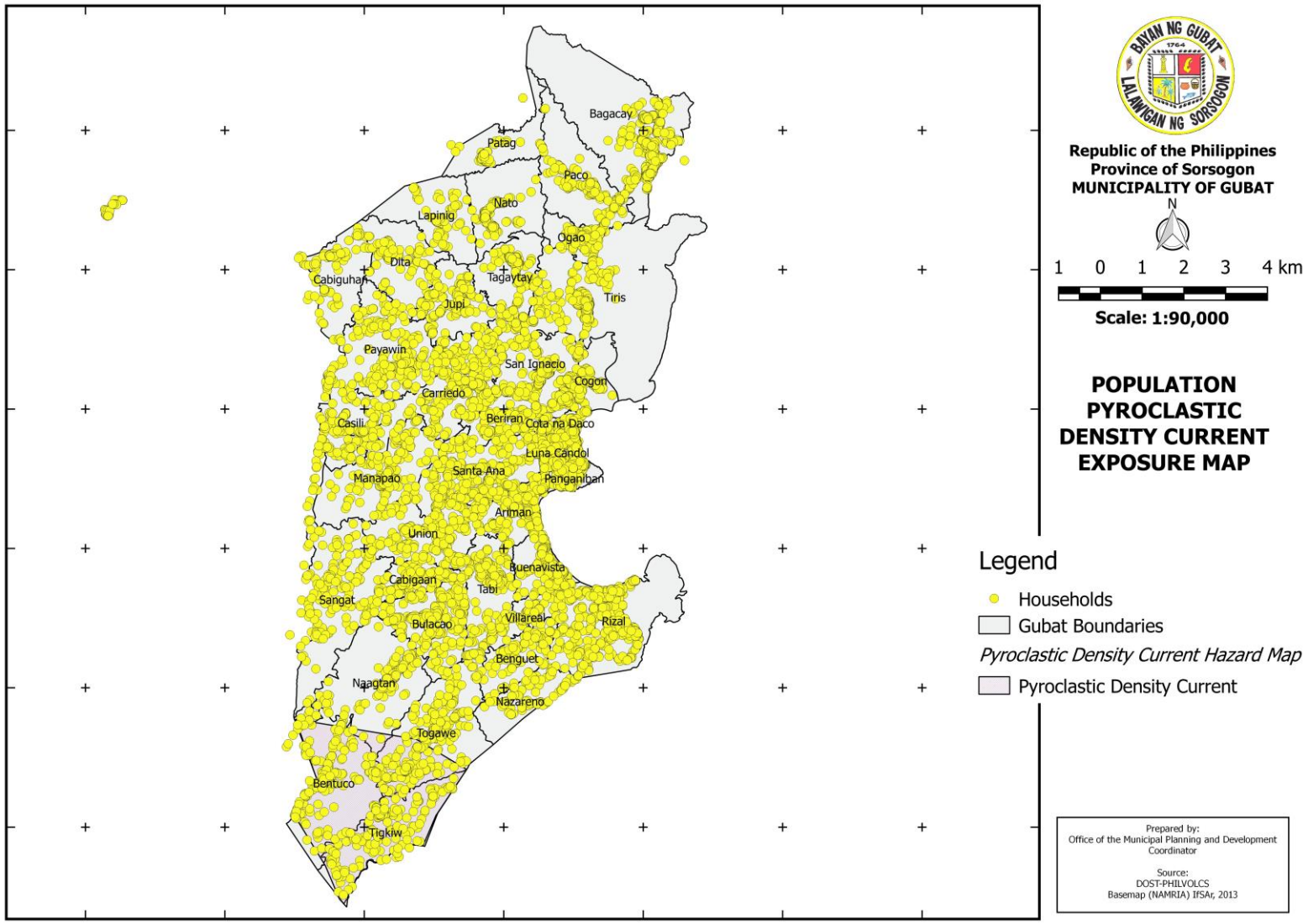


Figure 41. Population Exposure to Pyroclastic Density Current (CDRA, 2018).

B. Natural Resources

The natural resources of the municipality will be the most highly affected element from climate change hazards. This covers all the agricultural production lands and mangrove forests of the municipality including support infrastructures such as irrigation systems, farm to market road systems, and post-harvest facilities.

Around 82.56% or 9,429.07 hectares out of the total land area of 11,421.17 hectares is classified as agricultural. All 34 rural barangays are agricultural while one urban barangay, Luna Candol, has a small portion of its area devoted to palay and coconut. Gubat is an agricultural town with the majority of its area equivalent to 9,952 hectares utilized for agricultural production. Coconut land intercropped with other fruit-bearing trees such as banana, papaya, and cacao occupy the largest portion of the agricultural land (Table 20). Paddy rice area comprises 2,032.69 hectares with 69.49% irrigated paddies (Table 21).

Flooding incidents inundate rice paddies which could lead to a decrease in yield and farm productivity ultimately resulting in decrease in income and food supply. In 2018, 61% of the total rice area equivalent to 1,242.95 hectares were flooded due to heavy rains brought by the tail end of the cold front. In the same year during the TY Usman, 59% or a total area of 1,206.79 hectares were flooded which lasted for 3 days.

In the event of a dry spell or drought, irrigation water supply is compromised. A total of 620.24 hectares or 30.51% of the total rice area is rainfed and dependent on rainfall for irrigation. Rainfed farmers would be most affected by increasing temperature especially during the wet cropping season from June to September. In the previous years, rainfall was abundant in the month of June leaving no problem to our rainfed farmers. Nowadays, sufficient rainfall does not come until late July or August which prompts rainfed farmers to change their cropping schedule and being left behind by irrigated rice farmers. By the time they harvest their rice, prices would have already gone down.

Increased frequency and intensity of typhoons not only has adverse effects in lowland agriculture areas but upland agriculture areas as well. High value crops, perennial and annual fruit-bearing trees are toppled down by strong winds and rain-induced landslides. On the coastal communities, seaweed farms and fish cages are damaged along with their fishing gears and vessels. This creates a substantial damage on agricultural crops and potentially decreases income of the farmers. Environmental integrity and ecological balance are also compromised with the destruction of ecosystems. In 2019 when Typhoon Tisoy hit the municipality after making its first landfall at Prieto Diaz, more than 5,000 farmers who own riceland, fruit orchards, livestock animals, and seaweed farms were affected. MDRRMO reported more than PhP 220 million worth of production loss.

Mangrove forest of Gubat totals to 650 hectares situated in 7 coastal barangays. This provides coastal protection, marine ecosystem stabilizer, habitat of economically-significant aquatic organisms, carbon sequestration, and raw materials to houses such as nipa. Damage on mangrove forest would lead to ecological imbalance and puts coastal communities at great risk to storm surge and tsunami.

For capacity development, analysis shows that an estimated 5 percent of the farming families have knowledge on climate-smart and disaster-resilient sustainable farming techniques as a result of trainings conducted by the Office of the Municipal Agriculturist in collaboration with the Department of Agriculture. Meanwhile, all have access to hazard information sourced from media, barangay *bayabay* system, and online journalism.

Figures 43 to 49 describe the exposure of natural resources production areas to various hazards.

Figure 42. An area in Barangay Villareal that used to be a rice field affected by drought and ground shaking.

Table 20. Existing Natural Resources Attributes of Gubat by Barangay (MPDO, 2018).

BARANGAY	EXPOSURE INDICATORS				SENSITIVITY INDICATORS					
	Number of Farming Dependent Households	Total Area Allocation (Hectares)	Dominant Crop/ Variety of Produce	Average Output Per Hectare (PhP)	Number of Farming Families who Attended Climate Field School	Percentage of Farming Families Using Sustainable Production Techniques	Percentage of Farmers with Access to Hazard Information	Percentage of Production Areas with Infrastructure Coverage	Percentage Areas with Irrigation Coverage	Percentage Areas with Water Impoundment
Ariman	191	125.81	Rice	8,097,826.50	5	5%	100%	100%	81%	0%
Bagacay	193	627.21	Coconut	30,392,163.30	0	5%	100%	100%	9%	0%
Balud del Norte (Pob.)	0	0.00	0	-	0		100%			
Balud del Sur (Pob.)	0	0.00	0	-	0		100%			
Benguet	62	184.02	Coconut	9,079,215.75	0	5%	100%	100%	16%	0%
Bentuco	57	301.78	Coconut	14,266,489.77	0	5%	100%	100%	9%	0%
Beriran	108	210.57	Coconut	11,565,043.65	0	5%	100%	100%	18%	0%
Buenavista	96	129.56	Coconut	7,164,342.09	0	5%	100%	100%	29%	0%
Bulacao	230	253.69	Coconut	14,132,895.57	0	5%	100%	100%	44%	0%
Cabigaan	70	131.34	Coconut	6,728,391.27	0	5%	100%	100%	22%	0%
Cabiguhan	91	487.88	Coconut	21,954,600.00	0	5%	100%	100%	0%	0%
Carriedo	188	390.93	Coconut	20,733,214.14	0	5%	100%	100%	29%	0%
Casili	64	255.38	Coconut	12,214,134.27	0	5%	100%	100%	12%	0%
Cogon	56	40.36	Coconut	1,365,993.00	0	5%	100%	100%	0%	0%

Cota na Daco (Pob.)	12	17.00	Coconut	933,021.00	0	5%	100%	100%		0%
Dita	59	200.81	Coconut	9,944,828.55	0	5%	100%	100%	3%	0%
Jupi	220	246.33	Rice	14,460,607.89	0	5%	100%	100%	34%	10%
Lapinig	89	442.22	Coconut	21,280,317.03	0	5%	100%	100%	8%	0%
Luna Candol (Pob.)	18	12.56	Rice	864,445.41	5	5%	100%	100%	0%	0%
Manapao	186	346.44	Coconut	17,232,565.32	0	5%	100%	100%	16%	12%
Manook (Pob.)	1	0.10	Coconut	4,500.00	0	5%	100%	100%	0%	0%
Naagtan	68	525.80	Coconut	24,460,653.96	25	5%	100%	100%	6%	0%
Nato	177	416.47	Coconut	21,244,958.46	0	5%	100%	100%	16%	0%
Nazareno	30	192.31	Coconut	9,048,115.26	0	5%	100%	100%	5%	0%
Ogao	87	125.70	Coconut	6,752,061.45	1	5%	100%	100%	18%	0%
Paco	43	405.18	Coconut	18,796,703.94	0	5%	100%	100%	2%	0%
Panganiban (Pob.)	5	0.98	Coconut	44,226.00	0	5%	100%	100%	0%	0%
Paradijon (Pob.)	5	12.44	Coconut	5,593,410.00	0	5%	100%	100%	0%	0%
Patag	17	285.64	Coconut	12,999,697.74	0	5%	100%	100%	0%	0%
Payawin	116	425.95	Coconut	21,223,923.48	20	5%	100%	100%	15%	0%
Pinontingan (Pob.)	1	0.43	Coconut	19,183.50	0	5%	100%	100%	0%	0%
Rizal	180	318.37	Coconut	16,473,718.35	0	5%	100%	100%	22%	0%
San Ignacio	178	237.48	Rice	14,047,423.56	55	5%	100%	100%	40%	0%
Sangat	68	470.68	Coconut	21,843,063.27	0	5%	100%	100%	6%	0%
Sta. Ana	41	336.13	Coconut	15,744,005.28	0	5%	100%	100%	8%	0%

Tabi	224	234.56	Coconut	13,337,891.82	0	5%	100%	100%	38%	0%
Tagaytay	97	229.50	Coconut	11,923,699.50	0	5%	100%	100%	13%	0%
Tigkiw	21	182.67	Coconut	8,404,497.54	0	5%	100%	100%	4%	0%
Tiris	161	402.55	Coconut	20,288,221.65	0	5%	100%	100%	0%	0%
Togawe	15	333.37	Coconut	15,065,488.98	0	5%	100%	100%	1%	0%
Union	216	300.49	Coconut	16,193,261.34	0	5%	100%	100%	32%	0%
Villareal	56	111.37	Coconut	5,465,321.73	1	5%	100%	100%	13%	0%

Table 21. Paddy Rice Annual Production (OMAg, 2020).

Major Crop	**Location (Barangay)**	**Area**			**Annual Production**			**Product Market**	**Hazard Susceptibility (H/M/L)**					
		Ha		**% Utilization**	**Volume (MT)**		**Value (PhP)**		**No. of Farmers**	**Fl**	**Ln**	**Ts**	**Su**	**Others: Liquefaction**
		Irrigated	Non-irrigated		Irrigated	Non-irrigated								
Paddy Rice	Ariman	101.5	0	100	1169.28	0	17,539,200.00	Local	102	L	L	H	H	M
	Bagacay	56.07	34.23	100	645.93	347.78	14,905,548.00	Local	136	M	L	H	H	M
	Benguet	28.77	4.48	100	331.43	45.52	5,654,208.00	Local	3	L	L	L	L	M
	Bentuco	28.59	0	100	329.36	0	4,940,352.00	Local	3	L	L	L	L	L
	Beriran	36.99	50.06	100	426.12	498.45	13,868,616.00	Local	43	L	L	L	L	M
	Buenavista	37.11	18.47	100	427.51	187.66	9,227,436.00	Local	68	L	L	H	M	M
	Bulacao	110.46	2.73	100	1272.50	27.7368	19,503,540.00	Local	54	L	L	L	L	M
	Cabigaan	28.67	5.42	100	330.28	55.07	5,780,184.00	Local	73	L	L	L	L	M
	Carriedo	112.28	18.6	100	1293.47	188.98	22,236,624.00	Local	143	L	L	L	L	M
	Casili	30.09	0	100	346.64	0	5,199,552.00	Local	77	L	L	L	L	M
	Dita	5.73	32.12	100	66.01	326.34	5,885,232.00	Local	37	L	L	L	L	M
	Jupi	82.92	57.71	100	955.24	586.33	23,123,580.00	Local	190	L	L	L	L	M
	Lapinig	33.73	23.78	100	388.57	241.61	9,452,616.00	Local	71	L	L	L	L	M

	Luna-Candol	0	12.47	100	0	126.70	1,900,428.00	Local	40	M	L	H	H	M
	Manapao	56.66	11.78	100	652.72	119.68	11,586,120.00	Local	22	L	L	L	L	L
	Naagtan	33.32	0	100	383.85	0	5,757,696.00	Local	67	L	L	L	L	L
	Nato	65.91	38.41	100	759.28	390.24	17,242,932.00	Local	122	L	L	L	L	M
	Nazareno	10.17	6.25	100	117.16	63.5	2,709,876.00	Local	50	L	L	L	L	L
	Ogao	23.07	22.58	100	265.77	229.41	7,427,688.00	Local	41	L	L	M	M	M
	Paco	8.66	14.82	100	99.76	150.57	3,755,016.00	Local	50	L	L	M	M	L
	Patag	0	6.08	100	0	61.77	926,592.00	Local	16	L	L	L	L	L
	Payawin	62.33	23.33	100	718.04	237.03	14,326,116.00	Local	76	L	L	L	L	M
	Rizal	70.49	18.96	100	812.04	192.63	15,070,176.00	Local	100	M	L	H	H	M
	San Ignacio	96	44.02	100	1105.92	447.24	23,297,448.00	Local	44	M	L	H	H	M
	Sangat	27.59	0	100	317.84	0	4,767,552.00	Local	86	L	L	L	L	L
	Sta. Ana	25.76	0	100	296.76	0	4,451,328.00	Local	43	L	L	L	L	M
	Tabi	88.07	27.87	100	1014.57	283.14	19,465,884.00	Local	31	L	L	H	L	M
	Tagaytay	29.93	36.57	100	344.79	371.55	10,745,172.00	Local	20	L	L	L	L	M
	Tigkiw	7.68	0	100	88.47	0	1,327,104.00	Local	73	L	L	L	L	L
	Tiris	0	90.55	100	0	919.99	13,799,820.00	Local	109	H	L	H	H	M
	Togawe	2.66	0	100	30.64	0	459,648.00	Local	29	L	L	L	L	L
	Union	96.36	14.92	100	1110.07	151.59	18,924,816.00	Local	122	L	L	L	L	M
	Villareal	14.88	4.03	100	171.42	40.94	3,185,436.00	Local	52	L	L	L	L	L
	TOTAL	**1412.45**	**620.24**		**16271.42**	**6291.48**	**338,443,536.00**							

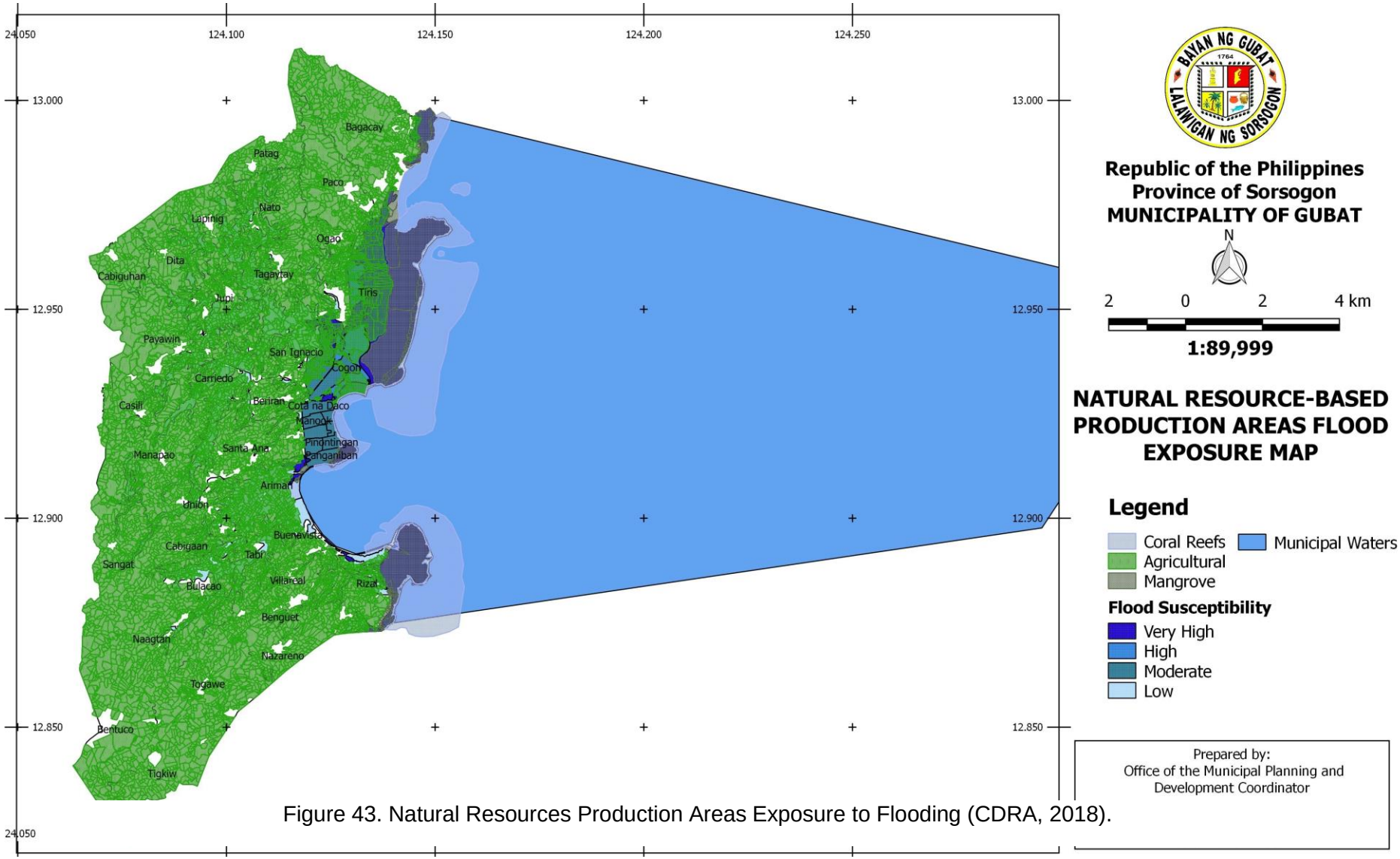


Figure 43. Natural Resources Production Areas Exposure to Flooding (CDRA, 2018).

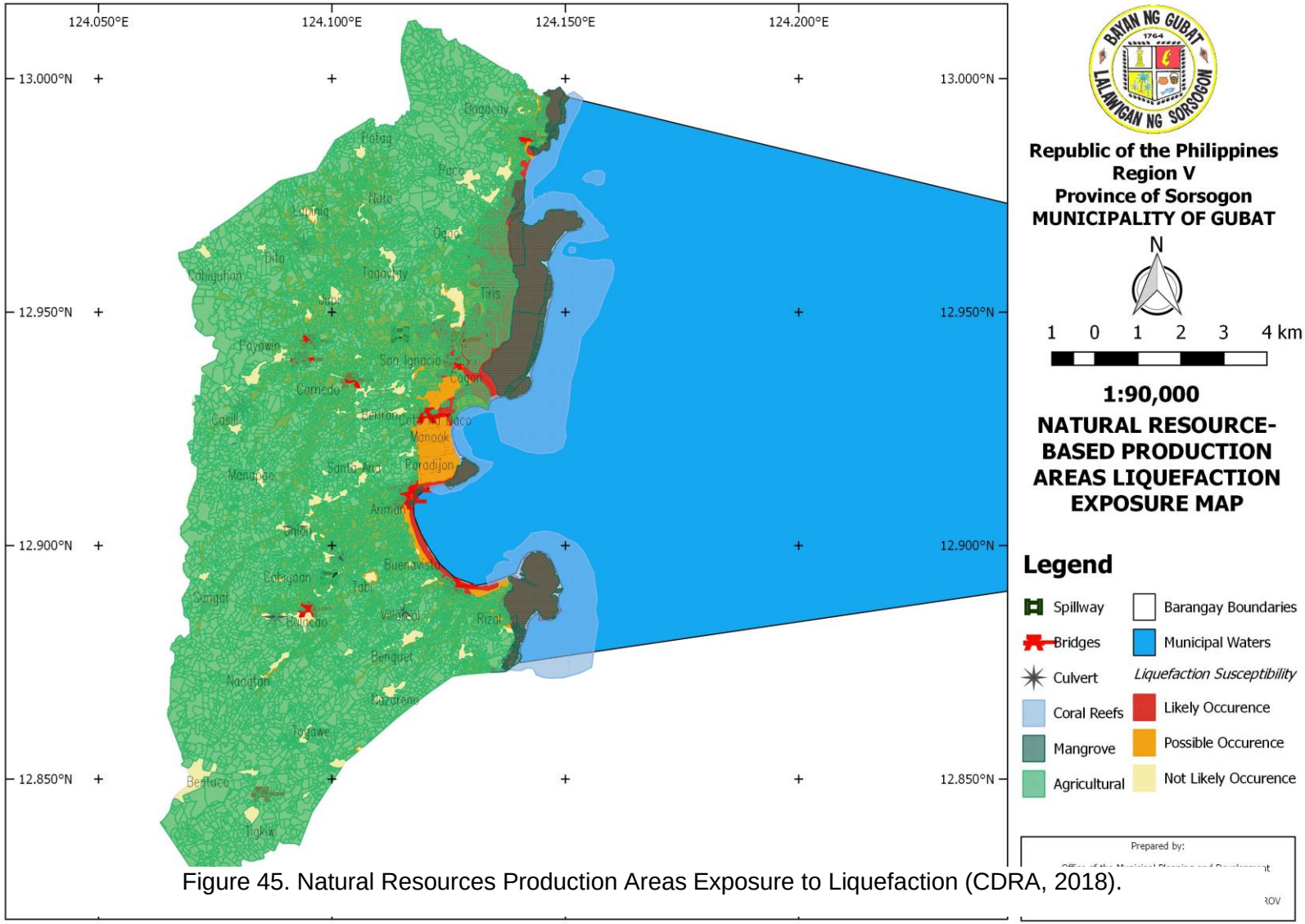


Figure 45. Natural Resources Production Areas Exposure to Liquefaction (CDRA, 2018).

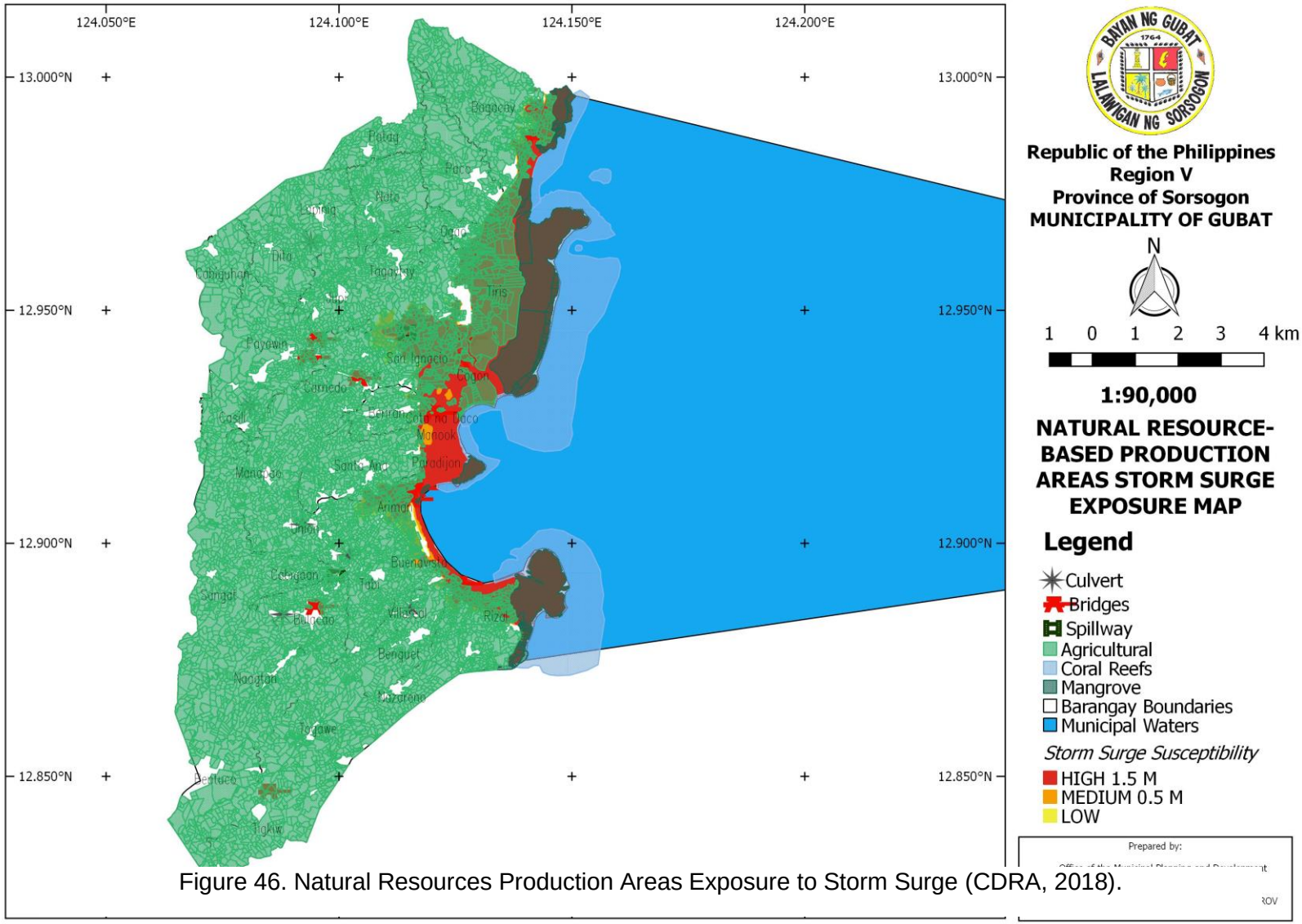


Figure 46. Natural Resources Production Areas Exposure to Storm Surge (CDRA, 2018).

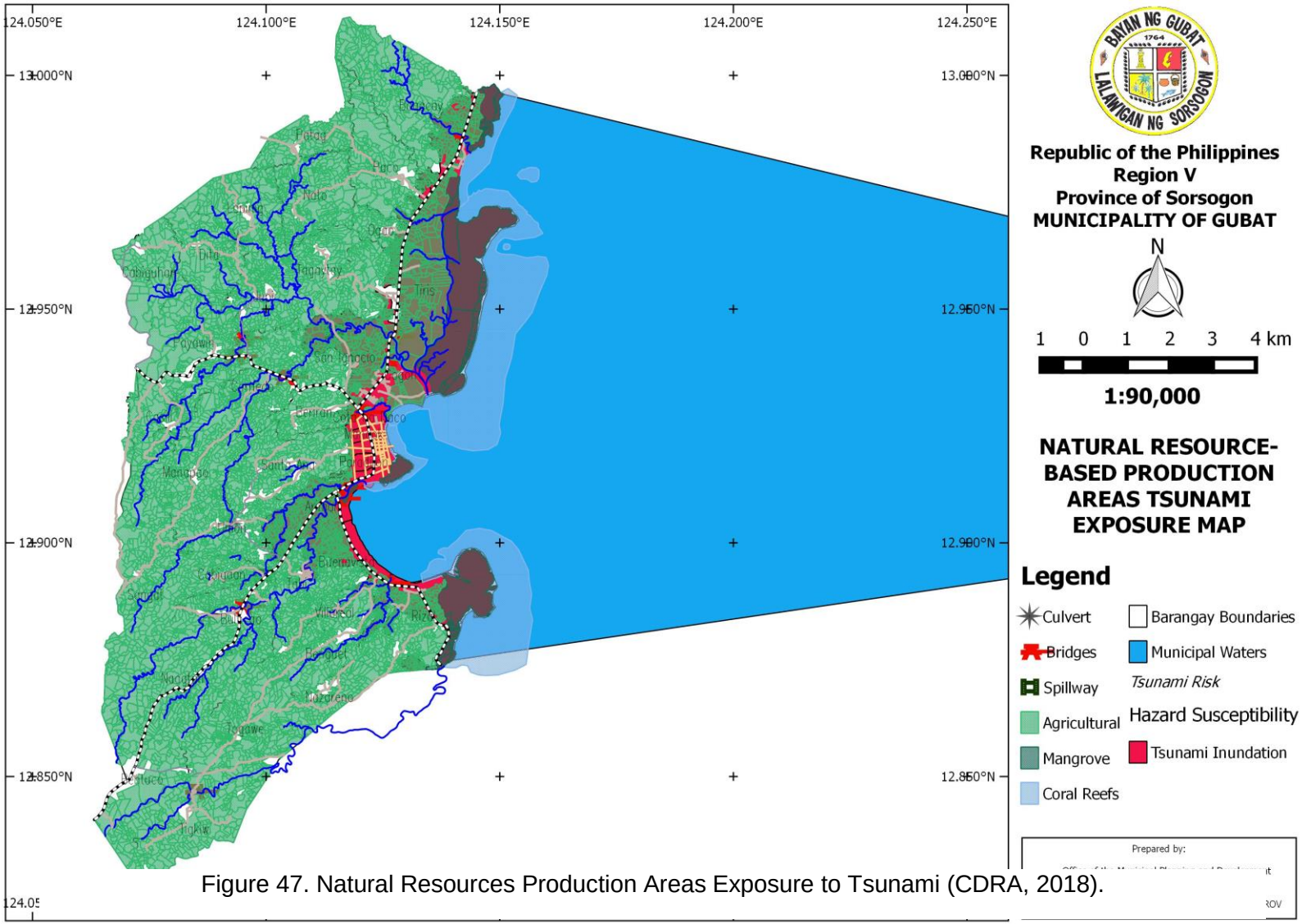


Figure 47. Natural Resources Production Areas Exposure to Tsunami (CDRA, 2018).

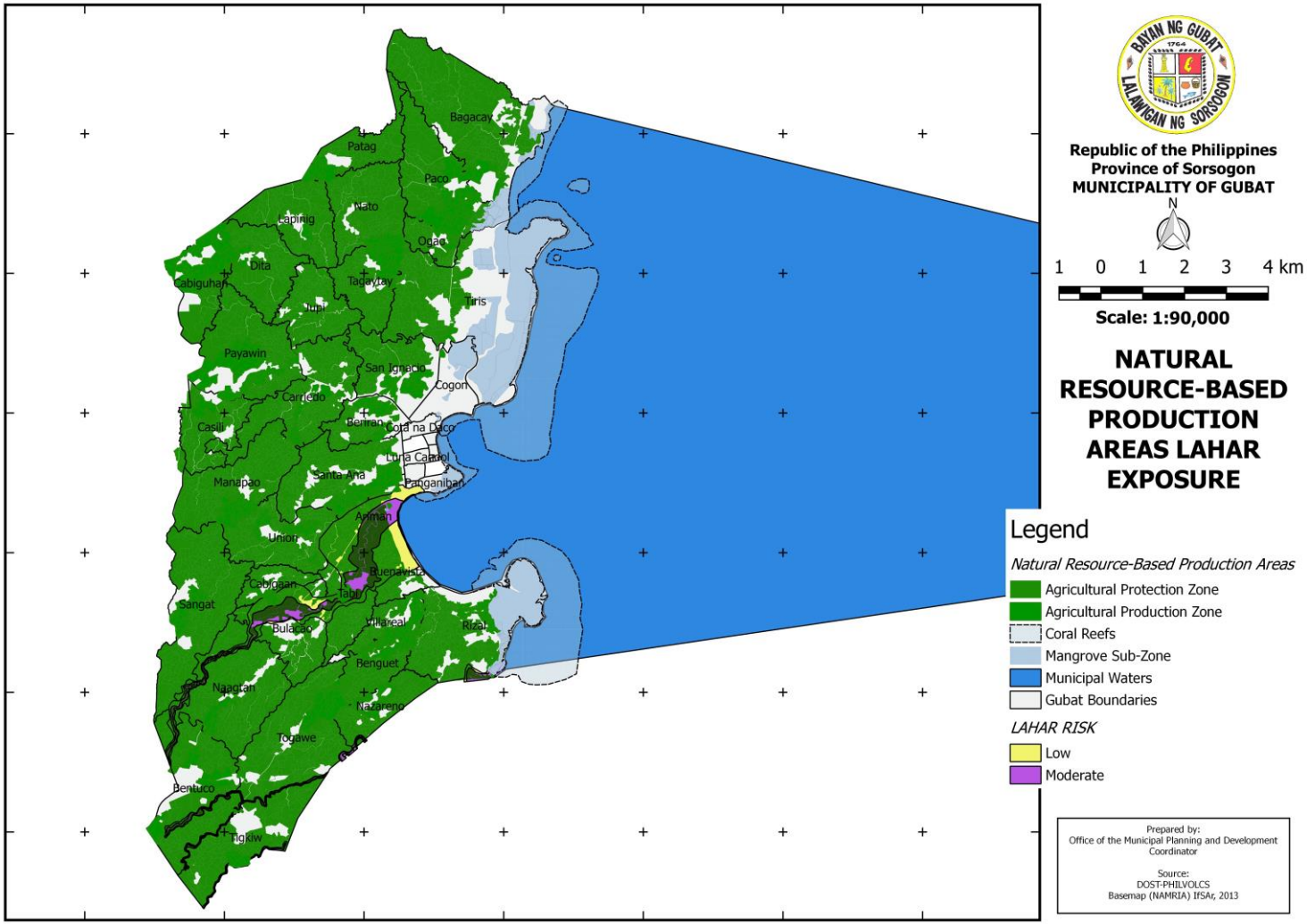


Figure 48. Natural Resources Production Areas Exposure to Lahar Flow (CDRA, 2018) (CDRA, 2018).

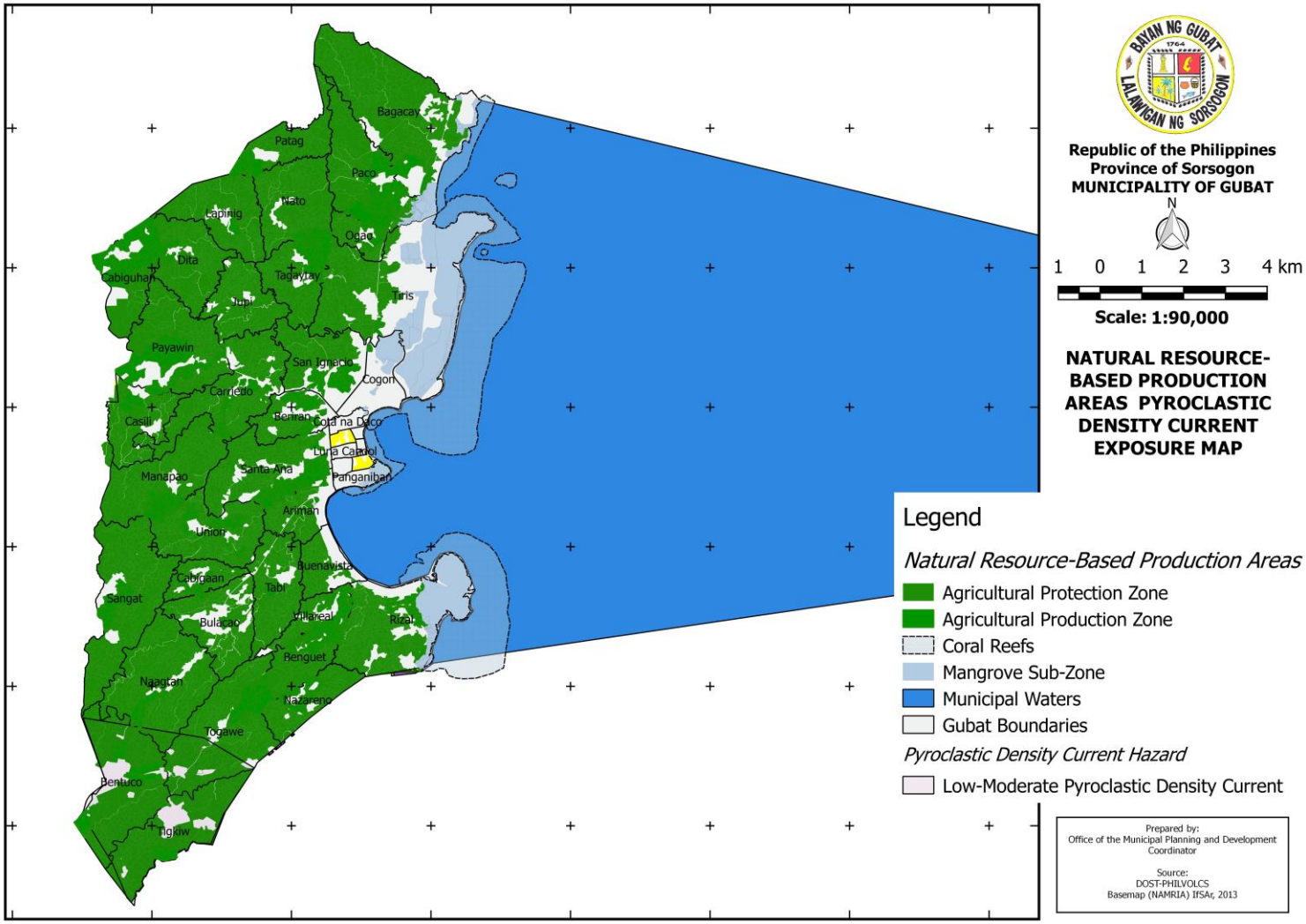


Figure 49. Natural Resources Production Areas Exposure to Pyroclastic Density Current (CDRA, 2018) (CDRA, 2018).

C. Critical Point Facilities

Climate change-related hazards can substantially impact critical point facilities ranging from educational facilities to health and social welfare centers. A total of 37 elementary schools, 10 secondary schools, 1 university, and 1 vocational school cater to the student population of the municipality. On the other hand, there are 42 barangay centers, one for each barangay, and 10 hospitals/clinics, including the Gubat District Hospital which serves not only Gubat residents but also neighboring municipalities. While there are infrastructures requiring renovation such as some bridges and footpaths, the majority of the educational and health centers are in good condition.

Regarding evacuation centers, only 11 out of 42 barangays have evacuation centers while some barangays utilize their multi-purpose halls and barangay halls as evacuation camps when necessary. Some of the schools in the municipality are also susceptible to flooding and landslide which are identified later in this document. Figures 50 to 56 show the exposure of critical point facilities in the municipality to various hazards.

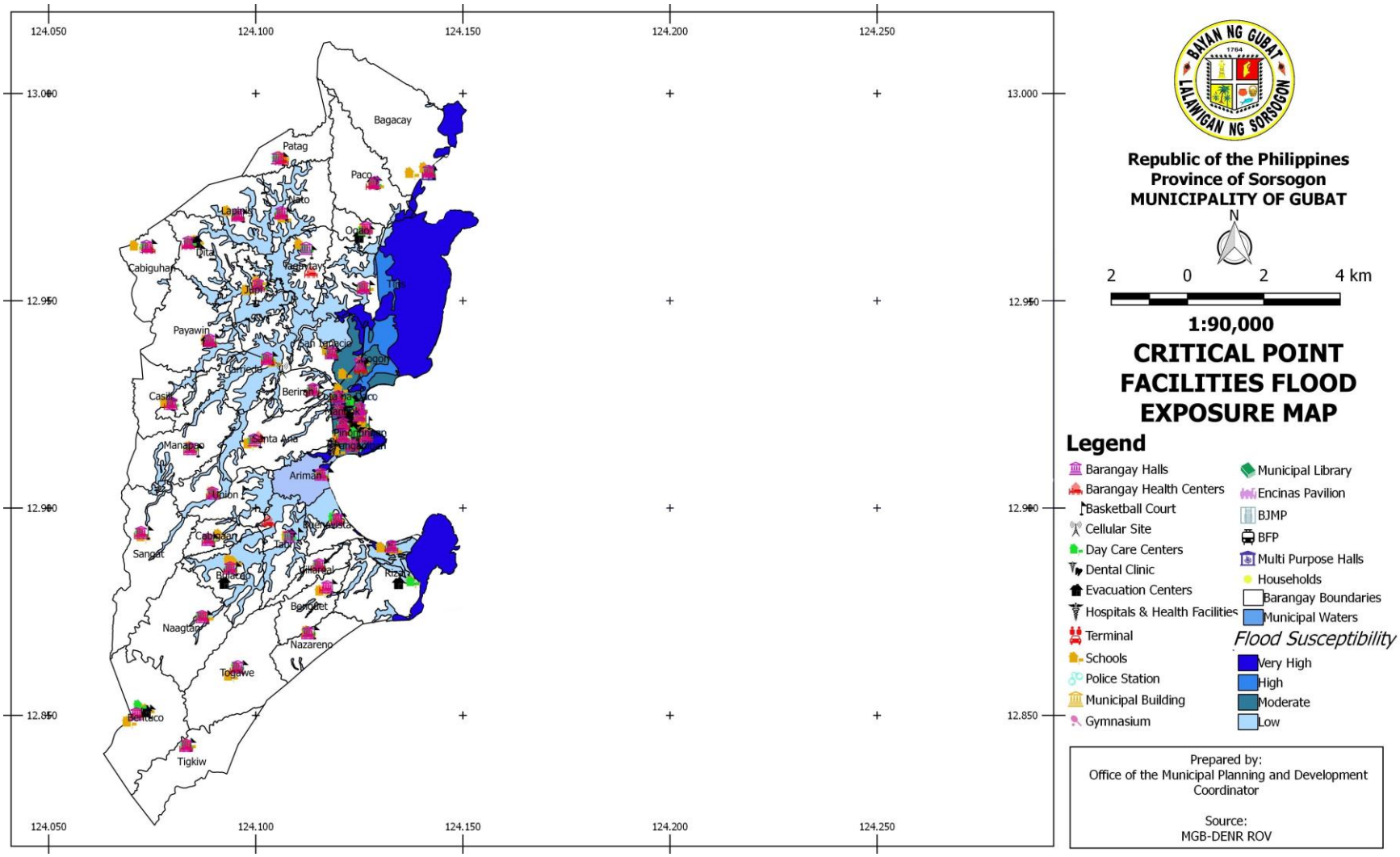


Figure 50. Critical Point Facilities Exposure Map to Flooding (CDRA, 2018).

