Sorsogon City Climate Change Vulnerability and Adaptation Assessment

UN HABITAT
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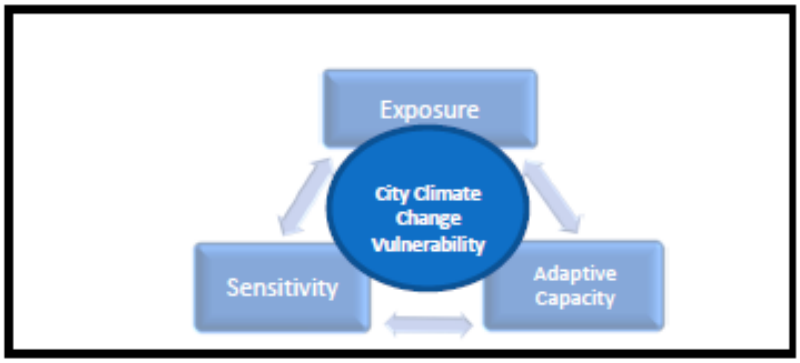
I. Executive Summary

Sorsogon City, situated at the southern most tip of Luzon Island in the Philippines embarked on a participatory climate change vulnerability and adaptation assessment with support from UN-HABITAT's Cities and Climate Change Initiative and the UN System-Spanish Government MDG Achievement Fund. The trigger for the Sorsogon City government in considering climate change more comprehensively were the two super typhoons that had hit and devastated the city in 2006. The assessment set out to understand its climate change vulnerability using as framework the city's exposure, sensitivity and adaptive capacities to projected climate change.



At all stages quantitative data was juxtaposed with community observations and at regular intervals were discussed with larger stakeholder groups. The V&AA results revealed that Sorsogon city based on previous events and projected scenario would be facing changes in temperature (to as high as 2°C in 2050) and changes in rainfall volume that could be about 30% more in 2050. With the global rise in temperature, it is likewise expected that more intense and stronger typhoons could pass and directly hit Sorsogon. The risks of these changed scenarios will definitely stress the socio-economic conditions in the city. Such is expressed considering that climate change effects could lead to flooding, erosion, land inundation and subsidence, water scarcity, higher incidence of vector diseases, etc. that may impact on people, critical development zones like settlements and commercial areas, and additional pressures institutions and governance. The assessment analysed the complexities of local climate change impacts and detailed how intense impacts could be relative to existing conditions.

The initial assessment identified urban hotspots (where severe climatic impacts met with populations in deprived areas). In addition a thorough assessment of the particularly vulnerable sectors was conducted. A detailed assessment (on the household level) of the vulnerabilities in the hotspots was also conducted. Towards identifying crucial adaptation measures, the city looked at the cost of business-as-usual by valuing projected impacts of climate change impacts.

II. Introduction

In September 2008 Sorsogon City, Republic of the Philippines joined UN-HABITAT's Cities and Climate Change Initiative as one of four initial pilot cities. This Initiative aims to strengthen the climate change response of cities and local governments. Cities are key drivers of climate change due to their high energy consumption, land use, waste generation and other activities that result in the release of the vast majority of greenhouse gases. At the same time, it is cities, and in particular the urban poor, in the developing world, that are most vulnerable to and have the least resilience against climate/weather events such as storms, floods and droughts. Cities need to respond to climate change by cutting their greenhouse gas emissions (mitigation). The negative impact of climate change seems however unavoidable and for most cities in developing countries adaptation to the risks is a must.

The Cities and Climate Change Initiative brings together local and national governments, academia, NGOs and international organizations with the aim of alerting cities to the action they can take and to strengthen the capacities of cities and their partners to respond to climate change. The key components of the Cities and Climate Change Initiative are:

- To promote active climate change collaboration between local governments and their associations;
- To enhance policy dialogue so that climate change is firmly established on the agenda;
- To support local governments in developing climate change action plans;
- To foster awareness, education, and capacity building strategies that support the implementation of climate change strategies.

Sorsogon City established a Technical Working Group that set out to develop in a highly participatory process a Climate Change Vulnerability and Adaptation Assessment. This document was first presented to a diverse stakeholder group in a validation meeting in December 2008. The meeting requested a much more thorough assessment. In response, the city wide approach was supplemented by the Barangay studies (which are reflected in the current draft). In May 2009 a 2-day city consultation was held developing the broad framework for climate change action which was further developed by the multi-stakeholder Issue Working Groups. These groups required yet more information which is now reflected in this document in addition to new information provided by the latest Philippines national and sub-national Climate Change models. This document is one of a series of documents which were all drafted in parallel, the others being the "Sorsogon Greenhouse Gas Assessment" and the "National Scoping Study: Philippines Cities and Climate Change". The Assessment team further decided to document the process of developing the Vulnerability Assessment in a publication entitled: "Participatory Vulnerability and Adaptation Assessment: A toolkit based on the Experience of Sorsogon City, Philippines". All the documents are available on the climate change pages of the UN-HABITAT, Philippines website (www.unhabitat.org.ph/climate-change).

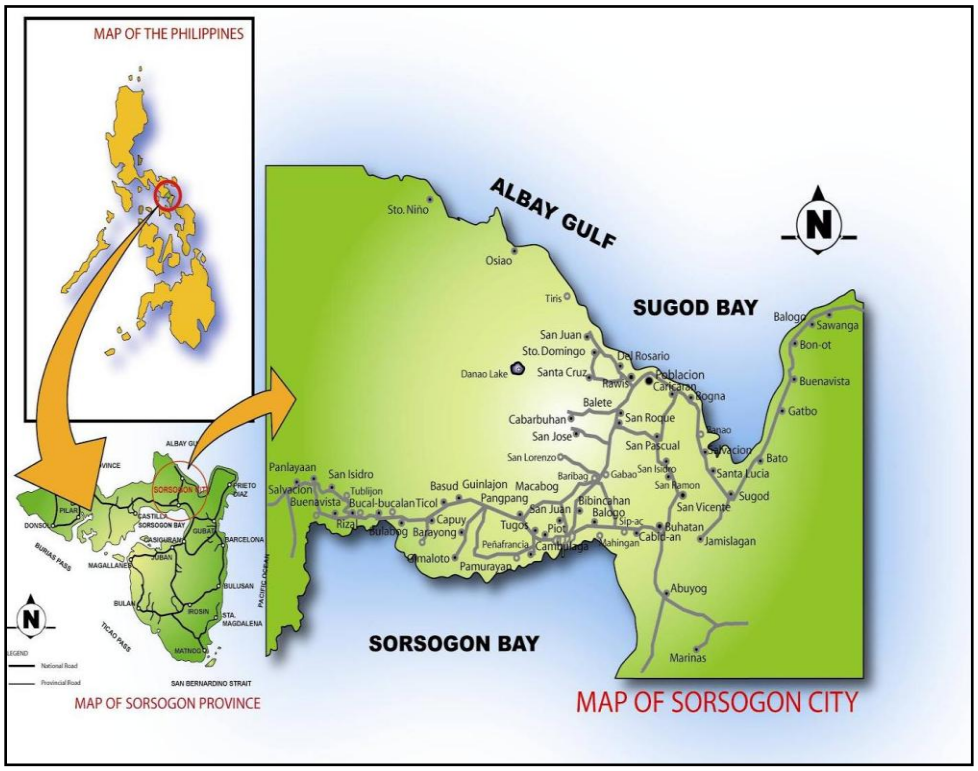
Whilst Sorsogon is a small city, its experiences have received considerable interest in the Republic of the Philippines as well as globally. In the Philippines many initiatives are underway to strengthen the policy framework for cities and climate change (for example the Climate Change Act of 2009 and the subsequent laws) and Sorsogon's efforts to mainstream climate

change into its development plan and its land use plan are expected to feed into revisions of the planning framework at the national level.

City Overview

Sorsogon City lies from 123° 53' to 124° 09' east longitude and from 12° 55' to 13° 08' north latitude, and is situated in the Philippine's Bicol Region. It is 600 kilometres southeast of Manila and is located at the southernmost tip of Luzon. As part of the geographical chain linking Luzon to the rest of the Philippines, it is a transshipment corridor and serves as the gateway to the Visayas and Mindanao Islands. Its geographical location is such that it opens into the Pacific Ocean to the West and East, through Albay Gulf and Sugod Bay and the China Sea through the Sorsogon Bay.

Figure 1



Sorsogon City was created by virtue of Republic Act 8806, which was signed into law on August 16, 2000 and ratified by a plebiscite on December 16, 2000. RA 8806, also known as the Cityhood Law, called for the merger of the municipalities of Sorsogon and Bacon into a component city of the province of Sorsogon. The City has a total population of 151,454 based on the 2007 national census of population. It is considered as the largest city in Bicol Region in terms of land area and one of the region's leading cities in terms of urbanization as it is one of the most populous cities in the region.

The Province of Sorsogon, where the City is located, has been identified by a study of the Manila Observatory and the Department of Environment and Natural Resources being at Very High Risk from combined Climate Disasters (Figure 2). Previous disaster events caused massive

destruction in Sorsogon City the most recent of them being Super Typhoons Milenyo (September 2006) and Reming (November 2006) which took place in the last quarter of 2006.

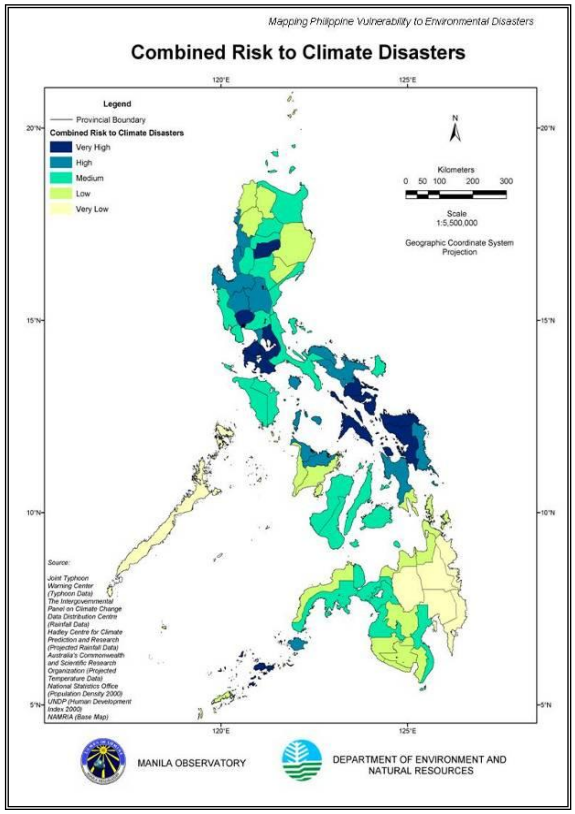
Table 1

Milenyo Damage	
Affected Families	27,101
Totally Damaged houses	10,070
(estimated) Damage to Agriculture and Fisheries sector	Php 234 Million
(estimated) Damage to Public Infrastructure	Php 208 Million

Source: City Planning and Development Office

Sorsogon City has a total population of 151,454 as of 2007 with a growth rate of 1.78% for the same year. As the center of the Province, the city believes that it is faced with the challenge of balancing its three and often conflicting roles. Being the administrative, commercial, and educational center of the province entails a high degree of urbanization. Continuing as an agriculture and fishery production area requires the conservation of land areas needed by these activities. As an eco-tourism destination, the state of natural and man-made sites is often threatened by the first two roles.

Figure 2: Combined Risks to Climate Disasters



Facing these challenges becomes more difficult for the city as year-on-year it continues to face climate induced disasters which not only affect physical structures but also social infrastructure that reduces its capacity to achieve sustainable urbanization. The city recognized that indeed climate over-time has changed and that local actions are needed citing the experiences they have had from the disastrous Typhoons Reming and Milenyo. As such, the city fully considers that climate change is not just a global or national issue, but a direct local issue as well. Sorsogon City thus took on the challenge of starting an initiative that would help them learn and analyze the local impacts of projected climate change scenarios in order for the city to develop appropriate responses.