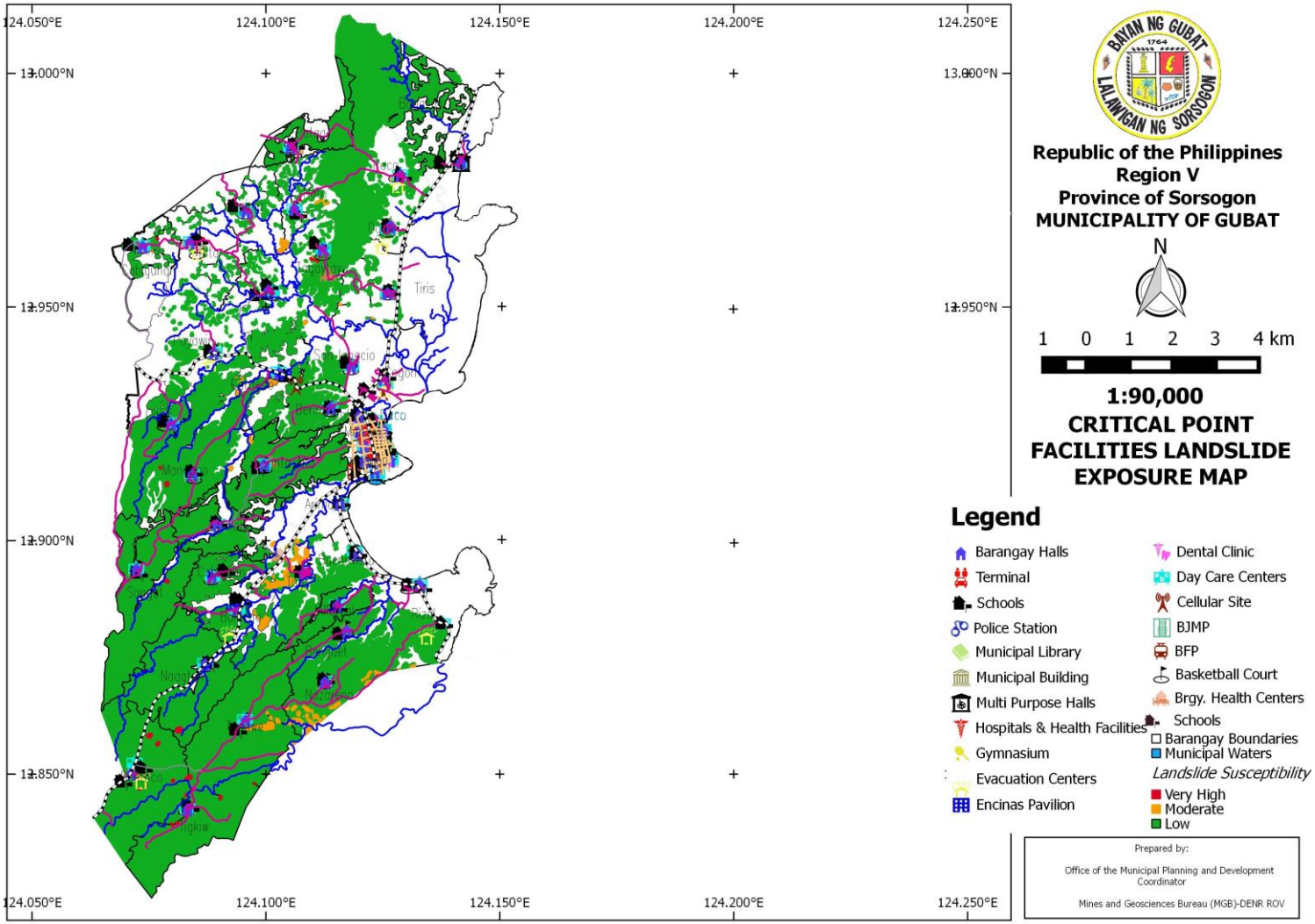


Figure 51. Critical Point Facilities Exposure Map to Landslide (CDRA, 2018).

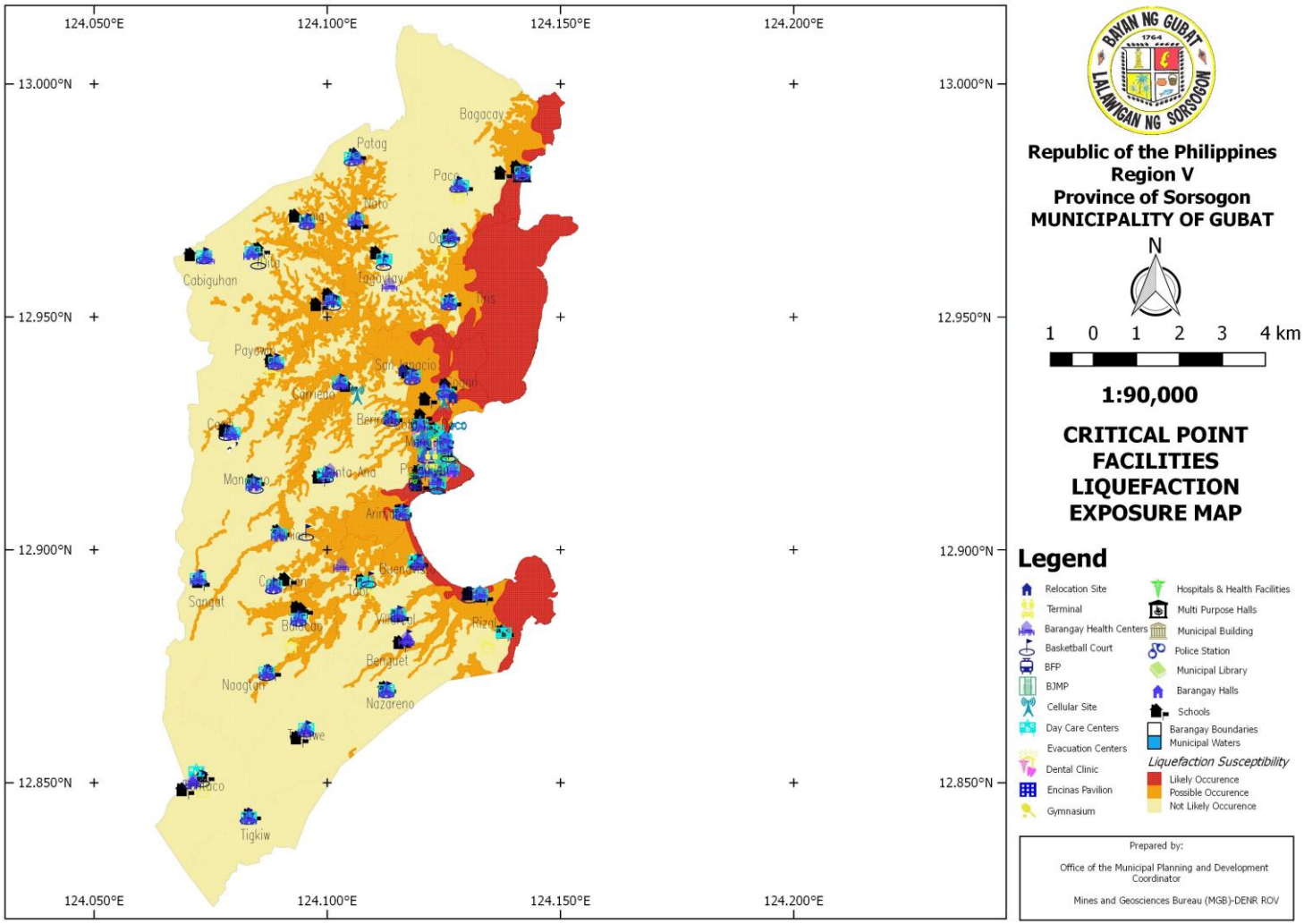


Figure 52. Critical Point Facilities Exposure Map to Liquefaction (CDRA, 2018).

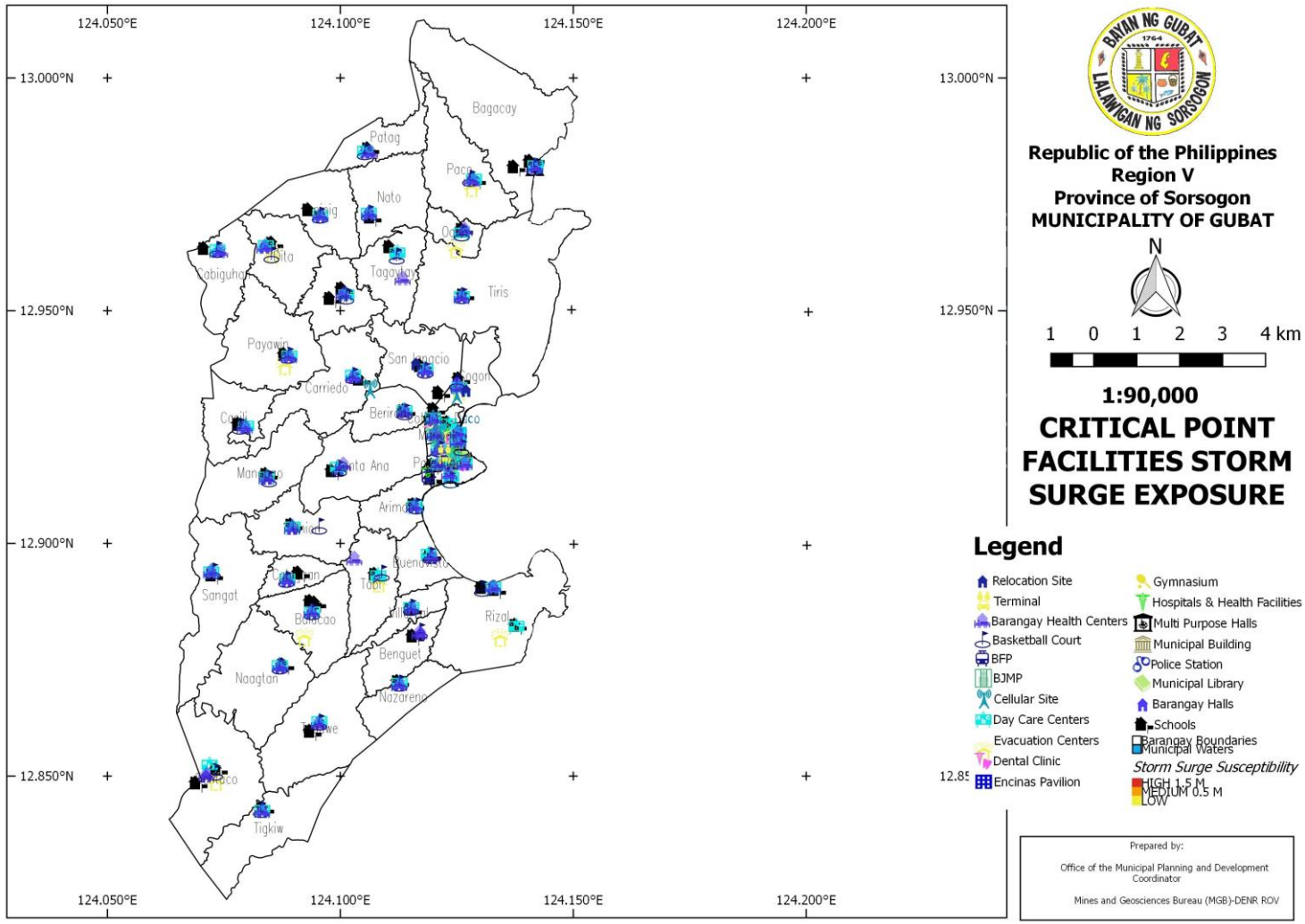


Figure 53. Critical Point Facilities Exposure Map to Storm Surge (CDRA, 2018).

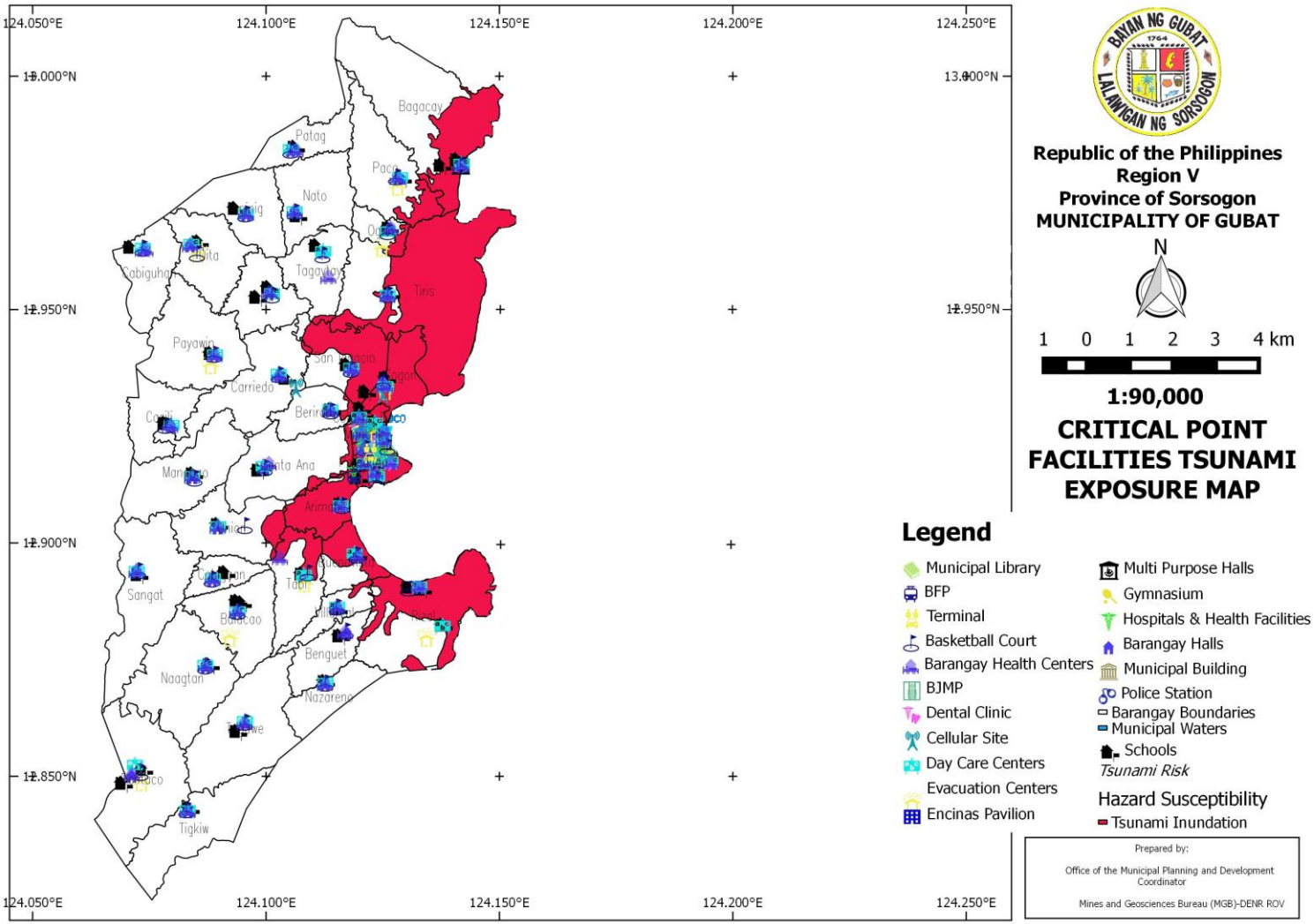


Figure 54. Critical Point Facilities Exposure Map to Tsunami (CDRA, 2018).

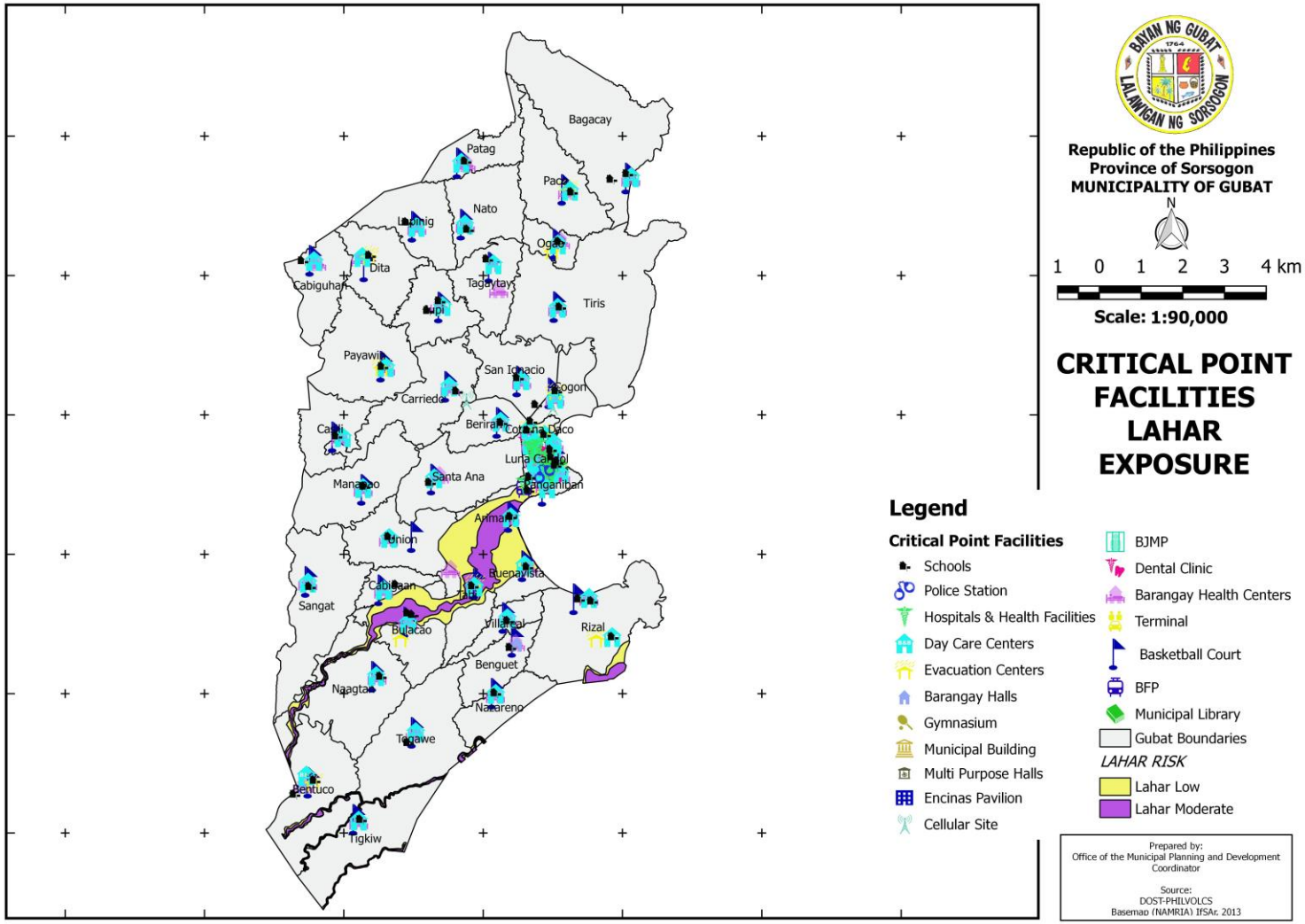


Figure 55. Critical Point Facilities Exposure Map to Lahar Flow (CDRA, 2018).

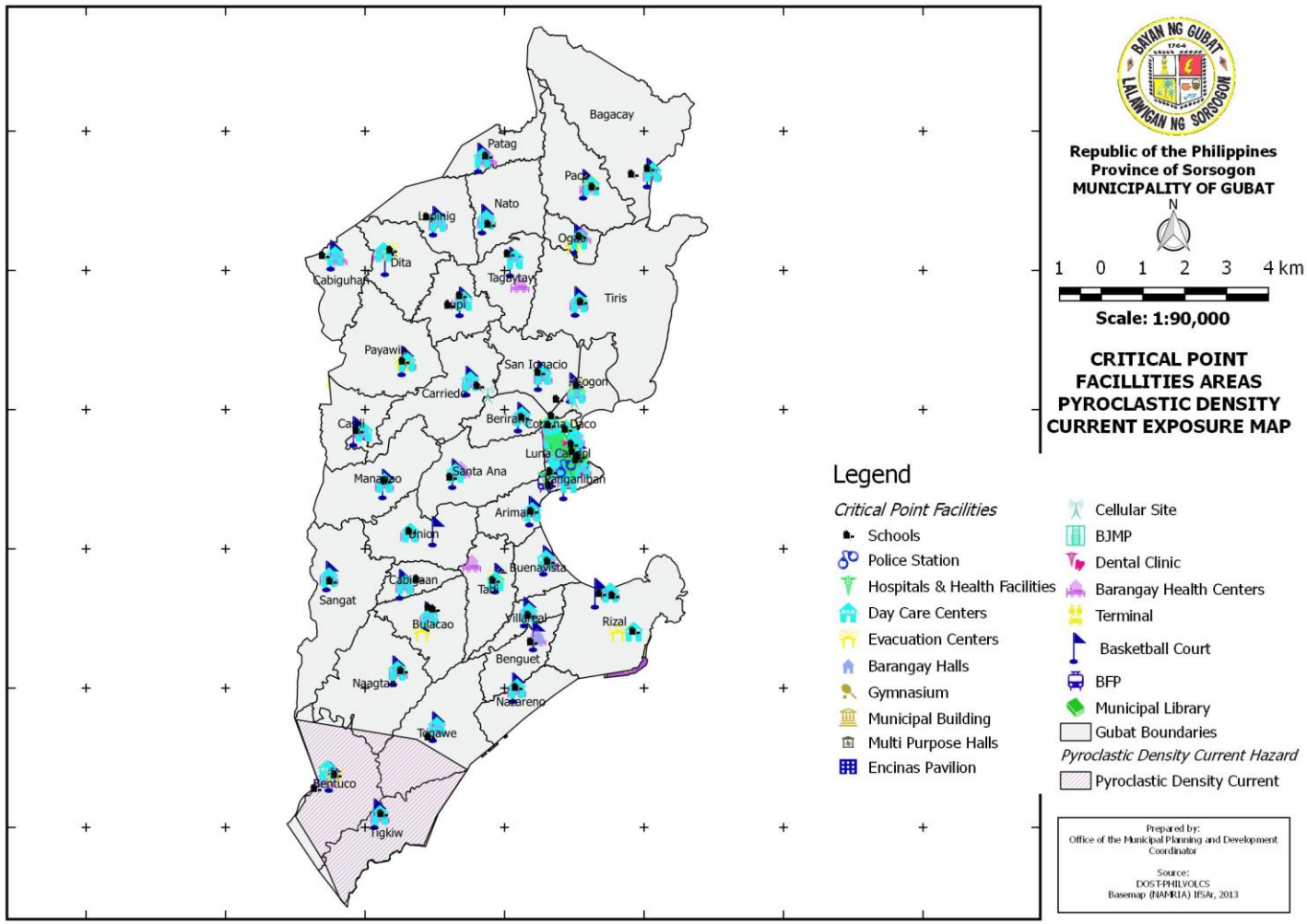


Figure 56. Critical Point Facilities Exposure Map to Pyroclastic Density Current (CDRA, 2018).

D. Lifeline Utilities

Road and other transport networks such as pathways are basic essentials in the economy since they allow the flow of goods and services from one area to another. In Gubat, roads run for a total length of 981.22 kilometers including all road classifications. In the event of road repair due to damages, it would require an amount roughly equivalent to PhP 12 billion based on the replacement cost at PhP 12 million per kilometer. Figure 57 shows that barangay roads make up the majority of the transport networks with 861.45 length in kilometers. Figures 58 to 64 illustrate the exposure of lifeline utilities to various hazards.

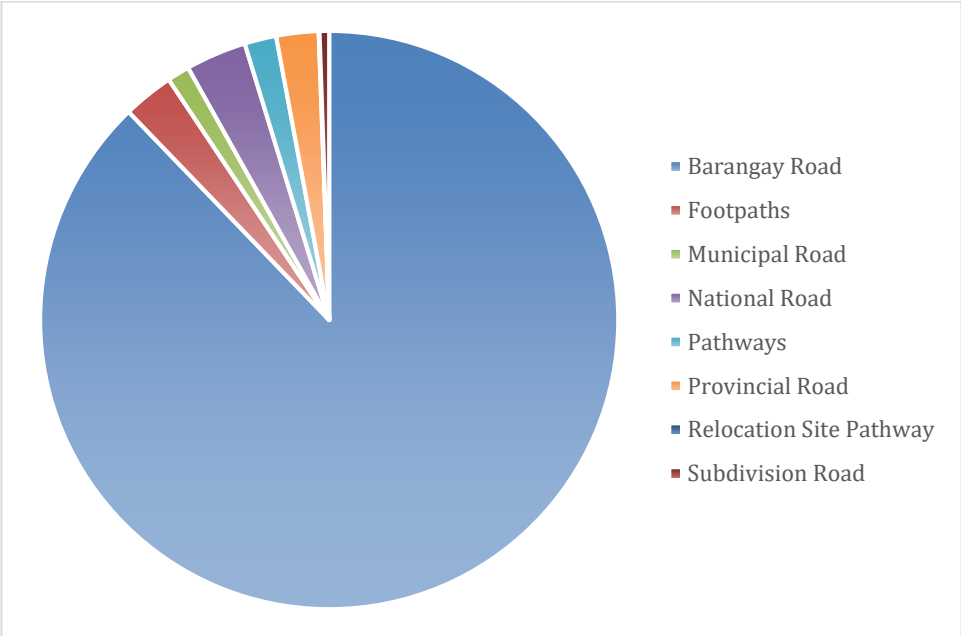


Figure 57. Road distribution by classification (MPDO, 2021).

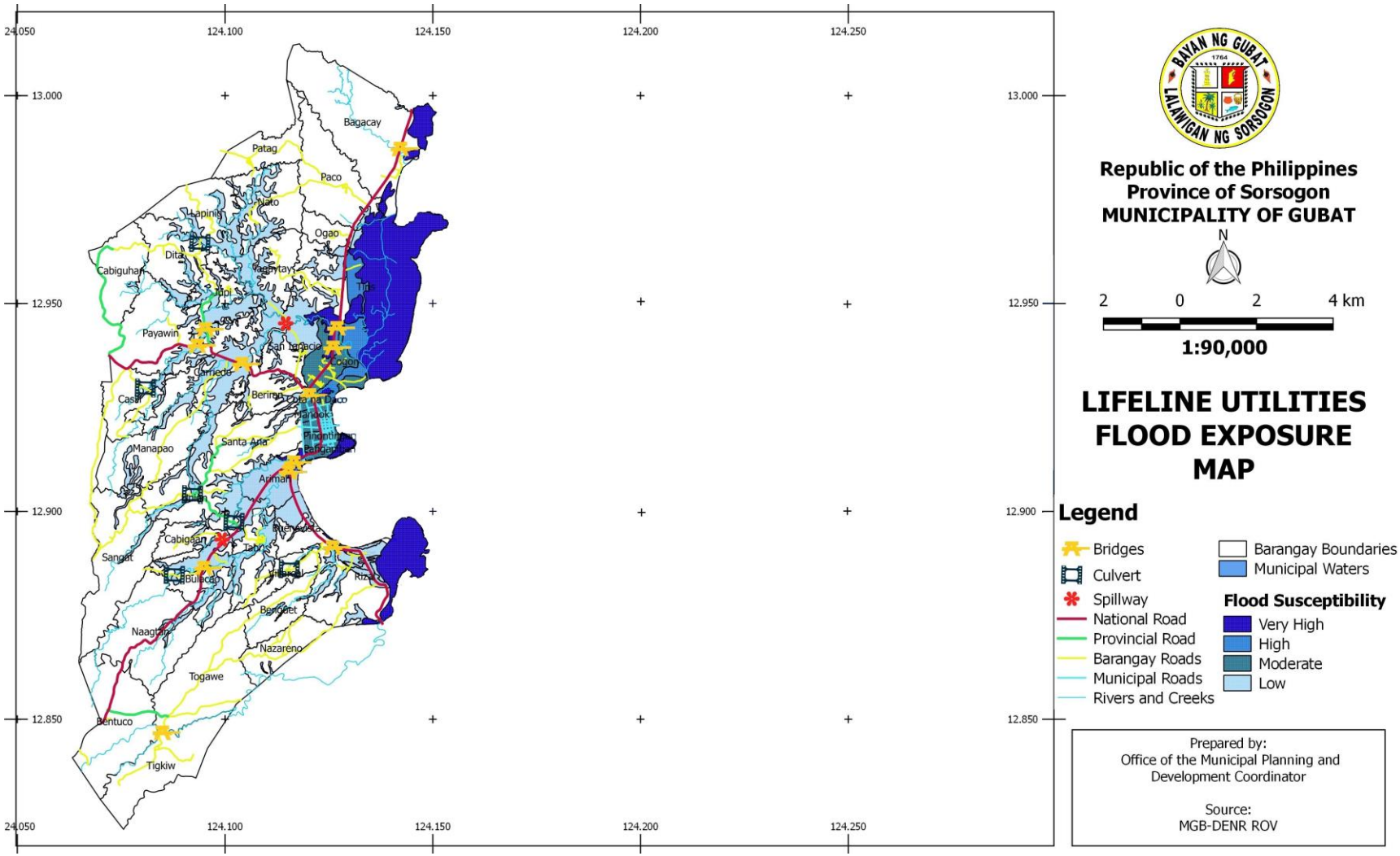


Figure 58. Lifeline Utilities Exposure Map to Flooding (CDRA, 2018).

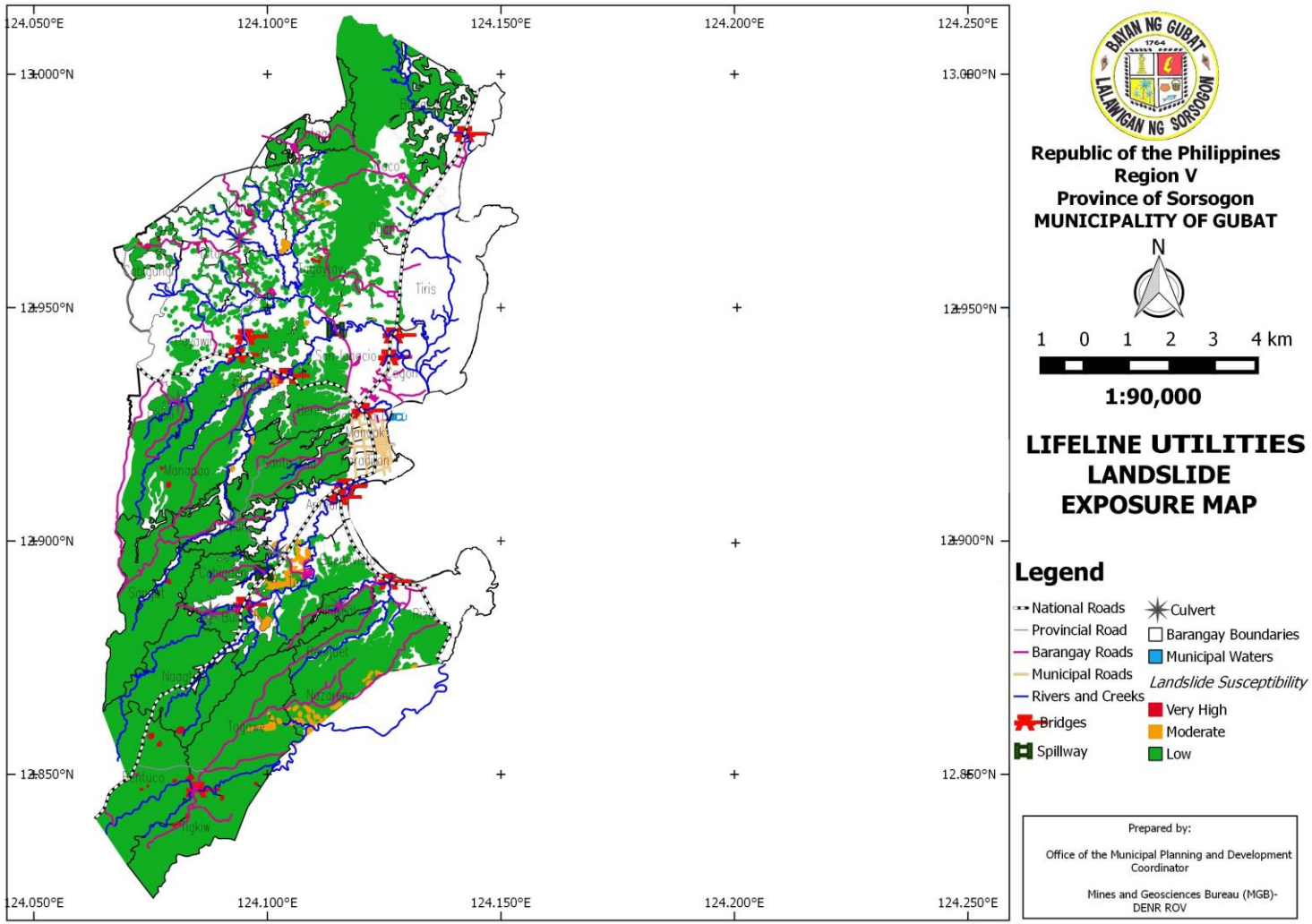


Figure 59. Lifeline Utilities Exposure Map to Landslide (CDRA, 2018).

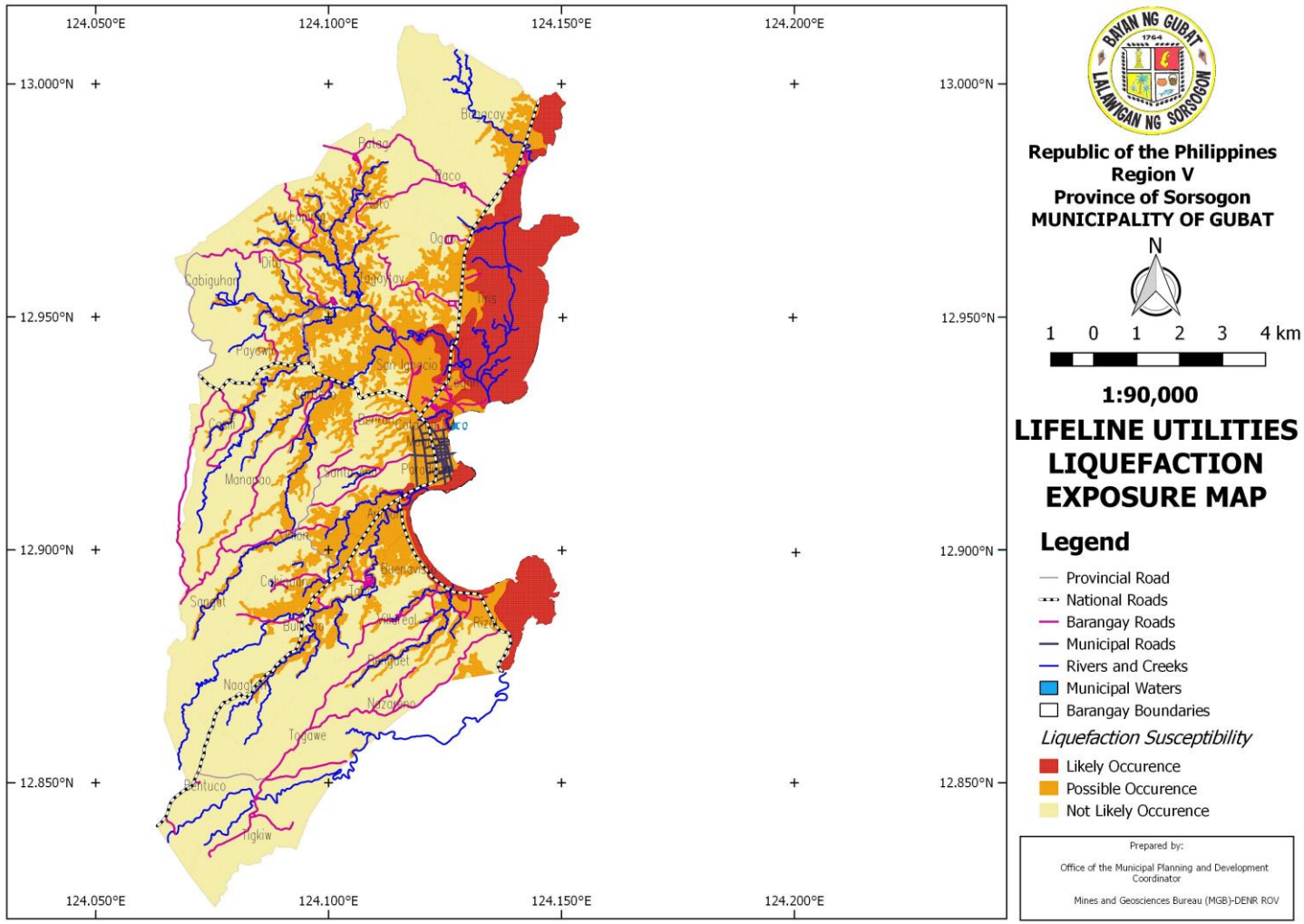


Figure 60. Lifeline Utilities Exposure Map to Liquefaction (CDRA, 2018).

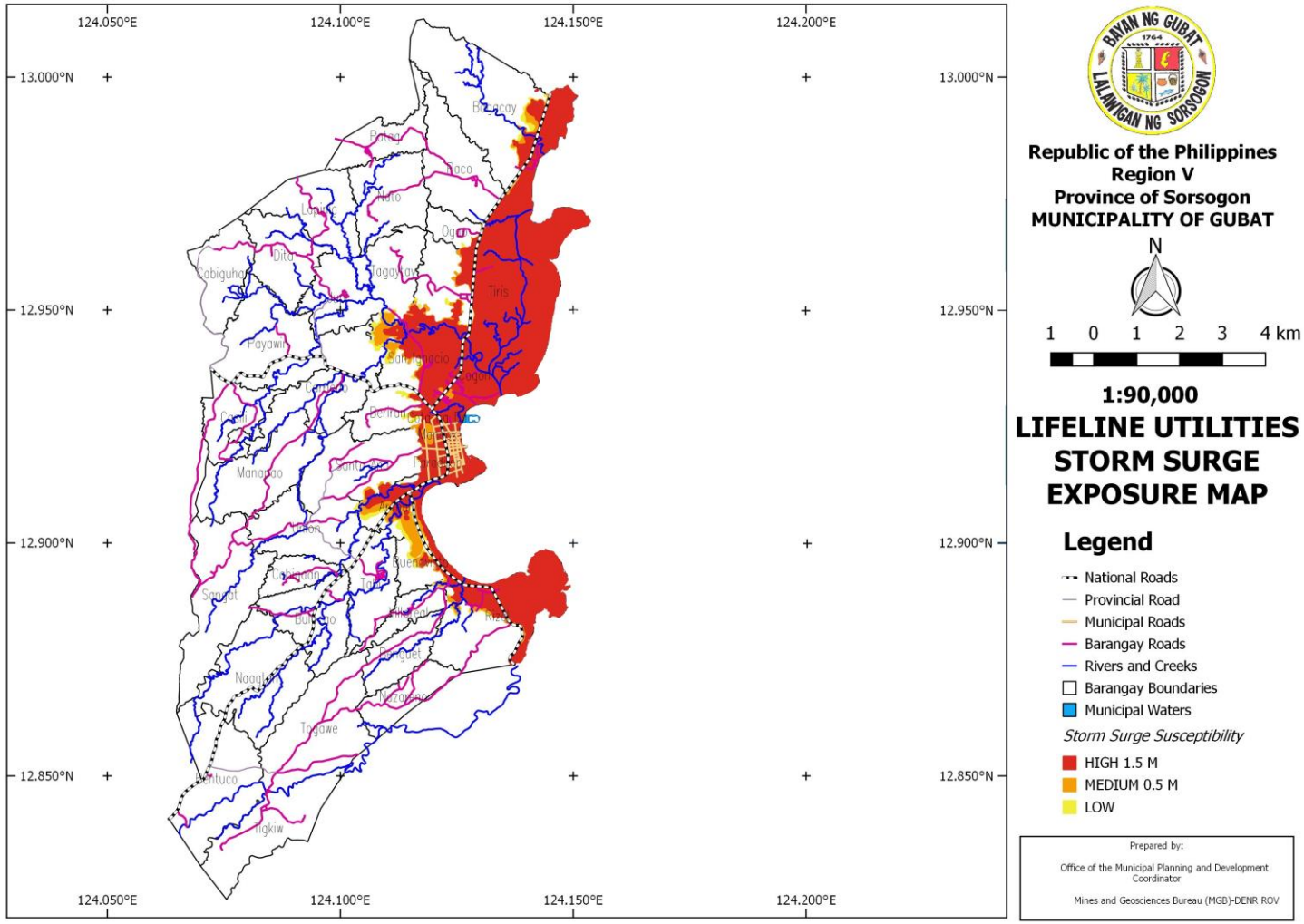


Figure 61. Lifeline Utilities Exposure Map to Storm Surge (CDRA, 2018).