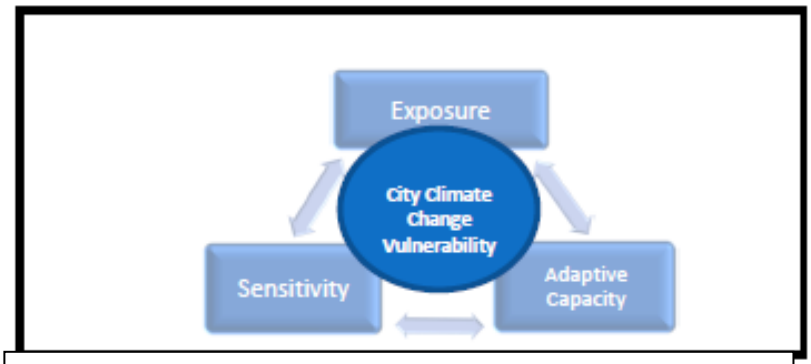
Sorsogon City built on its established partnership with the United Nations Human Settlements Programme (UN-HABITAT) to develop a work program for the city government in initiating local actions. As a starting point, the city worked with UN-HABITAT in a "learning by doing approach" for the conduct of a Climate Change Vulnerability and Adaptation Assessment (V&AA) using participatory approaches and processes.

Assessment Framework:

The climate change vulnerability and adaptation assessment used by Sorsogon City worked on defining the city's vulnerability context through assessments of its adaptive capacities, sensitivity, and exposure to climate variability and change (figure 2). The assessment process

considered the recommendations and discussion frameworks presented in the Intergovernmental Panel on Climate Change (IPCC) Third and Fourth Assessment Reports, the UNDP-Adaptation Planning Framework, Vulnerability and Response Approach (VARA) by the Oakridge National Laboratory, World Bank's Climate Resilient Cities Primer, the UNEP Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, and most especially UN-Habitat's Sustainable Cities Programme (SCP) local assessment tools and methodologies.

Figure 3



Vulnerability = f (Exposure, Sensitivity, Adaptive Capacity)

As defined by the IPCC, adaptive capacity describes the ability of a system to adjust to actual or expected climate stresses, or to cope with the consequences while sensitivity refers to the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Exposure relates to the degree of climate stress upon a particular unit of analysis. It may be represented as either long-term change in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events.

Vulnerability is generally understood as a function of a range of biophysical and socio-economic factors, commonly aggregated into three components that include an estimate of these elements namely (adaptive) capacity, sensitivity, and exposure to climate variability and change.

Initial/Preparatory activities:

Preparatory activities were conducted to ensure that the V&AA process would have strong support from both the elected officials and the technical staff of the city government. These activities centered on laying the foundations of the assessment in order to be clear in the scope of the process to be undertaken and the outcome it will deliver- that is to contribute to the city's sustainable development plans. In a purposive manner, the following activities were undertaken:

- briefing for the Local Chief Executive and key technical staff on Climate Change overviews that critically included both global and national climate change basic information and emerging issues and concerns related to local development.

- Creation of a technical team/working group (TWG) working for the city government on various sectors such that information and data could be successfully gathered and objectively analyzed.

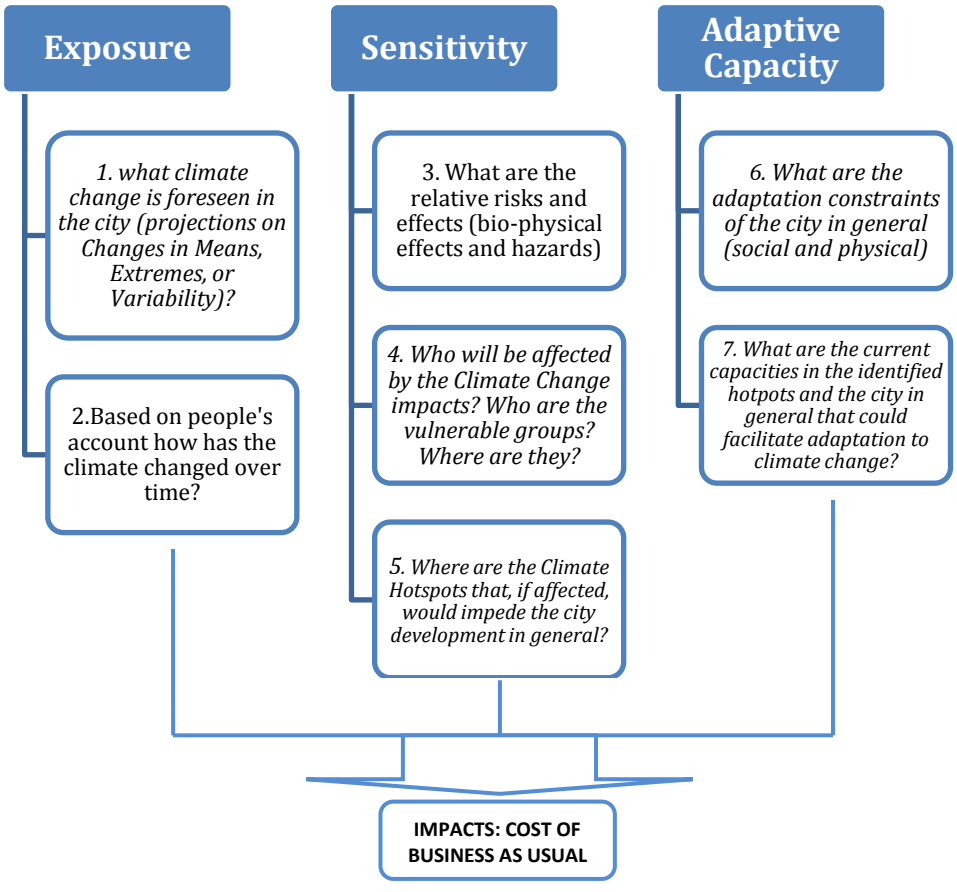
- Dialogues and discussions on the scope and objectives of the V&AA. The city government found this pre-assessment action crucial, acknowledging the complexities of projected impacts of climate change. Without intending to undermine or cut-short the science of climate change, the assessment team recognized the importance of having a purposive assessment wherein local realities would be the focus and the effects of CC to the city and its people highlighted.

An Administrative Order from the City Mayor was issued to ensure cooperation and participation from each of the city departments/offices working on sectoral concerns. This helped facilitate the consistent flow and sharing of information that the assessment requires.

The other local stakeholders apart from the city government were enjoined to participate in the whole process. The key stakeholders in the process were identified by the city through mapping exercises which defined the (possible) influences and inputs of local groups/individuals considering their mandate, knowledge/expertise, previous experiences or engagements, and role in local development processes. Initially, the identified stakeholders were engaged in key informant interviews (KII) and focus group discussions (FGD) and later on in data sharing, workshops, and multi-stakeholder consultations.

III. Purpose and Scope of the Assessment

Figure 4



The Sorsogon City V&AA was agreed to focus on determining the city's vulnerability by answering and analysing data for each of the 7 questions shown in the figure above. Moreover, since ultimately the V&AA is intended to contribute to the city's sustainable development, adaptation options were required to be identified at the end of the process. The scope of the options were agreed to be derived from the "projections of the cost of business as usual" by valuing impacts due to vulnerabilities minus adaptation costs. This procedure is viewed to be crucial in order to elicit decisions on: quick-win actions; short to long term policy development directions; joint or multi-stakeholder actions; national and local government partnerships; resource mobilization programming; etc.

IV. Sorsogon City Climate Change Vulnerability

3.1 Factors of City Vulnerability

3.1.1 National Climate Change: trends and projections:

Based on recent studies[1] in the country, the observed anomalies in climate in the Philippines from 1951-2006 are as follows:

- increase of 0.6104 ^{o}C in observed annual mean temperature;
- increase of 0.3742 ^{o}C in observed annual maximum temp;
- increase of 0.8940 ^{o}C in observed annual minimum temp;
- increased number of hot days and warm nights;
- decreased number of cold days and cool nights;
- increase of annual mean rainfall and rainy days
- increase in inter-annual variability of onset rainfall;
- average of 20 cyclones cross the Philippine Area of Responsibility where 8-9 make landfall each year - an increase of 4.2 in frequency for the period of 1990-2003

Using the PRECIS modeling system of the Hadley Centre, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA[2]) issued the following climate change projections for the Philippines for 2020 and 2050:

- The mean seasonal temperatures are expected to rise by about 0.9^{0}C to 1.4^{0}C by 2020 and 1.7 ^{0}C to 2.4 ^{0}C by 2050.
- Projection of seasonal temporal rainfall variation is largest (-35 % to +45%) during the six month period from March to August.

[1] UN-GoP MDG-F 1656: Tibig et al. 2009

[2] PAGASA is an attached agency to the Department of Science and Technology of the Philippine Government.

- Projection of seasonal temporal rainfall variation is less (-0.5 % to +25%) during sixth months from September to February.
- The highest increase in rainfall during the southwest monsoon season, which is from June to August, is likely in Region 01 (44%), Cordillera Autonomous Region (29%), Region 03 (34%), Region 04 (24%) and **Region 05 (24%)** in 2050.
- The model indicated that climate change will probably lead to an active southwest monsoon in Luzon and Visayas with future increases in rainfall that is more pronounced in June to August, and becoming greater with time.
- The drier seasons of March-April-May will become drier still, while the wetter seasons of June-August and September-November become wetter.

3.1.2 City Climate Change Exposure:

A. Existing Climate Data used for local planning and programming

Sorsogon City uses their classification as an area with *Type II climate*[3] as part of its basis for planning. Such classification account that there is no pronounced dry season in their area but they have a very pronounced maximum rain period from November to January. Local data further reveals that the rains start in late September or early October. Annual rainfall ranges from 2,800 mm to 3,500 mm. and rain is expected 200 days in a year and even in the driest months unexpected downpours occur.

Temperature in the city ranges from 21 ^{0}C to 32 ^{0}C. Relative humidity is 82%. Prevailing winds are the monsoons and Pacific Trade Winds. The Northeast Monsoon (Amihan) occurs from October to March while the Southwest Monsoon (Habagat) occurs from June to September. The Pacific Trade Winds (Gurang na Habagat) occurs during April and May.

B. People's account on climate change

Scientific projections from climate models are very useful for the V&AA, however in the absence of such information (which was the position at the start of the assessment process) that specifically focused on the geographical area of Sorsogon, local observations were very important. These were critical to validate national and regional (Asian) climate change data against the experiences of the city. People's accounts on how climate has changed over time were used in the assessment as reference to define the likelihood or probabilities of future changes. People's account were gathered through "ground-truthing" exercises, structured in the form of FGD and KII activities, which provided a local dimension to the highly technical discourse of what lies ahead that seemed vague and "far off" in some sense especially to local communities.

The initial exposure analysis, therefore, solicited inputs from the communities themselves. Their observations, as evidenced by the changes they experience in their daily lives, were outlined based on how changes in climate are manifesting and

[3] Modified Coronas Classification System

affecting them. People who have been living in Sorsogon for more than 20 years were particularly asked to join and contribute their accounts on how they have observed the local climate (e.g. temperature, rainfall, and sea-level) to have changed over the years.

According the citizens' accounts, the city has become increasingly warm as manifested in (a) the change in their fishing and farming yields and activity patterns; and (b) the electricity/energy consumption of households as they are now requiring more cooling appliances. Further, the people report that the summer months have become hotter- thus the proliferation of resorts and swimming pool facilities in the city. More pronounced (than temperature change) for the people is the change over time in the volumes of rain they expereince. There has been an increase in the frequency of serious erosion and flooding events that affect their economic activities (trading, farming, vending, etc).

Another local observations highlighted is the rise in tidal waters and the sea level. People from coastal barangays during FGDs shared their actual observation of inundation in beach areas and coastal shores especially in the Bacon District. Older citizens shared estimations that about 50 meters of land in Poblacion and about 15 meters of land along the shoreline in Cambulaga have been inundated by sea waters. Some people interviewed in Bacon Poblacion[4] recounted that during the 1950's the area where shore lines now are had actual access roads then, that it in fact served as their play area in those days and there were even houses there before.

Figure 5

People drew that the sea (level) has moved in ward and houses thus needed to move

[4] Bacon Poblacion faces the Pacific via the Albay Gulf

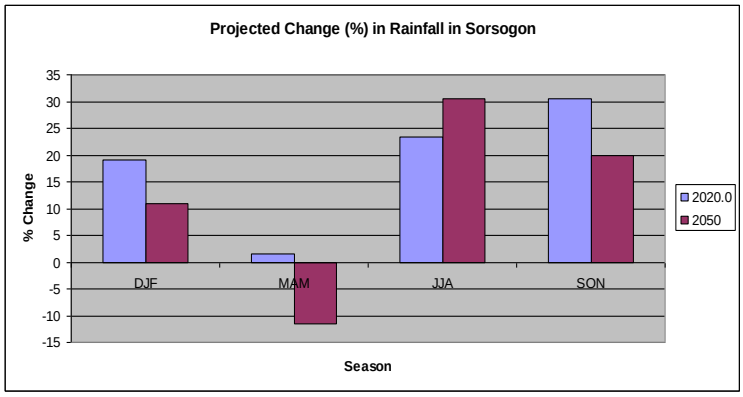
Beyond this line towards the sea is the flood prone area according to the community

C. Projected Changes in Means (Model based)

Figures 6 and 7 present the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) PRECIS projected climate

Figure 6

change scenarios for the Province of Sorsogon relative to **temperature and rainfall** for 2020 and 2050 using the A1B scenario of the IPCC.



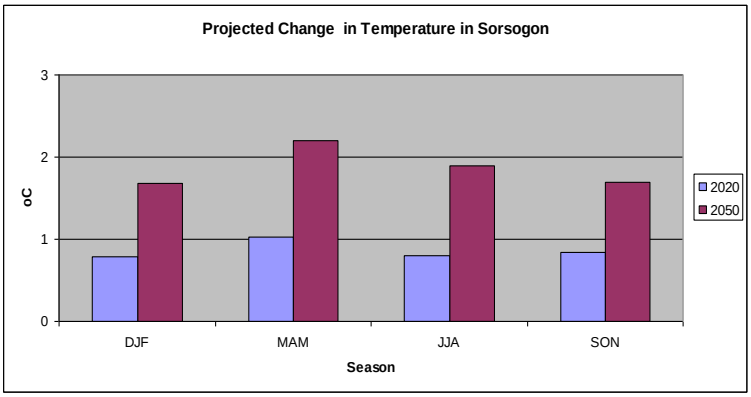
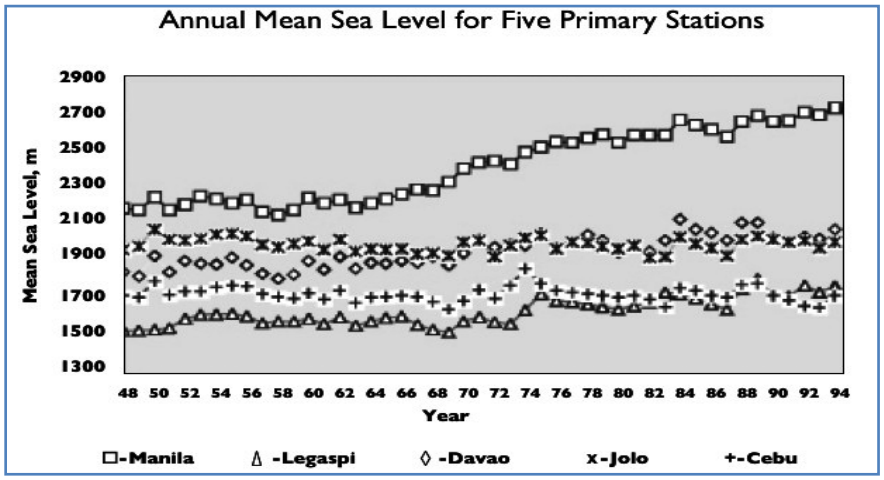


Figure 7

Generally, the figures show that Sorsogon will be more wet with temperatures getting hotter. Notably however in the 2050 scenario for precipitation, a clear change would be that Sorosogon could begin to possibly have a dry season contrary to the current climate where Sorsogon has more evenly distributed rains (see MAM projections for 2050 in Figure 4).

Sea level rise observations presented in the PINCCC revealed that an increasing trend in the annual mean sea level has occurred since the 1970s as observed from the tidal gauge station of the Coast and Geodetic Survey Department (CGSD) of NAMRIA in Legaspi, Albay. Legaspi and Sorsogon City face the same pacific waters and in fact shares territory in the Albay Gulf. Given this, Sorsogon City assumes that SLR is likewise a threat in their low lying coastal areas. In the absence of actual scientific observations, this was further substantiated and validated with community observations and personal accounts. Figure 8 presents the SLR obeservations as gathered in the five tidal stations in the country including that in Legazpi City, while Figure 9 is a manual simulation/visualization of the SLR impact in one of the city's urban barangay.

Figure 8



source: Amadore, 2005; PINCC

Figure 9:
Top photos: Barangay Sirangan satellite image (Right) its image with image simulated with 0.5 SLR;
Lower photos: Same barangay simulated 1m SLR (right) and with 2m SLR (left)

D. Projected Changes in Extremes

Records of the **El Nino Southern Oscillation**, a drought and extreme wet phenomenon, presents that the Bicol Region have been affected moderately and severely in various occurrences with **drought events**- severely in the years 1968-69, 1986-1987 and 1997-1998, and moderately in 1982-1983 events (Figure 8). Although there is no scientific modeling done to present the projection of drought events in the future, Sorsogon City assumes that drought events that may affect them would be more intense and may occur in shorter intervals or return period.

Figure 10

List of Drought Events in the Philippines During the Period 1968 - 1998

Date of Occurrence	Areas Affected	Damages
1. 1968-1969	Moderate to severe drought over most of the Philippines with Bicol Region as most severely affected	Total of $5x10^5$ mt of rice and corn production
2. 1972-1973	Central Luzon, Palawan, Visayas and Mindanao	Total loss of $6.3x10^5$ mt of rice and corn production
3. 1977-1978	The whole of Mindanao except Davao	Total loss of $7.5x10^5$ mt of rice and corn production
4. 1982-1983 Oct. 1982 - March 1983 Apr. 1983 - Sept. 1983	Western and Central Luzon, Southern Tagalog Provinces, Northern Visayas, Bohol and Western Mindanao Moderate to severe drought affected most of Luzon, Negros Occidental and Iloilo	Rice and corn pro- duction loss of $6.4x10^5$ mt; insurance claims amounted to P38 M; hydropower generation loss was P316 M
5. 1986-1987 Oct. 1986 - March 1987	Severe drought affected Bicol Region, Southern Negros, Cebu and Western Mindanao	Estimated agricultural damages of P47 M
Apr. 1987 - Sept. 1987	Severe drought affected mainland of Luzon, Central Visayas and Western Mindanao	Estimated hydro energy generation loss was P671 M
6. 1989-1990 Oct. 1989 - March 1990	Drought affected Cagayan Valley, Panay Island, Guimaras, Palawan and Southern Mindanao; affected rice and corn area totalled 283,562 hectares; major multipurpose water reservoirs reduced inflow	Estimated $5x10^5$ mt of rice and corn production losses; hydropower gene-ration loss of P348 M; 10% cutback in water production in Metro Manila
7. 1991-1992	Severe drought affected Mindanao, Central and Western Visayas and Cagayan Valley; affected agricultural areas of 461,800 hectares	P4.09 Billion agri-cultural losses; 20% shortfall in Metro Manila water supply
8. 1997-1998	About 70 % of the Philippines experienced severe drought; about 292,000 hectares of rice and corn area completely damaged	622,106 mt of rice production loss and 565,240 mt of corn amounting to P 3 B; water shortages; forest fires and human health impacts

Source: DOST-PAGASA, Rosalina De Guzman, "Impacts of Droughts in the Philippines" presented in the International Workshop on Droughts and Extreme Temperatures: Preparedness and Management for Sustainable Agriculture, Forestry

Tropical Cyclones/Stronger Typhoons and Storm surge - Sorsogon city is situated in the country's geographical Zone 6 where 3 typhoons/cyclones pass in two years. The city, based on historical records, is also prone to storm surge as revealed by data gathered from the Natural Disaster Reduction Branch of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (NRDB- PAGASA). These are shown in figures 9 and 10 below.

The city is highly at risk to the impacts of tropical cyclones as evidenced by previous events like typhoon Sisang in 1987 and the two most recent which took place in the last quarter of 2006 when Super Typhoons (Milenyo and Reming) caused massive destruction in Sorsogon. Although there is no observed statistically significant trend on tropical cyclones (Figure 13), which means that frequency would remain the same (Figure 11), Sorsogon City based on experience in 2006 considers climate change to cause stronger typhoons that could cause massive destruction in the city.

Figure 12: Historical Storm Surge recorded up to 1985 (Source: NRDB - PAG-ASA)

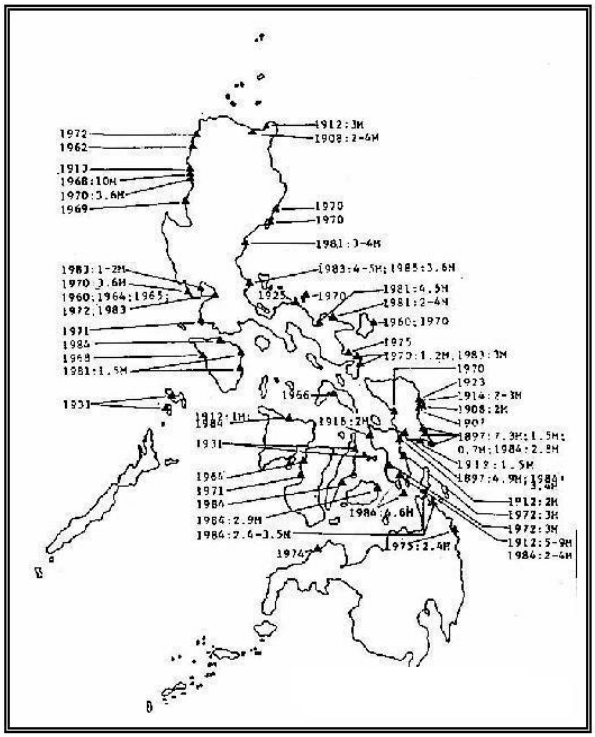


Figure 11: Frequency of Tropical Cyclone Passage over each Geographical Zone (source: PINCCC)

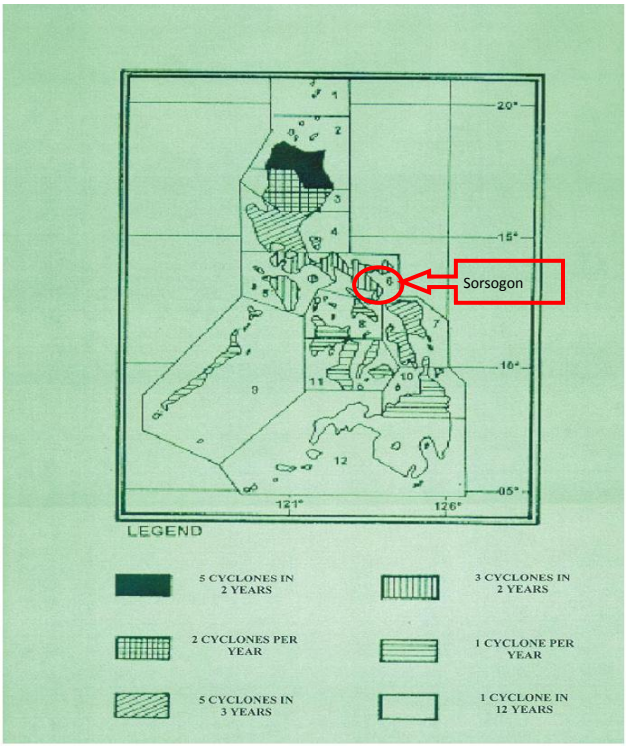
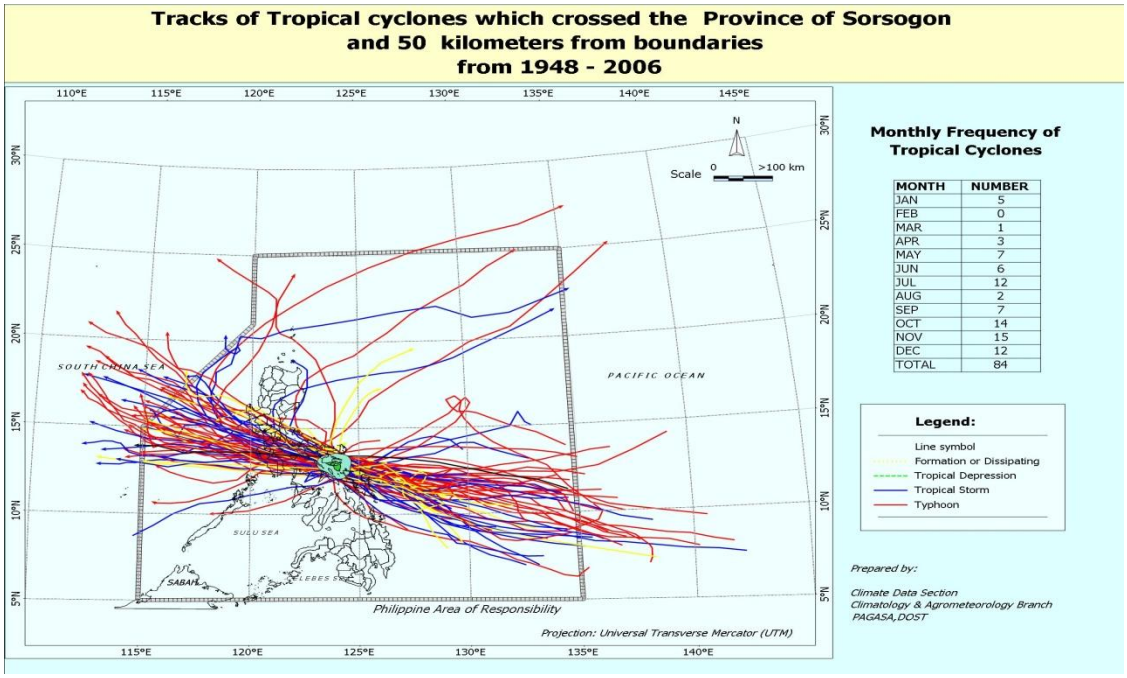


Figure 13



3.1.3 City CC Sensitivity: Biophysical effects and its bearing on socio-economic conditions

Having gained information on what the City is exposed to given climate change, local risk effects of such changes were then reviewed and assessed using various local information sources. Sectors and areas which would bear the impacts of the changes were then initially identified (see Table 2).