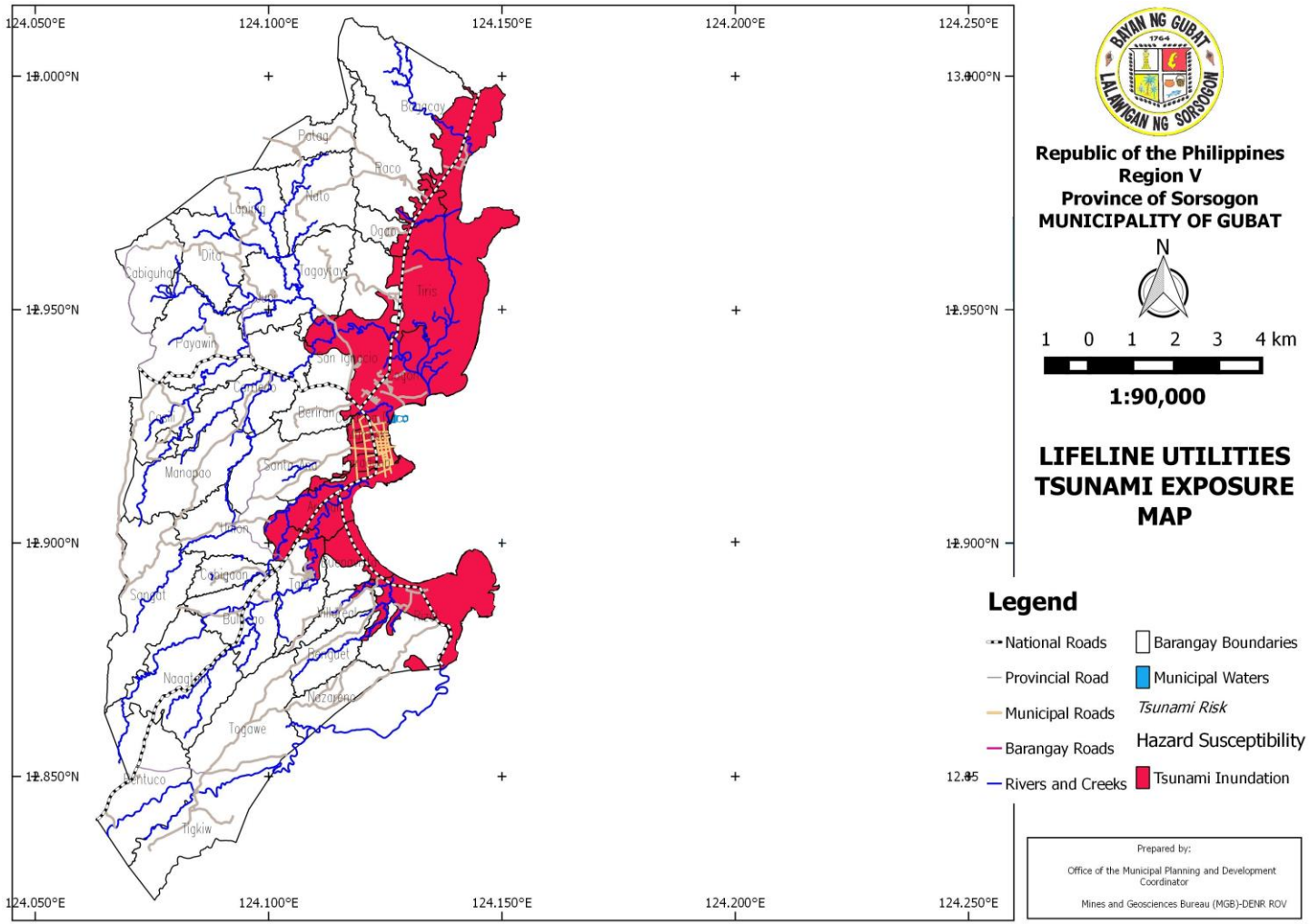


Figure 62. Lifeline Utilities Exposure Map to Tsunami (CDRA, 2018).

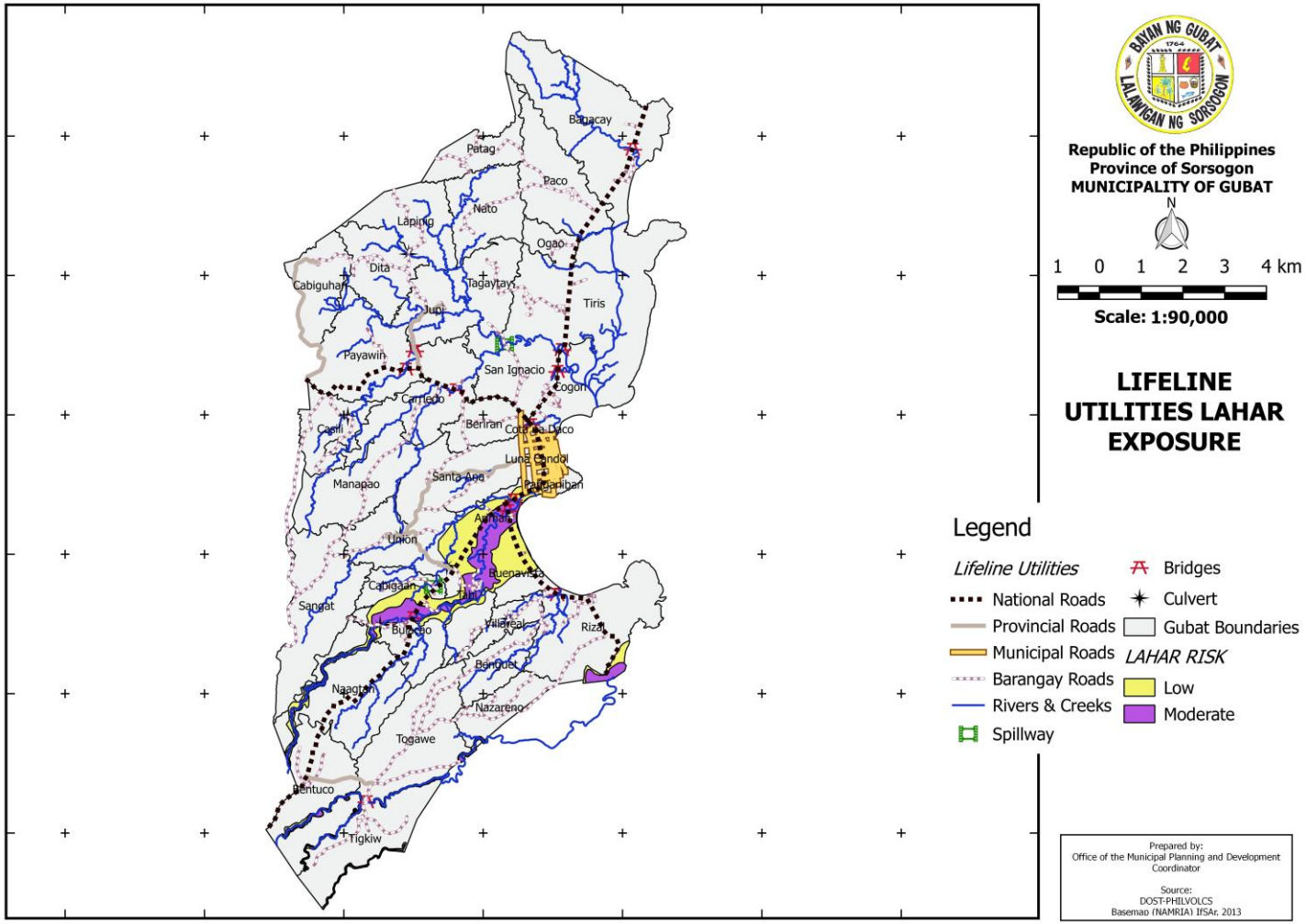


Figure 63. Lifeline Utilities Exposure Map to Lahar Flow (CDRA, 2018).

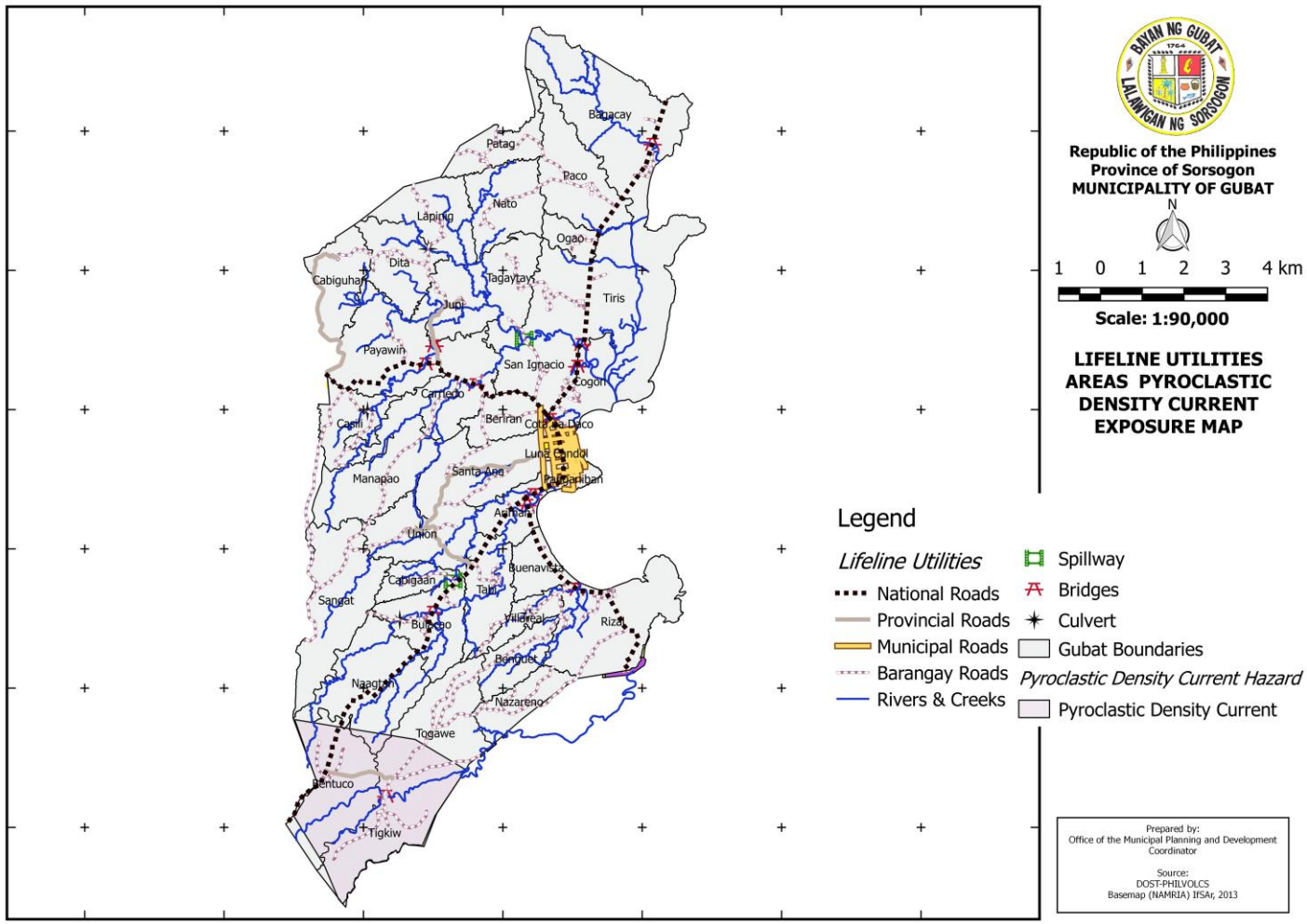


Figure 64. Lifeline Utilities Exposure Map to Pyroclastic Density Current (CDRA, 2018).

E. Urban Use

Residential areas have been excluded in the analysis of urban use areas exposure and were integrated in the population system of interest instead. Urban areas are limited to the commercial areas, tourism, cemetery, and parks in the municipality. Some barangays, majority of which are upland and agricultural-based areas, have no urban areas. A portion of mangrove and estuaries were also considered but only limited to those also used for tourism purposes.

A total of 1312 hectares are classified as urban use and with land use classifications as commercial, cemetery, parks, and tourism. In case of repair due to damages, it would require a total replacement cost of approximately PhP 394 billion (Table 22). Figures 65 to 71 describe the exposure of urban use areas to various hazards present in the municipality.

Table 22. Lifeline Facilities Database of Gubat (MPDO, 2018).

BARANGAY	Existing Land Use (Specific Use)	Total Area Allocation per Land Use Per Barangay (Hectare)	Total Area Allocation per Land Use Per Barangay (Sq.m)	Replacement Cost (PhP perSq. Meter)
Ariman	Commercial	2.05	20,500	615,000,000.00
	Cemetery	4.19	41,900	1,257,000,000.00
	Foreshore Land	4.73	47,300	1,419,000,000.00
	Estuary	2.10	21,000	630,000,000.00
	Easement (Coastal)	3.97	39,700	1,191,000,000.00
Bagacay	Foreshore Land	1.11	11,100	333,000,000.00
	Easement (Coastal)	0.39	3,900	117,000,000.00
Balud del Norte (Pob.)	Foreshore Land	0.39	3,900	117,000,000.00
Balud del Sur (Pob.)	Commercial	1.67	16,700	501,000,000.00
	Foreshore Land	0.22	2,200	66,000,000.00
Bentuco	Cemetery	2.9	29,000	870,000,000.00
Beriran	Commercial	0.13	1,300	39,000,000.00
Buenavista	Tourism	1.34	13,400	402,000,000.00
	Foreshore Land	9.52	95,200	2,856,000,000.00
	Easement (Coastal)	5.36	53,600	1,608,000,000.00
Cogon	Foreshore Land	3.15	31,500	945,000,000.00
	Parks & Recreation	0.5	5,000	150,000,000.00
	Easement (Coastal)	2.3	23,000	690,000,000.00
Cota na Daco (Pob.)	Commercial	3.52	35,200	1,056,000,000.00
	Cemetery	1.91	19,100	573,000,000.00
Luna Candol (Pob.)	Commercial	7.93	79,300	2,379,000,000.00
Manook (Pob.)	Commercial	5.4	54,000	1,620,000,000.00
Panganiban (Pob.)	Commercial	0.88	8,800	264,000,000.00
	Foreshore Land	4.53	45,300	1,359,000,000.00
	Easement (Coastal)	2.33	23,300	699,000,000.00
	Estuary	24.74	247,400	7,422,000,000.00
	Mangrove	21.74	217,400	6,522,000,000.00
Paradijon (Pob.)	Commercial	1.74	17,400	522,000,000.00

Payawin	Commercial	1.11	11,100	333,000,000.00
Pinontingan (Pob.)	Commercial	1.06	10,600	318,000,000.00
	Foreshore Land	0.58	5,800	174,000,000.00
	Easement (Coastal)	0.41	4,100	123,000,000.00
	Parks & Recreation	0.31	3,100	93,000,000.00
Rizal	Foreshore Land	5.76	57,600	1,728,000,000.00
	Easement (Coastal)	1.64	16,400	492,000,000.00
	Estuary	328	3,280,000	98,400,000,000.00
San Ignacio	Commercial	0.13	1,300	39,000,000.00
Tiris	Mangrove	273	2,730,000	81,900,000,000.00
	Estuary	580	5,800,000	174,000,000,000.00

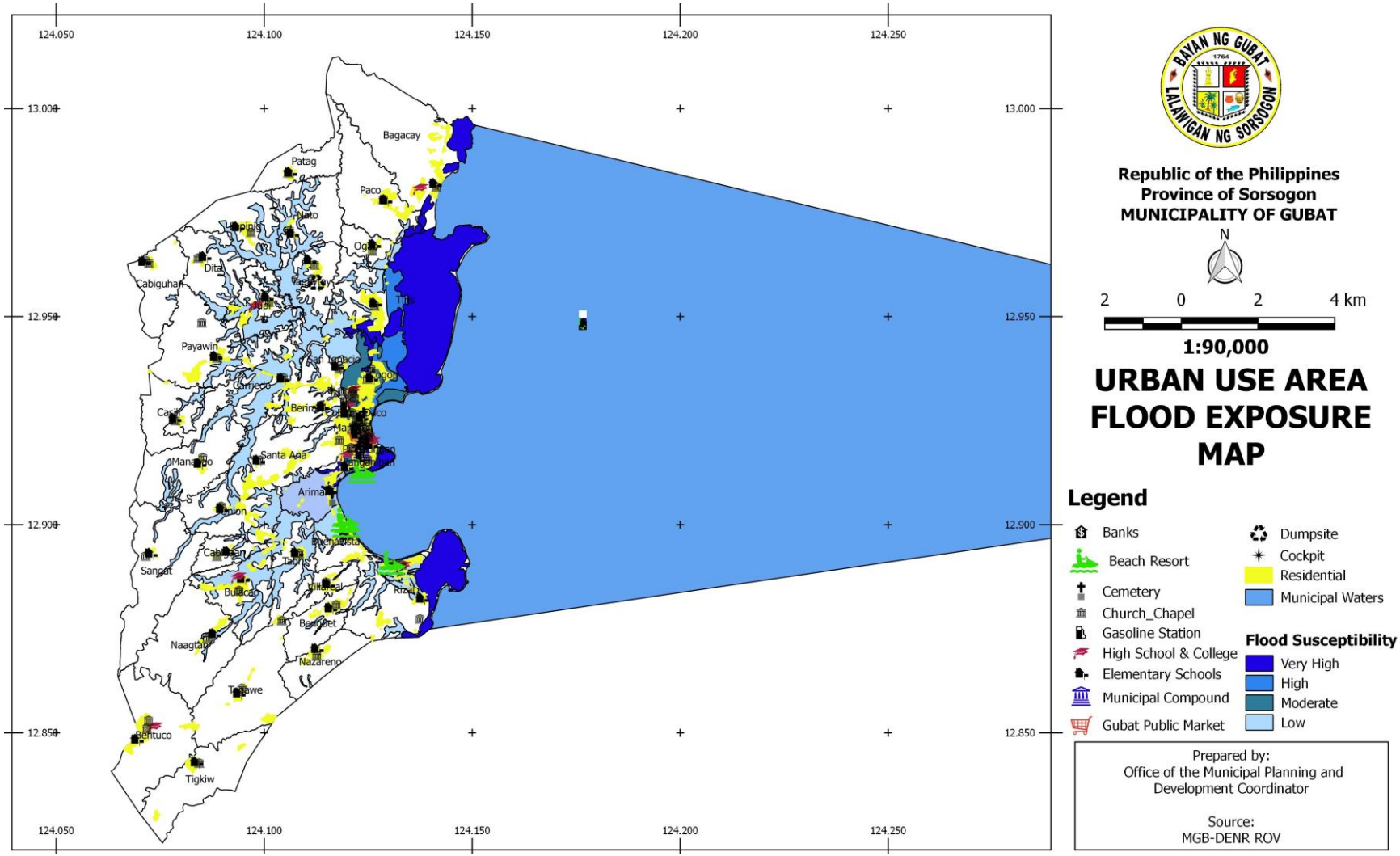


Figure 65. Urban Use Area Exposure Map to Flooding (CDRA, 2018).

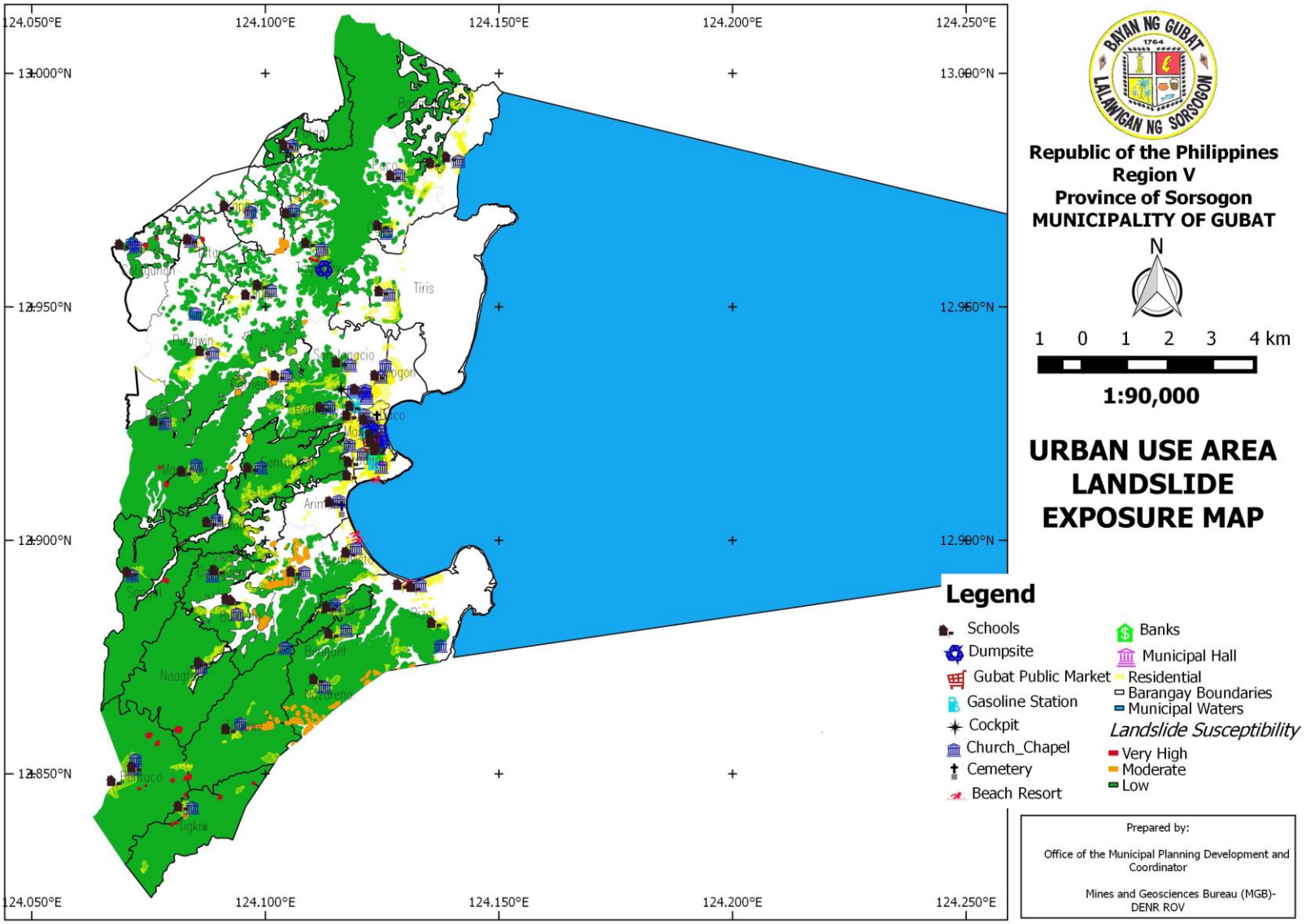


Figure 66. Urban Use Area Exposure Map to Landslide (CDRA, 2018).

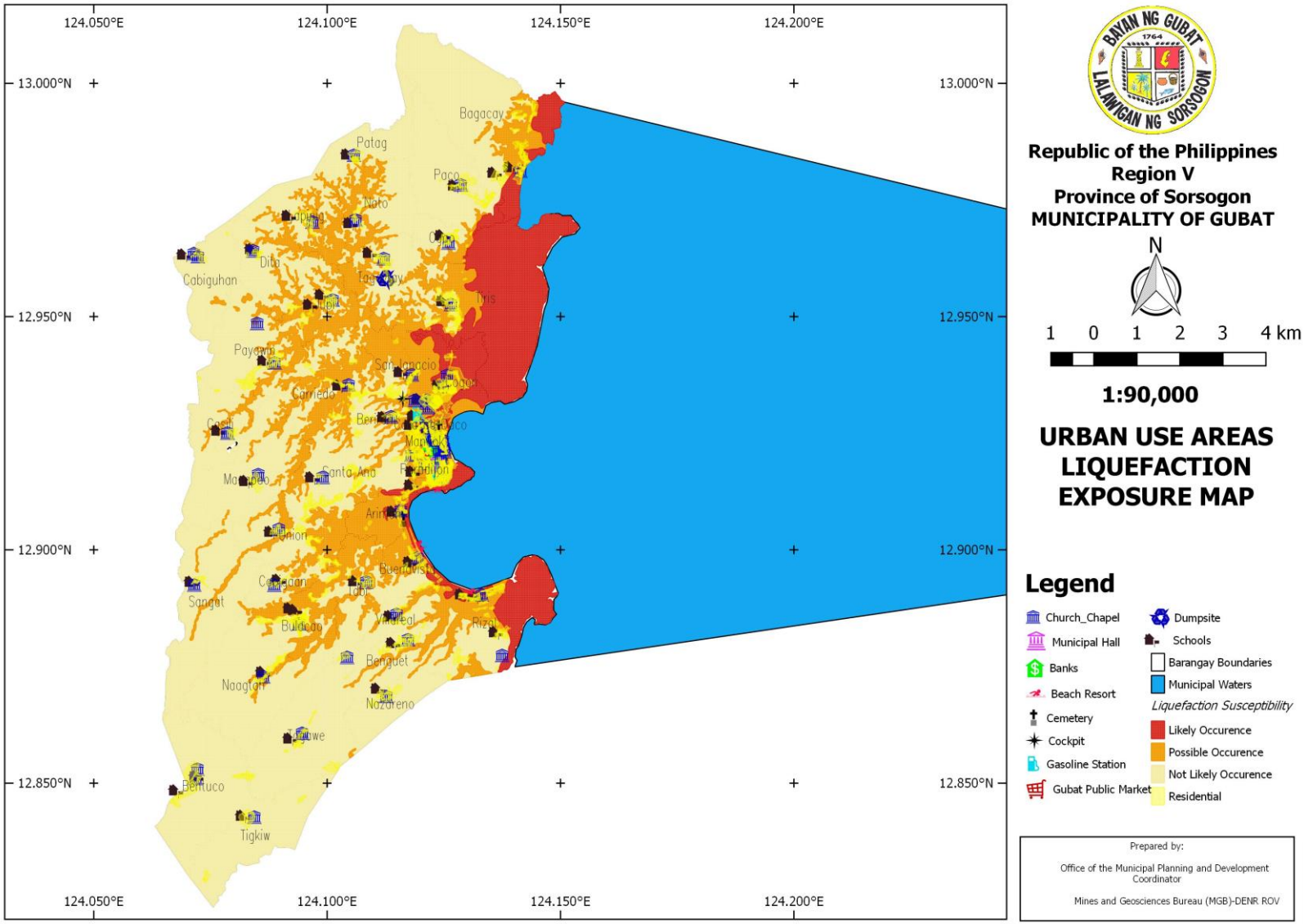


Figure 67. Urban Use Area Exposure Map to Liquefaction (CDRA, 2018).

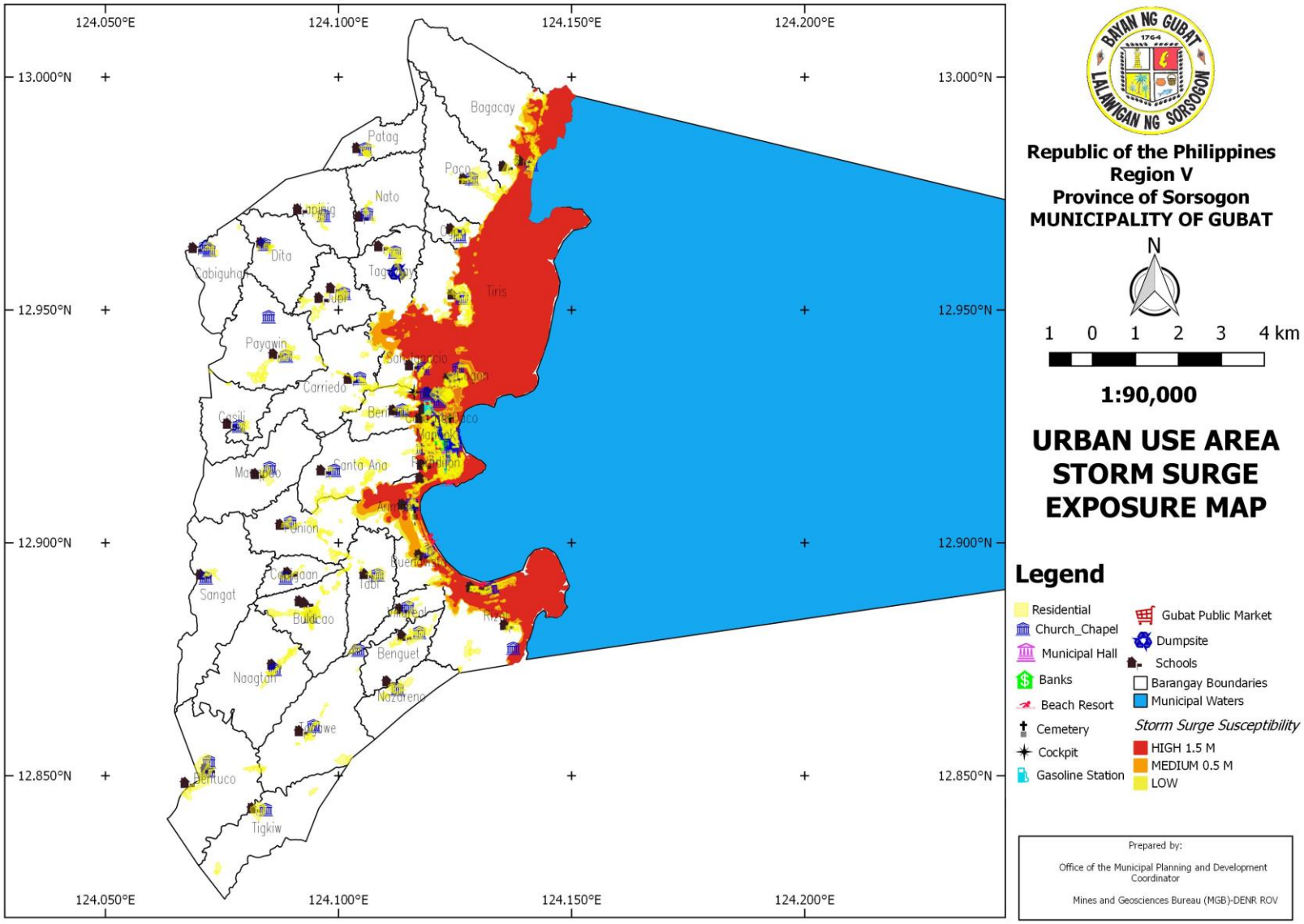


Figure 68. Urban Use Area Exposure Map to Storm Surge (CDRA, 2018).

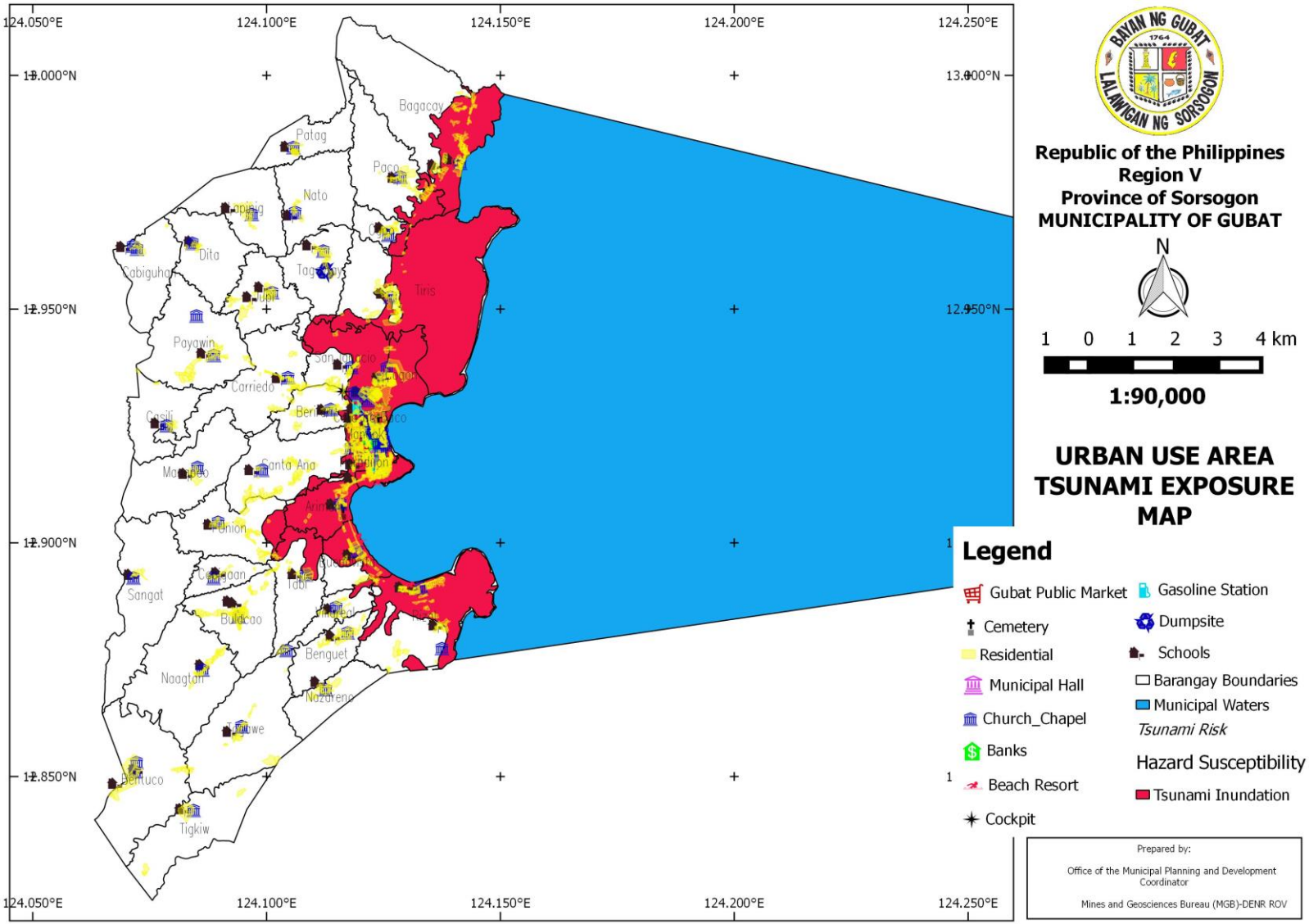


Figure 69. Urban Use Area Exposure Map to Tsunami (CDRA, 2018).

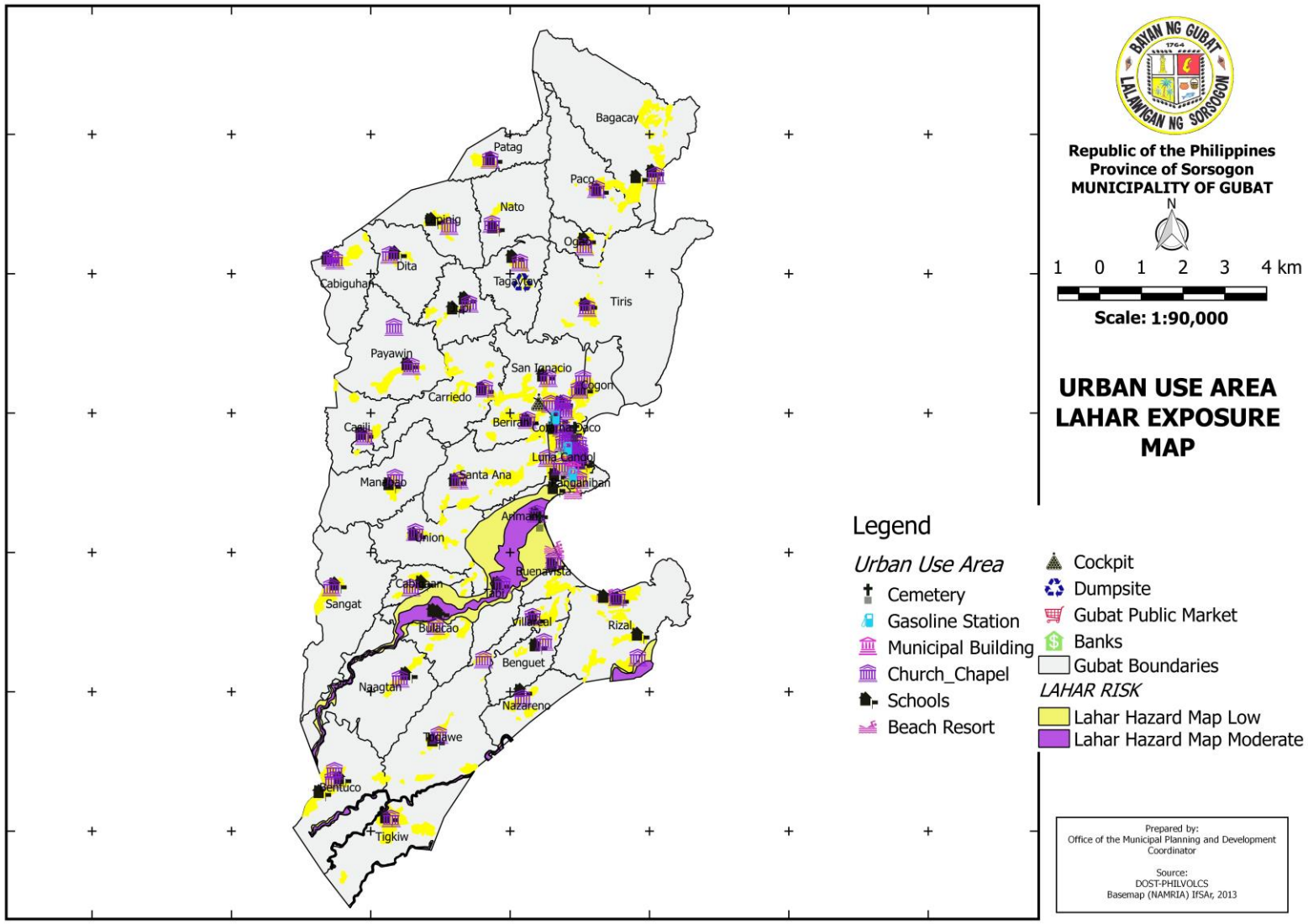


Figure 70. Urban Use Area Exposure Map to Lahar Flow (CDRA, 2018).

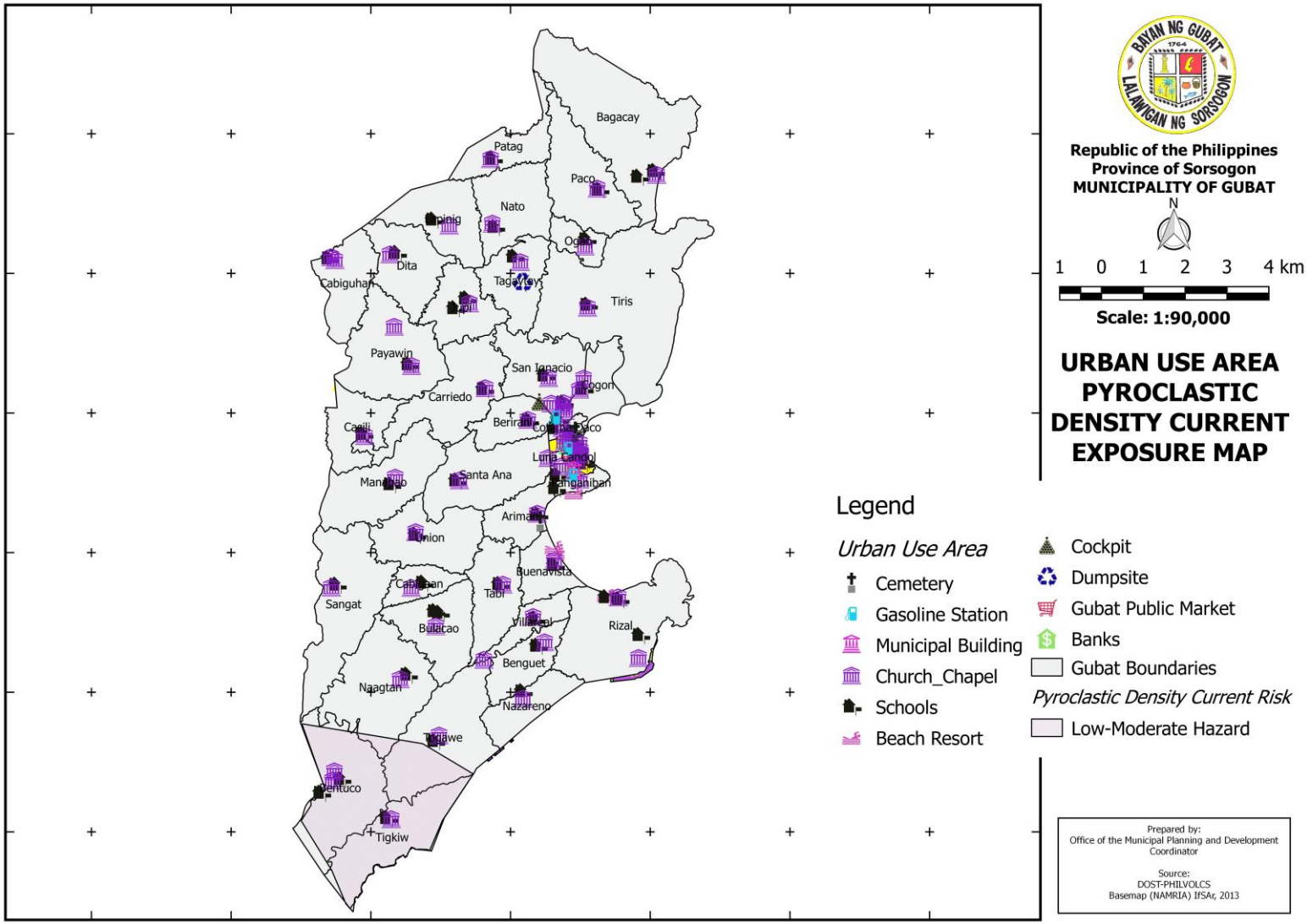


Figure 71. Urban Use Area Exposure Map to Pyroclastic Density Current (CDRA, 2018).