Table 2

Climate Driven Phenomena	Biophysical/Risk Effects (evidences from previous events)	Remarks (Data Source)	Critical Impact Areas/Sector
A. Changes Extreme			
Tropical Cyclones, storm surge	• Passing of more typhoons (exceeding the area average of" 3 typhoons within 2 years")	- City data and local observations	- Housing - Livelihood/Economy
	• More rain volume from Typhoons surpassing the average (2009)	- Case of Tropical Depression Dante (2009)	- Water drains, settlements
	• Stronger winds (between 150 to 260 km/hr.)	- Super Typhoons Sisang (1987) and Milenyo and Reming in 2006	- All sectors - Schools, Women, and

	• Increasing incidence of Evacuation of families from urban coastal areas especially those living in informal colonies/settlements • Occurrence of Storm Surge	- City Disaster Profile from CDCC - 1970 and 1983 as noted in the official records from NRDB-PAGASA	Children - Settlements, Livelihoods, basic infrastructure, sea-wall - Life lines (water, electricity power, communications)
Extreme rainfall, riverine floods	• Flashflood events • Riverbank erosion • Areas identified as land slide and erosion prone	- CDCC data - CDCC data - Local geo-hazard map (MGB-DENR)	- Agriculture, Livelihoods - Health - Land Use
El Nino/Southern Oscillation	• Recorded episodes of ENSO (El Nino and La Nina) that affected Sorsogon Province	- PAG-ASA - City Data	- Agriculture, Livelihoods - Health
B. Changes in Means			
Increased Precipitation	• Experiencing more than the average 200 days of rainfall/year; disrupted cropping pattern (e.g. drying of palay rice); decrease in palay rice production (lesser photosynthesis; water lag, bacteria); decrease in vegetable production; increasing "moss density"; decrease in salinity that affects production of cultured species (i.e. prawn, crabs, bangus (milk fish)) • Projected 1.0-1.5 change in rainfall ratio in the Bicol Region with 2x CO2 Scenario (Canadian Climate Change Model)	- City Agriculture Office - Philippine Initial National Communication on Climate Change (PINCCC)	- Watersheds - Agriculture, Livelihoods - Health
Increased in Temperature	• Projected 2-3 ^{o}C change in temperature in the Bicol Region with 2x CO2 Scenario (Canadian Climate Change Model)	- PINCCC	- Agriculture, Livelihoods - Water sector - Health

Sea-Level Rise	• Inundation of land in coastal Barangays • Changes in tides in Sorsogon Bay • Observed SLR in the Pacific side in Bacon District	- City visual records/accounts - City records - PINCC (Coast and Geodetic Survey Department or CGSD of NAMRIA in Legaspi, Albay)	- Agriculture, Livelihoods - Water sector - Health - Settlements, Land Use

With the goal to identify highly sensitive areas based on the tabulation above. , the assessment tried to present impacts areas exposed to combined risks from storm surge, sea level rise, flooding, and landslide.

Generally, the impacts of increased precipitation and extreme rainfall expected in the city are soil erosion, landslides, flooding, flashfloods due to river overflow, and disruptions in both agricultural and fisheries economic activities. Table 3 provides the list of landslide and flood-prone barangays in the city. The total population for each area is presented in the table but the actual number facing the risks may still vary given a more detailed assessment per barangay. The location of the barangays presented in Table 4 is illustrated in Figure 14.

Table 3: Barangays at risk with Landslide and Flooding

Type of Hazard	Area	Total Population (2007)
Landslides	Osiao	2,721
	Sto. Niño	2,008
	Salvacion	1,089
	Panlayaan	1,398
	San Isidro	2,748
	Rizal	3.098
	Buenavista	1,455
	Bucalbucalan	2,312
Flooding	**East/West Districts**	
	Basud	2,430
	Buhatan	2,858
	Burabod	2,197
	Capuy	2,479
	Gimaloto	907
	Salog	2,586
	Sirangan	2,491
	Talisay	2,660
	Sampaloc	5,214
	Piot	2,572
	Bitan-O	3,028
	Cambulaga	4,097
	Balogo	5,251
	Sulucan	586
	Bacon District	
	Poblacion	4,882
	Balete	2,537
	Buenavista	1,279
	Gatbo	2,378
	Osiao	2,721
	Sto. Niño	2,008

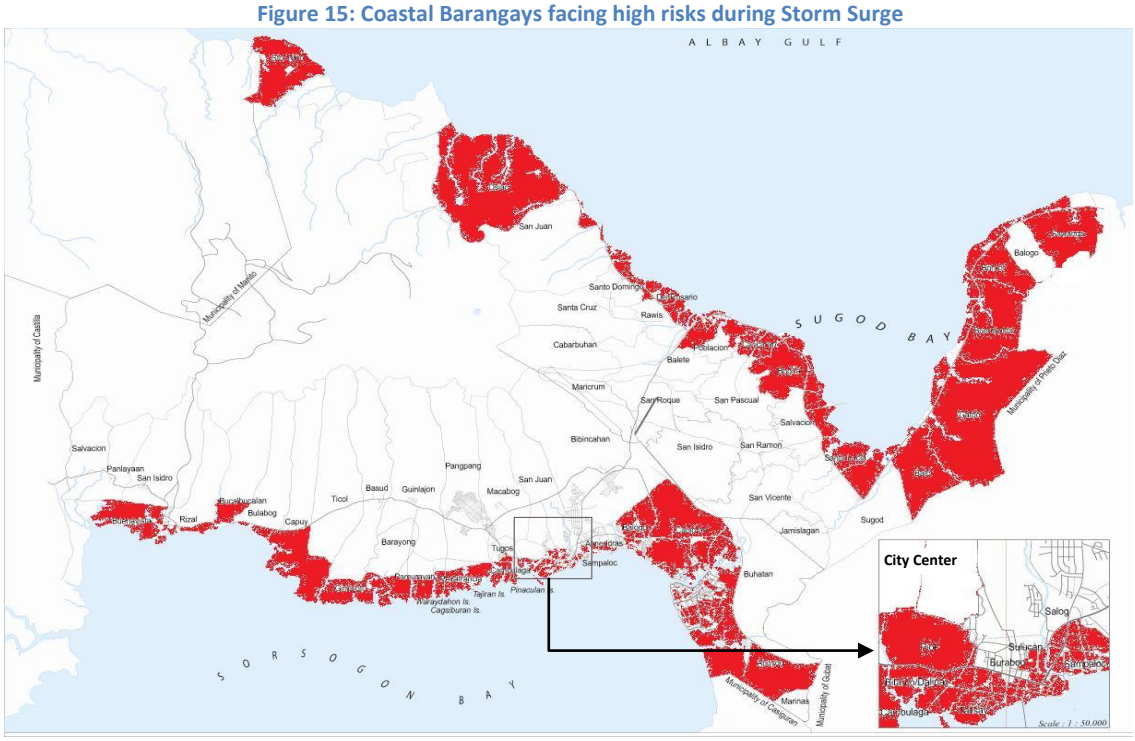
Figure 14: Barangays facing risks from Landside and Flooding

Further, the population of 34 coastal villages (Table 4) in Sorsogon City remains to be highly vulnerable to storm surges based on previous events as reported in the City Disaster Profile. In November 1987, the storm surge brought by Typhoon Sisang caused the death of more than 700 people in Sorsogon.

Table 4

EAST/WEST DISTRICT Coastal Areas		BACON DISTRICT Coastal Areas	
Barangay	**Population**	**Barangay**	**Population**
1. Abuyog	3,880	1. Bato	1,616
2. Balogo	5,251	2. Bogna	1,321
3. Bitan-o-Dalipay	3,028	3. Bon-ot	576
4. Bucalbucalan	2,312	4. Buenavista	1,279
5. Buenavista	1,455	5. Caricaran	1,580
6. Bulabog	2,164	6. Gatbo	2,378
7. Buhatan	2,858	7. Del Rosario	903
8. Cabid-an	5,426	8. Osiao	2,721
9. Cambulaga	4,097	9. Poblacion	4,882
10. Capuy	2,479	10. Rawis	1,192
11. Gimaloto	907	11. Salvacion	1089
12. Pamurayan	1,879	12. Sta. Lucia	413
13. Penafrancia	1,506	13. Sto. Domingo	1,333
14. Piot	2,572	14. Sto. Nino	2,008
15. Rizal	3,098	15. Sawanga	1,495
16. Sampaloc	5,214	16. Sugod	1,919
17. Sirangan	2,491	---	
18. Talisay	2,660	---	
TOTAL	**53,277**	**TOTAL**	**26,705**

Figure 15: Coastal Barangays facing high risks during Storm Surge

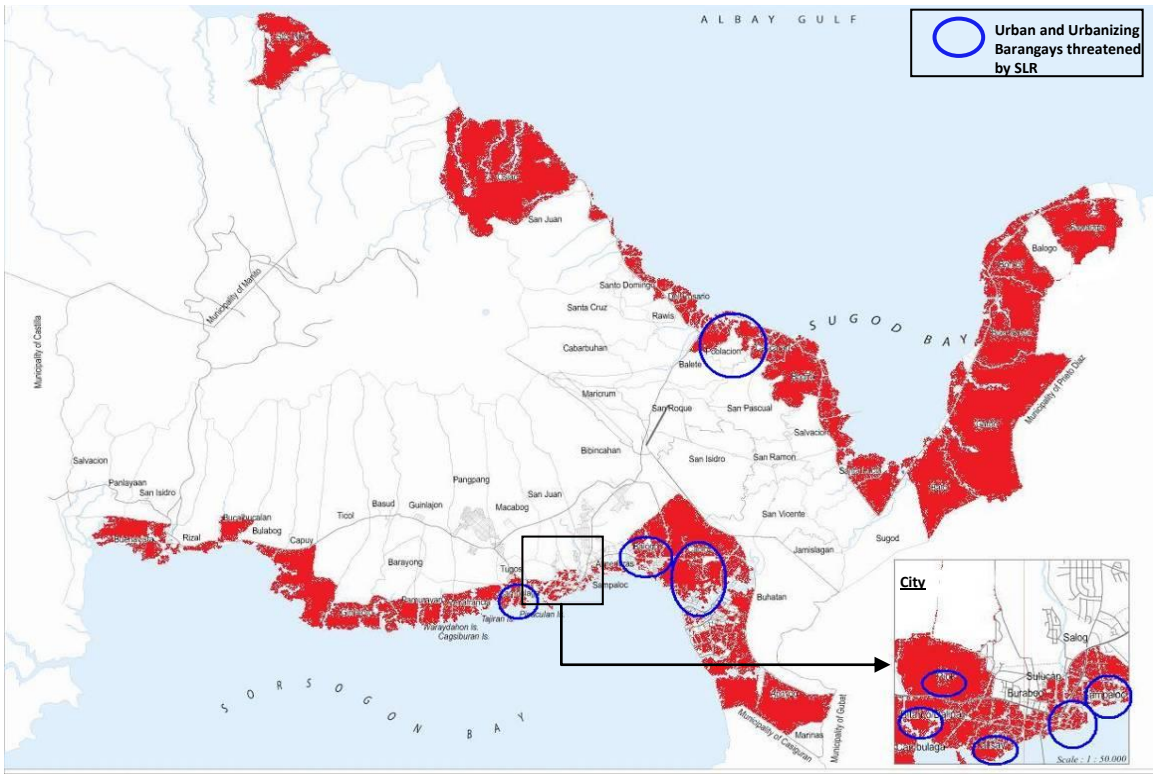


Though lacking official observation data, it is assumed that the 34 coastal barangays of the city would likely be affected by rising sea waters. A total of 8 urban and 1 urbanizing barangay (Cambulaga) face the risk of sea level rise (from people's account).

Table 5

Name of Barangay/Village	Population	Land Area (has.)
Balogo	5,251	152.85
Bitan-O	3,028	19.20
Cabid-an	5,426	223.56
Cambulaga (urbanizing)	4,097	37.10
Piot	2,572	65.96
Sampaloc	5,241	12.58
Sirangan	2,491	4.96
Talisay	2,660	12.40
Poblacion	4,882	174.51
Total	35,648	703.12

Figure 16: Coastal Barangays and identified Urban Areas at risk with Sea level Rise



A. Identified City Hotspots

In overlaying the projected climate change impacts in the maps above, there are Barangays which face multiple risks and therefore are identified as the "city climate change hotspots". These hotspots and their urban/rural classification together, population data, and the growth rate for the last 7 years per area are presented in Table 6. Of the Hotspots, 8 are urban villages, 1 is urbanizing, and the last 3 villages in the table are rural areas.

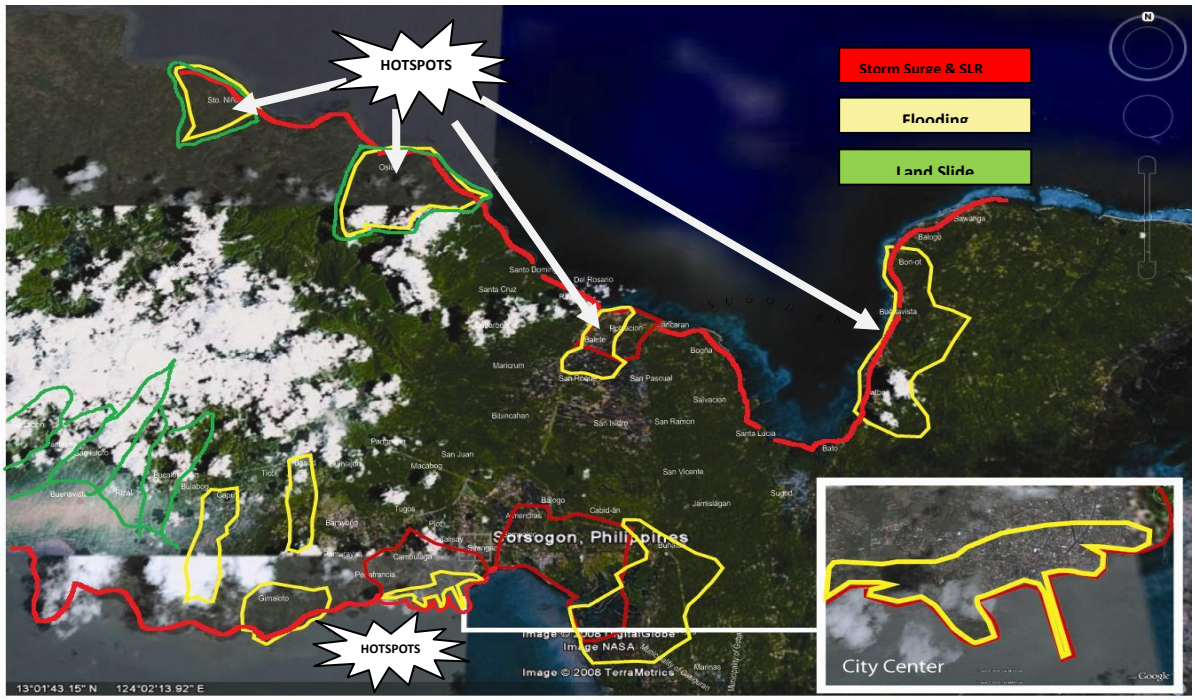
Table 6

Barangay	Classification	Land Area (Ha)	2007 Population	% Growth Rate (2000-2007)
Balogo	Urban	152.85	5251	11.46
Bitan-O Dalipay	Urban	19.20	3028	14.86
Cabid-an	Urban	223.56	5426	22.61
Cambulaga	Urbanizing	37.10	4097	22.03
Piot	Urban	65.96	2572	7.5
Sampaloc	Urban	12.58	5214	12.2
Sirangan	Urban	4.96	2491	14.3
Talisay	Urban	12.40	2660	6.58
Poblacion	Urban	174.51	4882	3.83
Sto. Nino	Rural	385.13	2008	4.78
Osiao	Rural	1015.66	2721	4.52
Gimaloto	Rural	143	907	7.17

The urban hotspots on the average are growing annually at the rate of 1.7%. Cabid-an registers the highest annual growth rate at 3.23% while four more areas are noted to have growth rates higher than the average and these areas are Bitan-O

Dalipay (2.12%), Sirangan (2.02%), Cambulaga (2%), and Sampaloc (1.74%). Projecting that the growth rate remains the same for these areas more people would become vulnerable to impacts of climate change. Risks will be higher and the costs for relief and rehabilitation would also considerably require more should a climate-induced disaster happen if anticipatory plans for climate adaptive social and physical infrastructures are not put in place.

Figure 17: Identified City Hotspots due to combined risks from Storm Surge, SLR, Flooding, and Land Slide



B. Risk Ratings

The assessment worked on rating the sensitivity of the city vis-a-vis projected impacts of CC to people, places and activity sectors after the identification of hotspots. This rating exercise was deemed important to assess which areas must be focused on considering their vital contribution to sustain local development programs of the city as well to identify which climate risks the city is most sensitive to. Results are shown in Table 7 to 9.

Table 7

CC Risk Indicator: Increased Rainfall																			
RISK EFFECTS	Flooding						Erosion						Landslide						Risk Rating *(total score over count of count of scores)*
Who/What will be affected?	Exposure			Sensitivity			Exposure			Sensitivity			Exposure			Sensitivity			
	Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			
	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	
People																			
- Population	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
Places																			
- Built-up Area	1	1	1	1	1	1	0.5	1	1	0.5	1	1	0.75	1	1	0.75	1	1	0.92
- Agricultural Zone	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Forest/Watershed Area	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Others…																			
Activity Sector (Local Economy and lifelines)																			
- Trading	1	1	1	1	1	1	0.25	0.5	1	0.25	0.5	1	0.5	1	1	0.5	1	1	0.81
- Tourism	1	1	1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	0.5	1	1	0.89
- Agriculture (Fishing /Farming)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.94
- Service Oriented livelihoods	1	1	1	1	1	1	0.25	0.5	1	0.25	0.5	1	0.25	1	1	0.25	1	1	0.78
- Infrastructure Systems	0.87	1	1	0.87	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.93
- bridges	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.94
- communications /power	0.5	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.89
- Public School Bldg.	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.94
- Roads/ seawall/river control	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.94

Exposure Rating Probability/Likelihood: 1=Frequent or Very Likely; .75=Likely; .50=Moderately Likely; .25=Low probability

Rating for Possible Adverse Effect: 1= Very Severe Consequence; .75= Severe Consequence; .50=-Moderate Consequence; .25= Low Consequence (previous experience as basis)

Table 8

CC Risk Indicator: Typhoon/Tropical Cyclones																			
RISK EFFECTS	Flooding						Storm Surge						Strong Wind						Risk Rating (total score over count of risk effects)
Who/What will be affected?	Exposure			Sensitivity			Exposure			Sensitivity			Exposure			Sensitivity			
	Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			
	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	
People																			
- Population	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
Places																			
- Built-up Area	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Agricultural Zone	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Forest/Watershed Area	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Others...																			
Activity Sector (Local Economy and lifelines)																			
- Trading	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Tourism	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Agriculture (Fishing /Farming)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.94
- Service Oriented livelihoods	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Infrastructure Systems	0.9375	1	1	0.9375	1	1	0.87	1	1	0.87	1	1	1	1	1	1	1	1	0.98
- bridges	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- communications /power	0.75	1	1	0.75	1	1	0.5	1	1	0.5	1	1	1	1	1	1	1	1	0.92
- Public School Bldg.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00
- Roads/ seawall/river control	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.00

Table 9

CC Risk Indicator: Sea Level Rise													
RISK EFFECTS	Permanent Flooding						Salinitization						Risk Rating (total score over count of risk effects)
Who/What will be affected?	Exposure			Sensitivity			Exposure			Sensitivity			
	Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			Probability or Likelihood of impact			Possible Adverse Consequence/s (expected losses)			
	2010	2020	2050	2010	2020	2050	2010	2020	2050	2010	2020	2050	
People													
- Population	1	1	1	1	1	1	1	1	1	1	1	1	1
													0
Places													0
- Built-up Area	1	1	1	1	1	1	1	1	1	1	1	1	1
- Agricultural Zone	1	1	1	1	1	1	1	1	1	1	1	1	1
- Forest/Watershed Area	1	1	1	1	1	1	1	1	1	0	0	0	0.75
- Others...													0
													0
Activity Sector (Local Economy and lifelines)													0
- Trading	1	1	1	1	1	1	1	1	1	1	1	1	1
- Tourism	1	1	1	1	1	1	1	1	1	1	1	1	1
- Agriculture (Fishing /Farming)	1	1	1	1	1	1	1	1	1	1	1	1	1
- Service Oriented livelihoods	1	1	1	1	1	1	1	1	1	1	1	1	1
- Infrastructure Systems	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- bridges	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- communications /power	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- Public School Bldg.	1	1	1	1	1	1	0	0	0	0	0	0	0.5
- Roads/ seawall/river control	1	1	1	1	1	1	0	0	0	0	0	0	0.5

C. Characterization of Social and Physical Sensitivities (People, Places and Activity Sectors)

This section outlines the possible interaction of CC exposure with specific socio-economic dimensions that contribute to greater city vulnerability. The intention is to provide explanations of the ratings provided in Tables 7-9 by detailing more information on why and how local factors are likely to be affected by climate change.

C. 1 Social

The social conditions of the people in Sorsogon are critical factors in their sensitivity to climate change impacts as they influence how people are able to adapt to changes and develop responses and action plans. The risk ratings specifically the sensitivity (decribed as expected losses in Tables 7-9) of people are generally associated with people's constraints due to poverty and gender, the consequences on their limited access to basic services and health, and their capacity to have support networks (as discussed below in social capital) as well as their current knowledge on what lies ahead due to climate change.

i. Poverty

Incidence of poverty in the city is 43% based on the latest (2006) estimates. As in the whole of the Philippines, poverty incidence is measured as "the proportion of

families/population with per capita income less than the per capita poverty threshold to the total number of families/population"[5]. The 43.5% poor translates therefore to 65,882 individuals or about 13,445 families living below the poverty threshold of P15,687.

The National Statistical Coordination Board regional reports reveal that Sorsogon (Province) posted a 9.8 percentage point increase in poverty incidence between 2000 and 2006. Mainly, people account this to unemployment and lack of livelihood opportunities. Relating this to climate-induced hazards, in 2006 two super typhoons struck the province and devastated the city, and the province in general. In these events, people lost their assets including those used for productive activities which enable them to earn a living. Those who are employed and engaged in micro businesses were likewise affected hence jobs were lost and daily wage earnings were negatively affected.

The people's poverty situation is believed to be closely linked with city's vulnerability to natural hazards. Poverty is a limiting factor for families to appropriately prepare and adapt to changes as their assets (physical, financial, technical, etc) are limited. During FGDs, there were stakeholders who raised that they think ***"the cycle of poverty in Sorsogon is very much related to the cycle of disaster-rehabilitation-disaster"*** that has been happening repeatedly given its exposure to climate and other natural disasters. This is believed to be so given that poor people suffer more (during disaster events) and require more support to rebuild and build back better, thus their limited earnings are stretched thinly to sustain their family's basic needs and the need to re-invest in damaged physical assets.

ii. *Access to Water and Sanitation:*

In 2006, 25% of the total number of households do not have sanitary toilets, while 27.8% have no access to potable water supply. Most of the urban areas access their water source from the Sorsogon Water District (SCWD). Other households get drinking water from artesian wells built in their barangays while still others have deep wells put up through the Barangay Water System Administration (BAWASA) Project.