VIII. Climate Change Vulnerability Assessment

Gubat is considered at high risk to climate change events and natural hazards because of its location, its coastal topography (narrow low-lying plains bordered by the ocean and a volcano), and a large population facing the Pacific Ocean (David, et al., 2008). Through maps provided by the Mines and Geosciences Bureau (MGB), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Bureau of Soil and Water Management (BSWM), and the community-based climate and disaster risk assessment conducted, three climate-induced hazards were identified that pose major risk to the town: super typhoons, extreme rainfall/ precipitation, and increased temperature/ dry days; and several hazards including flooding, storm surge/ sea level rise, earthquake/ ground shaking, volcanic eruption, and soil erosion/landslide.

A. Degree of Impact

The upland, coastal, and lowland non-coastal barangays, although with distinct vulnerabilities, share several common climate-related hazards including increased precipitation, super typhoons, natural flooding, rain-induced landslide, and soil erosion. The degrees of impact were assessed based on the exposure database. Scores were sorted by high, moderate, or low impact. Degree of impact for population was determined by exposure percentage and percentage of exposed vulnerable groups while taking consideration of the susceptibility of their area. Impact to critical point facilities was heavily influenced by the type of material of walls and existing condition. For production areas, exposure percentage and dominant crop weigh heavily in coming up with the impact score.

B. Adaptive Capacity

The CDRA team identified current adaptive capacities in terms of wealth, information, infrastructure, institution and governance, and social capital. Scores were assigned determining low, moderate, or high adaptive capacities. Overall, for wealth, the municipality has identified various fund sources for disaster mitigation and response such as disaster risk reduction and management (DRRM) fund, local budget for programs and services, and disaster relief services, funding from overseas development assistance, and other non-state actors. Most barangays have developed information systems that relay disaster information and early warning to its constituents including *bayabay*, text brigade, and public information board. Moreover, the Municipal Disaster Risk Reduction and Management Office utilizes the PAGASA and other weather bureaus such as the Japan Meteorological Agency (JMA), the Joint Typhoon Warning Center (JTWC), and subscription to Windy for comparison and advanced information that aids them in disaster preparedness, risk reduction, and management. Aside from the construction of preventive infrastructure and the rehabilitation of existing buildings, revetments, evacuation centers, irrigation canals, ripraps, erosion controls (e.g. embankments, geomats), the different barangays also partner with civil society organizations, people's organizations, volunteers, churches, and the academe for soft infrastructure interventions.

C. Vulnerability

Vulnerability indices were determined by multiplying the degree of impact by adaptive capacity. To substantiate the vulnerability indices, scores were assigned to each hazard. Higher weights were assigned to super typhoons, increased temperature, and flooding because of their impacts to natural resources, properties, and lives. Soil erosion, on the other hand, is a slow onset event. It takes years before the difference in productivity of agricultural land as well as shallowing of rivers and lakes (due to siltation) is observed.

All the coastal barangays are exposed to most of the climate-related hazards such as typhoons, flooding, and storm surge. In most upland areas, soil erosion is an additional hazard, while many areas reliant on agriculture are affected by increased precipitation, super typhoons, and increased temperature.

Typhoon and Extreme Rainfall

The municipality is characterized by a short dry season in the months of April to August, and a pronounced maximum rainfall at a rate of 298 - 370 mm from November to January brought about by the southwest monsoon (MDRRMO, 2017). Located on the eastern side facing the Pacific Ocean, Gubat is directly on the path of typhoons (MDRRMO, 2017).

Figure 72. Impact of typhoon Nona to houses along the coastline of Gubat.

Adapted from "Sorsogon's typhoon Nona victims seek help", by Bobet Lee Rodrigueza, 2015, Bicol Standard. Retrieved from http://www.bicolstandard.com/2015/12/typhoon-nona-sorsogon-help.html

Increased Temperature/ Dry Days

From 1971 to 2000, Gubat experienced a total of 360 days of extreme temperature exceeding 35°C using the threshold values compared to other areas in the Asia Pacific region (PAGASA, 2011). Based on climate projection, extreme temperatures are expected to increase to 411 days from the year 2006 to 2035 for all seasons with the highest increase in the months of March, April, and May (MDRRMO, 2019).

Table 23. Tabulated Estimation of Vulnerability Index Rating and Category (CDRA, 2018).

Major Decision Area	Vulnerability Rating Table				
	Exposure Elements	Degree of Impact	Adaptive Capacity	Index	Category
Super typhoon	Population	3	1	3	Low
	Urban	2	1	2	Low
	Natural Resources	3	3	9	High
	Critical Facilities	3	1	3	Low
	Lifeline Utilities	3	1	3	Low
Extreme Rainfall/Precipitation	Population	2	1	2	Low
	Urban	2	1	2	Low
	Natural Resources	3	2	6	High
	Critical Facilities	2	1	2	Low
	Lifeline Utilities	2	1	2	Low
Increased Temperature/Dry Days	Population	1	1	1	Low
	Urban	1	1	1	Low
	Natural Resources	3	2	6	High
	Critical Facilities	1	1	1	Low
	Lifeline Utilities	1	1	1	Low

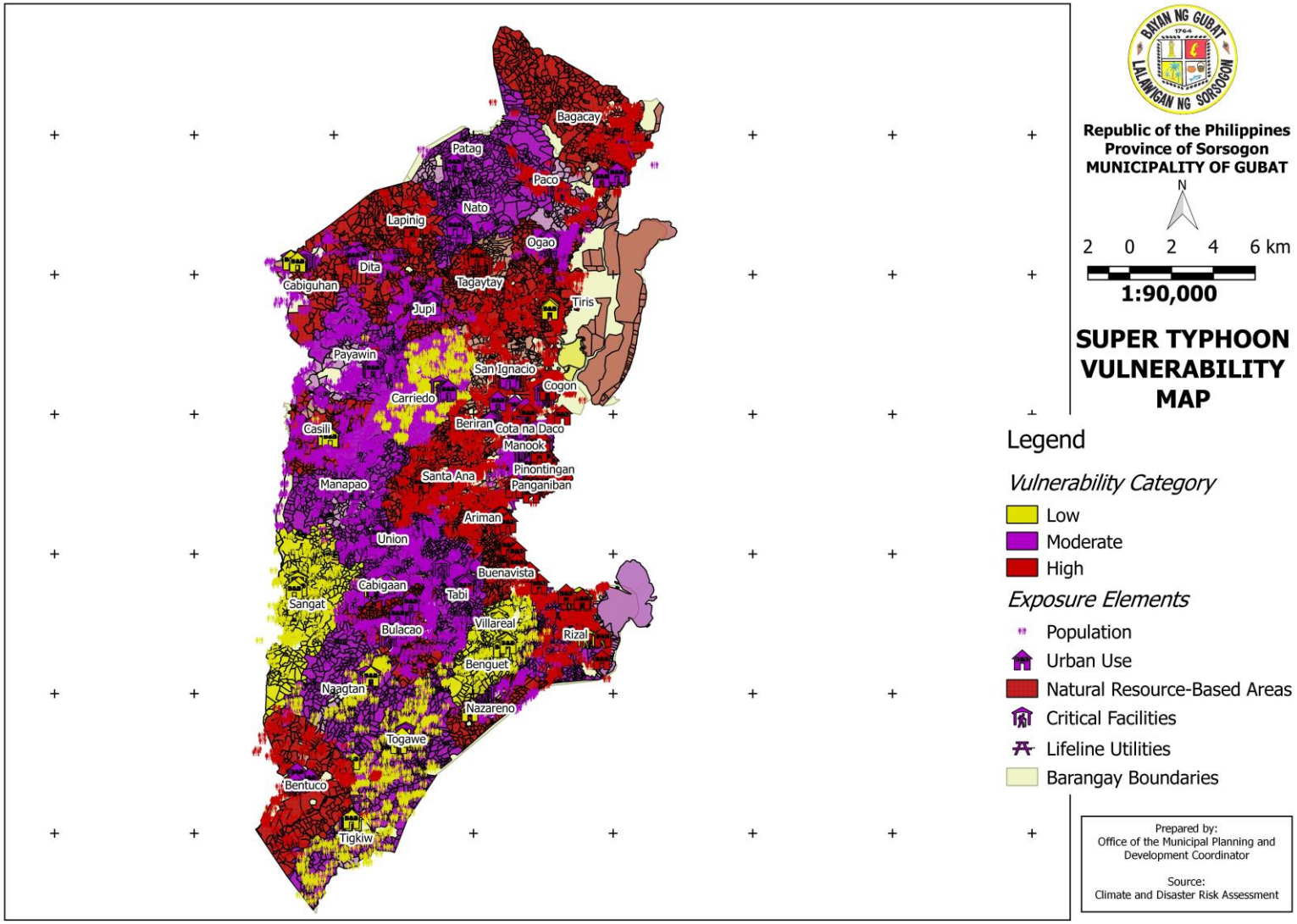


Figure 73. Super Typhoon Vulnerability Map (CDRA, 2018).

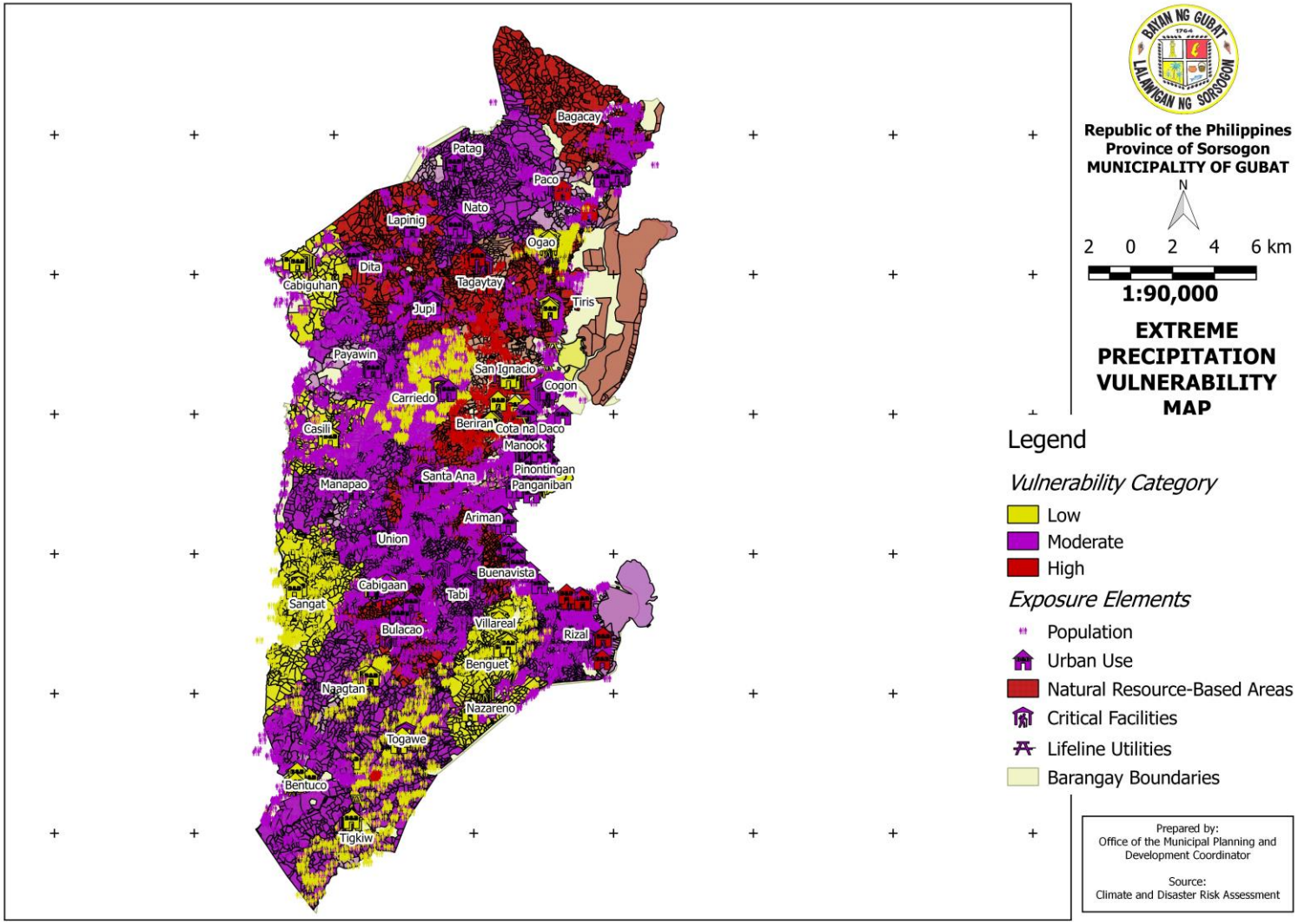


Figure 74. Extreme Precipitation Vulnerability Map (CDRA, 2018).

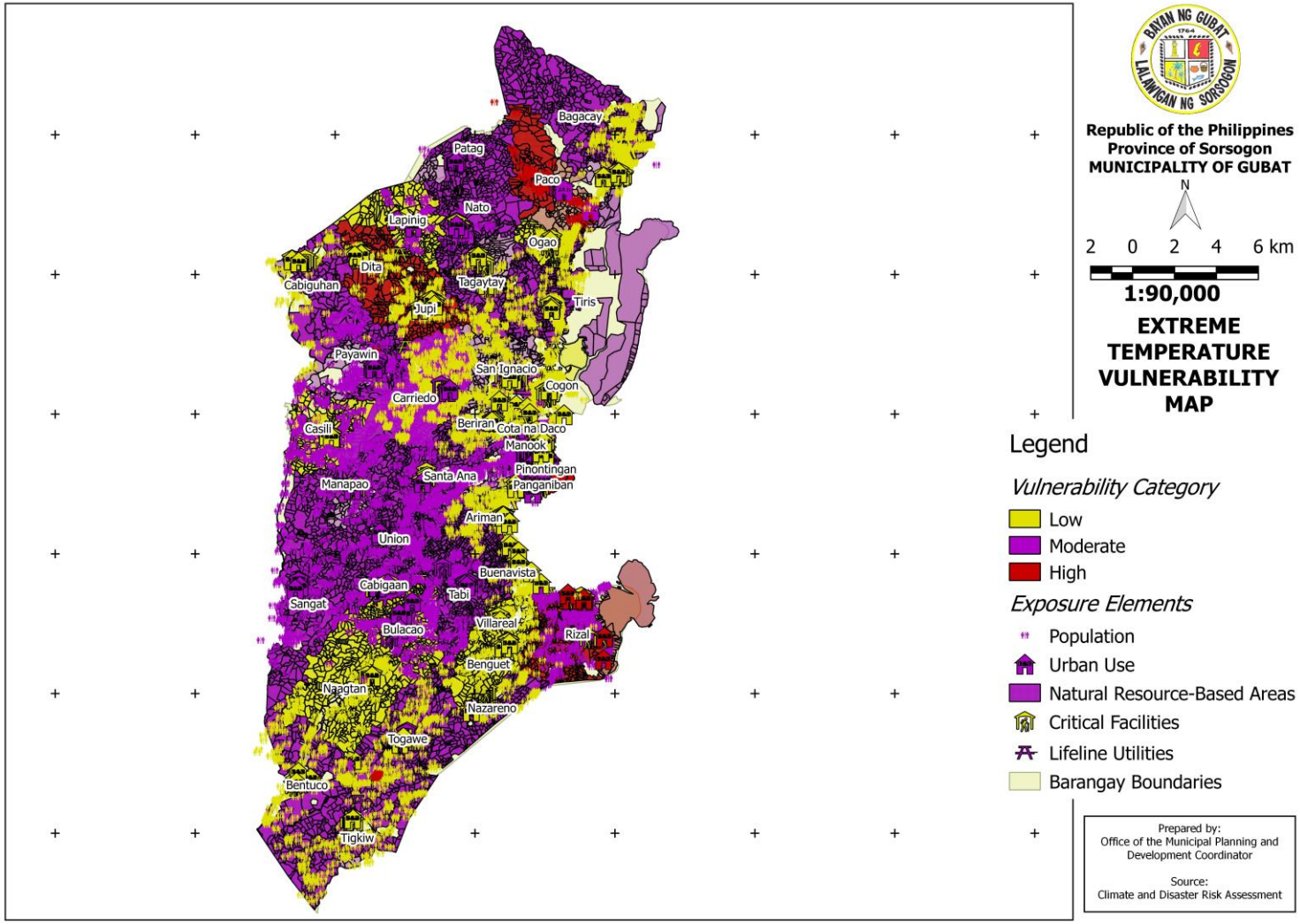


Figure 75. Extreme Temperature Vulnerability Map (CDRA, 2018).

Table 24. Analysis of Matrix Evaluating Five Adaptive Capacity Versus Six Dimensions (CDRA, 2018).

Dimension	Adaptive Capacity				
	Population	**Urban Uses**	**Natural Resources**	**Critical Facilities**	**Lifeline Utilities**
Wealth	Five percent (5%) of the local income from regular sources is appropriated by the municipality for relief, rehabilitation, reconstruction, and other works or services in connection with calamities All the 42 barangays allocate 5% of the annual barangay budget for Calamity Fund for relief, reconstruction, recovery, medicine In some barangay, the local church group also provides relief goods to disaster-stricken families.	Many projects of the municipality under its 20% local development funds are allocated to fund infrastructure for disaster risk reduction and management Most barangays allocate projects for DRRM from its 20% barangay development fund In some barangays, other partners provide budget support i.e. DepEd	In some barangays, BFA lends the thresher as a fundraising; meanwhile the MLGU provides free palay seeds; microfinance organizations are also present The Department of Agriculture through the Office of the Municipal Agriculturist provides farming inputs under the REHAB Program for flooded rice fields	Many projects of the municipality under its 20% local development funds are allocated to fund infrastructure for disaster risk reduction and management Most barangays allocate projects for DRRM from its 20% barangay development fund i.e. day care centers, health centers, multipurpose halls, evacuation centers, open courts, foot bridges, pathways NGAs contribution: DepEd budget is from its MOOE, Department of Public Works and Highways (DPWH) for the roads and communication towers. Fundraising and solicitations from alumni associations, OFWs, solicitations from politicians	Sorsogon Electric Cooperative II (SORECO II) for the electric lines, Gubat Water District (GWD) for the water system The LGU also provides counterpart funds for improvements of the water system, installation of solar lights, etc.

Dimension	Adaptive Capacity				
	Population	**Urban Uses**	**Natural Resources**	**Critical Facilities**	**Lifeline Utilities**
Information	The municipality has a regular radio program called *Boses sin Gubatnon* and a Facebook page that disseminates information and warnings about incoming typhoons or other necessary information Most barangays use the *bayabay* system or house to house visit by the purok leader or groups of local officials Many barangays maintain an Information Bulletin System IEC campaigns are also held in school i.e. earthquake drill Most households have a Ligtas Gubatnon public safety hotline sticker, which they can refer to in case of emergencies	MDRRMO has a public safety hotline MDRRMO provides preemptive evacuation information to most at risk residences especially on the coastal areas during typhoons Business establishments and public transportations have Ligtas Gubatnon public safety hotline stickers Many barangays utilize text brigade to disseminate information Early warning system is used by many barangays	Some barangays provide information warning near agricultural production areas that are exposed to hazards The Office of the Municipal Agriculturist inform farmers and fisherfolks about incoming typhoons	The MDRRMO and most barangays have hazard maps Signages are in place in some barangays pointing direction to the evacuation center or containing warning and danger signs	Spot maps, Ligtas Gubatnon billboards, and One Sorsogon billboards are installed in strategic areas around the barangays Power disruptions are announced by SORECO II Most households have access to cable and internet (mostly thru pocket Wi-Fi – mobile data).

Dimension	Adaptive Capacity				
	Population	**Urban Uses**	**Natural Resources**	**Critical Facilities**	**Lifeline Utilities**
Infrastructure	In the población, most houses are made of concrete materials that can withstand typhoons are heavy rains About 30% of the houses are still built with lightweight materials Solar panels are available as alternative source of energy for households	Over 90% of the roads in Gubat are Portland Cement Concrete Pavement (PCCP). Except for barangay roads where gravel and earth surface comprise less than 10% of the total length, all the municipal roads, provincial roads, and tertiary national roads are PCCP. Communities near the rivers are supported with riprap and river control Concrete barriers are installed Seawalls are present in some coastal barangays	Irrigation system is present in most agricultural areas, some farmers get their irrigation from open sources (rivers, creeks) as for machines and equipment, GSARCFA have freezer and sealer for their production center There are privately-owned ricemill, threshers, tractors and sprayers	Most barangays use the schools, day care centers, chapels, or barangay halls as evacuation center Facilities available in many barangays: bridges, footbridges, covered court gyms There are four (4) major telecommunications companies in Gubat, namely Smart-PLDT, Globe Telecommunication Companies, Halum Properties, Inc. (Halprop) and DCTV Cable Network Drainage and canals are present	Solar light posts line up the streets from San Ignacio to Rizal Electricity is provided by Sorsogon II Electric Cooperative (SORECO 2) serving the 42 barangays in the municipality. Power service is available 24/7 and power interruptions are mostly announced and scheduled Gubat Water District provides covers thirty-eight (38) barangays Some barangays have their own water pumping system run by the GWD that augments the demand of each household

Dimension	Adaptive Capacity				
	Population	**Urban Uses**	**Natural Resources**	**Critical Facilities**	**Lifeline Utilities**
Social Capital	Most barangays have policies in the form of a resolution for disaster risk reduction and management and PPAs KALAHI is one of the national groups that gives assistance to the community. Civil society groups are formed in the barangay. Some of these are the: women's Organization, Kapilya Pastoral Council (KPC), Barangay Agriculture and Fishery Council (BAFC), tricycle operators and drivers association, Chamber of Commerce Crop insurance for farmers Microfinance and lending institutions Active church organization (KPC) provides assistance in case of calamity (relief goods), practice *bayanihan* or *komunales*	Presence of Alumni Association, PTA Officers, Barangay Council and BAFC Women's group (KALIPI), BHWs, BNS and members of BAFC in coordination with schools are the ones delegated for relief operations after calamities. Barangay Tanods and other personnel are trained in Disaster Risk Reduction and Management Trainings for emergency response was given to Barangay Officials and tanods	Presence of farmers association, irrigators association Gubat St. Anthony Cooperative has partnered with some barangay for crop diversification, lending A Spanish NGO in 2010 conducted training on climate change to members BDRRMC. BRIA is one of the CSOs maintaining its natural resources, Samahang Mangingisdang Barangay Rizal (SMBR) and Rizal Beach Cottage Owners Association (RBCOA) are those organizations involved in public-private partnership Sustainable Livelihood Program of Department of Social Welfare and Development - beneficiaries are provided with trainings on vegetable production and organic agriculture by the Office of the Municipal Agriculturist	Presence of Barangay Council and Day Care PTA Officers. Also, presence of PTA Officers and DepEd in primary and secondary school. PTA, BNS, BHW, and the school alumni association are active in the barangays in mobilizing support to building critical facilities	Trainings for emergency response and water safety and evacuation was given to members of the BDRRMC, and youth groups Some of the barangay officials and representatives from the schools attended DRRM trainings Presence of LUWA in water supply. Presence of military group MDRRMO staff and personnel are trained on basic life support, emergency response, first aid

Dimension	Adaptive Capacity				
	Population	**Urban Uses**	**Natural Resources**	**Critical Facilities**	**Lifeline Utilities**
Institution and Governance	LDRRM Plan both at the municipal and barangay levels Most barangays have policies in the form of a resolution for disaster risk reduction and management PPAs LDRRMFIP and BDRRMC are present Presence of barangay council	MDRRMC is functional at the municipal level BDRRMC are present in most of the barangays	Some barangays have active Barangay Agriculture and Fisheries Council (BAFC) who are currently involved in a project funded by the municipal government providing farming inputs as loans to farmers The barangay has its local mangrove ordinance and has formulated a plan for mangrove protection through the ABS-CBN Foundation in coordination with the LGU	Most infrastructure projects are supported with a resolution and plans	MDRRMO operates 24/7 MDRRMO is equipped with ambulance

XI. Disaster Risk Assessment

Results of Risk Estimation and Vulnerability Index

Based on the results of the assessment, all barangays in Gubat are at risk during super typhoons and dry spells highly impacting the agricultural production areas and natural resources.

Super typhoons have broad effects on all the dimensions because they bring strong winds and heavy rains that cause flooding and destruction to infrastructures that are made of light weigh materials. Although the people are aware of the possible outcome when super typhoons strike, the barangays still have a lot of points in terms of information dissemination in order to lessen the catastrophic effects of these events.

In terms of flooding, agricultural production areas in low lying portions of the barangays are the most affected. This is exacerbated by the presence of rivers in some barangays when it overflows during typhoons and heavy rains.

Moreover, damages brought by increase in temperature or dry spell also pose big threats to agriculture, local water sources, and residents particularly if it lasts for a long period of time. This may cause drying out of springs and wells in the areas where most residents obtain their drinking water. Irrigation canals also dries up during these times, which greatly affects the growth of the crops that leads to lower quality of the produce and lower yield; and ultimately leads to lower income. High temperatures may also lead to higher incidence of heat-related diseases that affect the residents. It is safe to conclude that natural resources and population are at moderate to high risk during these events.

Flooding

Climate change projections in Gubat generally describe an increase in extreme events including stronger typhoons which could result in flooding, soil erosions, and landslides. To assess the areas at risk, hazard maps from MGB, National Mapping and Resource Information Authority (NAMRIA), and PHIVOLCS were overlayed.

The Office of the Municipal Planning and Development Coordinator estimates that 1,475 hectares (13%) of its total land area are at risk of flooding due to excessive rainfall. Although floods are often below one (1) meter and usually subside within an hour, the normal flow of networks, services, and businesses are usually disrupted (OMPDC, 2019).

In terms of population, results showed that many coastal barangays and all of the población barangays are at high risk of flooding especially Barangay Cogon, which is located on the lowest lying plain in the municipality. Based on historical accounts of residents, flood waters usually subside after a few hours as it flows along to the rivers.

Meanwhile, many upland areas are not at risk to flooding. In terms of agricultural production, the majority of exposed barangays are at moderate - high risk. Coconut, palay, root crops, and fruit trees on these areas may possibly be damaged.

Storm Surge/ Sea Level Rise

When a storm surge occurs, 2,111 hectares of land area can be affected. In case of a tsunami with a wave height of 7 meters at the coast, all urban villages including ten

coastal villages will be inundated. The projected sea level rise by the year 2100 is more than .7 meters, 3 to 5% higher than the global average.

Earthquake/Ground Shaking

Situated on the convergence of three geologic plates and the San Vicente-Linao fault (Lagmay et al., 2004), Gubat is at risk to earthquakes. Moreover, seismic, and volcanic activities of Mt. Bulusan twenty-nine kilometers from the town center, had caused several tectonic quakes in the past (MDRRMO, 2017).

Findings of the risk assessment show that all exposure units in the municipality are low risk to earthquakes. Though the degree of impact of such intensity is very destructive, the likelihood of occurrence is very low or rare, resulting in a low-risk score.

Volcanic Eruption

Mt. Bulusan is generally known for its sudden steam-driven or phreatic explosions. It has erupted 15 times since 1885 and is considered as the 4th most active volcano in the Philippines (Dela Cruz, 2015; Conway, 2012). Its eruption in 2016 shot two kilometers high of ash lasting for 16 minutes (ABSCBN News, 2016). The recent eruptions of the volcano posed low risk causing mild ashfall mostly in the southwest portion of the town including the barangays of Togawe, Bentuco, Nazareno, and Tabi.

Soil Erosion and Landslide

At the uplands, tropical cyclones and excessive rains may induce soil erosion and landslides. The OMPDC estimates that 1,796 hectares are susceptible to landslides around the municipality. Moreover, Gubat has already lost about seventy meters of its shore land to erosion over the past fifty years based on marine geological study (World Bank Philippines, 2012).

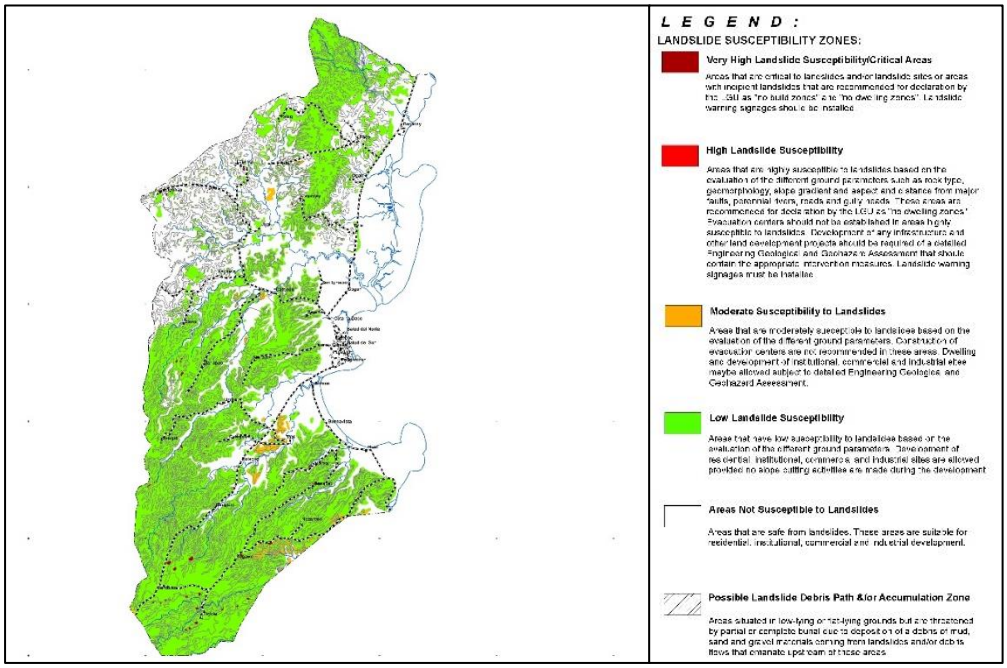


Figure 76. Landslide susceptibility map of Gubat (MDRRMO, 2018).

Table 25. Summary of risk estimation – flooding, landslide, storm surge, and sea level rise (CDRA, 2018).

Major Decision Area	Risk Estimation Table				
	Exposure Elements	Likelihood of Occurrence	Severity of Consequences	Risk Score	Risk Category
Flooding	Population	4	1	4	Low
	Urban	4	2	8	Moderate
	Natural Resources	4	4	16	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Landslide	Population	5	1	5	Moderate
	Urban	5	1	5	Moderate
	Natural Resources	5	3	15	High
	Critical Facilities	5	2	10	Moderate
	Lifeline Utilities	5	2	10	Moderate
Storm Surge	Population	6	3	18	High
	Urban	6	3	18	High
	Natural Resources	6	3	18	High
	Critical Facilities	6	2	12	High
	Lifeline Utilities	6	2	12	High
Sea Level Rise	Population	5	1	5	Low
	Urban	5	2	10	Moderate
	Natural Resources	5	1	5	Low
	Critical Facilities	5	1	5	Low
	Lifeline Utilities	5	1	5	Low

Table 26. Summary of risk estimation – dry spell, liquefaction, ground shaking, and ground rupture (CDRA, 2018).

Major Decision Area	Risk Estimation Table				
	Exposure Elements	Likelihood of Occurrence	Severity of Consequences	Risk Score	Risk Category
Dry Spell	Population	4	1	4	Low
	Urban	4	1	4	Low
	Natural Resources	4	4	16	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Liquefaction	Population	4	1	4	Low
	Urban	4	1	4	Low
	Natural Resources	4	1	4	Low
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Ground Shaking	Population	3	1	3	Low
	Urban	3	2	6	Moderate
	Natural Resources	3	1	3	Low
	Critical Facilities	3	2	6	Moderate
	Lifeline Utilities	3	2	6	Moderate
Ground Rupture	Population	3	1	3	Low
	Urban	3	1	3	Low
	Natural Resources	3	1	3	Low
	Critical Facilities	3	1	3	Low
	Lifeline Utilities	3	1	3	Low

Table 27. Summary of risk estimation – tsunami, ash fall, lahar flow, and pyroclastic density current (CDRA, 2018).

Major Decision Area	Risk Estimation Table				
	Exposure Elements	Likelihood of Occurrence	Severity of Consequences	Risk Score	Risk Category
Tsunami	Population	4	3	12	High
	Urban	4	3	12	High
	Natural Resources	4	3	12	High
	Critical Facilities	4	3	12	High
	Lifeline Utilities	4	3	12	High
Ash Fall	Population	4	1	4	Low
	Urban	4	1	4	Low
	Natural Resources	4	1	4	Low
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Lahar Flow	Population	4	1	4	Low
	Urban	4	1	4	Low
	Natural Resources	4	3	12	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Pyroclastic Density Current	Population	4	3	12	High
	Urban	4	1	4	Low
	Natural Resources	4	3	12	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low

Table 28. Summary of risk estimation – coastal erosion, soil erosion, and super typhoon (CDRA, 2018).

Major Decision Area	Risk Estimation Table				
	Exposure Elements	Likelihood of Occurrence	Severity of Consequences	Risk Score	Risk Category
Coastal Erosion	Population	4	1	4	Low
	Urban	4	2	8	Moderate
	Natural Resources	4	3	12	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Soil Erosion	Population	4	1	4	Low
	Urban	4	1	4	Low
	Natural Resources	4	4	16	High
	Critical Facilities	4	1	4	Low
	Lifeline Utilities	4	1	4	Low
Super Typhoon	Population	6	4	24	High
	Urban	6	4	24	High
	Natural Resources	6	4	24	High
	Critical Facilities	6	4	24	High
	Lifeline Utilities	6	4	24	High

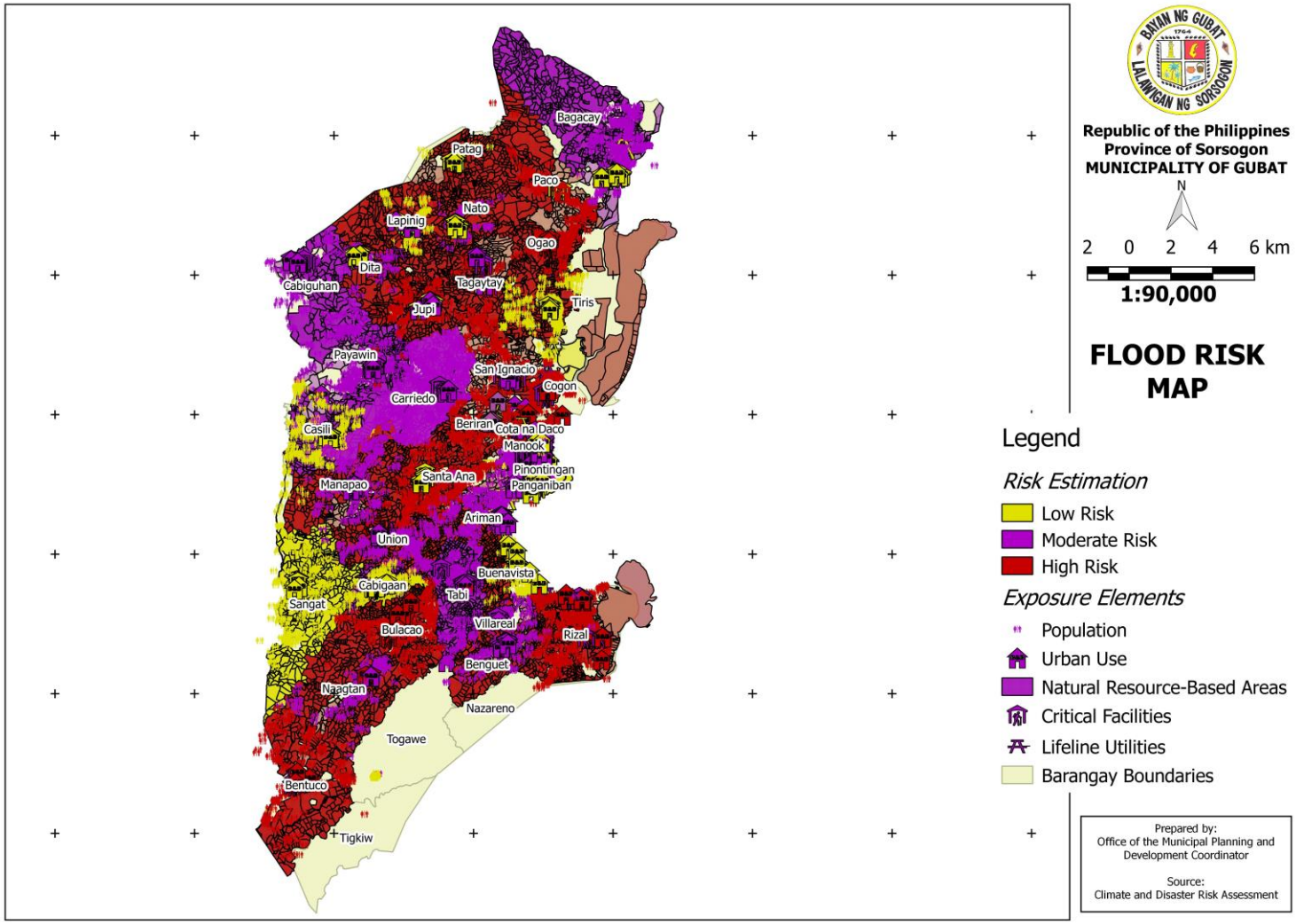


Figure 77. Flooding Risk Map (CDRA, 2018).

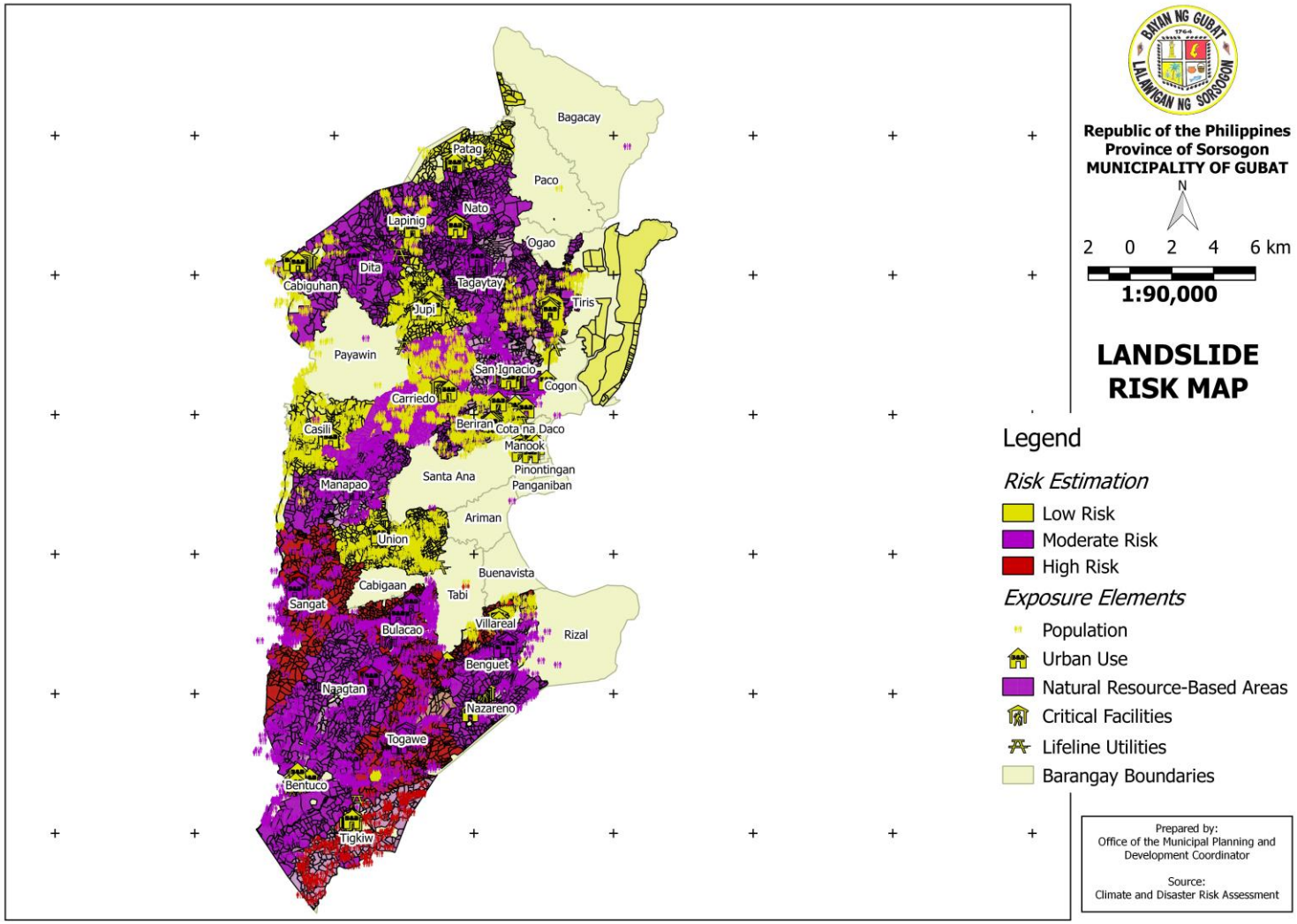


Figure 78. Landslide Risk Map (CDRA, 2018).