Climate change impacts in the city would affect people's access to water especially those sourcing it from artesian wells and deep wells - in the event of El Nino, water levels would recede while in longer rain periods water would be more prone to contamination due to increase water run-off. In fact the Sorsogon City Water District projects that the city would star losing its ground water sources from 2013. The

[5] Definition from National Statistical Coordination Board

SCWD links this projection with their observations from their operations data that reveals a decreasing yield from their sources. According to the water district, in 2000 the SCWD recorded an annual average yield of 155 liters per second, 150 lps in 2001, 120 in 2002 and 35 lps in 2003 when El Niño hit the Bicol region. The figures went up to 104 lps in 2004, down to 101 lps the following year and only 98 lps in 2006 and in 2007 to 92 lps this year. The increasing water demand and continuous environmental degradation (cutting of trees, pollution and improper waste disposal) and most especially climate change are all expected to further excacerbate the situation and hence the 2013 projection.

Given the depletion of groundwater, there were also some reported cases of salt water intrusion in coastal communities affecting potable water sources.

As evidence of the critical effect of climate extremes on the city, tropical cyclone post disaster reports account that water supply of the city was affected as water reservoirs and distribution pipe lines were damaged. The 2 typhoons for example that hit the city in the latter part of 2006 disrupted the supply for at least a month-putting further pressure on the health and sanitation of vulnerable households.

Table 10

	2005		2006	
	Percent	**Total**	**Percent**	**Total**
Access to safe drinking water	72%	17959	72.2%	18422
Access to safe means of excreta disposal	78.5%	19691	75%	19132
Establishments with sanitary permits	98.9%	897	88.53%	1055
Food handlers		1388		1475
Food establishments		405		810
Food handlers with health certificates	99.85%	1386	91%	1345
Households with complete basic sanitation facilities	70%	17557	71%	18098
Households with satisfactory garbage disposal	97.9%	24559	97	24767

In the urban-coastal hotspots (Poblacion, Sirangan, Bitan-O, Talisay, and Cambulaga) where FGDs were conducted, local leaders expressed that they have community members who lack access to water and sanitation though no actual details were provided given limited available data available during the conduct of the FGD.

iii. *Health and Nutrition:*

There are preliminary results at the national level that link health and climate change as indicated by the increase in disease incidence especially those which are vector borne. The same however has not been done at the city level though the city is vulnerable to and anticipates increases in vector-borne disease especially Dengue

Fever. Given increased precipitation and flooding of areas, urban slums are likely to breed more mosquitoes that may carry Dengue.

Children are seen to be at high risk given the assessment done by the Provincial Nutrition Committee held early 2007. The assessment revealed that eight barangays in Sorsogon City belong to the nutritionally depressed category and it includes Barangay Bitan-O, one of the identified climate change hotspots. Less healthy children or those who are nutritionally deprived are very likely to succumb to diseases, including Dengue fever. This situation could be further aggravated when food security in the city becomes an issue due to the effects of CC on agriculture.

In addition to Dengue fever, water borne diseases may also become prevalent due to climate change. These include cholera, leptospirosis, and diarrheal diseases. Given the water and sanitation conditions in the city where some 38% of the total households have no access to safe drinking water and sanitation, cholera and diarrheal diseases may rise due to contamination caused by flooding that is brought by increased precipitation.

iv. *Social Capital:*

Social capital refers to norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions. Urban poor groups and its federated network present in the City are actively working with most of the hotspots. However based on initial interviews, organizational capacities of the groups are still relatively weak.

During the FGD with communities and LGU assessment, no evidence has yet been found that inclusionary and collective action/cooperation is being done in the areas of disaster risks and preparedness measures towards building risk resilient communities. This could be attributed to the general public's limited knowledge and information on climate change risks and threats.

Non-Government organizations (NGO) are present and are operating in the city. They provide various services such as community organizing, livelihood support, environmental management assistance, and shelter provision. The city government however has limited engagement to date yet with the NGOs operating in the area. This is mainly due to the fact that the NGOs directly work with the community on projects and do not necessarily work together with the LGU on their initiatives. Active NGOs in the city and those which are possible partners have been assessed *(See Annex)* in order to identify possible directions that could be taken to establish partnerships with these vital social groups that could improve social capital especially with respect to resilience to climate chance impacts.

The FGDs were able to gather from the communities that Gawad Kalinga and Habitat for Humanities have projects in Poblacion Bacon. Most of the hotspots mentioned that they have been assisted previously by NGOs like People's Alternative Livelihood Foundation in Sorsogon, Inc (PALFSI), and Cope Foundation, Inc.

v. *Women and Disaster Risk Reduction:*

In the city, women account for 49.7% of the total population in 2000. Though the latest census does not present gender disaggregated data for the actual population of the city in 2007, it is assumed that women still account for the same percentage of the population for that year.

Generally, women are more vulnerable to climate variability and disasters than men because they have less access to resources, are victims of the gendered division of labour and are the primary caregivers to children, the elderly and the disabled even during disaster events. Women are also less able to mobilize resources for recovery and rehabilitation, more likely to be unemployed following disasters and are overburdened with domestic responsibilities, leaving them with less freedom to pursue sources of income to alleviate their economic burden. Also, lactating women during disasters are also prone to higher risks and stresses. On the other hand, experiences in previous disasters and coping strategies elsewhere indicate that women may also take the lead in accessing the natural resource base, rebuilding houses, caring for children or relatives, and working in community groups.

FGD with communities revealed that in the previous disasters that have devastated Sorsogon, women experienced heavy burdens especially because they needed to extend their roles to cope and recover from the damages in their homes and livelihoods. Women in Sorsogon City during the past two cyclones and in the context of disaster recovery expanded their roles to generate additional income to support the family. Immediately after the cyclone, women were at the forefront of looking for resources that could be used to restore or augment their limited and damaged livelihoods. They have tried accessing financial resources support and small business information and training programs from local micro-finance organizations in the City like the case of PALFSI. The Self-Employment Assistance Kabuhayan (SEA-K) program of the Department of Social Welfare and Development (DSWD) through the LGU of Sorsogon City was also amongst the available livelihood programs that were accessed by affected women. Overall, the women in Sorsogon played an important role in the livelihood and social recovery after the two super typhoons that devastated the city in the late 2006.

Further, women headed households are foreseen to have increased vulnerability given climate change impacts. Their higher vulnerability are projected with the likely occurrence of the following: decrease in potable water sources, damage to houses, disrupted livelihoods, increase incidence of vector-borne diseases in their family, flooding which limits mobility of those who are engaged in vending and services, among others.

vi. *Education and limited knowledge/information on CC:*

Based on the latest literacy mapping report for the city, the literacy rate is at 91%. This poses as an opportunity for a possible good reception and understanding of climate change risks. However, the current situation is that the general public has very limited knowledge and information on climate change. Efforts at the national level to mainstream climate change issues and information in the national education curricula for students across levels has not yet translated or perhaps piloted in

schools in Sorsogon. Also, limited IEC materials have been disseminated in the city to develop people's understanding of the basics of climate-related issues.

Table 11

	TOTAL POPULATION			Total # of literates			Total # of illiterates			Literacy rate		
	M	F	T	M	F	T	M	F	T	M	F	T
Bacon,E	9039	8623	17662	7100	6755	13855	732	700	1432	90.65	90.63	90.63
Bacon,W	11282	11083	22065	7217	6567	13894	2437	2335	4772	74.67	73.33	73.33
Sor. East	25420	23927	49347	22111	20786	42897	415	369	784	98.16	98.21	98.21
Sor.West	22234	21984	44218	18825	18951	37776	1143	912	2055	94.26	94.84	94.84
Total	67975	65617	133292	55253	53059	108422	4727	4316	9043	92.06	91.29	91.29

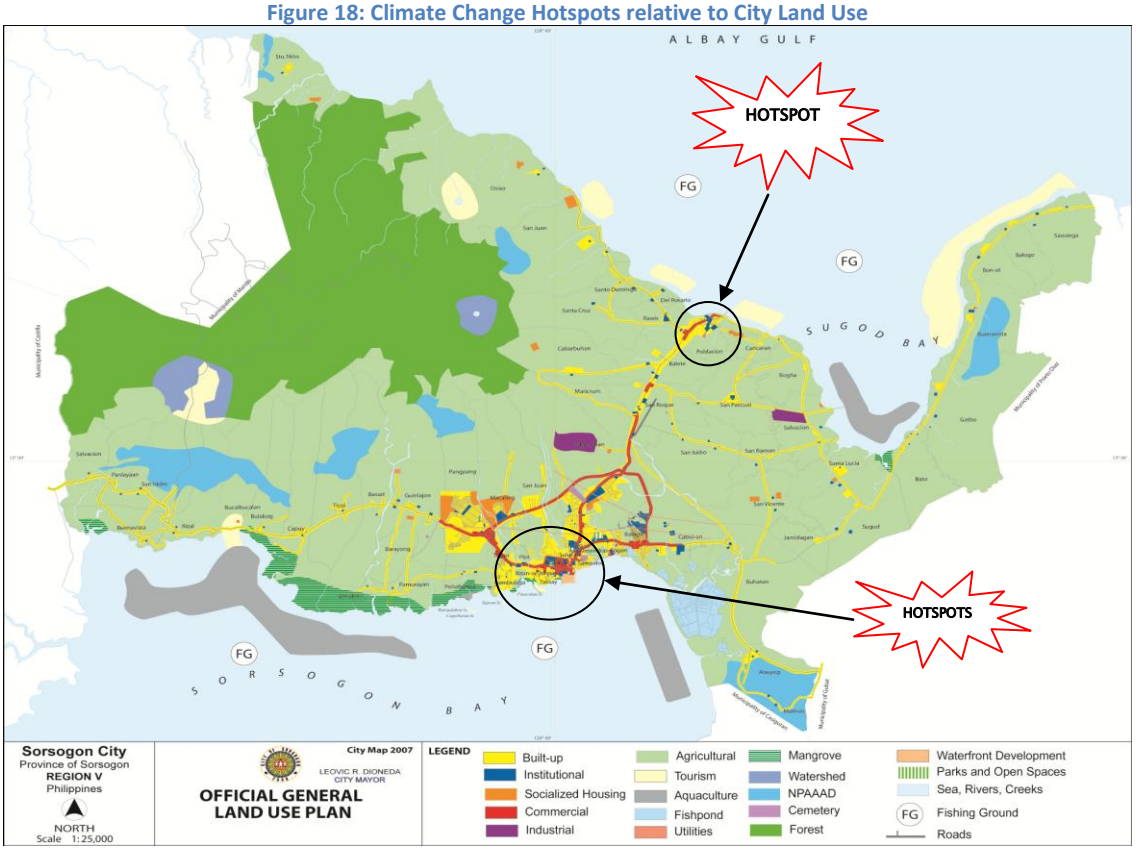
C.2 Location and Land Use

The location of people and land use are critically looked at in this V&AA because they are important to identify risks of CC impacts on an area level. Area sensitivity assessment is especially vital to establish the link of climate change with the city's spatial plan and resource management program. In the risk rating in table 7-9, the built-up and agricultural zones of the city are believed to be facing very severe consequences due to the risk indicators shown (typhoon, increased precipitation, and sea level rise).

i. *Built-up Zone*

Figure 18 presents the city climate change hotspots against the current general City Land Use Plan (CLUP). Most of the hotspots are situated in built-up and commercial areas identified in the current approved CLUP (2007-2012).

Figure 18: Climate Change Hotspots relative to City Land Use



Forty five percent of the households in the city dont rights to the land their houses are built on. According to the City CLUP, a majority of the dwelling units are single detached houses, of recent construction, and are made of wood and temporary materials. Median floor area is 22 square meters for an average of 5 persons per family.

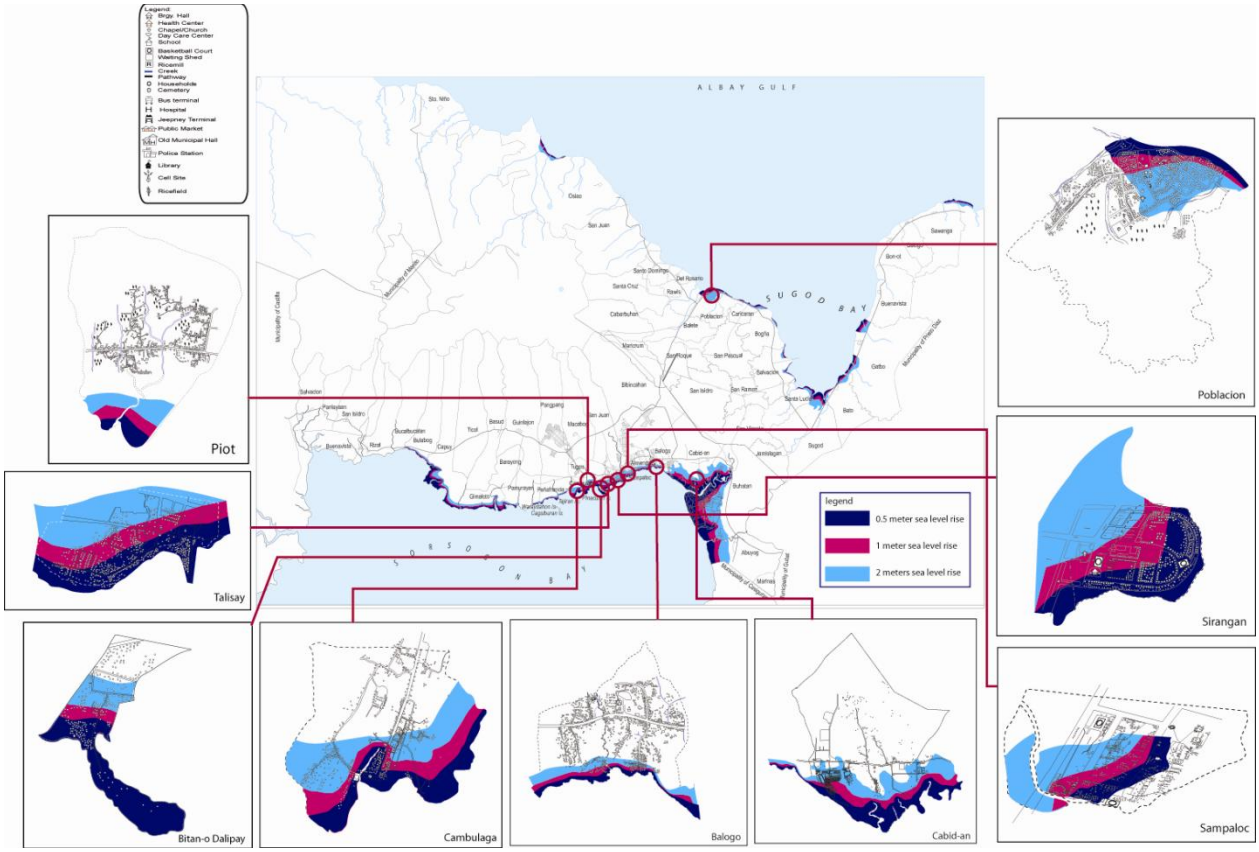
Considering that informal settlements are usually situated in coastal areas, riverbanks, road-right-of-ways, and there are unlawful blighted dwellings on private and government lands, expected losses are perceived to be high all three risk indicators sampled in the risk rating. High scores were given because most of the houses in poor urban communities are either made of makeshift materials or light materials which are susceptible to damage that could be brought about by strong tropical winds and heavy rains.

House structure reinforcement and new technology to adapt to stronger winds, heavier rain fall, and the increasing sea level are not yet popular with the general public. The vulnerable urban communities are hesitant to build stronger structures because of the lack of security in tenure. People use indigenous means to cope with cyclones like tying their makeshift house to strong poles, and putting weight (e.g. old tires and stones/rocks) on the roof. However such indigenous ways have proven to be insufficient to protect houses from damage. With about 5000 housing structures in the city being damaged yearly by typhoons, about Php 150 million is spent for housing reconstruction each year assuming a Php 30,000 cost of reconstruction for each.

Meanwhile, it is notable that the commercial spaces where businesses operate are located in the Hotspots (Figure 18). These commercial spaces are likewise exposed to flooding, strong winds, and sea level rise. It is noted that commercial structures which are technically sound would have greater resilience to these exposures especially when it was factored in the structural designs. What the city however notes is that during the Super Typhoon events in 2006 and even during the Typhoon Sisang in 1987, the strong winds, flooding and storm surge caused major damage to structures in the commercial area. This prompted the city to make the “siting” of commercial spaces their main factor for sensitivity.

Inundation of lands that could be brought by sea level rise in the hotspots is summarized in Figure 19. Dramatic locational movements and displacements are likely to happen as spaces currently used and occupied following the land use plan would be altered. The city however still has the capacity to adapt to SLR as there are still available lands that could be developed to address the future residential/commercial needs. The challenge now for the city is to do anticipatory planning and incorporate climate change parameters in their CLUP so that it becomes more responsive to projected impacts of the changing global climate.

Figure 19: Combined projected SLR mapping in urban hotspots



- **Public Infrastructure and Linkage system:**

Public infrastructure and linkage systems are susceptible to damage from extreme weather events, hence the high risk rating for these in Table 7 and 8. During the previous disasters brought by super typhoons Milenyo and Reming, there are bridges and roads in the city that became inaccessible. Electricity and communication transmission lines were down- communication services was offline for three days while electricity were out for almost 3 months in some areas. When extreme events occur again in the future, extensive contingency preparation must be done to support these vital linkage infrastructures especially the bridges linking various areas in the City. The condition of the bridges in Sorsogon City as reported by DPWH is presented in Table 7.

Sea level rise threatens the protective infrastructure (not included in the risk rating). The seawall that protects most of the coastal communities from storm surge has been heavily damaged by the two super typhoons in 2006. Though repair activities have already been done, only minor sections have been repaired due to limited budget from both local and national government. As revealed during FGDs, most of the hotspots considered the present condition of the sea wall in their areas as a major factor that increases their vulnerability to storm surge and sea level rise. The city government however lacks consolidated information on the structural gaps

of the sea wall considering that the said protective infrastructure is managed and maintained by the national government through the Department of Public Works and Highways.

Table 12: Condition of Bridges in Sorsogon City (2006)

Bridge Name	Location	Year Constructed	Seismic Vulnerability Rating	Structural Condition of Bridge Components	Total Rating	Remarks
Buhatan	Buhatan (Maharlika Hwy)	1973	58	78	64.80	Damage detected is critical
Alice	Maharlika Hwy	1969	43	75	55.80	Damage detected is critical
Cawayan	Basud (Maharlika Hwy)	1977	73	55	65.80	Damage is slightly critical
Bagacay	Bulabog (Maharlika Hwy)	1961	73	25	53.80	Routine maintenance is necessary
Tublijon	Rizal (Maharlika Hwy)	1965	63	25	47.80	Routine maintenance is needed
Abuyog	Abuyog (Maharlika Hwy)	1973	50	43	42.20	Damage is slightly critical
Sorsogon	San Juan Diversion Road	2001	63	10	41.80	Painting is recommended
Gabao	San Roque Sorsogon-Bacon	1950	48	25	38.80	Routine maintenance is necessary
San Juan	Bacon-Manito	1979	48	25	38.80	Routine maintenance is necessary
Milabiga	Bacon-Manito	1979	46	25	37.60	Routine maintenance is necessary
Mati	Sto. Domingo Bacon-Manito	1979	43	25	35.80	Routine maintenance is necessary
Otoc	Rawis Bacon-Manito	1979	43	25	35.80	Routine maintenance is necessary
Rangas	Rawis Bacon-Manito	1979	43	25	35.80	Routine maintenance is necessary
Gomihan	Bibincahan Diversion Road	2001	43	10	29.80	Routine maintenance is necessary

Source: Department of Public Works and Highways

ii. Agricultural Zone

The agricultural area of Sorsogon City dominates the total land use with 22,970 hectares or 73.4% of the total land area still classified for agriculture use. The area's main produce includes rice, copra, abaca, vegetables, pili and other crops and fruits (Table 13).

Table 13

Crop	Production (metric tons)	Areas Planted	Number of Farmers
Rice	9,451.08	2,051.77	2081
Copra	6,318.67	9,930.00	7,277
Abaca	640	1,997.00	720
Vegetables			533
a. Leafy vegetables	160	20	43
b. Fruit vegetables	600	60	55

c. Root vegetables	60	5	30
Pili	152.21	112.59	116
Cassava	1530	85	249
Sweet Potato	810	54	160
Coffee	6.825	19.5	9
Pineapple	30	5	22
Banana	4,120	206	458
Papaya	90	5	160

Climate stresses faced by the agricultural zone are mainly associated with flooding and strong winds. Areas planted with rice would be at risk of flooding, while Pili and coconut plantations are highly sensitive to strong winds. As an indication of vulnerability, 25,598 of the total 903,919 coconut trees were damaged by the 2006 super typhoons thus the score of 1 in the risk rating for agriculture relative to Typhoons (Table 8). To date, the trees are still trying to recover since it takes 3-5 years for them to begin producing fruit. There were no reports available on Pili tree plantation damages. Pili trees' susceptibility to losses and damages must be noted and further reviewed considering that the province is believed to be the major source (70%) of the total Pili production in the whole region.

iii. *Forest and Watersheds*

Table 14

FORESTLAND	FOREST RESERVE (PNOC)	MANGROVE FOREST RESERVE	MANGROVE TIMBERLAND	MANGROVE FOR FISHPOND DEVELOPMENT	TOTAL
A. Bacon	3,1566.41	199.00	-	-	-
B. Sorsogon	3,603.97	204.33	107.58	341.47	-
TOTAL	6,760.38	403.33	107.58	341.47	7,612.76

Source: City Environment and Natural Resources Office; CLUP

Classified forestland accounts to 24% of the total land area of the city. The CLUP report that there are secondary growth forest in the city they are accounted for by open and close canopy mature trees, covers the timberland. Some areas are cultivated, and the rest are brush land and grassland. Forestland is composed of the timberland area that is part of the PNOC geothermal field, the watershed area in the northeast part of the city, and the mangrove areas along the coasts of Sorsogon Bay and Sugod Bay.

There are no reports that provide on further detail on the biodiversity and effective forest cover of the city or the state of the watershed. These aspects are crucial in defining further the sensitivity of the city's environmental condition in view of climate change impacts. The city fully recognizes that forestland is very important in both their mitigation and adaptation actions much as it is crucial for heat absorption and evapotranspiration. These are basically the assumptions as to why the forest zones got a high risk rating in Tables 7 and 8.

C.3 Activity Sectors – Local Economy and Lifelines

Activity sector gathered hight scores/rating for sensitivity and exposure Table 7-9, the discussion below presents the importance of specific economic/ activity sectors to the city and how/why severe consequences are perceived for each topic discussed and considered.

i. Trade, Commerce, and Service Oriented Livelihoods

Sorsogon City is the center of trade and commerce of the Province. The majority of the commercial establishments operating in Sorsogon are primarily geared towards retail and wholesale while other economic activities fall under the service industry. Among these are hotels, lodging houses and restaurants, repair shops, groceries and supermarkets, hospitals, clinics, and transport and telecommunications companies. The Permits and License Division of the city report that as of 2007, 60% of registered business is service-oriented while 11% are small manufacturing shops.

Businesses are mainly concentrated in the downtown area near the public market and major commercial establishments. The presence of 12 financial institutions – nine of which are branches of national banks – further reinforces Sorsogon City's position as sub-regional center. With the onset of cityhood, two medium-scale malls have been constructed, and a third is in the planning and initial marketing stage. Also, a 300-hectare Economic Zone has been identified in the north-eastern part of the city. It covers the barangays of Buhatan, Cabid-an, and Bibincahan. Within the Economic Zone and along the diversion road a 50-hectare agro-industrial zone is being proposed. As support to the transshipment corridor role of the province, it will accommodate the food terminal (bagsakan), warehouses, storage facilities, and light industries.

The threat of climate-induced risks to Sorsogon City has far-reaching implications for trade and commerce. Increased precipitation threatens the commercial areas with flooding incidents while hotter days are expected to alter production patterns of the small manufacturing shops. With these, the service oriented livelihoods of the people are likely to be affected especially those which are dependent on climate and weather patterns (i.e. fish and agri products processing/ trading/vending; tourism; transport). Further, the health issues which may be brought about by the changing climate pose a great threat to those engaged in service oriented livelihoods.

Following the sea level-rise scenarios of 0.5 m, 1.0 m of the IPCC as well as the 2.0 m worst case scenario, the downtown area where major commercial establishments are located would be inundated. This can be seen by comparing the succeeding Figures (21 and 22).