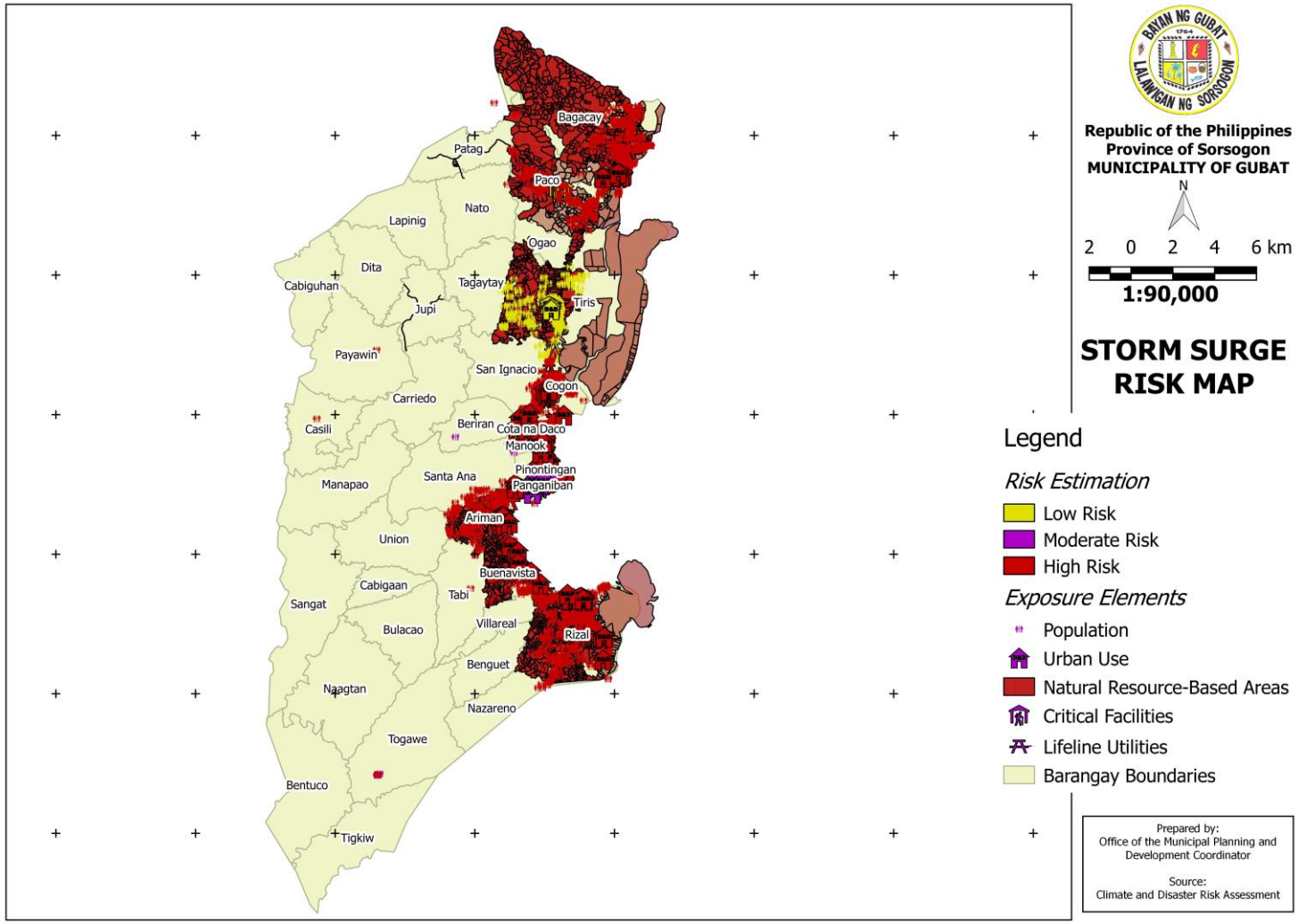


Figure 79. Storm Surge Risk Map (CDRA, 2018).

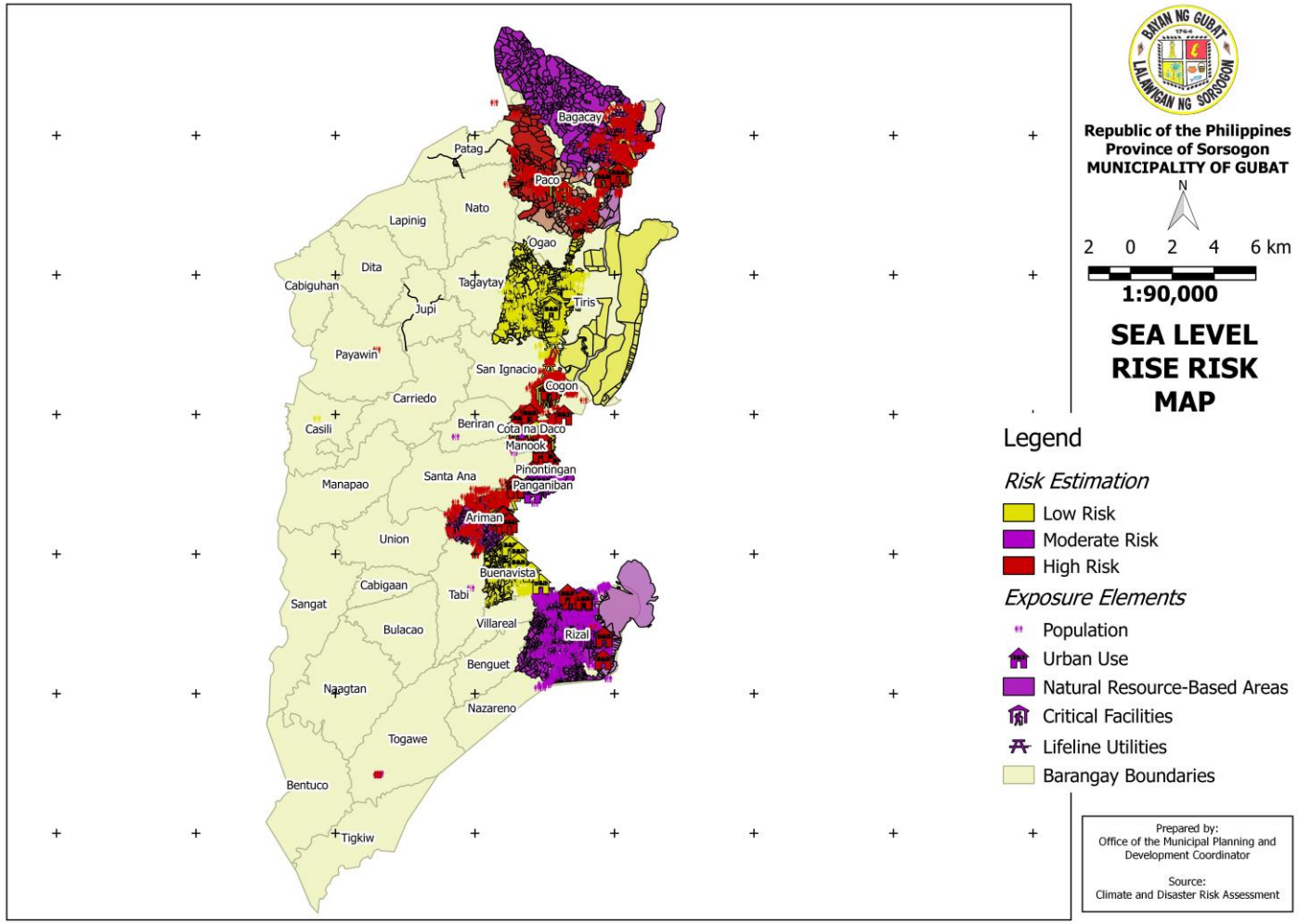


Figure 80. Sea Level Rise Risk Map (CDRA, 2018).

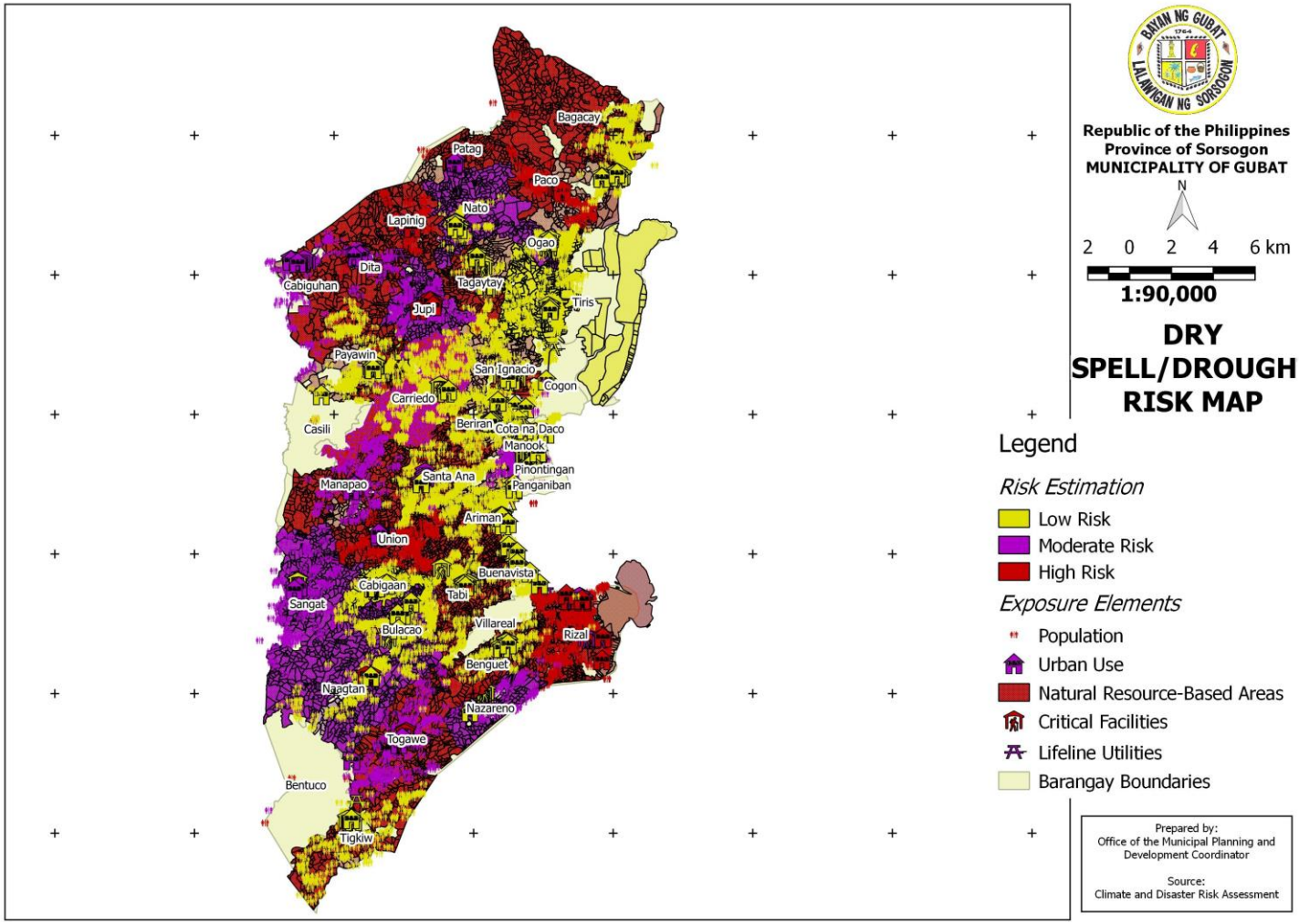


Figure 81. Dry Spell/Drought Risk Map (CDRA, 2018).

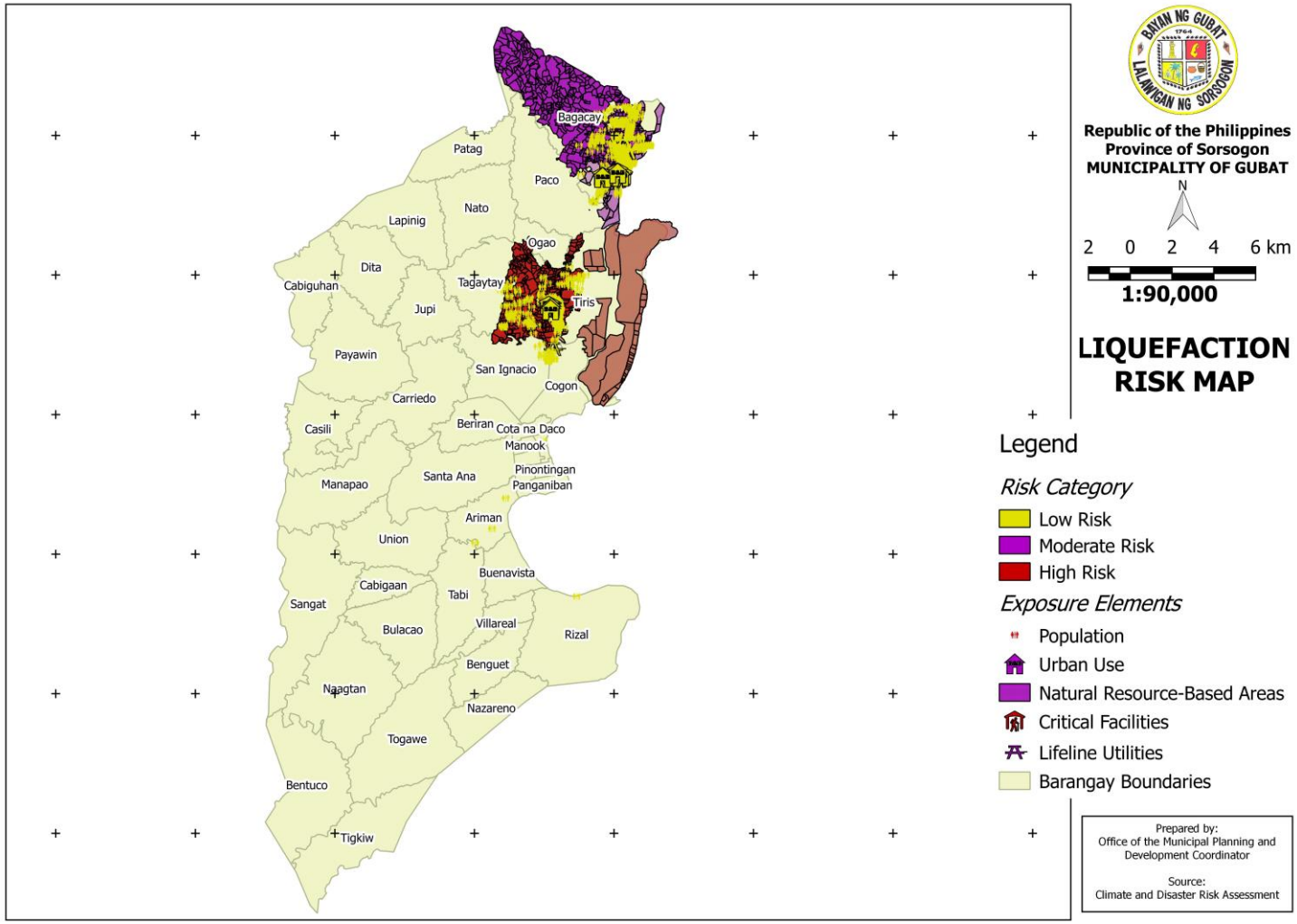


Figure 82. Liquefaction Risk Map (CDRA, 2018).

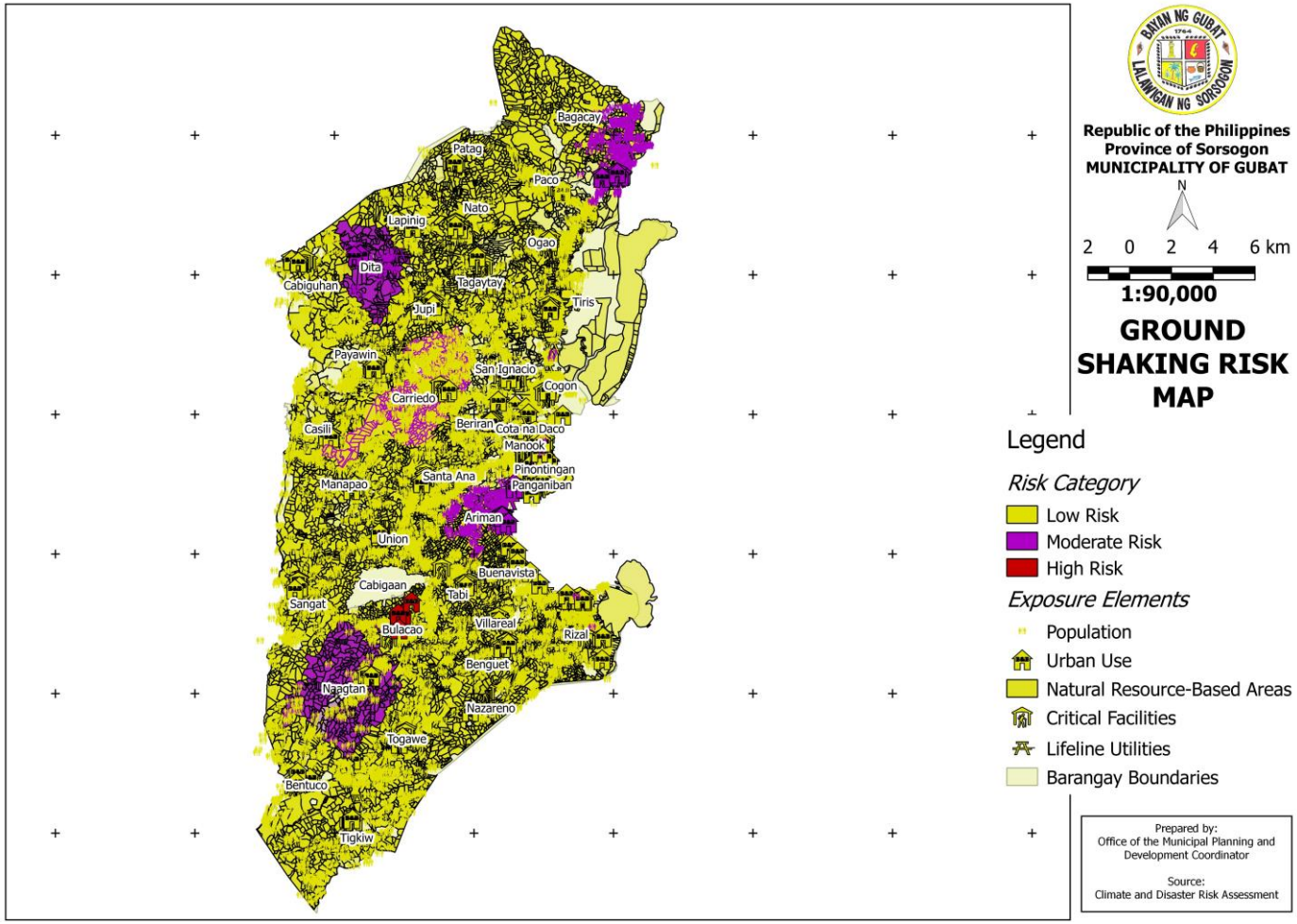


Figure 83. Ground Shaking Risk Map (CDRA, 2018).

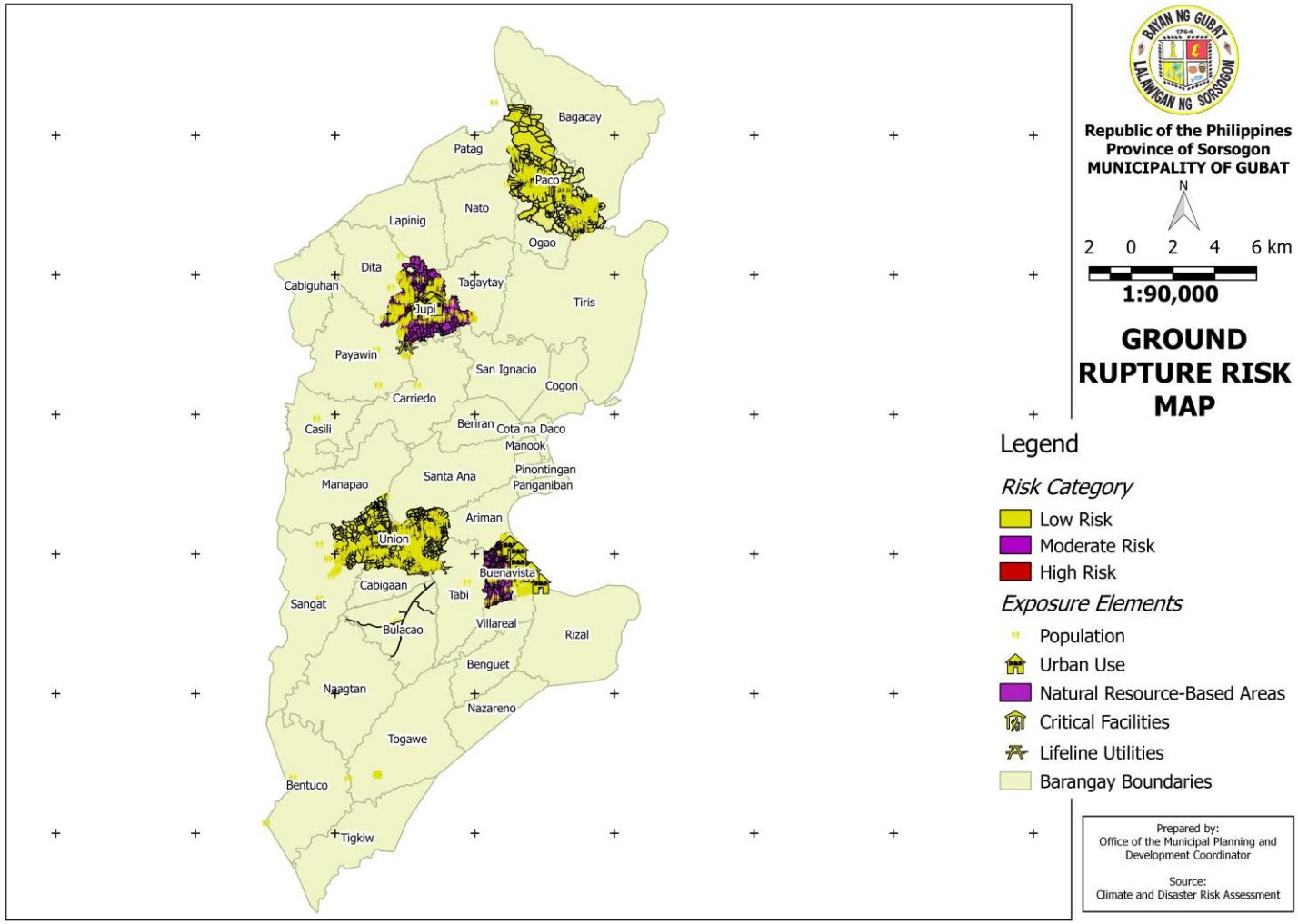


Figure 84. Ground Rupture Risk Map (CDRA, 2018).

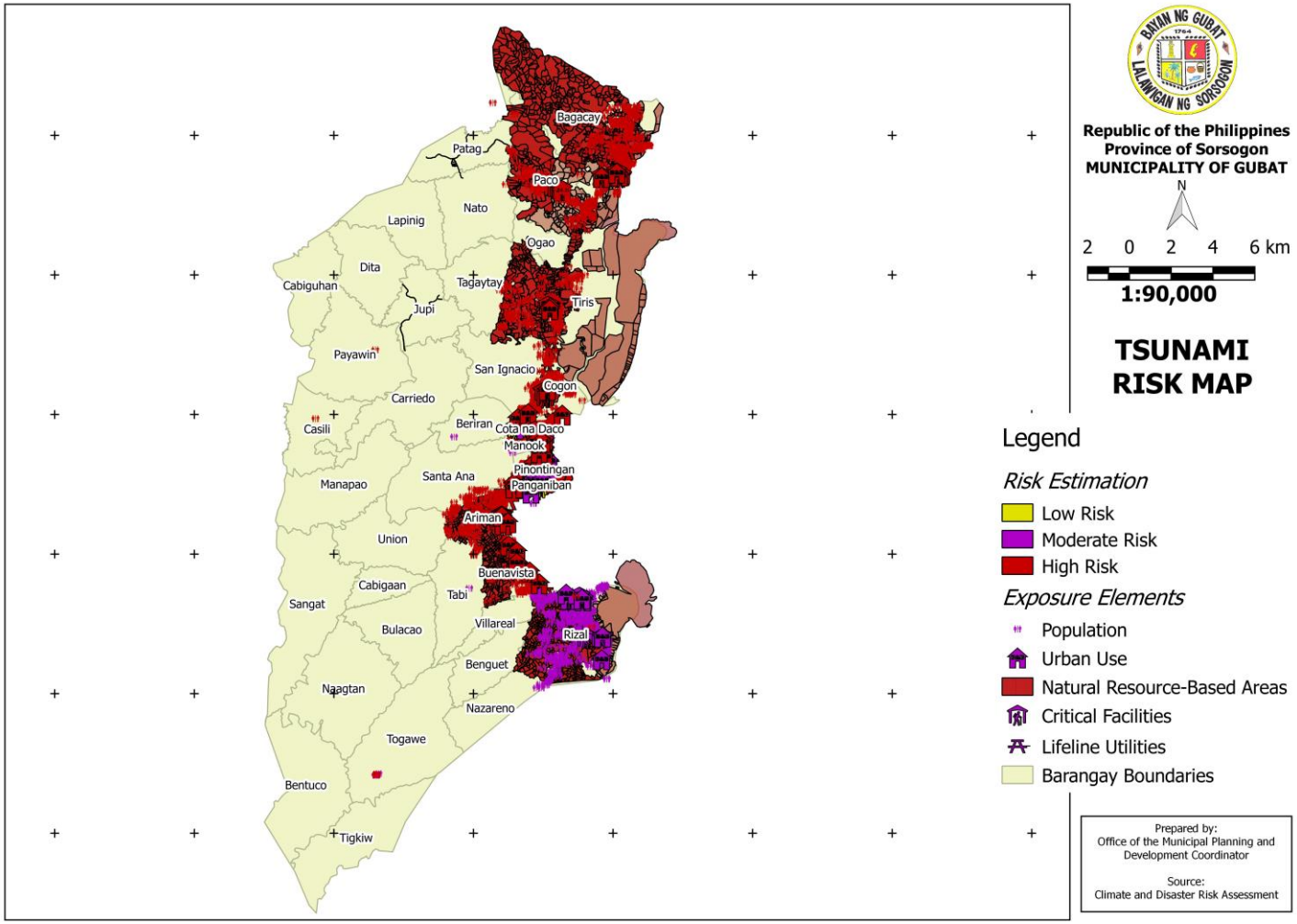


Figure 85. Tsunami Risk Map (CDRA, 2018).

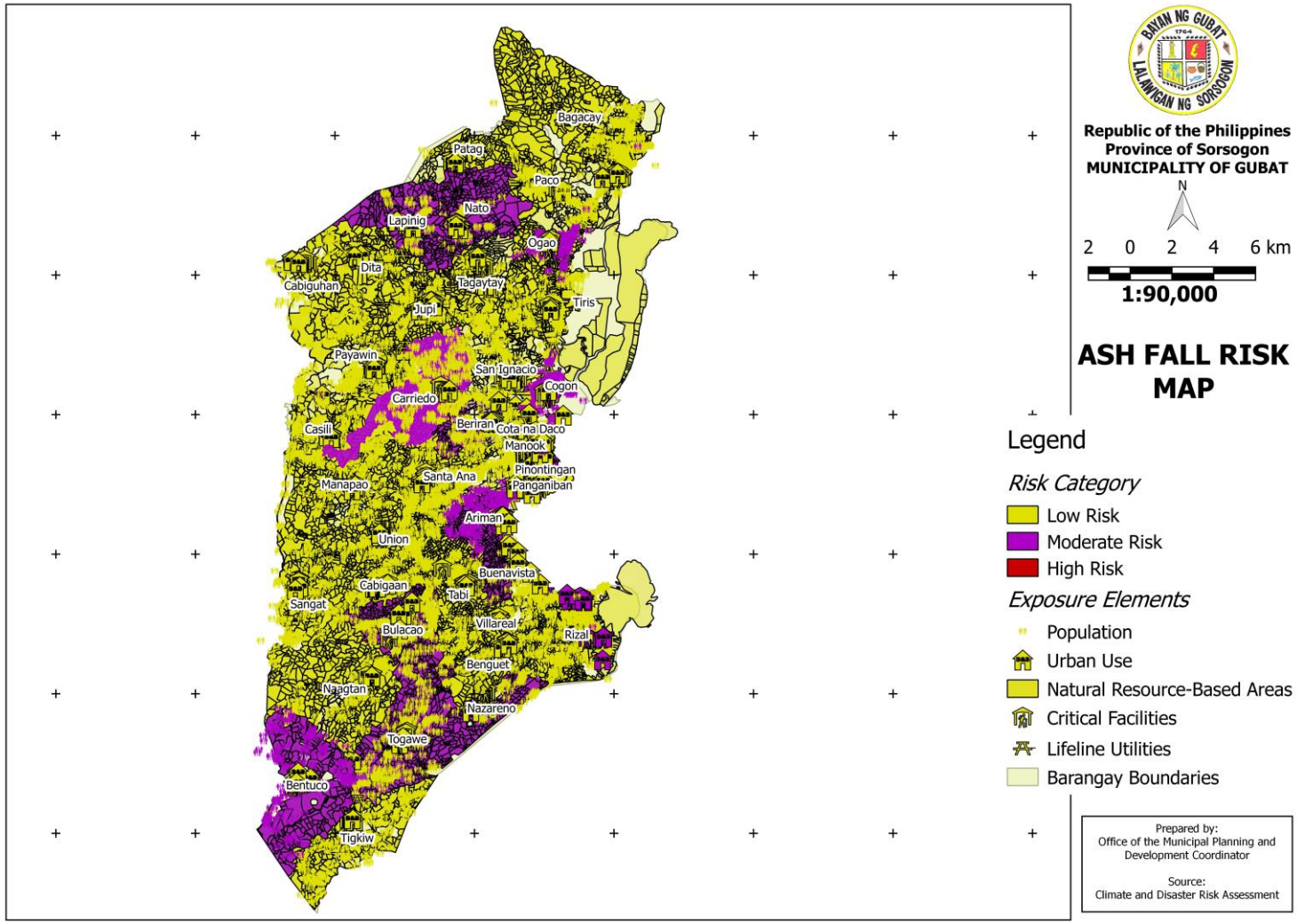


Figure 86. Ash Fall Risk Map (CDRA, 2018).

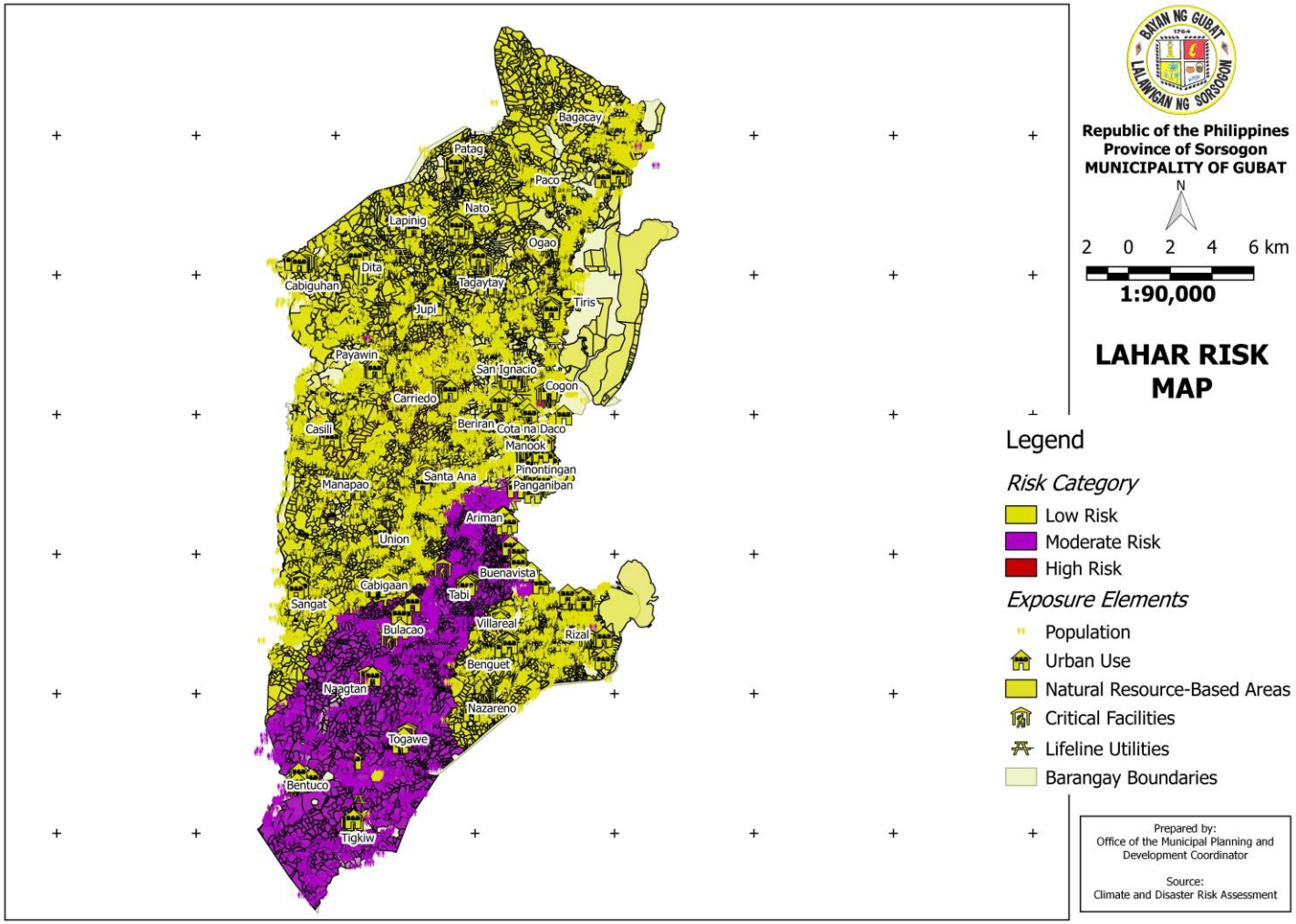


Figure 87. Lahar Flow Risk Map (CDRA, 2018).

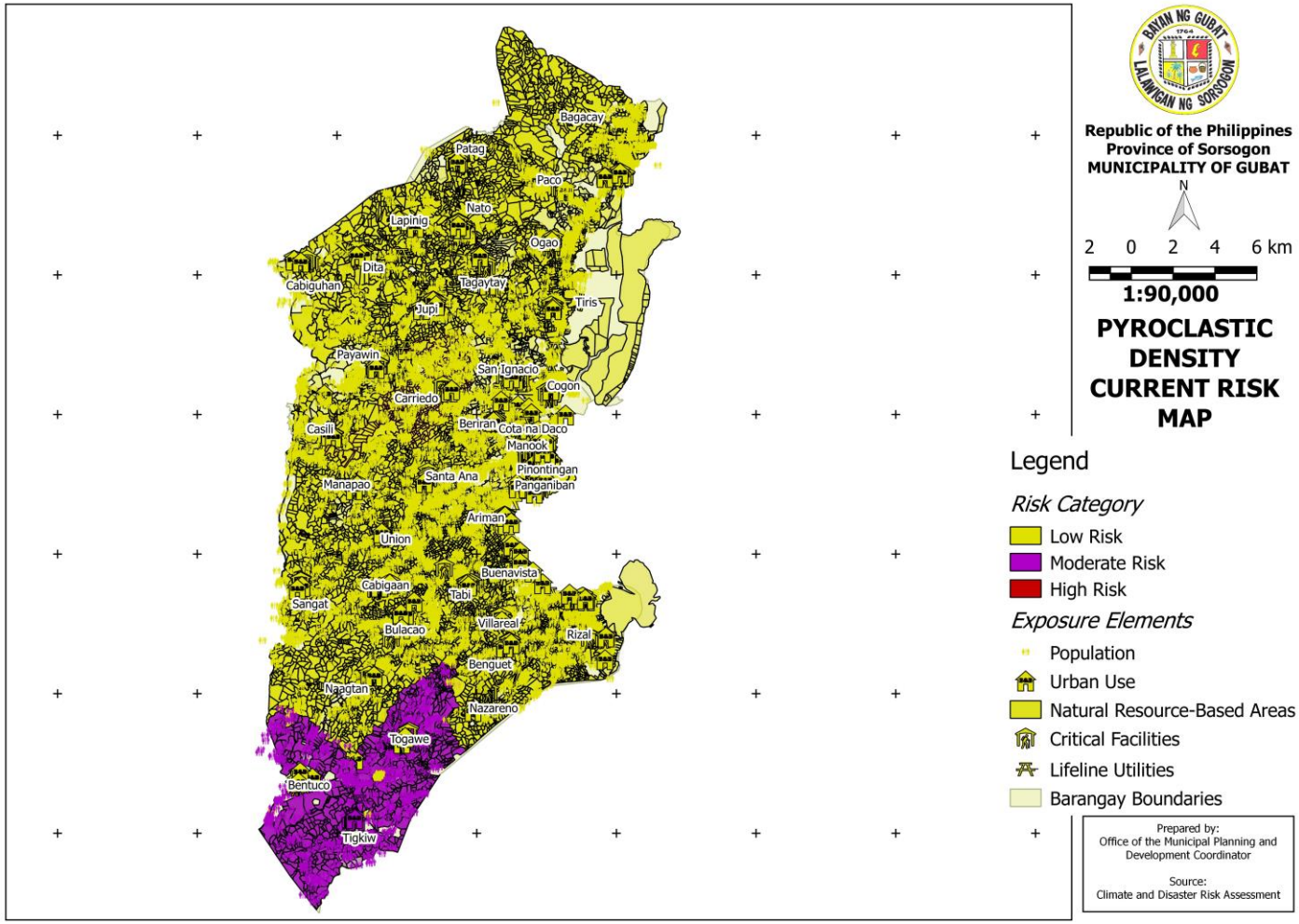


Figure 88. Pyroclastic Density Current Risk Map (CDRA, 2018).

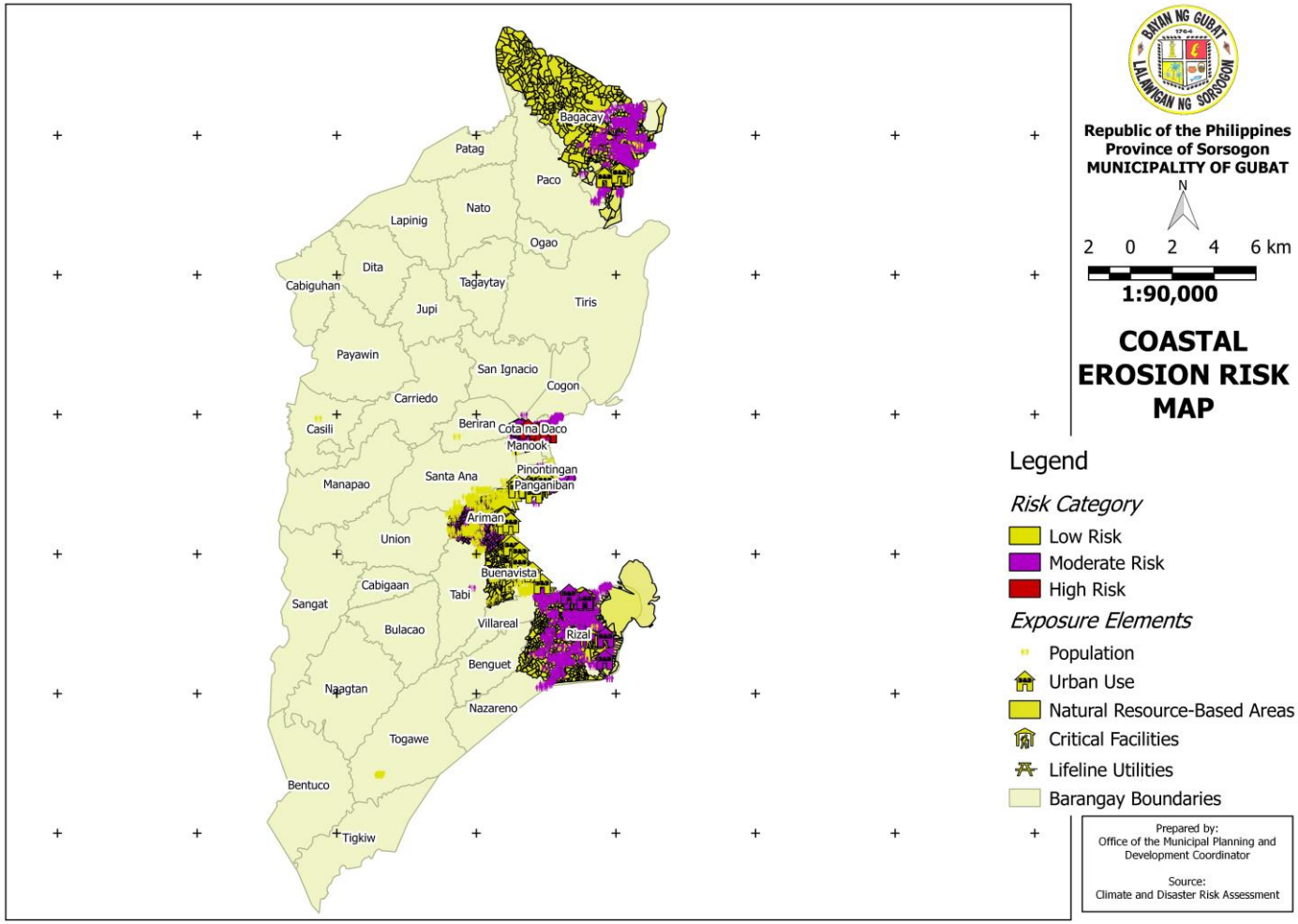


Figure 89. Coastal Erosion Risk Map (CDRA, 2018).

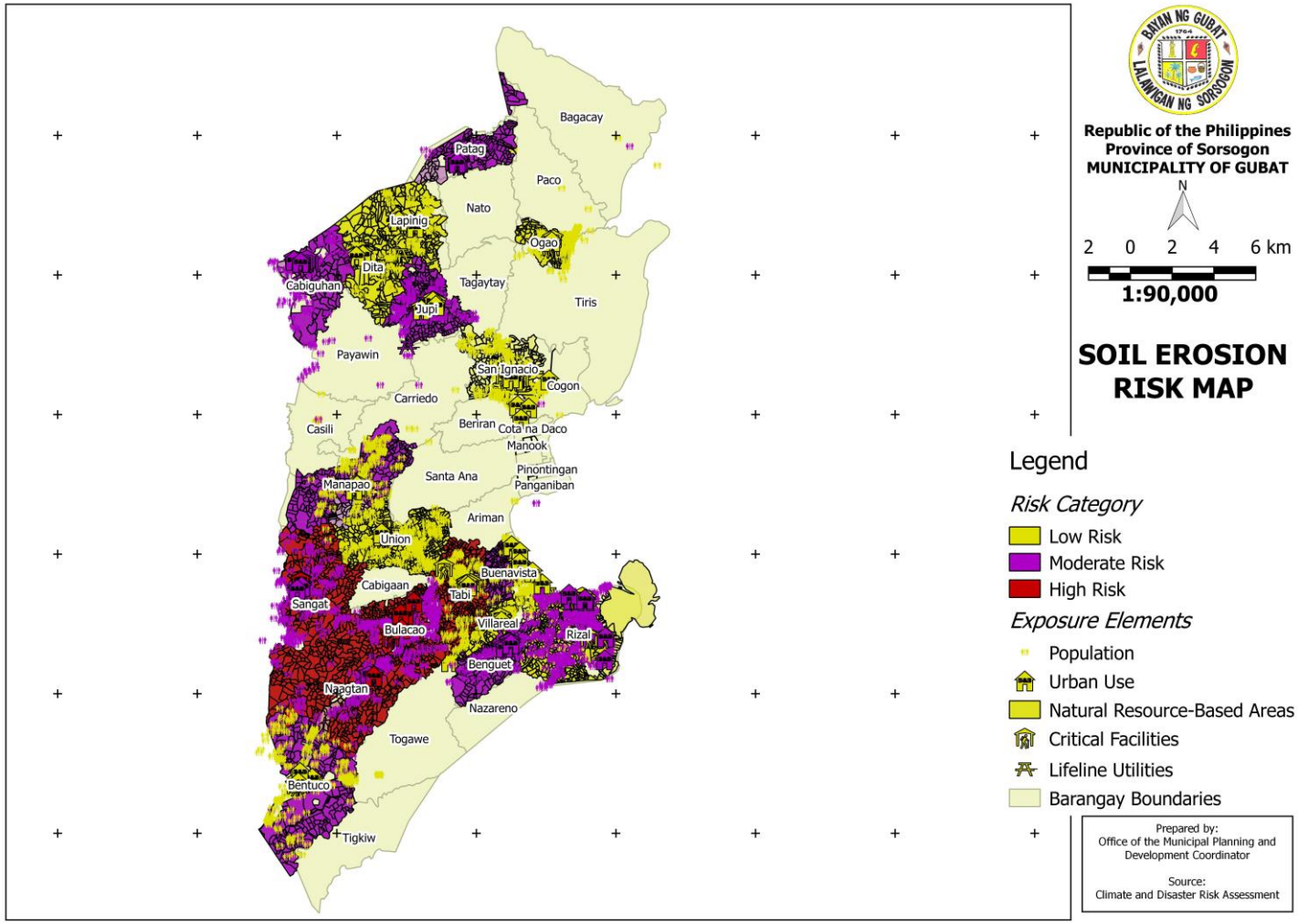


Figure 90. Soil Erosion Risk Map (CDRA, 2018).

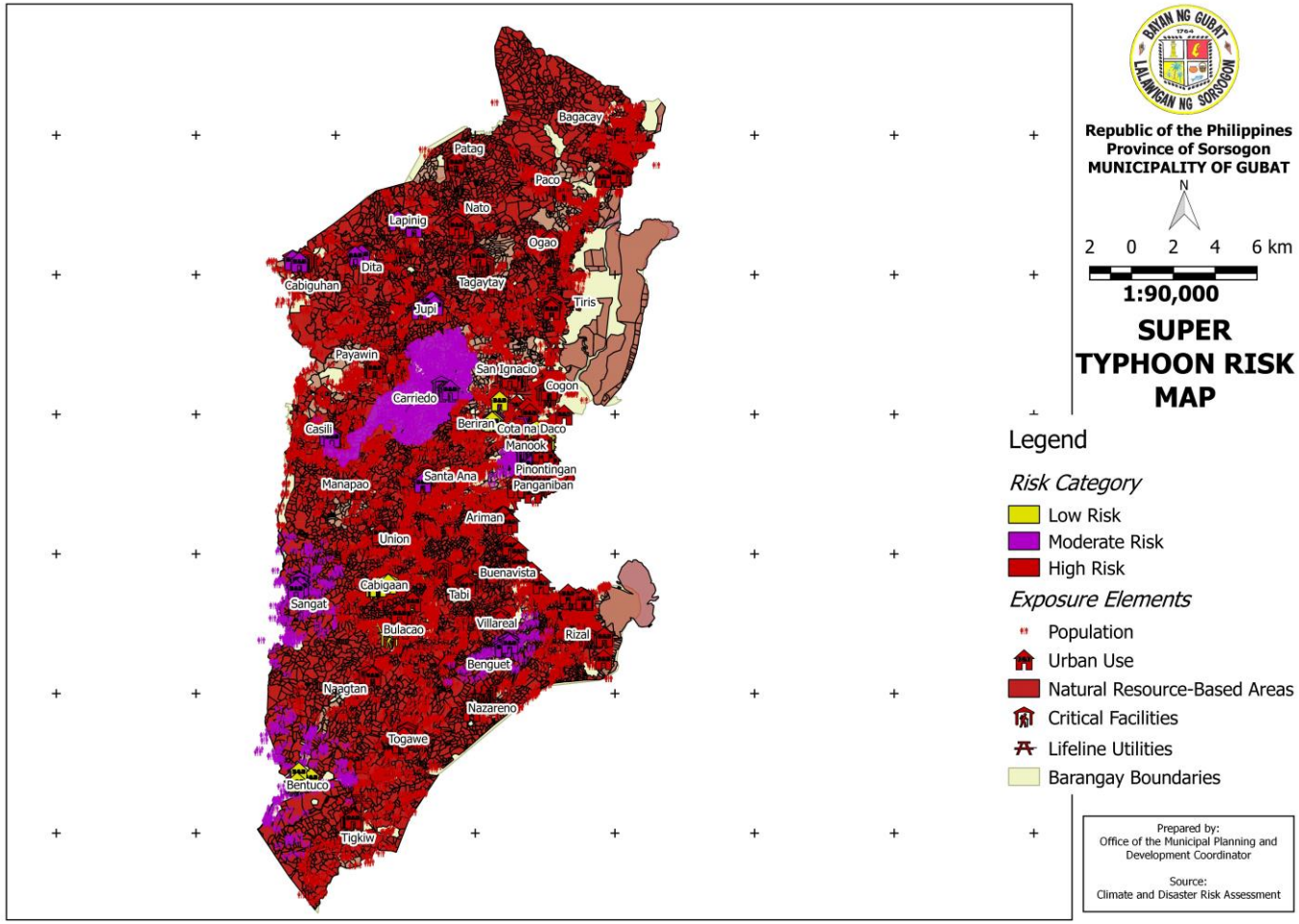


Figure 91. Super Typhoon Risk Map (CDRA, 2018).

X. Major Decision Areas

Major decision areas from all forty-two (42) barangays were drawn to identify the decision areas, assess the degree of impacts of hazards to each area, and to summarize the list of risk management and adaptation/mitigation measures. Based on the FGDs conducted in each barangay, degree of impacts is varying depending on their geographical locations. Flooding, storm surge and threats of tsunamis are imminent hazards that have direct and indirect impacts in low-lying coastal barangays while flooding from overflow of rivers, soil erosion near riverbanks and landslide were the hazards identified in upland and mountainous barangays.

Figure 92. Landslide-prone area along the road in Barangay Naagtan.

Table 29. Summary of Decision Areas Matrix.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
Ariman	One of the densely populated coastal rural barangays, Ariman is adjacent to the población and has an estimated elevation of 4.4 meters or 14.4 feet above mean sea level	● Low-lying portion is susceptible to flooding during heavy rains ● Areas along the Gubat bay are highly susceptible to storm surges and tsunamis ● Agriculture lands and residential areas are prone to soil erosion during extreme rainfall ● Portion of agricultural areas are at risk during drought, especially the non-irrigated sections	● Potential severe damages to residential and agricultural areas due to extreme rainfall, storm surges brought about by severe typhoons ● High magnitude earthquakes pose risk of tsunamis ● Possibility of injuries or death due to increased intensity of typhoons which provokes flooding ● Economic losses	● Drainage system improvement ● Program on climate change ● Provide warning signages/billboards to hazard prone areas. ● Introduce farmers to climate-resilient varieties available in the market. ● Promote rice-based diversified system of farming. ● Construction of additional irrigation system
Bagacay	The most populated rural barangay located in the western part of the town, Bagacay is a fast-urbanizing coastal barangay with an estimated elevation of 4.3 meters or 14.1 feet above mean sea level	● Low-lying portion, especially at the residential areas of the barangay is susceptible to flooding due to extreme rainfall and severe typhoons ● Residential areas along the shore are highly susceptible to storm surges and tsunamis	● Potential severe damages to residential, institutional, and agricultural areas due to flooding, storm surges and overflow of rivers ● Potential risk to residential areas along the shore due to earthquake-induced tsunamis ● Possibility of injuries or death due to increased intensity of typhoons	● Construction of riprap/flood control structure near the river and farmland ● Relocate houses along coastal areas ● Drainage system improvement ● Program on climate change

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
		● Agriculture lands and residential areas are prone to soil erosion during extreme rainfall and overflow of rivers	● Potential risk to agricultural lands brought about by soil erosion along riverbanks	● Provide warning signages/billboards to hazard prone areas. ● Installation of automated weather station. ● Introduce farmers to climate-resilient varieties available in the market. ● Promote rice-based diversified system of farming. ● Construction of additional irrigation system
Balud del Norte	The most densely populated barangay in the town, Balud del Norte is a low-lying coastal area with an elevation estimated at 6.3 meters or 20.7 feet above mean sea level	● Majority of families are susceptible to storm surge ● Prone to the potential threat of tsunami	● Strong typhoons will cause storm surge and extensive flooding which will damage properties and infrastructure ● High magnitude earthquakes pose risk of tsunamis ● Possibility of injuries or death due to increased intensity of typhoons which provokes flooding	● Relocation area for residents of Balud del Norte ● The Barangay need Early Warning Device System. ● The Barangay need Early Warning Device System.
Balud del Sur	With a total area 9.7 square meters, Balud del Sur is one of the high population density barangays of the town where majority of the	● Majority of families are susceptible to storm surge ● Potential threat of tsunamis	● Strong typhoons will cause storm surge and extensive flooding which will damage properties and infrastructure ● High magnitude earthquakes pose risk of tsunamis	● Relocation area for residents of Balud del Sur ● The Barangay need Early Warning Device System.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	areas are residential and commercial spaces		● Possibility of injuries or death due to increased intensity of typhoons which provokes flooding	
Benguet	Located in the southern part, Benguet is an upland rural barangay with an estimated elevation of 44.0 meters or 144.4 feet above mean sea level	● Portion of barangay is susceptible to rain-induced landslide ● Agricultural areas and crops are at risk of damage due to extreme rainfall or drought	● Potential and severe damage residential area near the mountains ● Possible injuries and deaths to the residents along mountains ● Heavy rains pose risks to crops by lowering the quality of produce ● Potential economic losses due to drought or extreme rainfall	● Relocate houses near the mountainous area ● Enroll farmers to free crop insurance of PCIC. ● Put up slope protection or promote tree planting along landslide-prone areas. ● Provide warning signages/billboards to hazard prone areas.
Bentuco	One of the densely populated far-flung barangays, Bentuco is upland agricultural with an estimated elevation of 125 meters or 410.1 feet above sea level	● Portion of Sitios Cabuluan and Ariman are susceptible to rain-induced landslide ● Portion of agricultural areas are at risk to flooding in low lying areas ● Significant areas of Gubat is at risk of low to no supply of water due to dry spell	● Heavy rains pose risks to crops by lowering the quality of produce ● Damage to properties ● Possibility of injuries or death due to increased intensity of rains which provokes landslides and flooding ● Depleted water sources ● Inadequate water supply to dependent barangays	● Enroll farmers to free crop insurance of PCIC. ● Put up slope protection along landslide-prone areas. ● Promote tree planting along landslide-prone areas and watersheds. ● Provide warning signages/billboards to hazard prone areas. ● Introduce farmers to climate-resilient varieties available in the market.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Pass an ordinance prohibiting cutting of trees along springs
Beriran	Adjacent to población, barangay Beriran's economic activity mainly relies on agriculture	● The whole barangay is poses risk to flooding due to extreme rainfall and severe typhoons	● Potential damage to roads and rice fields ● Potential and severe damage residential area near the mountains ● Possible injuries and deaths to the residents along mountains ● Possible stop of transportation ● Residents are susceptible to diseases ● Cause severe health problems	● Program on climate change ● Construction of drainage system ● Provide warning signages/billboards to hazard prone areas.
Buenavista	One of the coastal barangays adjacent to the población, Buenavista is the major tourism destination of the town and will be home to a state university	● Low-lying portion is susceptible to flooding during heavy rains ● Areas along the Gubat bay are highly susceptible to storm surges and tsunamis ● Agriculture lands and residential areas are prone to soil erosion during extreme rainfall ● Portion of agricultural areas are at risk during	● Potential severe damages to residential, agricultural and tourism areas due to extreme rainfall, storm surges brought about by severe typhoons ● High magnitude earthquakes pose risk of tsunamis ● Possibility of injuries or death due to increased intensity of typhoons which provokes flooding ● Agricultural areas and crops are at risk of damage due to drought	● Program on climate change ● Provide warning signages/billboards to hazard prone areas. ● Installation of automated weather station. ● Introduce farmers to climate-resilient varieties available in the market. ● Promote rice-based diversified system of farming.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
		drought, especially the non-irrigated sections	● Economic losses	● Construction of additional irrigation system
Bulacao	A fast-urbanizing rural barangay, Bulacao is in the southwest portion of the town	● Portions of barangay (Sitios Malidlid and Calumpit) poses risk to flooding during rainy season and typhoons ● Areas along river are at risk to soil erosion during heavy rains and severe typhoons ● Portions of barangay (Sitio Centro and Anibong) are susceptible to landslide during heavy rainfall with ● Landslide along the national highway that cause problem to transportation ● Whole barangay is at risk to volcanic ash fall	● Potential damage to roads ● Potential and severe damage residential area near the mountains ● Possible injuries and deaths to the residents along mountains ● Possible stop of transportation ● Residents are susceptible to diseases ● Cause severe health problems	● Drainage system improvement ● Program on climate change ● Program/plan to train all Barangay Officials ● Climate Data gathering and capacity building
Cabigaan	Interspersed with lowland and hilly areas, barangay Cabigaan is an agricultural community with a total land area of 198.74 hectares	● Majority of the areas have potential flooding occurrence and soil erosion in rice fields and riverbanks due to extreme rainfall	● Potential and severe damage to agricultural areas and residential units	● Construction of riprap/flood control structure near the river and farmland ● Relocate houses near the mountainous area

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
		● Mountainous areas are at risk of landslides		
Cabiguhan	The barangay is located at the west side of the, since it is upland and mountainous, majority of its areas prone to landslides	● Majority of residential buildings located in Centro is at risk of landslide during heavy rains and severe typhoon ● Part of agricultural areas are at risk of flooding due to its low-lying location	● Potential damage to roads ● Potential and severe damage residential area near the mountains ● Possible injuries and deaths to the residents along mountains ● Possible stop of transportation ● Residents are susceptible to diseases ● Possible economic losses	● Put up slope protection or promote tree planting along landslide-prone areas. ● Provide warning signages/billboards to hazard prone areas. ● The Barangay needs an Early Warning Device System. ● Provide opportunities for alternative livelihood specifically to farmers during calamities
Carriedo	Barangay Carriedo is rural barangay with agricultural lands surrounded by mountains, and rivers	● Low-lying areas of barangay pose risk to flooding due to extreme rainfall and sever typhoons ● Portion of agricultural areas are at risk during drought, especially the non-irrigated sections	● Severe potential damages to existing residential structures ● Heavy rains pose risks to irrigation facilities, crops by lowering the quality of produce ● Potential economic losses due to drought	● Drainage system improvement ● Program on climate change ● Program/plan to train all Barangay Officials ● Climate Data gathering and capacity building ● Provide opportunities for alternative livelihood specifically to farmers during calamities

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
Casili	Situated in the northeast side of the town, barangay Casili is an upland agricultural barangay with an elevation estimated at 23.9 meters or 78.4 feet above mean sea level	● Some areas are landslide prone due to extreme rainfall or severe typhoons ● Agricultural areas and crops are at risk of damage due to drought or extreme rain fall	● Potential landslide to some areas ● Potential displacement, injuries, and fatalities due to flood and storm surge ● Potential difficulty in access to transportation means in case of emergency ● Economic losses ● Potential damages in natural resources	● Formulation of contingency plan to minimize potential injuries during relocation ● Establishment of early warning system ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Strengthen local programs for environmental concerns ● Construction of slope protection
Cogon	One of the sub-urban and coastal barangays, the majority of the areas are low-lying. The 2000 population of the barangay are highly susceptible to different kinds of hazards.	● Large area of barangay is prone to flooding, potentially caused by overflow of Tingting river during heavy rains and typhoon ● Majority of areas are at risk to storm surge and tsunamis	● Severe potential damages to existing residential structures ● Heavy rains pose risks to irrigation facilities, fishponds ● Possible injuries and deaths to the residents along the shores ● Potential economic losses	● Relocation of residential structures ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system Creation of local zoning ordinance ● Construction of River/Flood control facility ● Construction of an integrated drainage system

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Strengthen local programs for environmental concerns
Cota na Daco	One of the urban and coastal barangays where Purok 1 is located along the shores of Gubat Bay, and portions of Puroks 3 and 4 where a creek is situated	● Majority of areas have potential for all types of hazards specifically flood ● The area is potential to submerge in the long term due to sea level rise ● Projected tidal patterns may result to storm surge ● Usually flooded every during rainy season ● Affecting large portions of the rice fields in puroks 3 and 4 ● Coastal erosion will more likely displace infrastructures and houses in the area	● Severe potential damages to existing residential structures ● Potential submersion of fishponds and other infrastructure (Fish landing and cemetery) ● Potential displacement, injuries and fatalities due to flood and storm surge ● Severe potential damages to existing residential structures ● Potential displacement, injuries and fatalities due to major flood ● Potential damage to natural resources ● Potential economic losses	● Relocation of residential structures ● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system Creation of local zoning ordinance ● Construction of River/Flood control facility ● Construction of an integrated drainage system ● Strengthen local programs for environmental concerns
Dita	Situated in the northern part of the town, Dita is an inland and mountainous barangay	● Some areas are landslide prone due to extreme rainfall	● Severe potential damages to existing residential structures ● Heavy rains pose risks to agricultural areas	● Put up slope protection or promote tree planting along landslide-prone areas.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	with an elevation estimated at 36.0 meters or 118.1 feet above mean sea level	● Part of barangay is at risk of flooding due to extreme rainfall ● Agricultural areas and crops are at risk of damage due to dry spell	● Possible injuries and deaths to the residents along the shore ● Potential economic losses	● Provide warning signages/billboards to hazard prone areas. ● The Barangay needs an Early Warning Device System. ● Provide opportunities for alternative livelihood specifically to farmers during calamities
Jupi	An upland and inland rural barangay, Jupi is in the northern part of the town with an estimated elevation of 24.3 meters or 79.7 feet above mean sea level	● Some areas are landslide prone due to extreme rainfall ● Part of barangay is at risk of flooding due to extreme rainfall and river overflow ● Agricultural areas and crops are at risk of damage due to dry spell	● Severe potential damages to existing residential structures ● Heavy rains pose risks to agricultural areas especially those along rivers ● Possible injuries and deaths to the residents along the shore ● Potential economic losses	● Provide warning signages/billboards to hazard prone areas. ● The Barangay needs an Early Warning Device System. ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Put up slope protection or promote tree planting along landslide-prone areas. ● Strengthen local programs for environmental concerns ● Establishment of an integrated irrigation system

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
Lapinig	Situated in the boundary of Bato, Sorsogon City, Lapinig is an upland agricultural barangay with an elevation of 27.6 meters or 90.6 feet above sea level. Lapinig's main activity is coconut farming.	● Majority of areas are landslide prone due to extreme rainfall ● Part of barangay is at risk of flooding due to extreme rainfall ● Agricultural areas and crops are at risk of damage due to dry spell	● Severe potential damages to existing residential structures ● Potential landslide to some areas ● Potential displacement, injuries and fatalities due to flood and storm surge ● Have difficulty in transportation in case of emergency ● Economic losses ● Potential damages in natural resources ● Loss of jobs ● Problem in finding in products to sell	● Relocation of residential structures ● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Strengthen local programs for environmental concerns ● Establishment of an integrated irrigation system.
Luna Candol	The whole barangay is one of the urban barangays, it is identified as flood prone due to its low-lying location	● Low-lying areas of barangay pose risk to flooding due to extreme rainfall and severe typhoons	● Severe potential damages to existing residential structures, commercial and government infrastructures ● Potential displacement, injuries and fatalities due to major flood	● Relocation of residential structures ● Formulation of contingency plan to minimize potential injuries during relocation

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
			● Potential economic losses	● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system Creation of local zoning ordinance ● Construction of River/Flood control facility ● Construction of an integrated drainage system
Manapao		● Majority of agricultural areas are at high risk from flooding due to extreme rainfall and severe typhoon ● Agricultural areas and crops are at risk of damage due to dry spell	● Pose risks and damage to irrigation facilities and crops by lowering the quality of produce ● Economic losses	● Installation of automated weather station. ● Introduce farmers to climate-resilient varieties available in the market. ● Promote rice-based diversified system of farming. ● Conduct regular training on Climate Smart FBS. ● Installation of automated weather stations to monitor the amount of rainfall.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Strengthen local programs for environmental concerns ● Establishment of an integrated irrigation system.
Manook	Located at the center of the town, its topographic classification is urban upland with combination of commercial, institutional and residential areas	● Low-lying areas of barangay pose risk to flooding due to extreme rainfall and severe typhoons	● Severe potential damages to existing residential and commercial infrastructures ● Potential displacement, injuries, and fatalities due to major flood ● Potential economic losses	● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance ● Establishment of early warning system Creation of local zoning ordinance ● Construction of an integrated drainage system
Naagtan	Situated at the southern part of the town, Naagtan is an upland barangay with an elevation of 51.2 meters or 168 feet above sea level	● Low-lying areas (Purok 2, 5, 6, 7) are susceptible to flooding and soil erosion due to extreme rainfall and river overflow ● Settlements and roads along the mountainous area are at high risk to landslides	● Potential damages to crops and agricultural lands brought about by heavy rains or severe typhoon and construction of a private canal system ● Potential damages to residential areas and roads due to landslides and soil erosion near riverbanks	● Align the private canal to the river/ irrigation system ● Construction of box culverts along the riverbank ● Construction of drainage and canal system to direct water flow ● Adjust cropping season

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Explore other crops ● Install early warning system along the river ● Regulate/ prohibit building of settlement along the riverbank ● Construct river/ box culverts ● Strengthen/ enhance the slope protection present ● Put/ install warning signages ● Prohibit settlement
Nato	Nato is an upland barangay situated in the northern part of the town with an estimated elevation of 27.9 meters or 91.5 feet above sea level	● Majority of areas are landslide prone ● Part of barangay is at risk of flooding due to extreme rainfall ● Agricultural areas and crops are at risk of damage due to dry spell	● Severe potential damages to existing residential structures ● Potential landslide to some areas ● Potential displacement, injuries and fatalities due to flood and storm surge ● Economic losses ● Potential damages in natural resources	● Formulation of contingency plan to minimize potential injuries during relocation ● Establishment of early warning system ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Construction of slope protection ● Relocate the residential area near the mountains

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Strengthen local programs for environmental concerns ● Establishment of an integrated irrigation system.
Nazareno	Nazareno is an upland barangay that borders Barcelona town	● Some areas are landslide prone ● Part of barangay is at risk of flooding due to extreme rainfall and severe typhoon ● Agricultural areas and crops are at risk of damage due to dry spell, typhoon or extreme rainfall	● Pose risks and damage to agricultural lands especially rice fields and cocolands ● Potential economic losses ● Potential displacement, injuries and fatalities due to major flood and landslide ● Whole barangay is at risk to ashfall	● Construction of slope protection ● Implementation of community warning systems ● Information Bulletin Board for prevention of Ash Fall ● Implementation of varieties of crops that can be planted even in dry season ● Construction of irrigation system
Ogao	Located in the northeast portion of the town. Majority of the area is located upland and only a portion is along the coast of Gubat bay	● Portions of residential and agricultural areas/fishponds (Purok 1 and 2) pose risks to flooding due to extreme rainfall and severe typhoon	● Pose risks and damage to agricultural lands and fishponds ● Economic losses ● Potential displacement, injuries and fatalities due to major flood and landslide	● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance Establishment of early warning system

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
		● Purok 3 is prone to landslides brought about by heavy rains		● Creation of local zoning ordinance ● Construction of River/Flood control facility ● Construction of an integrated drainage system ● Program on climate change ● Program/plan to train all Barangay Officials
Paco	Purok 1 belongs to the lowlands of the barangay facing the Pacific Ocean it is also an agricultural area mostly rice fields and high value crops gardens	● Purok 1 has the potential to submerge in the long term due to sea level rise. ● During extreme dry days, rice fields and high value crops and vegetable gardens usually dry up.	● Severe potential damages to existing residential structures ● Potential submersion of rice fields and high value crops and vegetable gardens. ● Potential Disruption of livelihood activities. ● Potential economic losses ● Potential damages in natural resources	● Relocation of residential structures ● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement of affected households ● Establishment of early warning system ● Strengthen local programs for environmental concerns ● Provide opportunities for alternative livelihood specifically to farmers during calamities

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Establishment of an integrated irrigation system.
Panganiban	One of the coastal-urban barangays, Panganiban is located at the southernmost part of the población with areas comprising mostly of residential and commercial spaces	● More than half of residential area is highly susceptible to flooding, storm surge and tsunami ● Portion of residential area can be affected by coastal erosion	● Strong typhoons, heavy rains and earthquakes pose risks to settlements and livelihood located near Gubat bay ● Possibility of displacement, injuries, and fatalities due to major flood, storm surge or tsunami ● Potential economic losses	
Paradijon	With an approximated elevation of 15m above mean sea level (MSL), barangay Paradijon is one of the highly populated urban barangays of the town	● Low-lying areas of barangay pose risk to flooding due to extreme rainfall and severe typhoons	● Severe potential damages to existing residential structures, commercial and government infrastructures ● Potential displacement, injuries and fatalities due to major flood ● Potential economic losses	● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system Creation of local zoning ordinance ● Construction of River/Flood control facility ● Construction of an integrated drainage system

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
Patag	An inland barangay located in the northern part of the town, Patag has a high elevation estimated at 30 meters or 98.4 feet above sea level	● Significant percentage of the barangay is susceptible to landslide	● Strong typhoons and extreme rainfall events pose risks to settlement and livelihood located in the periphery of mountainous areas ● Possibility of deaths or injuries due to increased intensity of typhoons which provokes landslides	● Formulation of contingency plan to minimize potential injuries during relocation/calamities ● Creation of local zoning ordinance ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system Creation of local zoning ordinance ● Construction of slope control
Payawin	Located at the west side of the town, which is bounded by Barangay Jupi on its East, Barangay Dita on its North, Barangay Cabiguhan on its West, and Barangay Carriedo and Casili on its South, it consists an area of 443.60 has.	● Significant area of the barangay (Sitio Tubog, Karagtig and Pangi) poses threat to flooding due to heavy rains and strong typhoons	● Strong typhoons, and heavy rains pose risks to settlements and livelihood located near river and mountainous areas ● Potential displacement, injuries and fatalities due to flooding ● Potential economic losses ● Potential damages in natural resources	● Establishment of the early warning system ● Improve Information, Education and Communication methods ● Mandatory relocation of affected households in case of severe calamities like super typhoon and heavy rains
Pinontingan	The whole area is prone to sea level rise and super typhoon and is experiencing scattered	● Areas prone to flooding and are potential to submerge in the long term due to sea level rise	● Severe potential damages to existing residential and institutional structures	● Relocation of residential structures ● Formulation of contingency plan to

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	flooding specially during wet season Purok 1 has experienced storm surges	● Projected tidal patterns may result to storm surge ● Critical facilities cannot withstand the effects of super typhoon	● Potential displacement, injuries and fatalities due to flood, storm surge and super typhoon ● Severe potential damages to existing residential and institutional structures	minimize potential injuries during relocation ● Creation of local zoning ordinance ● Establishment of early warning system ● Establishment of climate adaptive institutional structures ● Establishment of climate adaptive residential and institutional structures ● Establishment of early warning system ● Formulation of contingency plan to minimize potential injuries ● Creation of more linkages for funding support in case of calamities
Rizal	Purok Mabaga, Central, Calundan, Bongsaran 1 and 2, Bagong Silang, and a portion of Sitio Contod are located near Gubat Bay	● Areas prone to flooding and are potential to submerge in the long term due to sea level rise. ● Projected tidal patterns may result to storm surge	● Severe potential damages to existing residential structures ● Potential submersion of cottages in Rizal beach resort, hotels, and other business establishments	● Relocation of residential structures ● Formulation of contingency plan to minimize potential injuries during relocation ● Creation of local zoning ordinance

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	Purok Contod, Central, Mabaga, Bagong Silang and Calundan are surrounded by rivers and creeks. Purok Bongsaran 2, Mabaga, and Pili areas are mostly rice fields Purok Contod where an estuary from a creek is located	● During extreme dry days, rice fields which is usually flooded dries up ● As experienced, coastal erosion will more likely damage existing tourism infrastructures	● Potential displacement, injuries, and fatalities due to flood and storm surge ● Potential economic losses ● Potential damages in natural resources ● Potential Economic losses	● Provision of comprehensive housing program for resettlement ● Establishment of early warning system ● Strengthen local programs for environmental concerns ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Establishment of an integrated irrigation system. ● Strengthen local programs for environmental concerns
San Ignacio	Adjacent to the town's población, San Ignacio is a fast-urbanizing barangay	● Settlements near Tingting River are highly susceptible to flooding ● Part of agricultural lands may be affected by overflow of nearby river	● Strong typhoons, and heavy rains pose risks to settlements and livelihood located near river ● Potential displacement, injuries, and fatalities due to flooding ● Potential economic losses ● Potential damages in natural resources	● Formulation of contingency plan to minimize potential injuries during relocation/calamities ● Creation of local zoning ordinance ● Establishment of early warning system ● Strengthen local programs for environmental concerns

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Establishment of an integrated irrigation system. ● Strengthen local programs for environmental concerns ● Construction of River/Flood control facility
Sangat	One of the upland barangays located in southern part of the town	● Portions of barangay (Purok 1 and 5) are at risk to flooding and landslide during rainy season and typhoons ● Residents near the river are at risk to soil erosion ● Majority of the rice fields is vulnerable to damages during dryspell ● Whole barangay is at risk to ashfall	● Potential damage to agricultural, residential, and other institutional areas ● Possible injuries and casualties to people ● Residents are susceptible to diseases ● Cause severe health problems	● Construction of slope protection ● Relocate the residential area near the mountains ● Construction of piles and retaining walls ● Construction of riprap ● Implementation of community warning systems ● Information Bulletin Board for prevention of Ash Fall ● Implementation of varieties of crops that can be planted even in dry season

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Construction of irrigation system
Sta. Ana	Adjacent to the central business district of the town, Sta. Ana is a fast-urbanizing upland agricultural barangay	● Portion of barangay is prone to landslide due to extreme rainfall ● Agricultural areas are at risk due to extreme rainfall ● Agricultural areas are at risk due to dry spell	● Potential damage to agricultural, residential, and other institutional areas ● Possible injuries and casualties to people ● Economic losses	● Construction of slope protection ● Relocate the residential area near the mountains ● Construction of piles and retaining walls ● Construction of riprap ● Implementation of community warning systems ● Implementation of varieties of crops that can be planted even in dry season
Tabi	The barangay is located at the southwestern side of the town with a combination of low-lying and mountainous terrain	● Majority of low-lying farmlands are highly susceptible to flooding ● Part of residential areas may be affected by overflow of river or moderate erosion ● Some residential and agricultural areas can be moderately affected by landslide ● Some part of agricultural land (ricefields) may be affected by dry spell	● Strong typhoons, and heavy rains pose risks to settlements and livelihood located near river and mountainous areas ● Potential displacement, injuries, and fatalities due to flooding ● Potential economic losses ● Potential damages in natural resources	● Construction of riprap/flood control structure near the river and farmlands ● Drainage system improvement ● Program on climate change ● Provide warning signages/billboards to hazard prone areas. ● Introduce farmers to climate-resilient varieties available in the market.

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
				● Promote rice-based diversified system of farming. ● Construction of additional irrigation system
Tagaytay	An upland rural barangay of the town, Tagaytay is in the northwestern part of the town with an estimated elevation of 31.7 meters or 104 feet above sea level	● Some residential and agricultural areas can be moderately affected by landslide ● Some part of agricultural lands and crops may be affected by dry spell	● Possible damages agricultural areas and residents due to extreme rainfall or dry spell	● Formulation of contingency plan to minimize potential injuries during calamities ● Provision of comprehensive housing program for resettlement ● Establishment of early warning system ● Strengthen local programs for environmental concerns ● Provide opportunities for alternative livelihood specifically to farmers during calamities ● Introduce farmers to climate-resilient varieties available in the market.
Tigkiw	Sharing common borders with barangays in Barcelona and Casiguran towns, Tigkiw is at the southernmost	● Some residential and agricultural areas can be significantly affected by landslide	● Strong typhoons and extreme rainfall events pose risk to settlement and livelihood located in the periphery of	● Enroll farmers to free crop insurance of PCIC. ● Put up slope protection

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	part and has the highest elevation among the barangays at 137 meters or 449.5 feet above sea level	● Part of residential and agricultural areas may be affected by overflow of river, moderate erosion, or liquefaction	elevated and mountainous areas and riverbanks	● Provide warning signages/billboards to hazard prone areas. ● Introduce farmers to climate-resilient varieties available in the market. ● Installation of automated weather station to monitor amount of rainfall
Tiris	Tiris is a low-lying coastal barangay situated along Gubat bay which boasts of a variety of agricultural activities i.e., vegetable farming, rice production, and fisheries and aquatic activities	● Majority of agricultural lands and fisheries and aquaculture areas in the low-lying portion are at risk of flooding and coastal erosion due to sea level rise and river overflow ● Some settlement can be moderately affected by flooding due to extreme rainfall or severe typhoon ● Part of agricultural land (rice fields and fishponds) is at risk during dry spell and increase of water temperature	● Strong typhoons, extreme rainfall and sea level rise events pose risk to settlement and livelihood located along Gubat bay and Tingting river ● Potential damage to rice fields, high value crops, vegetable gardens, fishponds, and other aquatic activities during dry spell	● Enroll farmers to free crop insurance of PCIC. ● Provide warning signages/billboards to hazard prone areas. ● Introduce farmers to climate-resilient varieties available in the market ● Installation of automated weather station to monitor amount of rainfall ● Construction of additional irrigation system ● Construction of river control
Togawe	An upland barangay in the southern part of the town, Togawe's main	● Portion of the barangay is susceptible to rain-induced landslide	● Heavy rains pose risks to crops by lowering the quality of produce	● Enroll farmers to free crop insurance of PCIC. ● Put up slope protection

Decision Area	Description	Problem/ Hazards	Impacts/ Implications	Recommended Interventions
	economic industry is coconut farming	● Significant areas of Gubat is at risk of low to no supply of water due to dry spell that could affect water source	● Damage to properties ● Possibility of injuries or death due to increased intensity of rains which provokes landslides and flooding ● Depleted water sources ● Inadequate water supply to dependent barangays	● Promote tree planting along landslide-prone areas and watersheds. ● Provide warning signages/billboards to hazard prone areas.
Union	Interspersed with lowland and hilly areas, barangay Union is an agricultural community with a total land area of 371.1 square meters	● Barangay is highly at risk to flooding during extreme rainfall and super typhoon ● Agricultural areas are at risk due to dry spell	● Possible damages to agricultural areas, local water sources and residents	● Construction of riprap/flood control structure near the river and farmland ● Relocate houses near the mountainous area
Villareal	Situated at the southwestern side of the town, Villareal is an inland rural barangay that shares common borders with barangays Tabi, Benguet, Buenavista, Nazareno and Rizal	● Some areas are landslide prone ● Part of barangay is at risk of flooding due to extreme rainfall and severe typhoon ● Agricultural areas and crops are at risk of damage due to dry spell, typhoon, or extreme rainfall	● Pose risks and damage to agricultural lands especially rice fields and cocolands ● Potential economic losses ● Potential displacement, injuries, and fatalities due to major flood and landslide ● Whole barangay is at risk to ashfall	● Construction of slope protection ● Implementation of community warning systems ● Information Bulletin Board for prevention of Ash Fall ● Implementation of varieties of crops that can be planted even in dry season ● Construction of irrigation system

XI. Recommendations

Climate change and disaster resilience means taking actions to prepare and adapt to both current and predicted impacts. Recommendations on adaptation strategies were formulated based on the data directly collected from the barangays. Participatory approach on interventions would include strategies on wealth, information, technology, infrastructure, social capital, and institution and governance.

Wealth

1. Implement more efficient and effective approach on resource and fiscal management i.e., utilization of the 5% calamity fund from the municipal down to the barangay level, collection of local income and other receipts, government service delivery (ease of doing business).
2. Adopt a proactive approach on resource and financial generation e.g., encourage investors, develop new local economic enterprises.
3. Access resources through external sources i.e., grants, donations, and fundraising activities specifically for climate change and disaster adaptation programs and activities.
4. Device mechanism on subsidy and incentive programs for the agriculture sector.
5. Encourage farmers to avail of the free crop insurance and other incentives being offered by the Department of Agriculture or other agencies.

Information

1. Intensify multisectoral information and education campaigns (IEC) on climate change and disaster adaptation strategies for communities.
2. Implement timely and sustained early warning information dissemination method during emergencies i.e., LGU-initiated mobile infocast, website and other social media platforms, radio, traditional house-to-house dissemination or *bayabay.*
3. Install warning signages/billboards to hazard prone areas.
4. Provide public safety hotlines for rescue and emergency services.

Technology

1. Sustain skills development training and seminars for farmers and fisherfolks i.e., introduction to climate-resilient varieties, rice-based diversified system of farming, intercropping and mixed cropping and other modern methods of farming, aquasilviculture, pisciculture.
2. Provide opportunities for farmers and other stakeholders to innovative value-added production techniques i.e., food processing of fish and marine products, coconut, rice, and other crops.
3. Encourage the use of solar power and other energy-efficient technologies i.e., streetlight, other machines.
4. Install early warning device systems and rain gauges to barangays.

Infrastructure

1. Construct additional irrigation systems to agricultural areas.
2. Construct drainage systems especially to low-lying and flood-prone areas.
3. Construct disaster-resilient and climate-adaptive evacuation centers.
4. Construct flood/river controls and drainage system in flood-prone areas.

5. Construct wastewater treatment facilities to minimize the effects of water pollution and other water contaminants.
6. Design a systematic housing and resettlement plan for residents living in hazard prone areas.
7. Install or construct slope protections on landslide prone areas.
8. Improve roads, bridges, revetments, sea walls, concrete barriers, and other protective mechanisms to mitigate the effects of hazards.
9. Invest in green engineering technology and alternative sources of energy.

Social Capital

1. Sustain capacity development program for the barangay local government units (BLGUs), CSOs, POs, MSMEs and tourism sector i.e., climate change and disaster preparedness seminars, basic life support trainings, sustainable livelihood methods, environmental awareness education campaigns, encourage citizen participation through volunteer programs.
2. Assist in the reactivation or formation of organizations of farmers, fisherfolks and other marginalized sectors i.e., proactive accreditation of organizations.
3. Initiate community-based learning to mainstream climate change adaptation and disaster risk reduction.
4. Enroll farmers and fisherfolks in available crop insurance policies.
5. Adopt a whole-of community approach to enjoin civil society organizations, people's organizations, cooperatives, microfinance institutions, faith-based organizations, businesses, academe, and other non-state actors to join in disaster risk reduction and management.

Institution and Governance

1. Conduct continuous capacity (vertical and horizontal) development of MDRRMC and creation or revival of BDRRMCs.
2. Update local policy and plans i.e., CDRA, LCCAP, SWMP.
3. Institutionalize land-use plan and adoption of zoning ordinance.

XII. Conclusion

Disasters disrupt the normal functions of a community affecting its "environment, societal infrastructure, and services" and overwhelm "local capacity to cope using its own resources causing displacement, economic loss, property damage, death and injury, environmental degradation, and profound emotional suffering" (Weiner & Rosman, 2019). According to Greenwatch, the Philippines is the third most vulnerable country in the world to climate change, and also ranked third on the 2018 World Risk Index of most-disaster prone countries in the world. This is a result of the combination of climate and non-climate-induced hazards such as typhoons, earthquakes, volcanic eruptions, and anthropogenic activities such as insurgencies and terrorisms (Heintze et al., 2018).

In 2015, three significant universal agreements took place underscoring the role of climate change and disaster mitigation to sustainable development. These are the Sendai Framework for Disaster Risk Reduction (SFDRR), the Conference of Parties (COP) Paris Agreement, and the United Nations Sustainable Development Goals (SDG). In the Philippines, the passage of the Disaster Risk Reduction and Management Act of 2010 and the Climate Change Act of 2009 provided local governments the guidelines for key actions to address intensifying climate-related

hazards and human-induced disasters. They underscore that understanding and assessing the vulnerabilities and adaptive capacities of local governments through a Disaster Risk Reduction and Management (DRMM) Plan is important to determine the risk of systems, reduce the vulnerability of individuals, and mitigate the negative impacts of disasters to economic and human development. The implementation of the DRRM Plan should be made by people directly affected by the plan, and those who will implement it also participate in its formulation (Perez & Gotangco, 2013).

To formulate disaster risk-sensitive plans, a climate and disaster risk assessment is imperative to assess the degree of exposure of communities to hazards, examine vulnerabilities and sensitivities, and provide scientific-based information and data. The climate and disaster risk assessment conducted by the municipality affirmed that disasters are results of the interaction of hazards, exposure, adaptive capacities, and vulnerabilities of communities. However, despite the increasing frequency and severity of hazards, the negative impacts of disasters can be prevented and mitigated by sound disaster preparedness through a combination of structural, technological, and non-structural measures such as policies, social capital, knowledge development, and capacity-building.

This means that disaster risk reduction and the increased vulnerabilities should be at the core of socio-economic and governance policies of communities. With the enormous challenge of both natural and man-made disasters and resource constraints, building safe communities has become even more compelling. Local communities should continue to improve their adaptive capacities to mitigate the impacts of disasters. With this, collective actions between and among various stakeholders – local governments, civil society, private organizations, and other non-state actors from local, national, and international levels is imperative in implementing disaster preparedness plan and integrating it into the overall development strategies through systematic efforts that would reduce exposure to hazards, lessen vulnerabilities of people, and improve disaster preparedness toward sustainable development.

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Table 1. Population Exposure Database.

BARANGAY (A)	EXPOSURE INDICATORS (B)						SENSITIVITY INDICATORS (C)																ADAPTIVE CAPACITY (D)					
			Barangay Population																									
	Total Land Area (Hectares)	Residential Area (Hectares)	Total Male	Total Female	Total Population	Population Density per Hectare of Residential Area	Population of Informal Settlers	Percentage of Informal Settlers From the Total Population	Population Living in Dwelling Units with Walls Made from Light to Salvageable Materials (Households)	Percentage of Population Living in Dwelling Units with Walls Made from Light to Salvageable Materials from the total Household	Total Population of Age below 15 years old (Young Dependents)	Percentage of Age below 15 years old (Young Dependents) from the total Population	Total Population Age 65 and above (Old Dependents)	Percentage of Age 65 and above (Old Dependents) from the total population	Population of Young and Old Dependents	Percentage of Young and Old Dependents From the Total Population	Population of Persons with Disabilities	Percentage of Persons with Disabilities from the Total Population	Total Number of Households	Total Number of Households Living Below the Poverty Threshold	Percentage of Households Living Below the Poverty Threshold	Population of Malnourished Individuals	Perventage of Malnourished Individuals from the Total Population	Wealth	Information	Infrastructure	Technology	Institution and Governance	Social Capital
Ariman	170	16.99	916	893	1809	106.47	104	5.75	79	10.12	647	35.77	118	6.52	765	42.29	37	2.05	405	286	70.62	7	9.88	Amount	IEC Campaign	descriptive/none	early warning system	policies/	CSOs
Bagacay	767	27.83	1794	1731	3525	126.66	192	5.45	59	13.20	1255	35.60	260	7.38	1515	42.98	61	1.73	781	468	59.92	26	11.52						
Balud del Norte (Pob.)	7.52	6.57	1017	960	1977	300.91	399	20.18	52	18.91	657	33.23	137	6.93	794	40.16	82	4.15	447	334	74.72	8	16.32						
Balud del Sur (Pob.)	7.59	3.93	627	645	1272	323.66	17	1.34	45	32.61	407	32.00	104	8.18	511	40.17	27	2.12	275	168	61.09	5	0.71						
Benguet	187.65	35.34	268	269	537	15.20	24	4.47	1	0.27	195	36.31	57	10.61	252	46.93	13	2.42	138	66	47.83	4	2.17	5% Calamity fund for food relief and purchase of equipment	Thru "bayabay" barangay council are assign purok by purok for information diddsimenation	with riprap in landslide prone area	limited network access	with resolution no. 2017.2s and 2017.73s' with programs of tree planting of mahogany	presence of BDRMS but only identified not trained and organized; Trained barangay tanod and kagawad; Barangay Officials and Youth organization attended trainings for military earthquake drill and first aid
Bentuco	477.55	5.73	793	800	1593	278.01	163	10.23	8	3.38	599	37.60	115	7.22	714	44.82	37	2.32	364	243	66.76	6	2.47						
Beriran	168.57	17.67	525	510	1035	58.57	63	6.09	6	2.32	376	36.33	77	7.43	453	43.77	24	2.32	237	159	67.09	4	2.78						

Buenavista	157	18.84	621	642	1263	67.04	220	17.42	7	1.46	482	38.16	103	8.16	585	46.32	36	2.85	259	158	61.00	4	0.00						
Bulacao	304.04	17.75	1006	1138	2144	120.79	142	6.62	0	0.00	769	35.87	188	8.77	957	44.64	35	1.63	479	258	53.86	1	1.20	5% Calamity fund for food relief and recovery	Information dissemination thru house to house visit of kagawads and BHW	With riprap and river control for households near the river, residents have 80% conrete houses and20 % light materials	None	with resolution for Barangay Site and evacuation center	presence of BDRRMC, Womens group and Youth organization; BDRRMC, BNS and HW with 10 Kagawads and 2 Barangay Tanod with First Aid Training; Youth organization with military training on Fire prevention and safety drill
Cabigaan	114.64	3.53	543	524	1067	302.27	73	6.84	2	1.20	417	39.08	79	7.40	496	46.49	41	3.84	240	141	58.75	7	1.12						
Cabiguhan	247.21	6.54	407	372	779	119.11	122	15.66	2	0.40	293	37.61	36	4.62	329	42.23	14	1.80	167	106	63.47	6	1.75						
Carriedo	413.76	19.279	1084	1102	2186	113.39	21	0.96	8	3.31	804	36.78	150	6.86	954	43.64	76	3.48	500	291	58.20	10	2.02						
Casili	223.79	23.89	525	518	1043	43.66	38	3.64	5	0.96	405	38.83	71	6.81	476	45.64	24	2.30	242	166	68.60	9	2.47						
Cogon	173	28.18	1276	1234	2510	89.07	46	1.83	13	3.16	862	34.34	129	5.15	991	39.48	38	1.51	521	332	63.72	6	13.73						
Cota na Daco (Pob.)	31.7	20.75	940	883	1823	87.86	140	7.68	57	46.72	620	34.01	148	8.12	768	42.13	26	1.43	411	290	70.56	8	3.05						
Dita	284.48	4.63	261	262	523	112.96	41	7.84	4	1.48	200	38.24	38	7.27	238	45.51	12	2.29	122	79	64.75	5	2.89						
Jupi	236.22	6.53	616	595	1211	185.45	53	4.38	8	7.27	416	34.35	108	8.92	524	43.27	30	2.48	271	168	61.99	3	2.61						
Lapinig	296.6	8.29	257	260	517	62.36	71	13.73	3	0.52	218	42.17	35	6.77	253	48.94	14	2.71	110	68	61.82	4	6.24						
Luna Candol (Pob.)	19.59	9.57	1316	1348	2664	278.37	177	6.64	35	14.06	845	31.72	228	8.55	1073	40.28	58	2.18	579	271	46.80	5	1.15						
Manapao	391.32	8.8	509	490	999	113.52	42	4.20	3	0.89	398	39.84	65	6.51	463	46.35	38	3.80	249	167	67.07	6	0.00						
Manook (Pob.)	18.11	10.58	679	680	1359	128.45	4	0.29	0	0.00	392	28.84	119	8.76	511	37.60	12	0.88	338	197	58.28	0	4.32						
Naagtan	509.67	9.94	566	532	1098	110.46	27	2.46	9	3.30	393	35.79	102	9.29	495	45.08	37	3.37	240	147	61.25	2	1.39						
Nato	309.47	7.85	619	563	1182	150.57	322	27.24	4	3.42	429	36.29	102	8.63	531	44.92	43	3.64	273	186	68.13	2	3.15						
Nazareno	181.52	9.2	269	270	539	58.59	27	5.01	3	0.96	206	38.22	47	8.72	253	46.94	20	3.71	117	49	41.88	1	4.39						
Ogao	97.05	9.08	732	666	1398	153.96	69	4.94	13	3.94	512	36.62	111	7.94	623	44.56	48	3.43	312	187	59.94	11	2.96						
Paco	393.35	8.64	740	759	1499	173.50	155	10.34	9	2.31	548	36.56	102	6.80	650	43.36	41	2.74	330	194	58.79	5	3.95						
Panganiban (Pob.)	51.5	16.77	782	882	1664	99.22	35	2.10	16	5.32	489	29.39	166	9.98	655	39.36	36	2.16	390	173	44.36	0	3.43						
Paradijon (Pob.)	18.33	11.006	626	667	1293	117.48	20	1.55	10	6.76	379	29.31	134	10.36	513	39.68	55	4.25	301	136	45.18	0	1.94						
Patag	200.39	4.58	327	300	627	136.90	188	29.98	3	0.86	225	35.89	54	8.61	279	44.50	25	3.99	148	83	56.08	4	3.16						

Payawin	443.6	18.44	798	788	1586	86.01	216	13.62	12	3.51	610	38.46	110	6.94	720	45.40	44	2.77	347	188	54.18	4	0.27						
Pinontingan (Pob.)	16.1	8.3	693	710	1403	169.04	185	13.19	1	0.15	413	29.44	163	11.62	576	41.05	65	4.63	342	137	40.06	3	7.42						
Rizal	573	56.16	1248	1350	2598	46.26	26	1.00	48	12.80	872	33.56	271	10.39	1143	44.00	52	2.00	650	346	53.23	9	2.06						
San Ignacio	300.35	23.31	948	921	1869	80.18	415	22.20	5	2.54	593	31.73	149	7.97	742	39.70	33	1.77	375	227	60.53	3	1.88						
Sangat	516.27	12.5	456	410	866	69.28	155	17.90	3	0.81	328	37.88	70	8.08	398	45.96	24	2.77	197	103	52.28	3	2.06	5% budget allocation for Calamity Fund for relief & recovery, medicine	IEC Campaign, Active Bayabay system or house to house visit by the purok leader, Information Bulletin System	Barangay Hall serves as evacuation center	Information thru internet	Resolution and LDRRM Plan	Organized groups and trained staff; Barangay Response Team, Barangay Tanod
Sta. Ana	391.37	32.07	811	738	1549	48.30	39	2.52	8	2.22	547	35.31	138	8.91	685	44.22	33	2.13	372	226	60.75	6	1.07						
Tabi	268.38	11.74	697	743	1440	122.66	44	3.06	4	1.72	496	34.44	136	9.44	632	43.89	43	2.99	360	228	63.33	1	5.22						
Tagaytay	248.79	7.14	588	558	1146	160.50	221	19.28	12	5.36	482	42.06	74	6.46	556	48.52	28	2.44	232	166	71.55	9	2.90						
Tigkiw	377.06	44.31	474	479	953	21.51	64	6.72	6	1.22	342	35.89	76	7.97	418	43.86	26	2.73	224	147	65.63	5	3.54						
Tiris	972	22.005	1104	1078	2182	99.16	67	3.07	17	5.96	805	36.89	173	7.93	978	44.82	62	2.84	492	241	48.98	17	2.03						
Togawe	510.26	17.78	632	585	1217	68.45	133	10.93	6	1.99	448	36.81	113	9.29	561	46.10	32	2.63	285	178	62.46	6	2.61	5% Budget allocation for the calamity fund from the IRA of barangay where 30% is for relief and recovery and 70% purchase of medicine	Thru bayabay with the use of megaphone, Kagawads are assign by sitio	with slope protection and riprap in the landslide prone area; ES is the temporary evacuation center	None	With resolution	with the presence of BDRRMC with First Aid Training, water rescue and fire prevention with the help of MDRRMC
Union	327.87	10.24	592	614	1206	117.77	92	7.63	7	5.26	425	35.24	119	9.87	544	45.11	36	2.99	301	166	55.15	3	0.71						
Villareal	117.15	8.99	332	302	634	70.52	66	10.41	1	0.75	216	34.07	66	10.41	282	44.48	19	3.00	133	55	41.35	3	0.00	5% budget allocation for Calamity Fund	Using the megaphone and bayabay, Kagawads are assign their purok	Makeshift houses relocated in the barangay site, presence of River control	None	With resolution	Trained Staff Barangay Tanod as BDRRMC

																									for information dissimination; limited cignal of the cellphone and presence of information bulletin in the barangay hall	and having fire wall in there houses			

Table 2. Natural Resources Production Exposure Database.

BARANGAY	EXPOSURE INDICATORS				SENSITIVITY INDICATORS						ADAPTIVE CAPACITY					
	Number of Farming Dependent Households	Total Area Alocation (Hectares)	Dominant Crop/ Variety of Produce	Average Output Per Hectare (PHP)	Number of Farming Families who Attended Climate Field School	Percentage of Farming Families Using Sustainable Production Techniques	Percentage of Farmers with Access to Hazard Information	Percentage of Production Areas with Infrastructure Coverage	Percentage Areas with Irrigation Coverage	Percentage Areas with Water Impoundment	Wealth	Information	Infrastructure	Technology	Institution and Governance	Social Capital
Ariman	191	125.81	Rice	8,097,826.50	5	5%	100%	100%	81%	0%						
Bagacay	193	627.21	Coconut	30,392,163.30	0	5%	100%	100%	9%	0%						
Balud del Norte (Pob.)	0	0.00	0	-	0		100%									
Balud del Sur (Pob.)	0	0.00	0	-	0		100%									
Benguet	62	184.02	Coconut	9,079,215.75	0	5%	100%	100%	16%	0%	budget allocated from fundraising of BEFA from rental of threser; Microfinance for fertilizer with 30% interest	No data	Small irrigation system with 200m concrete line canal from NIA mini dam and BRIA mini dam with gate 1, gate and gate 3; solar dryer post harvest facilities and machines like tractor and threser			presence of BFARMC, BEFA with 37 members, BRIA with 30 members and BAFC; with trained staff; Barangays attended seminar on cacao plantation sponsored by GSAC and seminar on livelihood, hog raising sponsored by SLP-DSWD

													sponsored by LGU-MAO			
Bentuco	57	301.78	Coconut	14,266,489.77	0	5%	100%	100%	9%	0%						
Beriran	108	210.57	Coconut	11,565,043.65	0	5%	100%	100%	18%	0%						
Buenavista	96	129.56	Coconut	7,164,342.09	0	5%	100%	100%	29%	0%						
Bulacao	230	253.69	Coconut	14,132,895.57	0	5%	100%	100%	44%	0%	Anibong Bulacao Cabigaan Association Fundraising for maintenance of the irrigation and dam	with Bulletin board for general information	presence of Anibong Bulacao Cabigaan Association irrigation system supplies the entire farmland in the barangay; open court is the temporary solar dryer; 2 private mechanical dryer; there are tractor and threser for barangay use	Farmer uses resilient varieties hybrid in sitio Malidlid; also food prcessing (pili candy); GSAC endorsed cacao planting; there are 2 farmers uses ancient practice for hilamon and organic farming	presence of Joint resolution of ABCA wiith Sagpan Irrigation	presence of ATABIA, BAFC, ABCA, Malidlid Irrigators and Naagtan-Butbot Irrigation Association
Cabigaan	70	131.34	Coconut	6,728,391.27	0	5%	100%	100%	22%	0%						
Cabiguhan	91	487.88	Coconut	21,954,600.00	0	5%	100%	100%	0%	0%						
Carriedo	188	390.93	Coconut	20,733,214.14	0	5%	100%	100%	29%	0%						
Casili	64	255.38	Coconut	12,214,134.27	0	5%	100%	100%	12%	0%						
Cogon	56	40.36	Coconut	1,365,993.00	0	5%	100%	100%	0%	0%						
Cota na Daco (Pob.)	12	17.00	Coconut	933,021.00	0	5%	100%	100%		0%						
Dita	59	200.81	Coconut	9,944,828.55	0	5%	100%	100%	3%	0%						
Jupi	220	246.33	Rice	14,460,607.89	0	5%	100%	100%	34%	10%						
Lapinig	89	442.22	Coconut	21,280,317.03	0	5%	100%	100%	8%	0%						
Luna Candol (Pob.)	18	12.56	Rice	864,445.41	5	5%	100%	100%	0%	0%						
Manapao	186	346.44	Coconut	17,232,565.32	0	5%	100%	100%	16%	12%						
Manook (Pob.)	1	0.10	Coconut	4,500.00	0	5%	100%	100%	0%	0%						
Naagtan	68	525.80	Coconut	24,460,653.96	25	5%	100%	100%	6%	0%						
Nato	177	416.47	Coconut	21,244,958.46	0	5%	100%	100%	16%	0%						

Nazareno	30	192.31	Coconut	9,048,115.26	0	5%	100%	100%	5%	0%						
Ogao	87	125.70	Coconut	6,752,061.45	1	5%	100%	100%	18%	0%						
Paco	43	405.18	Coconut	18,796,703.94	0	5%	100%	100%	2%	0%						
Panganiban (Pob.)	5	0.98	Coconut	44,226.00	0	5%	100%	100%	0%	0%						
Paradijon (Pob.)	5	12.44	Coconut	5,593,410.00	0	5%	100%	100%	0%	0%						
Patag	17	285.64	Coconut	12,999,697.74	0	5%	100%	100%	0%	0%						
Payawin	116	425.95	Coconut	21,223,923.48	20	5%	100%	100%	15%	0%						
Pinontingan (Pob.)	1	0.43	Coconut	19,183.50	0	5%	100%	100%	0%	0%						
Rizal	180	318.37	Coconut	16,473,718.35	0	5%	100%	100%	22%	0%						
San Ignacio	178	237.48	Rice	14,047,423.56	55	5%	100%	100%	40%	0%						
Sangat	68	470.68	Coconut	21,843,063.27	0	5%	100%	100%	6%	0%	None	None	Irrigation system in purok 3, Post harvest facilities like solar dryer, machine like tractor	Using resilient varieties like hybrid palay from DA; Fertilizers for pest and kuhol	Resolution; LDRRM Plan and Bigasang Barangay program	BAFC
Sta. Ana	41	336.13	Coconut	15,744,005.28	0	5%	100%	100%	8%	0%						
Tabi	224	234.56	Coconut	13,337,891.82	0	5%	100%	100%	38%	0%						
Tagaytay	97	229.50	Coconut	11,923,699.50	0	5%	100%	100%	13%	0%						
Tigkiw	21	182.67	Coconut	8,404,497.54	0	5%	100%	100%	4%	0%						
Tiris	161	402.55	Coconut	20,288,221.65	0	5%	100%	100%	0%	0%						
Togawe	15	333.37	Coconut	15,065,488.98	0	5%	100%	100%	1%	0%	None	None	With solar dryer, Tresher and sprayer	With resilient varieties using Abaca (hagpas) endorsed by PHIL-FIDA	With resolution; programs of hog dispersal	with the presence of BAFC; GSAC promoted cacao planting; LGU-MAO crop insurance
Union	216	300.49	Coconut	16,193,261.34	0	5%	100%	100%	32%	0%						
Villareal	56	111.37	Coconut	5,465,321.73	1	5%	100%	100%	13%	0%	with budget of 10,000 annually especifically for trainings and seminar but without ordinance	with Information Bulletin System in the Barangay Hall and house to house consultation	All ricefields are irrigated, with 1.5km irrigation and communal irrigation less than 10 hectares, with solar dryer, thresher and tractor	bamboo planted at Purok 1-7 to protect from soil erosion in river side	Action Plan based on trainings	Maragadao-Villareal Irrigation System Association, Trained Staff Local Farming Technician and Crop Insurance from DAR

Table 3. Critical Point Facilities Exposure Database.

BARANGAY	EXPOSURE INDICATORS					SENSITIVITY INDICATORS			ADAPTIVE CAPACITY					
	Type	Name	No.	Area (Sq. Meters)	Capacity (Classrooms, Bed Capacity, Loading Capacity)	Wall Materials Used	Existing Condition	Structure Employing Hazard Resistant Design	Wealth	Information	Infrastructure	Technology	Institution and Governance	Social Capital
Ariman	Bridges	Aropag			15 Tons, 30m length	RCDG	Good	Yes	Availability of funds from LGU and external organizations, national government agencies like DPWH	Availability of internet service providers, radio and television networks, IEC trainings provided by LGU	Evacuation centers, Material Recovery Facilities		Enforcement of environmental laws, local ordinances, and other policies	Active participation of Barangay LGU, civic society organizations
		Aropag flood control dikes			0.43	concrete aspalt overlay	Good	Yes						
		Ariman			10 tons, 52 m length	Concrete	Good	Yes		bridges - DPWH managed				
	Footbridges	Purok 1, Sitio Alamag			15m	Concrete								
		Purok 6, Sitio Tangke 1			13m	Concrete								
		Purok 6, Sitio Tangke 2			12m	Concrete								
	ECCD Center	Ariman Day Care Center		40	25 persons	Concrete	Good	Yes		footbridges - LGU managed				
	Health Center	Ariman Health Center		32	20 persons	Concrete	Good	Yes						
	Preparatory	Ariman Elementary School			1 classroom	concrete								
	Elementary School	Ariman Elementary School		5,068	6 Classrooms	Concrete/ Makeshift	Good /Fair	Yes	na	na	na	na	na	
	electric posts	Wooden	14											
		Steel	38											

		Concrete	16												
	churches/ chapels	Nuestra Senora del Carmen													
	fire stations	Bureau of Fire Protection													
	Multi-purpose Hall	Ariman Barangay Hall		32	30 persons	Concrete	Good	Yes							
Bagacay	Bridge	Bagacay			15 Tons, 36m lenth	Concrete	Good	Yes							
		Flood control dikes			.64 km	concrete aspalt overlay	Good	Yes							
	Footbridge	Purok 4			14m	comcrete									
	Sea wall				.36 km	concrete aspalt overlay									
	Day Care Center	Bagacay Day Care Center		70	50 persons	Concrete	Good	Yes							
	Health Center	Bagacay Health Center		63	50 persons	Concrete	Good	Yes							
	Preparatory	Bagacay Elementary School			1 classroom										
	Elementary School	Bagacay Elementary School		7,700	18 Classrooms	Concrete	Good /Fair	Yes							
	Secondary School	Bagacay National High School		13,436	20 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	19												
		Steel	52												
		Concrete	1												
	churches/ chapels	Sto. Nino Chapel													
	Multi-purpose Hall	Bagacay Barangay Hall		104	100 persons	Concrete	Good	Yes							
Balud del Norte	Day Care Center	Balud del Norte Day Care Center		20	30 persons	Concrete	Good	Yes							

	Health Center	Balud del Norte Health Center		20	20 persons	Concrete	Good	Yes						
	Evacuation Center	Balud del Norte Evacuation Center		150	100 persons	Concrete	Good	Yes						
	electric posts	Wooden	9											
		Steel	5											
		Concrete												
	churches/ chapels	International communion of charismatic epispopal												
		Holy Cross												
	Multi-purpose Hall	Balud del Norte Barangay Hall		40	50 persons	Concrete	Good	Yes						
Balud del Sur	Sea wall				.24 km									
	Day Care Center	Balud del Sur Day Care Center		35	60 persons	Concrete	Good	Yes						
	Health Center	Balud del SurHealth Center		49	1 Bed/50 persons	Concrete	Good	Yes						
	Preparatory	Eclectic Education Center			1 classroom	Concrete								
	Elememtaru	Eclectic Education Center			6 classrooms	Concrete								
	electric posts	Wooden	18											
		Steel	17											
		Concrete	3											
	churches/ chapels	Sto. Nino Chapel												
	Multi-purpose Hall	Balud del Sur Barangay Hall		150	100 persons	Concrete	Good	Yes						
Benguet	Footbridges	Purok 6 A	1		5.6 m	Concrete	Good							
		Purok 6 B	1		3m	Concrete	Good							
		Purok 5	1		9m	Concrete	Good							

		Purok 3 a	1		3m	Concrete	Good							
		Purok 3 b	1		8m	Concrete	Good							
		Purok 2	1		12.6m	Concrete	Good							
	Day Care Center	Benguet Day Care Center	1	40	25 persons	Concrete	Fair	Yes						
	Health Center	Benguet Health Center	1	24	1 Bed/10 persons	Concrete	Fair	Yes						
	Preparatory	Benguet Elementary School	1		1 classroom	Semi/concrete	Fair							
	Elementary School	Benguet Elementary School	1	16,000	7 Classrooms	Concrete	Good	Yes						
	electric posts	Wooden	21			wood	Good							
		Steel	15			steel	Good							
		Concrete				concrete	Good							
	churches/ chapels	Sta Cruz chapel	1			concrete	Good							
	Multi-purpose Hall	Benguet Barangay Hall	1	64	50 persons	Concrete	Good	Yes						
Bentuco	Day Care Center	Bentuco Day Care Center		40	25 persons	Concrete	Good	Yes						
	Health Center	Bentuco Health Center		30	3 table/30 persons	Concrete	Good	Yes						
	Preparatory	Bentuco Elementary School			1 classroom									
	Elementary School	Bentuco Elementary School		10,252	13 Classrooms	Concrete	Good Fair	Yes						
	Secondary School	Bentuco National High School		10,000	12 Classrooms	Concrete	Good Fair	Yes						
	Evacuation Center	Bentuco Evacuation Center		40	80 persons	Concrete	Good	Yes						
	electric posts	Wooden	24											
		Steel	18											
		Concrete												
	churches/ chapels	San Nicolas de Tolentino Church												

		Iglesia ni Cristo												
		Nazareno , Km. 28												
		Salvacion , Sitio Cabuluan												
		San Isidro, Sitio Ariman												
		San Isidro, Km. 31												
	Multi-purpose Hall	Bentuco Barangay Hall		40	100 persons	Concrete	Good	Yes						
	Day Care Center	Beriran Day Care Center		110	20 persons	Concrete	Good	Yes						
	Health Center	Beriran Health Center		64	40 persons	Concrete	Good	Yes						
	Preparatory	Beriran Elementary school			1 classroom									
	Elementary School	Beriran Elementary school		4,000	5 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	21											
		Steel	11											
		Concrete	9											
	churches/ chapels	Brgy. Chapel												
		Sitio Chapel												
	Multi-purpose Hall	Beriran Barangay Hall		64	30 persons	Concrete	Good	Yes						
Buenavista	Bridge													
	Day Care Center	Buenavista Day Care Center		12	25 persons	Concrete	Good	Yes						
	Health Center	Buenavista Health Center		56	40 persons	Concrete	Good	Yes						
	Preparatory	Buenavista			1 classroom									

		Elementary School												
	Elementary School	Buenavista Elementary School		9,995	6 Classrooms	Concrete	Good Fair	Yes						
	electric posts	Wooden	5											
		Steel	32											
		Concrete	3											
	churches/ chapels	San isidro chapel												
		Contod Chapel												
		Christians looking unto Jesus ministry												
	Multi-purpose Hall	Buenavista Barangay Hall		56	40 persons	Concrete	Good	Yes						
Bulacao	Bridge	Bulacao	1		15 Tons, 39 m length	Concrete, asphalt ovelayed	Fair/for rehab	Yes	with budget from DPWH					DPWH
	Footbridges	Pangdan-Malidlid	1		17m	concrete	Fair/for rehab	No	with budget under barangay 20%	None	80% of the footbridges are concrete can withstand climate projection and 20% cannot withstannd	None	With resolution	with the presence of Barangay Council and other NGOs
		Malidlid	1		5.2 m	concrete	Good	Yes						
		Calumpit	1		5m	concrete	Good	Yes						
		Calumpit-Malidlid	1		14m	concrete	Fair/for rehab	No						
		Bagaluba s	1		25m	concrete	Good	Yes						
		Lucha 1	1		15m	concrete	Fair/ No handle	No						
		Lucha 2	1		6m	concrete	Good	Yes						
		Anibong	1		16.2	concrete	Good	Yes						
		Pangdan	1		6m	concrete	Good	Yes						
		Malidlid	1		11m	concrete	Good	Yes						
		Malidlid	1		3.4 m	concrete	Good	Yes						
	Flood Control Dixe	Centro West	1		.32 km	Concrete, asphalt ovelayed	Good	Yes						

	Day Care Center	Bulacao Day Care Center	1	30	35 Persons	Concrete	Good	Yes	budget under barangay General Fund	None	Concrete and can withstand climate projection	None	with resolution	presence of Barangay Council and Day Care PTA Officers
	Health Center	Bulacao Health Center	1	96	1 Bed/20 Persons	Concrete	Good	Yes	budget under barangay General Fund	None	Concrete and can withstand climate projection	None	with resolution	presence of the Barangay Council, BNS and BHW
	Preparatory	Bulacao Elementary school	1		1 classroom	Concrete	Good	Yes	with budget under DepEd, Financial Assistance from Barangay	None	Concrete and can withstand climate projection	None	with resolution	presence of the Barangay Council, PTA Officers and DepEd
	Elementary School	Bulacao Elementary school	1	17,099	15 Classrooms	Concrete	Good	Yes						
	Secondary School	Bulacao National High School	1	4,630	16 Classrooms	Concrete	Good	Yes						
	Evacuation Center	Bulacao Evacuation Center	1	198	90 Persons	Concrete	Good	Yes	None	None	Concrete and can withstand climate projection (New)	with signages		presence of Barangay Council and BDRRMO
	water sources	Barangay Water Station	1			N/A	Good	Yes	No budget for maintenance	None		None		presence of BAWASA and LUWA
	electric posts	Wooden	42			Wood	Fair	No	with budget under 20% for replacement of bulb	None		None		presence of Barangay Council and Barangay Electrician
		Steel	14			Steel	Good	Yes						
		Concrete	7			Concrete	Good	Yes						
	covered court/gym	Open court	1			concrete	Good	Yes						
	churches/ chapels	St. Joseph Chapel	1			Concrete	Good	Yes						
	Multi-purpose Hall	Bulacao Barangay Hall	1	96	100 Persons	Concrete	Good	Yes	with budget under Barangay General Fund	General Bulletin Board	Concrete and can withstand climate projection		with resolution	presence of Barangay Council
Cabigaan	Footbridges	Purok 2 a			5.7m	concrete								
		Purok 2 b			4m	concrete								
		Purok 1			6m	concrete								
		Purok 2 c			7m	concrete								
		Purok 2 d			3m	wooden								
		Cabigaan Bridge			12m	concrete								
	Day Care Center	Cabigaan Day Care Center		80	30 persons	Concrete	Good	Yes						
	Health Center	Cabigaan Health Center		36	1 bed/20 persons	Concrete	Good	Yes						

	Elementary School	Cabigaan Elementary School		5,597	13 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	14												
		Steel	22												
		Concrete													
	churches/ chapels	San isidro Labrador													
	Multi-purpose Hall	Cabigaan Barangay Hall		60	30 persons	Concrete	Good	Yes							
Cabiguhan	Day Care Center	Cabiguhan Day Care Center		42	40 persons	Concrete	Good	Yes							
	Health Center	Cabiguhan Health Center		48	1 bed/40 persons	Concrete	Good	Yes							
	Elementary School	Cabiguhan Elementary School		8,923	7 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	16												
		Steel	11												
		Concrete													
	churches/ chapels	San isidro Labrador													
	Multi-purpose Hall	Cabiguhan Barangay Hall		36	30 persons	Concrete	Good	Yes							
Carriedo	Bridge	Carriedo			15 Tons, 29m length	Concrete aspalt overlayed	Good	Yes							
	Footbridge	Sitio Langka A			4m	wood									
		Sito Langka B			6m	concrete									
		Sitio Langka C			16.7m	concrete									
		Sitio Langka D			7m	concrete									
		Sitio Biaw !			15m	Concrete									
		Sitio Biaw 2			14m	concrete									
		Sitio Biaw 3			9m	concrete									

		Purok 5 (Sitio Ulag)			3.9	concrete								
		Purok 5 (Sitio Ulag)			14.3	concrete								
		Purok 5 (Sitio Ulag)			16.7	concrete								
		Purok 5 (Sitio Ulag)			12	concrete								
		Purok 5 (Sitio Ulag)			9.3	concrete								
		Purok 6 (Sitio Barayo)			6.6	concrete								
		Purok 6 (Sitio Barayo)			8.6	concrete								
		Purok 6 (Sitio Barayo)			11.8	concrete								
		Purok 3 (Sitio Langka)			6.6	concrete								
		Purok 3 (Sitio Langka)			6.1	concrete								
		Purok 1 Centro			11.3	concrete								
		Purok 1 Centro			16.4	concrete								
		Purok 1 Centro			7.6	concrete								
		Purok 2 Centro			13.7	concrete								
	Flood Control Dixe				.25 km	Concrete aspalt overlayed								
	Day Care Center	Carriedo Day Care Center		60	25 persons	Concrete	Good	Yes						
	Health Center	Carriedo Health Center		45	2 beds/30 persons	Concrete	Good	Yes						
	Elementary School	Carriedo Elementary School		8,784	18 Classrooms	Concrete	Good /Fair	Yes						

	electric posts	Wooden	55												
		Steel	14												
		Concrete													
	churches/ chapels	Nstra Sra de Buenviaje Chapel													
	Multi-purpose Hall	Carriedo Barangay Hall		130	50 persons	Concrete	Good	Yes							
Casili	Footbridge	Casili Bridge			6m	Concrete									
	Day Care Center	Casili Day Care Center		30	30 persons	Concrete	Good	Yes							
	Health Center	Casili Health Center		40	30 persons	Concrete	Good	Yes							
	Elementary School	Casili Elementary school		10,280	9 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	27												
		Steel	41												
	churches/ chapels	Nstra Sr. de Salvacion													
		Every Home for Christ Foursquare gospel													
	Multi-purpose Hall	Casili Barangay Hall		40	50 persons	Concrete	Good	Yes							
Cogon	Day Care Center	Cogon Day Care Center		42	30 persons	Concrete	Good	Yes							
	Health Center	Cogon Health Center		30	1 bed/20 persons	Concrete	Good	Yes							
	Preparatory	Cogon Elementary School			1 classroom										
	Elementary School	Cogon Elementary School		6,393	12 Classrooms	Concrete	Good /Fair	Yes							
	Secondary School	SLMCS Gubat Campus		45,000	9 classrooms	Concrete	Good /Fair	Yes							

	Evacuation Center	Cogon Evacuation Center		162	50 persons	Concrete	Good	Yes							
	electric posts	Wooden	71												
		Steel	78												
		Concrete	26												
	churches/ chapels	San Lorenzo Martir Chapel													
		Sta. Rita Church													
	Multi-purpose Hall	Beriran Barangay Hall		40	15 persons	Concrete	Good	Yes							
Cota na Daco	Bridge	Mararag			15 Tons, 34m length	Concreted aspalt overlayed	Good	Yes							
	Footbridge	Gumang Bridge			16.8	concrete									
	Flood Control Dixe	Cota na Daco			.15 km	Concreted aspalt overlayed									
	Day Care Center	Cota na Daco Day Care Center		48	35 persons	Concrete	Good	Yes							
	Health Center	Cota na Daco Health Center		30	30 persons	Concrete	Good	Yes							
	Preparatory	Aguinaldo Elementary School			1 classroom										
	Elementary School	Aguinaldo Elementary School		12,000	10 Classrooms	Concrete	Good	Yes							
		Bonifacio Elementary School		5,089	11 Classrooms	Concrete/ Makeshift	Good /Fair	Yes							
	Secondary School	none													
	Evacuation Center	Cota na Daco Evacuation Center		150	80 persons	Concrete	Good	Yes							
	electric posts	Wooden	5												
		Steel	25												
		Concrete	3												

	churches/ chapels	Perpetual Help Chapel												
		Kingdom Hall												
	Multi-purpose Hall	Cota na Daco Barangay Hall		30	30 persons	Concrete	Good	Yes						
Dita	Day Care Center	Dita Day Care Center		42	20 persons	Concrete	Good	Yes						
	Health Center	Dita Health Center		110	50 persons	Concrete	Good	Yes						
	Preparatory	Dita Elementary School			1 classroom									
	Elementary School	Dita Elementary School		5,679	6 Classrooms	Concrete	Good /Fair	Yes						
	Evacuation Center	Dita Evacuation Center		200	250 persons	Concrete	Good	Yes						
	electric posts	Wooden	7											
		Steel	12											
		Concrete												
	churches/ chapels	Our Lady of Salvation Chapel												
	Multi-purpose Hall	Dita Barangay Hall		80	100 persons	Concrete	Good	Yes						
Jupi	Bridge	Jupi Brigde 1			15tons, 27m length	Concrete								
	Footbridge	Bridge 1			25m	Concrete								
		Bridge 2			6m	Concrete								
		Bridge 3			6m	Concrete								
		Bridge 4			10m	Concrete								
	Day Care Center	Jupi Day Care Center		35	30 persons	Concrete	Good	Yes						
	Health Center	Jupi Health Center		130	60 persons	Concrete	Good	Yes						
	Elementary School	Jupi Elementary School		8,345	15 Classrooms	Concrete	Good /fair	Yes						

	Secondary School	Jupi National High School		10,000	10 Classrooms	Concrete	Good /fair	Yes							
	electric posts	Wooden	20												
		Steel	26												
		Concrete													
	churches/ chapels	St. Vincent Chapel													
		San Isidro													
	Multi-purpose Hall	Jupi Barangay Hall		130	60 persons	Concrete	Good	Yes							
Lapinig	Footbridge	Lapinig			6m	Concrete									
	Day Care Center	Lapinig Day Care Center		40	30 persons	Concrete	Good	Yes							
	Health Center	Lapinig Health Center		50	20 persons	Concrete	Good	Yes							
	Preparatory	Lapinig Elementary School			1 classroom										
	Elementary School	Lapinig Elementary School		10,000	4 Classrooms	Concrete	Good	Yes							
	electric posts	Wooden	12												
		Steel	30												
		Concrete	6												
	churches/ chapels	San isidro chapel													
	Multi-purpose Hall	Lapinig Barangay Hall		96	20 persons	Concrete	Good	Yes							
Luna Candol	Day Care Center	Luna Candol Day Care Center		48	30 persons	Concrete	Good	Yes							
	Health Center	Luna Candol Health Center		30	10 persons	Concrete	Good	Yes							
	electric posts	Wooden	27												
		Steel	55												
		Concrete	6												
	churches/ chapels	St. Anthony													

		de Padua Church												
		Nstra. Sra de Salvacion												
	Multi-purpose Hall	Luna Candol Barangay Hall		30	200 persons	Concrete	Good	Yes						
Manapao	Footbridge	Manapao-Sta Ana Boundery			17m	wooden								
	Day Care Center	Manapao Day Care Center		200	20 persons	Concrete	Good	Yes						
	Health Center	Manapao Health Center		20	25 persons	Concrete	Good	Yes						
	Elementary School	Manapao Elementary School		9,497	12 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	26											
		Steel	24											
		Concrete												
	churches/ chapels	St. Anthony de Padua chapel												
	Multi-purpose Hall	Manapao Barangay Hall		20	25 persons	Concrete	Good	Yes						
Manook	Day Care Center	Manook Day Care Center		32	20 persons	Concrete	Good	Yes						
	Preparatory	Children's Nook			2 classrooms	Concrete								
	Health Center	Manook Health Center		9	10 persons	Concrete	Good	Yes						
	electric posts	Wooden	5											
		Steel	24											
		Concrete	6											
	churches/ chapels	Iglesia ni Cristo												
		Living Word												
		Seventh Day Adventist												

		Manook Brgy. Chapel												
	Multi-purpose Hall	Manook Barangay Hall		32	20 persons	Concrete	Good	Yes						
Naagtan	Footbridge	Ilawod 1			11.6m	Concrete								
		Ilawod 2			14m	Concrete								
		Isla Berde			7m	Concrete								
		Isla Puti			20m	Concrete								
		Iraya 1			13m	Concrete								
		Iraya 2A			4.8m	Concrete								
		Iraya 2B			12m	Concrete								
		Iraya 2C			12m	Concrete								
		Iraya 2D			4m	Concrete								
		Ariman A			11m	Concrete								
		Ariman B			15m	wood								
	Flood Control Dixe				.12 km									
	Day Care Center	Naagtan Day Care Center		24	20 persons	Concrete	Good	Yes						
	Health Center	Naagtan Health Center		120	80 persons	Concrete	Good	Yes						
	Preparatory	Naagtan Elementary School			1 classroom									
	Elementary School	Naagtan Elementary School		3,614	6 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	31											
		Steel	10											
		Concrete	2											
	churches/ chapels	Nstra. Sra de Salvacion												
	Multi-purpose Hall	Naagtan Barangay Hall		35	30 persons	Concrete	Good	Yes						
Nato	Footbridge	Nasunugan			5m	concrete								
		Nakurit			8m	concrete								
	Day Care Center	Nato Day Care Center		32	30 persons	Concrete	Good	Yes						

	Health Center	Nato Health Center		20	10 persons	Concrete	Good	Yes							
	Preparatory	Nato Elementary School			1 classroom										
	Elementary School	Nato Elementary School		15,093	9 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	22												
		Steel	24												
	churches/ chapels	Nstra Sra de Monserat													
	Multi-purpose Hall	Nato Barangay Hall		30	10 persons	Concrete	Good	Yes							
Nazareno	Day Care Center	Nazareno Day Care Center		20	40 persons	Concrete	Good	Yes							
	Health Center	Nazareno Health Center		12	30 persons	Concrete	Good	Yes							
	Elementary School	Nazareno Elementary School		5,000	5 Classrooms	Concrete	Good /Fair	Yes							
	electric posts	Wooden	41												
		Steel	4												
		Concrete													
	churches/ chapels	Catholic, Nazareno													
	Multi-purpose Hall	Nazareno Barangay Hall		15	30 persons	Concrete	Good	Yes							
Ogao	Day Care Center	Ogao Day Care Center		30	30 persons	Concrete	Good	Yes							
	Health Center	Ogao Health Center		70	60 persons	Concrete	Good	Yes							
	Preparatory	Ogao Elementary School			1 classroom										
	Elementary School	Ogao Elementary School		5,000	8 classrooms	Concrete	Good /Fair	Yes							
	Evacuation Center	Ogao Evacuation Center		162	150 persons	Concrete	Good	Yes							
		Wooden	11												

	electric posts	Steel	19											
		Concrete												
	churches/ chapels	Ogao Brgy. Chapel												
	Multi-purpose Hall	Ogao Barangay Hall		36	30 persons	Concrete	Good	Yes						
Paco	Day Care Center	Paco Day Care Center		30	50 persons	Concrete	Good	Yes						
	Health Center	Paco Health Center		48	50 persons	Concrete	Fair	Yes						
	Elementary School	Paco Elementary School		8,474	8 Classrooms	Concrete/ Makeshift	Good /Fair	Yes						
	Secondary School													
	Evacuation Center	Paco Evacuation center		105	80 persons	Concrete	Good	Yes						
	electric posts	Wooden	28											
		Steel	45											
		Concrete	1											
	churches/ chapels	Sto. Domingo Chapel												
		Nuestra del Salvacion Chapel												
	Multi-purpose Hall	Paco Barangay Hall		20	10 persons	Concrete	Fair	Yes						
Panganiban	sea wall				.65km									
	Day Care Center	Panganiban Day Care Center		100	25 persons	Concrete	Good	Yes						
	Health Center	Panganiban Health Center		30	30 persons	Concrete	Good	Yes						
	Preparatory	Gubat South Central School			1 classroom									
	Elementary School	Gubat South		15,737	25 Classrooms	Concrete	Good /Fair	Yes	na	with child friendly signages	MRF,	GULAYAN, composting, rain	policies, emergency plan, clinics etc	PTAs, SCHOOL organizations, Yes-O

		Central School										catchment, solar panel		
	electric posts	Wooden	32											
		Steel	18											
		Concrete												
	churches/ chapels	Our Lady of Fatima chapel												
	Multi-purpose Hall	Panganiban Barangay Hall		400	50 persons	Concrete	Good	Yes						
Paradijon	Day Care Center	Paradijon Day Care Center				Concrete	Good	Yes						
	Health Center	Paradijon Health Center				Concrete	Good	Yes			solar powered	ambulance		
	Secondary School	Gubat National High school		68,877		Concrete						equipment		
	electric posts	Wooden	22											
		Steel	5											
		Concrete												
	Multi-purpose Hall	Nazareno Barangay Hall				Concrete	Good	Yes						
Patag	Day Care Center	Nazareno Day Care Center		30	30 persons	Concrete	Good	Yes						
	Health Center	Nazareno Health Center		30	30 persons	Concrete	Good	Yes						
	Elementary School	Patag Elementary School		12,273	12 Classrooms	Concrete/ Makeshift	Good /Fair	Yes						
	electric posts	Wooden	36											
		Steel	7											
		Concrete												
	churches/ chapels	Sacred Heart of Jesus chapel												
	Multi-purpose Hall	Nazareno Barangay Hall		42	50 persons	Concrete	Good	Yes						
Payawin	Bridge	Payawin			15 Tons, 20m length	Concrete aspalt overlayed	Good	Yes						

	Day Care Center	Payawin Day Care Center		63	50 persons	Concrete	Good	Yes							
	Footbridge	Sitio Pange A			14m	wood									
		Sitio Pange B			18m	wood									
		Sitio Pange C			10m	wood									
		Sitio Pange D			10m	wood									
		Sitio Pange E			4.4m	concrete									
		Sitio Pange F			9.3m	wood									
		Sitio Pange G			17m	wood									
	Health Center	Payawin Health Center		35	3 bed/6 persons	Concrete	Good	Yes							
	Elementary School	Payawin Elementary School		5,161	9 Classrooms	Concrete	Good /Fair	Yes							
	Evacuation Center	Payawin Evacuation Center		180	400 persons	Concrete	Good	Yes							
	electric posts	Wooden	34												
		Steel	19												
		Concrete	11												
	churches/ chapels	San Isidro Labrador (Pange)													
		San Isidro Labrador (Tubog)													
		San Rafael Chapel													
	Multi-purpose Hall	Payawin Barangay Hall		45	30 persons	Concrete	Fair	Yes							
Pinontingan	Bridge														
	Day Care Center	Pinontingan Day Care Center		40	30 persons	Concrete	Good	Yes							
	Health Center	Pinontingan Health Center		30	1 bed/20 persons	Concrete	Good	Yes							

	Elementary School	Gubat North Central School		20,000	56 Classrooms	Concrete	Good /Fair	Yes						
	Cellsites													
	water sources													
	sub-stations													
	electric posts	Wooden	38											
		Steel	13											
		Concrete	2											
	covered court/gym													
	churches/ chapels													
	hospitals/ clinics													
	fire stations													
	fire hydrants													
	Multi-purpose Hall	Pinontingan Barangay Hall		40	30 persons	Concrete	Good	Yes						
Rizal	Bridge	Maragadao			20 Tons , 30m length	Concreted aspalt overlayed	Good	Yes						
	Footbridge	Bagong Silang 1			202	concrete								
		Bagong Silang 2			201	concrete								
	Day Care Center	Rizal Day Care Center		42	30 persons	Concrete	Good	Yes						
	Health Center	Rizal Health Center		35	40 persons	Concrete	Good	Yes						
	Preparatory	Rizal Elementary School			1 classroom									
		Bongsaran Elementary School			1 classroom									
	Elementary School	Rizal Elementary School		10,295	16 Classrooms	Concrete	Good /Fair	Yes						

		Bongsaran Elementary School		3.006	10 Classrooms	Concrete	Good /Fair	Yes							
	Secondary School	Rizal National High School		4275	12 Classrooms	Concrete	Good /Fair	Yes							
	Evacuation Center	Rizal Evacuation Center		300	150 persons										
	Cellsites														
	water sources														
	sub-stations														
	electric posts	Wooden	34												
		Steel	51												
		Concrete	5												
	covered court/gym														
	churches/ chapels	St. John, Mabaga Rizal													
		Fatima, Contod, Rizal													
		Nuestra del Salvacion, Dalingding, Rizal													
	hospitals/ clinics														
	fire stations														
	fire hydrants														
	Multi-purpose Hall	Rizal Barangay Hall		30	60 persons	Concrete	Good	Yes							
San Ignacio	Bridge														
	Footbridge	Sitio Marukbaruk (Palapay)			14m	Concrete									
		Sitio Marukbar			38m	Concrete									

		uk (Palapay)												
		Boundery San Ignacio-Tagaytay			27m	Concrete								
	Day Care Center	San Ignacio Day Care Center		40	30 persons	Concrete	Fair	Yes						
	Health Center	San Ignacio Health Center		24	10 persons	Concrete	Good	Yes						
	Preparatory	Landmark Baptist Academy												
	Elementary School	San Ignacio Elementary School		9,887	12 Classrooms	Concrete/ Makeshift	Good /Fair	Yes						
	Elementary	Landmark Baptist Academy												
	Secondary School	Landmark Baptist Academy		1,109	1 Building	Concrete	Good	Yes						
	Cellsites													
	water sources													
	sub-stations													
	electric posts	Wooden	23											
		Steel	54											
		Concrete												
	covered court/gym													
	churches/ chapels	San Ignacio Chapel												
		Agustinian Church												
		Jesus Conquers Christian Ministry												
		Iglesia ni Cristo												

	Multi-purpose Hall	Nazareno Barangay Hall		42	30 persons	Concrete	Fair	Yes						
Sangat	Day Care Center	Sangat Day Care Center	1	30	25 persons	Concrete	Good	Yes	Budget allocation from barangay		Concrete and can withstand climate projection		With resolution	presence of PTA Officers
	Health Center	Sangat Health Center	1	12	15 persons	Concrete	Good	Yes					with resolution	presence of BNS and BHW
	Preparatory	Sangat Elementary School	1	9,021	1 classroom	Concrete	Good	Yes	Budget allocation from MOOE of DepEd; Fundraising of Alumni Association (Purchase Tent)	Public Safety Hotline			with a plan to have a evacuation center; having earthquake drill	PTA Officers, Alumni Association
	Elementary School	Sangat Elementary School	1		8 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	11			Wood	Good	Yes	None					
		Steel	21			Steel	Good	Yes	None					
		Concrete/ Solar streetlights	3			Concrete	Good	Yes	None		Solar light			
	open court/solar dryer	concrete	1			Concrete	Good	Yes	None		Concrete and can withstand climate projection			
	churches/ chapels	Sangat chapel	1			Concrete	Good	Yes	Budget allocation from KPC					
	water sources	LUWA	1			Concrete	Good	Yes	Budget allocation from LUWA					LUWA
	military camp	temporary	1				Good	Yes	None					Military group
	Multi-purpose Hall	Sangat Barangay Hall	1	15	40 persons	Concrete	Good	Yes	Budget allocation from 20% of barangay	Public Safety Hotline	Concrete and can withstand climate projection		with resolution	Barangay Council
Santa Ana	Footbridge	Purok 3-Purok 5			10m	Concrete								
		Purok 6			5m	Concrete								
	Day Care Center	Santa Ana Day Care Center		30	36 persons	Concrete	Good	Yes						
	Health Center	Santa Ana Health Center		12	1 bed/20 persons	Concrete	Good	Yes						
	Elementary School	Sta. Ana Elementary School		9,000	10 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	45											
		Steel	49											
		Concrete												

	churches/ chapels	Sta. Ana Chapel												
	Multi-purpose Hall	Santa Ana Barangay Hall		54	40 persons	Concrete	Good	Yes						
Tabi	Bridge	Tiris Bridge			15tons, 47m length	concreted aspalt overlayed								
		Casitas Bridge			15tons, 20m length									
	Footbridge	Purok 1 Centro			4.6m	Concrete								
		Purok 1 Centro			22.67m	Concrete								
		Purok 4 Sitio Alamag			4.6m	Concrete								
		Purok 4 Sitio Alamag			5.6m	Concrete								
		Purok 4 Sitio Ulag			2.6m	Concrete								
	Flood Control Dixe				.19 km	Concrete								
	Day Care Center	Tabi Day Care Center		30	25 persons	Concrete	Good	Yes						
	Health Center	Tabi Health Center		54	20 persons	Concrete	Good	Yes						
	Elementary School	Tabi Elementary Schol		40,000	12 Classroom	Concrete	Good /Fair	Yes						
	electric posts	Wooden	32											
		Steel	29											
		Concrete	7											
	churches/ chapels	San Ramon Nonato Chapel												
		Iglesia ni Cristo												
	Multi-purpose Hall	Tabi Barangay Hall		54	20 persons	Concrete	Good	Yes						

	Day Care Center	Tagaytay Day Care Center		48	50 persons	Concrete	Fair	Yes							
	Health Center	Tagaytay Health Center		48	50 persons	Concrete	Good	Yes							
	Preparatory	Tagaytay Elementary School													
	Elementary School	Tagaytay Elementary School		8185	12 Classrooms	Concrete	Good	Yes							
	electric posts	Wooden	21												
		Steel	5												
		Concrete													
	churches/ chapels	Salvacion													
	Multi-purpose Hall	Tagaytay Barangay Hall		28	50 persons	Concrete	Good	Yes							
Tigkiw	Bridge	Tigkiw Bridge			21.2 m										
	Day Care Center	Tigkiw Day Care Center		30	25 persons	Concrete	Good	Yes							
	Health Center	Tigkiw Health Center		64	40 persons	Concrete	Good	Yes							
	Preparatory	Tigkiw Elementary School													
	Elementary School	Tigkiw Elementary School		10,000	7 Classrooms	Concrete/ Makeshift	Good /Fair	Yes							
	electric posts	Wooden	21												
		Steel	2												
		Concrete	3												
	churches/ chapels	San Agustin Chapel													
		Salvacion Chapel													
	Multi-purpose Hall	Tigkiw Barangay Hall		64	40 persons	Concrete/ Makeshift	Good	Yes							
Tiris	Bridge	Tiris			15 Tons	Concrete	Good	Yes							
		Casitas			15 Tons	Concrete	Good	Yes							
	Footbridge	Sitio Katibuan			3m	concrete									

	Day Care Center	Tiris Day Care Center		50	30 persons	Concrete	Good	Yes						
	Health Center	Tiris Health Center		32	15 persons	Concrete	Good	Yes						
	Elementary School	Tiris Elementary School		11,530	13 Classrooms	Concrete	Good /Fair	Yes						
	Cellsites													
	water sources													
	sub-stations													
	electric posts	Wooden	33											
		Steel	41											
		Concrete	2											
	covered court/gym													
	churches/ chapels	Penafrancia Chapel												
	Multi-purpose Hall	Tiris Barangay Hall		35	40 persons	Concrete	Good	Yes						
	Day Care Center	Togawe Day Care Center	1	35	40 persons	Concrete	Good	Yes	budget is based on request		Concrete and can withstand climate projection			presence of PTA Officers
	Health Center	Togawe Health Center	1	54	30 persons	Concrete	Good	Yes					with plan of improvement of health center	Presence of BNS and BHW
	Elementary School	Togawe Elementary School	1	9,680	10 Classrooms	Concrete	Good /Fair	Yes	DepEd MOOE; Financial assistance from barangay					Presence of PTA Officers and Togawe ES Alumni Association
	water sources	Spring/LUWA	2			Concrete/ Earth	Good	No	budget from LUWA		*no water shed (spring)*			LUWA
	electric posts	Wooden	34			Wood	Fair	Yes	None		None			Barangay Council and Barangay Electrician
		Steel	34			Steel	Good	Yes			Concrete and can withstand climate projection			
		Concrete	16			Concrete	Good	Yes						
	open court/solar dryer		1			Concrete	Good	Yes	10% budget from SK Fund					SK Federation
	churches/ chapels	Del Rosario Chapel	1			Concrete	Good	Yes	budget from KPC					KPC
	military camp	military camp	1			n/a	Good	Yes	None		Temporary shelter			1st Battalion

	Multi-purpose Hall	Togawe Barangay Hall	1	54	30 persons	Concrete	Good	Yes	20% DF of barangay		Concrete and can withstand climate projection	with generator		Barangay Council
Union	Footbridge	Purok 1			4m	concrete								
		Purok Ubo A			14m	concrete								
		Purok Ubo B			11m	wood								
		Centro			9m	concrete								
		Arasyang			4m	concrete								
		Calundan 1			13m	concrete								
		Calundan 2			6m	concrete								
		Calundan 3			6m	wood								
		Calundan 4			7m	wood								
	Day Care Center	Nazareno Day Care Center		25	30 persons	Concrete	Good	Yes						
	Health Center	Nazareno Health Center		30	1 bed/10 persons	Concrete	Good	Yes						
	Preparatory	Union Elementary School												
	Elementary School	Union Elementary School		6,777	8 Classrooms	Concrete	Good /Fair	Yes						
	electric posts	Wooden	7											
		Steel	40											
		Concrete												
	churches/ chapels	San Isidro Labrador												
		San Isidro Labrador (Arasyang)												
		San Isidro Labador (Calundan)												
	Multi-purpose Hall	Nazareno Barangay Hall		120	150 persons	Concrete	Good	Yes						
Villareal	Footbridge	Purok 2	1		9.8m	Concrete	Good	Yes	Budget allocation for realignment	None	Concrete and can withstand climate projection	None	with resolution	Barangay Council
		Purok 4	1		4.9m	Concrete	Good	Yes						
		Purok 5	1		3.3m	Concrete	Good	Yes						

		Purok 7	1		10m	Concrete	Good	Yes						
	Day Care Center	Villareal Day Care Center	1	40	60 persons	Concrete	Good	Yes	with budget allocation (60,000.00)	None	Concrete and can withstand climate projection	None	with resolution	PTA Officers
	Health Center	Villareal Health Center	1	20	50 persons	Concrete	Good	Yes	with budget allocation (100K)	None	for improvement	None	with resolution	BNS and BHW
	Preparatory	Villareal Elementay School	1			Concrete	Good	Yes	DepEd MOOE; Budget is only for feeding		Concrete and can withstand climate projection			PTA Officers and Alumni Association
	Elementary School	Villareal Elementay School	1	4,665	8 Classrooms	Concrete	Good	Yes						
	water sources	Spring/LUWA	3			Concrete/ Earth	Good	Yes	with budget allocation for installation (2M)	None	Concrete and can withstand climate projection		with resolution	LUWA and Barangay Council
	electric posts	Wooden	16			Wood	Good	Yes	with budget allocation for installation	None	Concrete and can withstand climate projection	with solar lights	with resolution	
		Steel	12			Steel	Good	Yes						
		Concrete	1			Concrete	Good	Yes						
	covered court/gym		1			Concrete	Good	Yes						
	churches/ chapels	Ang Dating Daan Coordinating Council	1			Concrete	Good	Yes	NA	NA	NA	NA	NA	NA
		Divino Rostro Chapel	1			Concrete	Good	Yes						
	Multi-purpose Hall	Villareal Barangay Hall	1	20	50 persons	Concrete	Good	Yes	with budget allocation for repair	Hotline	Concrete and can withstand climate projection		with resolution	Barangay Council

Table 4. Lifeline Utilities Exposure Database.

BARANGAY	EXPOSURE INDICATORS				SENSITIVITY INDICATORS			ADAPTIVE CAPACITY					
	Road Name	Road Classification	length in km	Replacement Cost per linear kilometer (12M per km)	Surface Type	Existing Condition	Hazard Resistant Design	Wealth	Information	Infrastructure	Technology	Institution and Governance	Social Capital
Ariman	Ariman - Rizal	National Road	1.27	15,240,000.00	concrete/asphalt	good	Yes to flooding	budget for MOOE	signages	slope protection, concrete barriers	green engineering	policies	na
	Ariman-Bentuco	National Road	1.82	21,840,000.00	concrete/asphalt								
	Pathways	Pathways	0.22	2,640,000.00	concrete	good							
	Footpaths	Foothpaths	0.872	10,464,000.00	concrete	good							
Bagacay	Cogon-Bagacay	National Road	2.58	30,960,000.00	concrete/asphalt	good	yes or no (hazard)				traffic lights	speed limit	traffic enforcers trained
	Purok 1	Barangay Road	0.27	3,240,000.00	concrete	good	including erosions/ landslide/ coastal erosions/ rock falls						NGOs putting signages/ ex. Boysen, globe,corporate social responsibilities
	Purok 2	Barangay Road	0.45	5,400,000.00	concrete	good							
	Purok 3	Barangay Road	0.3	3,600,000.00	concrete	good							
	Pathways	Pathways	0.439	5,268,000.00	concrete	good							
	Footpaths	Foothpaths	0.564	3,600,000.00	concrete	good							
Balud del Norte	Burgos Street	Municipal Road	0.29	3,480,000.00	concrete	good							
	Aguinaldo Street	Municipal Road	0.78	9,360,000.00	concrete	good							
	Prieto Street	Municipal Road	0.09	1,080,000.00	concrete	good							
	Burgos Street	Municipal Road	0.29	3,480,000.00	concrete	good							
	Pathways	Pathways		-									
	Footpaths	Foothpaths	1.095	13,140,000.00	concrete	good							
Balud del Sur	Burgos Street	Municipal Road	0.39	4,680,000.00	concrete	good							
	Rizal Street	Municipal Road	0.23	2,760,000.00	concrete	good							
	Prieto Street	Municipal Road	0.09	1,080,000.00	concrete	good							
	Herrera Street	Municipal Road	0.19	2,280,000.00	concrete	good							
	Diaz Street	Municipal Road	0.17	2,040,000.00	concrete	good							

	Burgos Street	Municipal Road	0.39	4,680,000.00	concrete	good								
	Pathways	Pathways												
	Footpaths	Foothpaths	0.294	3,528,000.00	concrete	good								
Benguet		Barangay Road	5.3	63,600,000.00	concrete/earth									
	Pathways	Pathways	0.118	1,416,000.00	concrete	good								
	Footpaths	Foothpaths	1.084	13,008,000.00	concrete	good								
Bentuco	Ariman-Bentuco	National Road	2.75	33,000,000.00	concrete/asphalt	good								
	Bentuco-Kabuluan	Provincial Road	1.53	18,360,000.00	concrete	good								
	Pathways	Pathways	0.885	10,620,000.00	concrete	good								
	Footpaths	Foothpaths												
Beriran		Barangay Road	1.78	21,360,000.00	concrete	good								
	Pathways	Pathways	0.068	816,000.00	concrete	good								
	Footpaths	Foothpaths	3.593	43,116,000.00	concrete	good								
Buenavista	Ariman-Rizal	National Road	1.57	18,840,000.00	concrete	good								
	Pathways	Pathways	0.543	6,516,000.00	concrete	good								
	Footpaths	Foothpaths	1.322	15,864,000.00	concrete	good								
Bulacao	Bulacao Road	Barangay Road	0.92	11,040,000.00	concrete/earth	good	Yes							
	Ariman-Bentuco	National Road	2.14	25,680,000.00	concrete	good	Yes							
	Pathways	Pathways	0.251	3,012,000.00	concrete	good	No							
	Footpaths	Foothpaths	1.921	23,052,000.00	concrete	good	No							
Cabigaan		Barangay Road	1.39	16,680,000.00	concrete	good								
	Pathways	Pathways	1.256	15,072,000.00	concrete	good								
	Footpaths	Foothpaths	0.101	1,212,000.00	concrete	good								
Cabiguhan	Cabiguhaan Road	Provincial Road	3.6	43,200,000.00	concrete/earth									
		Barangay Road	5.68	68,160,000.00	concrete/earth									
	Pathways	Pathways	0.337	4,044,000.00	concrete	good								
	Footpaths	Foothpaths	0.193	2,316,000.00	concrete	good								
Carriedo	Cabiguhan-Ariman	National Road	1.39	16,680,000.00	concrete/asphalt									
		Barangay Road	3.4	40,800,000.00	concrete/gravel									
	Pathways	Pathways	0.318	3,816,000.00	concrete	good								
	Footpaths	Foothpaths	1.458	17,496,000.00	concrete	good								
Casili	Casili-Sangat	Barangay Road	396	4,752,000,000.00	concrete/earth									
	Casili-Manapao	Barangay Road	396	4,752,000,000.00	concrete/gravel/earth									
	Pathways	Pathways	1.004	12,048,000.00	concrete	good								

	Footpaths	Foothpaths		-									
Cogon	Cogon-Bagacay	National Road	2.1	25,200,000.00	Asphalt	good							
		Barangay Road	0.51	6,120,000.00	concrete	good							
	Holy Family Subd.			-									
	St. Joseph	Sudivision Road	0.32	3,840,000.00	concrete	good							
	St. Peter	Sudivision Road	0.13	1,560,000.00	concrete	good							
	St. Andrew	Sudivision Road	0.19	2,280,000.00	concrete	good							
	St. John	Sudivision Road	0.2	2,400,000.00	concrete	good							
	St. Philip	Sudivision Road	0.19	2,280,000.00	concrete	good							
	St. James	Sudivision Road	0.17	2,040,000.00	concrete	good							
	St. Simon	Sudivision Road	0.16	1,920,000.00	concrete	good							
	St. Matthew	Sudivision Road	0.14	1,680,000.00	concrete	good							
	St. Paul	Sudivision Road	0.12	1,440,000.00	concrete	good							
	St. Thadeus	Sudivision Road	0.3	3,600,000.00	concrete	good							
	St. Paul Ext.	Sudivision Road	0.11	1,320,000.00	concrete	good							
	St. Anthony Subd.			-									
	Camia St.	Sudivision Road	0.18	2,160,000.00	concrete	good							
	Cattleya St.	Sudivision Road	0.27	3,240,000.00	concrete	good							
	Waling-Waling St.	Sudivision Road	0.14	1,680,000.00	concrete	good							
	Rose St.	Sudivision Road	0.22	2,640,000.00	concrete	good							
	Sun Flower St.	Sudivision Road	0.38	4,560,000.00	concrete	good							
	Daisy St.	Sudivision Road	0.1	1,200,000.00	concrete	good							
	Santan St.	Sudivision Road	0.22	2,640,000.00	concrete	good							
	Ilang-Ilang St.	Sudivision Road	0.21	2,520,000.00	concrete	good							
	Lily St.	Sudivision Road	0.06	720,000.00	concrete	good							

	Sampaguita St.	Sudivision Road	0.07	840,000.00	concrete	good							
	Rosal St.	Sudivision Road	0.09	1,080,000.00	concrete	good							
	Untitled Path Lily to Sampaguita	Sudivision Road	0.04	480,000.00	concrete	good							
	Holy Spirit Subd.												
	Holy Spirit Road 1	Sudivision Road	0.21	2,520,000.00	concrete	good							
	Holy Spirit Road 2	Sudivision Road	0.08	960,000.00	concrete	good							
	Holy Spirit Road 3	Sudivision Road	0.21	2,520,000.00	concrete	good							
	Holy Spirit Road 4	Sudivision Road	0.22	2,640,000.00	concrete	good							
	Relocation Site	relocation site pathway	0.461	5,532,000.00	concrete/earth								
	Pathways	Pathways											
	Footpaths	Foothpaths											
Cota na Daco	Cabiguhan-Ariman	National Road	0.36	4,320,000.00	concrete	good							
	Bonifacio Drvie	Municipal Road	0.18	2,160,000.00	concrete	good							
	Bonifacio Street	Municipal Road	0.35	4,200,000.00	concrete	good							
	Quezon Street	Municipal Road	0.18	2,160,000.00	concrete	good							
	Padrique Street	Municipal Road	0.23	2,760,000.00	concrete	good							
	Pathways	Pathways	0.283	3,396,000.00	concrete	good							
	Footpaths	Foothpaths	0.088	1,056,000.00	concrete	good							
Dita		Barangay Road	1.98	23,760,000.00	concrete	good							
	Pathways	Pathways	0.47	5,640,000.00	concrete	good							
	Footpaths	Foothpaths	0.152	1,824,000.00	concrete	good							
Jupi	Jupi-Dita	Barangay Road	0.83	9,960,000.00	concrete	good							
	Jupi-Payawin	Provincial Road	1.72	20,640,000.00	concrete	good							
	Pathways	Pathways	0.357	4,284,000.00	concrete	good							
	Footpaths	Foothpaths	1.472	17,664,000.00	concrete	good							
Lapinig		Barangay Road	2.91	34,920,000.00	concrete	good							
	Pathways	Pathways											
	Footpaths	Foothpaths	0.253	3,036,000.00	concrete	good							

Luna- Candol	Cabiguhan-Ariman	National Road	0.34	4,080,000.00	concrete								
	Highway 59	Municipal Road	1.45	17,400,000.00	concrete/gravel/earth								
	Luna Street	Municipal Road	1.09	13,080,000.00	concrete	good							
	Bonifacio Street	Municipal Road	0.3	3,600,000.00	concrete	good							
	Quezon Street	Municipal Road	0.33	3,960,000.00	concrete	good							
	Zulueta Street	Municipal Road	0.33	3,960,000.00	concrete	good							
	Diaz Street	Municipal Road	0.16	1,920,000.00	concrete	good							
	Herrera Street	Municipal Road	0.21	2,520,000.00	concrete	good							
	Pathways	Pathways	0.169	2,028,000.00	concrete	good							
	Footpaths	Foothpaths	0.586	7,032,000.00	concrete	good							
Manapao		Barangay Road	4.72	56,640,000.00	concrete/gravel/earth								
	Pathways	Pathways	0.299	3,588,000.00	concrete	good							
	Footpaths	Foothpaths	0.082	984,000.00	concrete	good							
Manook	Cabiguhan-Ariman	National Road	0.32	3,840,000.00	concrete	good							
	Bonifacio Street	Municipal Road	0.35	4,200,000.00	concrete	good							
	Quezon Street	Municipal Road	0.35	4,200,000.00	concrete	good							
	Herrera Street	Municipal Road	0.17	2,040,000.00	concrete	good							
	Padrique Street	Municipal Road	0.28	3,360,000.00	concrete	good							
	Pathways	Pathways	0.207	2,484,000.00	concrete	good							
	Footpaths	Foothpaths	0.25	3,000,000.00	concrete	good							
Naagtan	Ariman-Bentuco	National Road	2.81	33,720,000.00	concrete	good							
	Pathways	Pathways											
	Footpaths	Foothpaths	0.401	4,812,000.00	concrete	good							
Nato	Relocation Site	Barangay Road	0.37	4,440,000.00	concrete	good							
	Pathways	Pathways	0.098	1,176,000.00	concrete	good							
	Footpaths	Foothpaths	0.719	8,628,000.00	concrete	good							
Nazareno		Barangay Road	3.98	47,760,000.00	concrete	good							
	Pathways	Pathways	2.015	24,180,000.00	concrete	good							
	Footpaths	Foothpaths											
Ogao	Cogon-Bagacay	National Road	0.79	9,480,000.00									

		Barangay Road	1	12,000,000.00	concrete	good								
	Pathways	Pathways	0.19	2,280,000.00	concrete	good								
	Footpaths	Foothpaths	1.789	21,468,000.00	concrete	good								
Paco	Cogon-Bagacay	National Road	0.93	11,160,000.00										
	Paco-Patag	Barangay Road	1.96	23,520,000.00	concrete/earth									
	Paco-Nato	Barangay Road	1.08	12,960,000.00	concrete/earth									
	Pathways	Pathways	0.272	3,264,000.00	concrete	good								
	Footpaths	Foothpaths	0.479	5,748,000.00	concrete	good								
Panganiban	Cabiguhan-Ariman	National Road	0.61	7,320,000.00	concrete	good								
	Panganiban Street	Municipal Road	0.37	4,440,000.00	concrete	good								
	Bonifacio Street	Municipal Road	0.17	2,040,000.00	concrete	good								
	Quezon Street	Municipal Road	0.25	3,000,000.00	concrete	good								
	Pathways	Pathways												
	Footpaths	Foothpaths	0.539	6,468,000.00	concrete	good								
Paradijon	Cabiguhan-Ariman	National Road	0.33	3,960,000.00	concrete	good								
	Dote Lane Street	Municipal Road	0.21	2,520,000.00	concrete	good								
	Bonifacio Street	Municipal Road	0.41	4,920,000.00	concrete	good								
	Pathways	Pathways	0.045	540,000.00	concrete	good								
	Footpaths	Foothpaths	0.354	4,248,000.00	concrete	good								
Patag	Patag-Bacon	Barangay Road	0.74	8,880,000.00	concrete/earth									
		Barangay Road	2.45	29,400,000.00	concrete/earth									
	Pathways	Pathways	0.328	3,936,000.00	concrete	good								
	Footpaths	Foothpaths	0.606	7,272,000.00	concrete	good								
Payawin	Cabiguhan-Ariman	National Road	3.38	40,560,000.00	concrete/asphalt	good								
	Payawin-Jupi	Provincial Road	0.28	3,360,000.00										
		Barangay Road	0.93	11,160,000.00	concrete/earth									
	Pathways	Pathways												
	Footpaths	Foothpaths	0.236	2,832,000.00	concrete	good								
Pinontingan	Monreal Street	Municipal Road	0.3	3,600,000.00	concrete	good								
	Escurel Street	Municipal Road	0.4	4,800,000.00	concrete	good								

	Quezon Street	Municipal Road	0.33	3,960,000.00	concrete	good							
	Burgos Street	Municipal Road	0.52	6,240,000.00	concrete	good							
	Rizal Street	Municipal Road	0.41	4,920,000.00	concrete	good							
	Zulueta Street	Municipal Road	0.05	600,000.00									
	Pathways	Pathways											
	Footpaths	Foothpaths	0.22	2,640,000.00	concrete	good							
Rizal	Ariman-Rizal	National Road	3.28	39,360,000.00	concrete/asphalt	good							
	Calundan-B Silang	Barangay Road	1	12,000,000.00	concrete	good							
	Rizal-Dalingding	Barangay Road	2.25	27,000,000.00	concrete/gravel								
	Pathways	Pathways	1.243	14,916,000.00	concrete	good							
	Footpaths	Foothpaths	0.453	5,436,000.00	concrete	good							
San Ignacio	Cabiguhan-Ariman	National Road	1.47	17,640,000.00									
		Barangay Road	2.58	30,960,000.00	concrete/earth								
	Jardinville Subd.												
	Road 1	Subdivision Road	0.221	2,652,000.00	concrete	good							
	Road 2	Subdivision Road	0.22	2,640,000.00	concrete	good							
	Road 3	Subdivision Road	0.09	1,080,000.00	concrete/earth								
	BLISS	Barangay Road	0.39	4,680,000.00	concrete	good							
	Pathways	Pathways	0.746	8,952,000.00	concrete	good							
	Footpaths	Foothpaths	0.96	11,520,000.00	concrete	good							
Sangat	Sangat Road	Provincial Road	3.15	37,800,000.00	concrete/earth	good	No	With budget under 20% DF of the Barangay		with concrete barriers in Purok 1		with resolution	Barangay Council
	Pathways	Pathways	0.361	4,332,000.00	concrete	good	Yes						
	Footpaths	Foothpaths	0.163	1,956,000.00	concrete	good	Yes						
	Water System												
	Electric lines					good	Yes	Budget allocation from SORECO II					
Sta. Ana	Union-Sta. Ana	Provincial Road	1.41	16,920,000.00	concrete	good							
		Barangay Road	4.78	57,360,000.00	concrete/earth								

	Apgo Road	Barangay Road	2.58	30,960,000.00	concrete/earth								
	Pathways	Pathways	0.368	4,416,000.00	concrete	good							
	Footpaths	Foothpaths	2.583	30,996,000.00	concrete	good							
Tabi	Ariman-Bentuco	National Road	1.14	13,680,000.00	concrete	good							
	Tabi-Union	Provincial Road	0.19	2,280,000.00									
	Centro	Barangay Road	0.63	7,560,000.00	concrete	good							
	Tabi-Union	Barangay Road	0.19	2,280,000.00	concrete	good							
	Sitio Alamag	Barangay Road	0.5	6,000,000.00	concrete	good							
	Tabi Road	Barangay Road	1	12,000,000.00	concrete	good							
	Pathways	Pathways	0.091	1,092,000.00	concrete	good							
	Footpaths	Foothpaths	0.08	960,000.00	concrete	good							
Tagaytay		Barangay Road	0.24	2,880,000.00	concrete/gravel								
	Tagaytay Road	Barangay Road	1.22	14,640,000.00	concrete/gravel								
	Pathways	Pathways	0.156	1,872,000.00	concrete	good							
	Footpaths	Foothpaths	1.304	15,648,000.00	concrete	good							
Tigkiw		Barangay Road	0.78	9,360,000.00	concrete/gravel								
	Sitio Balete	Barangay Road	1.1	13,200,000.00	concrete/gravel								
	Tigkiw na saday	Barangay Road	1.86	15,648,000.00	concrete/earth								
	Pathways	Pathways	1.682	20,184,000.00	concrete	good							
	Footpaths	Foothpaths		-									
Tiris		National Road	1.94	23,280,000.00	concrete/asphalt	good							
		Barangay Road	0.78	9,360,000.00	concrete/gravel								
	Sitio Tingting	Barangay Road	0.33	3,960,000.00	concrete/gravel								
	Boundary Tagaytay-Tiris	Barangay Road	1.96	23,520,000.00	concrete/gravel								
	Pathways	Pathways	0.396	4,752,000.00	concrete	good							
	Footpaths	Foothpaths	0.406	4,872,000.00	concrete	good							
Togawe	Togawe Road	Provincial Road	7.78	93,360,000.00	concrete/earth	good	Yes	With budget under 20% DF; Concreting of Pathways	None	With slope protection, concrete barriers		With resolution	presence of Barangay Council
	Pathways	Pathways	0.967	11,604,000.00	concrete	good	Yes						
	Footpaths	Foothpaths		-	concrete/earth	good	Yes						
	Electric lines												SORECO
	Water System												LUWA

Union	Tabi-Union	Provincial Road	3.31	39,720,000.00	concrete	good							
	Union-Sta. Ana	Provincial Road	0.19	2,280,000.00									
	Pathways	Pathways	0.835	10,020,000.00	concrete	good							
	Footpaths	Foothpaths	0.806	9,672,000.00	concrete	good							
Villareal	Villareal Road	Barangay Road	2.33	27,960,000.00	concrete/earth	good	Yes	with budget allocation for road widening 2.3km from purok 1-7				with resolution	
	Pathways	Pathways	0.412	4,944,000.00	concrete	good	Yes						
	Footpaths	Foothpaths	0.37	4,440,000.00	concrete	good	Yes						
	electric lines							SORECO					SORECO
	water pipes							LUWA					LUWA

Table 5. Urban Use Areas Exposure Database.

BARANGAY	EXPOSURE INDICATORS				SENSITIVITY INDICATORS				ADAPTIVE CAPACITY					
	Existing Land Use (Specific Use)	Total Area Allocation per Land Use Per Barangay (Hectare)	Total Area Allocation per Land Use Per Barangay (Sq.m)	Replacement Cost (PHP perSq. Meter)	Percentage of Buildings with walls with Light to Salvageable Materials	Percentage of Building in Dilapidated/ Condemned Condition	Percentage Structures not Employing Hazard-Resistant Building Design	No Access/ Area Coverage to Infrastructure-Related Hazard Mitigation Measures	Wealth	Information	Infrastructure	Technology	Institution and Governance	Social Capital
Ariman	Commercial	2.05	20,500	615,000,000.00										
	Cemetery	4.19	41,900	1,257,000,000.00										
	Foreshore Land	4.73	47,300	1,419,000,000.00	NA									
	Estuary	2.10	21,000	630,000,000.00	NA									
	Easement (Coastal)	3.97	39,700	1,191,000,000.00	NA									
Bagacay	Foreshore Land	1.11	11,100	333,000,000.00	NA									
	Easement (Coastal)	0.39	3,900	117,000,000.00	NA									
Balud del Norte (Pob.)	Foreshore Land	0.39	3,900	117,000,000.00	NA									
Balud del Sur (Pob.)	Commercial	1.67	16,700	501,000,000.00										
	Foreshore Land	0.22	2,200	66,000,000.00	NA									
Bentuco	Cemetery	2.9	29,000	870,000,000.00										
Beriran	Commercial	0.13	1,300	39,000,000.00										
Buenavista	Tourism	1.34	13,400	402,000,000.00										

	Foreshore Land	9.52	95,200	2,856,000,000.00	NA									
	Easement (Coastal)	5.36	53,600	1,608,000,000.00	NA									
Cogon	Foreshore Land	3.15	31,500	945,000,000.00	NA									
	Parks & Recreation	0.5	5,000	150,000,000.00										
	Easement (Coastal)	2.3	23,000	690,000,000.00	NA									
Cota na Daco (Pob.)	Commercial	3.52	35,200	1,056,000,000.00										
	Cemetery	1.91	19,100	573,000,000.00										
Luna Candol (Pob.)	Commercial	7.93	79,300	2,379,000,000.00										
Manook (Pob.)	Commercial	5.4	54,000	1,620,000,000.00										
Panganiban (Pob.)	Commercial	0.88	8,800	264,000,000.00										
	Foreshore Land	4.53	45,300	1,359,000,000.00	NA									
	Easement (Coastal)	2.33	23,300	699,000,000.00	NA									
	Estuary	24.74	247,400	7,422,000,000.00	NA									
	Mangrove	21.74	217,400	6,522,000,000.00	NA									
Paradijon (Pob.)	Commercial	1.74	17,400	522,000,000.00										
Payawin	Commercial	1.11	11,100	333,000,000.00										
Pinontingan (Pob.)	Commercial	1.06	10,600	318,000,000.00										
	Foreshore Land	0.58	5,800	174,000,000.00	NA									
	Easement (Coastal)	0.41	4,100	123,000,000.00	NA									
	Parks & Recreation	0.31	3,100	93,000,000.00										
Rizal	Foreshore Land	5.76	57,600	1,728,000,000.00	NA									
	Easement (Coastal)	1.64	16,400	492,000,000.00	NA									
	Estuary	328	3,280,000	98,400,000,000.00	NA									
San Ignacio	Commercial	0.13	1,300	39,000,000.00										
Tiris	Mangrove	273	2,730,000	81,900,000,000.00	NA									
	Estuary	580	5,800,000	174,000,000,000.00	NA									

PHOTO DOCUMENTATION

Figure 1. The CDRA Core Team of Municipality of Gubat at Local Government Academy, UP Los Baños during the CDRA Training conducted by UP School of Environmental Science and Management.

Figure 2. Participants of Barangay Togawe pose for a group photo after the conduct of CDRA Focus Group Discussion (FGD).

Figure 3. Participants from various sectors of Barangay Bagacay identifying the Adaptive Capacities of their community.

Figure 4. Picture taken during the actual visit of the CDRA Core Team to inspect damages on pathways

Figure 5. Slope protection structure at Barangay Naagtan

Figure 6. CDRA Facilitator explains to the participants the relevance of the activity to the local development plans.

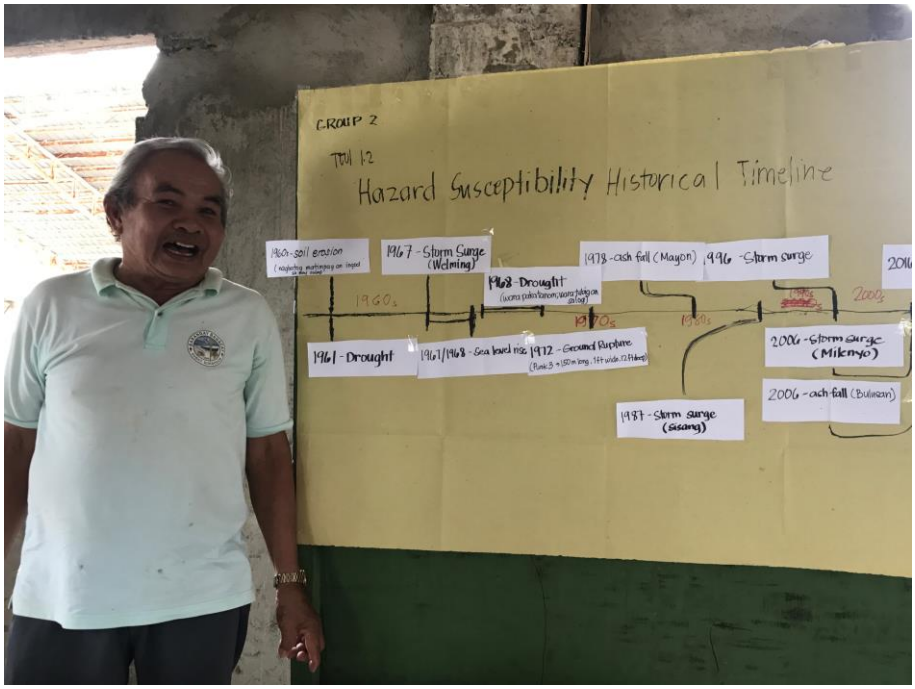

Figure 7. A Barangay Council member reports their output on Hazard Historical Timeline to the rest of the group in Barangay Bagacay.

Figure 8. Uniformed personnel participate in the conduct of CDRA FGD in Brgy. Togawe.

Figure 9. Several stakeholders from all sectors like women, youth, elderly, and farmers are invited during the CDRA FGDs to ensure inclusive participation.

Figure 10. After the fieldwork in 42 barangays, CDRA Core Team huddle to consolidate the FGD results.