Figure 20: City Urban Land Use Map highlighting the Commercial/Trading Area

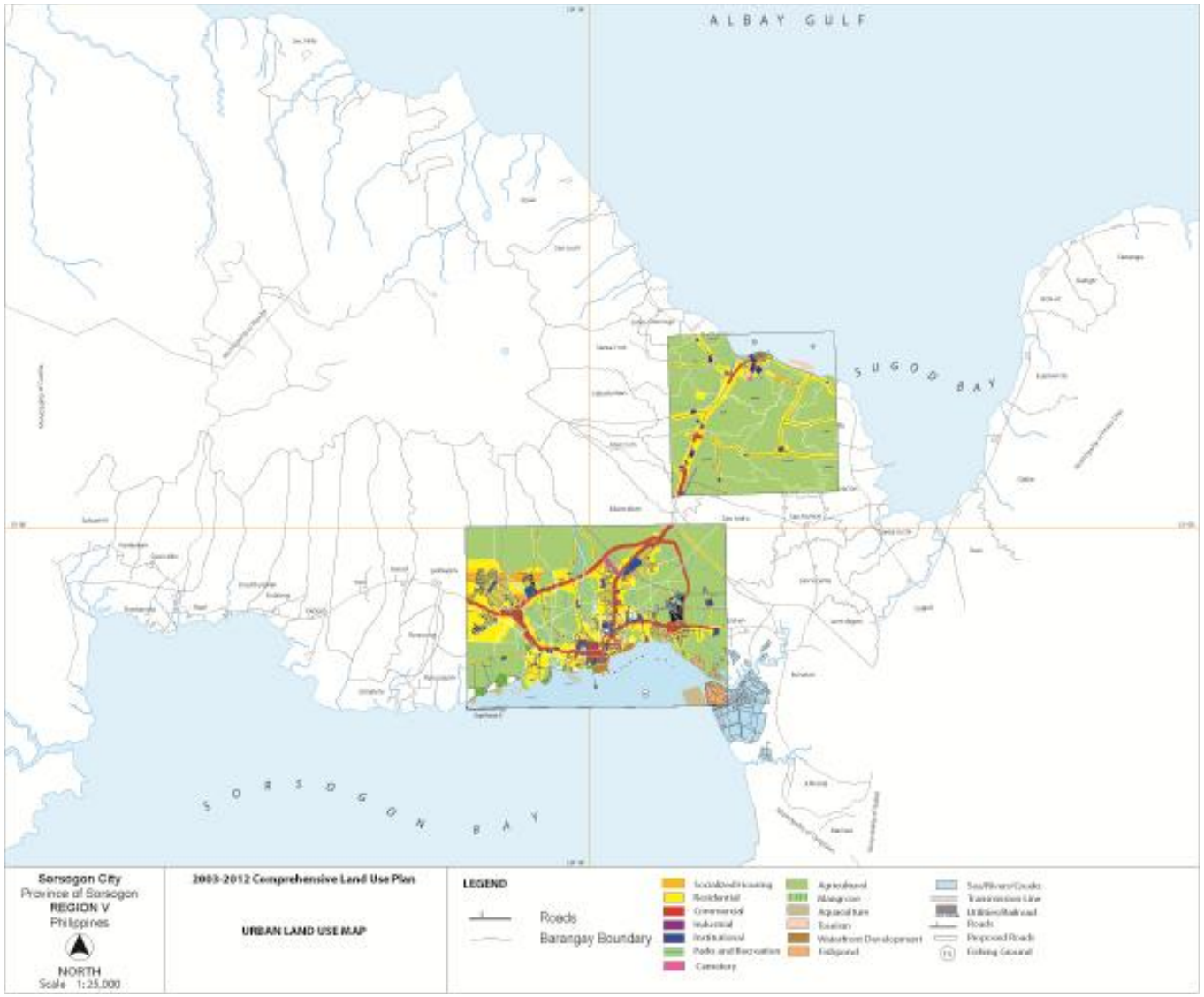
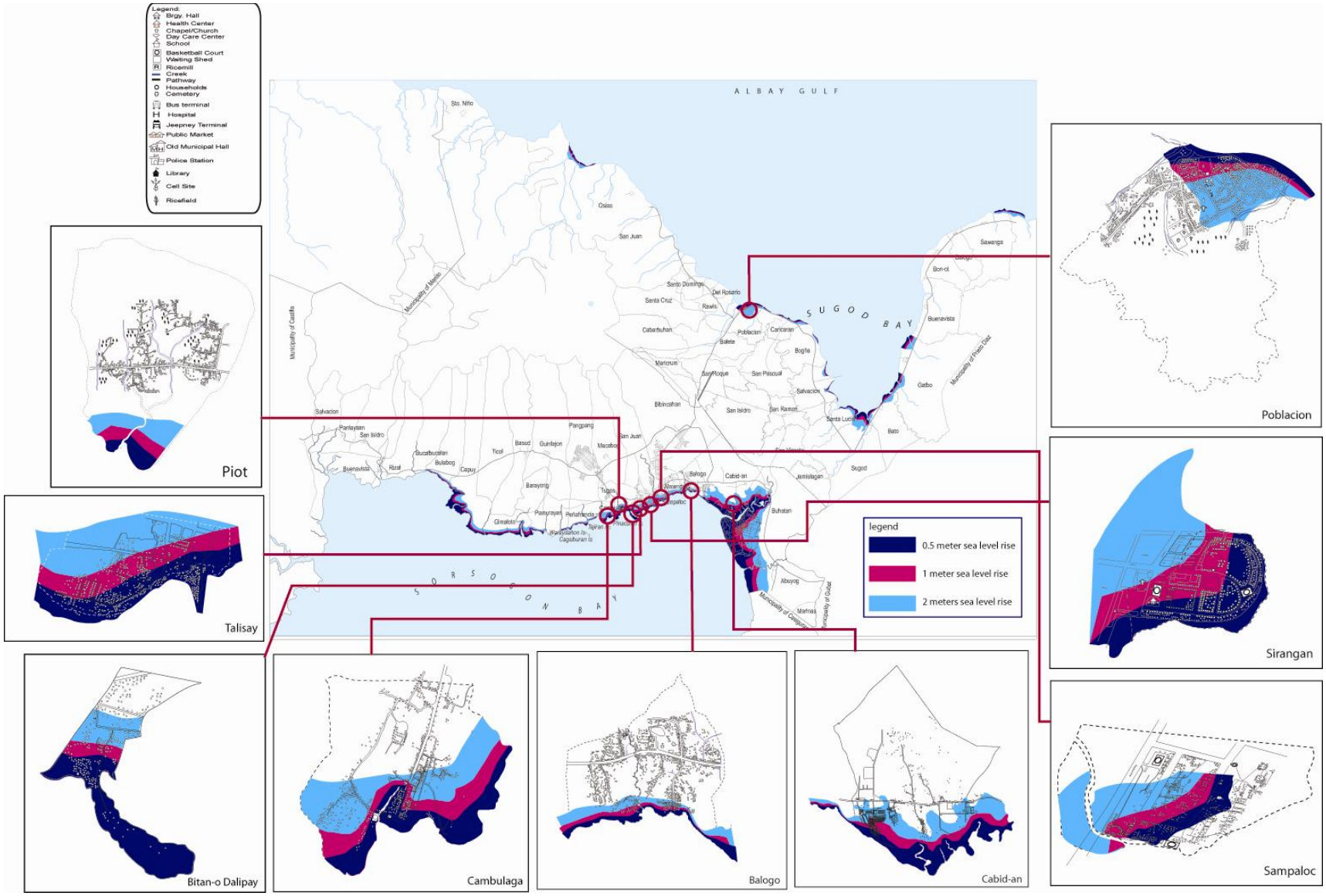


Figure 21


Legend:
Brgy. Hall
Health Center
Chapel/Church
Day Care Center
School
Basketball Court
Waiting Shed
Ricemill
Creek
Pathway
Households
Cemetery
Bus terminal
Hospital
Jeepney Terminal
Public Market
Old Municipal Hall
Police Station
Library
Cell Site
Ricefield
ALBAY GULF
SUGOD BAY
SOROSOGON BAY
legend
0.5 meter sea level rise
1 meter sea level rise
2 meters sea level rise
Piot
Talisay
Bitan-o Dalipay
Cambulaga
Balogo
Cabid-an
Poblacion
Sirangan
Sampaloc

ii. Tourism

The presence of whale sharks in the town of Donsol placed Sorsogon Province in the world tourism map. Because of the city's role as provincial administrative and commercial hub, foreign and domestic tourists invariably included the city in their itinerary. Besides historic turn-of-the century structures like the Provincial Capitol and the Sorsogon national High School, Sorsogon also serves as jump-off point to the tourist spots of the province.

It is for its many natural attractions, though, that Sorsogon is known. Rompeolas, with its walkway that serves as promenade, offers spectacular views of sunrises and sunsets, as does Paroja Hill and Grotto, which overlooks Sorsogon bay. Bucalbucalan and Palhi Springs in the West District and Busay Falls in the PNOC Exploration Site are ideal for cooling down, especially in the summer months. Bacon district has beaches, limestone caves, lakes and a marine sanctuary. Most notable of these are Paguriran Beach, which is surrounded by dark basalt, Tolonggapo in Caricaran and the Bato Limestone Caves inside which were found prehistoric artifacts.

The City caters to the needs of the majority of 60,415 Filipino tourists as the commercial hub of the province. Reports say that 38,881 foreign and 1,088 balikbayans that visit the province in 2006 *(Dept. of Tourism Region V Office).* To attract more visitors and to highlight the City's tourism potentials, two festivals are held annually: The Pili Festival in June and the Kasanggayahan Festival, which celebrates the Province of Sorsogon's foundation in October.

The tourism sector is projected to be greatly at risk with multiple exposures to climate change especially since its activities are very much related to seasonal weather and climate patterns. The areas at risk are the beach resorts and the parks located in the coastal areas. This would also have an impact on the tourism related businesses in the area – affecting the livelihoods and revenues that will be derived in this sector. The Caricaran resort area also should work on utilizing and adapting building designs and structures that are more resilient to stronger winds and more frequent and prolonged rainfall. As the area is directly facing the Pacific zone, the identified risks are mostly linked to extreme event hazards brought by cyclones (e.g. excessive rainfall and stronger winds).

iii. Agriculture

Agriculture plays a major role in the economy of Sorsogon City and its production is highly vulnerable to extreme rainfall and increased precipitation. Rice production covers a total land area of 2,482.4 hectares, where 23.42% or 581.4 hectares are cultured based on rain-fed system. The total rice production in the city involves 3,313 farmers. The city has a total area of 9,930 hectares of land devoted to coconut farming, in which there are 2,964 coco farms tended

by 7,272, coco farmers. There are 903,919 coco trees, 25,598 of which were damaged by past typhoons (2006). It also has 749,677 fruit bearing trees, while non-bearing trees account to 146,446. Other crops include banana, jackfruit, papaya, coffee, avocado, guava, santol, bamboo, cassava, gabi, camote, pineapple, and vegetables. Production of food crops, except for coffee and pili nut, is marketed as fresh. Sorsogon accounts for 70% of the total Pili production in Bicol Region.

The City Agriculture Office with the support of the Department of Agriculture (DA) at the national level has produced and has been promoting new rice varieties that could better withstand the hazards and variability brought about by climatic conditions. For instance the City Agriculture Office is now promoting and distributing some seed stocks that are adaptable to excessive water (flooding), strong winds and humidity. The IRRI 46 variety is an example of this adaptation. Table 9 shows the rice varieties that were developed and promoted by DA as adaptation to climate variability such excessive water, drought and strong winds. However, adaptation is deemed to be not enough to reduce the risk exposure of farmers to climate variability. Thus, preparedness measures, adaptation measures and farm planning that is based on "seasonality" (anticipating weather disturbances and climate variability) play a crucial role in this respect. Preparedness practices of the local farmers that could be enhanced further include the use of open-pollinated seed stocks, diversification of farming systems like inter-cropping and integration of vegetable growing and root crops, backyard livestock, savings mobilization and community-based insurance scheme. In the long term, the city government should also embark on identifying alternative or buffer plots that could be used for agricultural production that are more secure from the risks of flooding, drought and sea level rise.

Table 15: Rice Varieties Adaptable to Specific Climate Variability and Shocks

Rice Variety/Breed	Resiliency Type
▪ IR 64 ▪ PSB Rc18 ▪ PSB Rc 76H ▪ IR 42	Adaptable to excessive rain water and flooding. Also classified as tall varieties.
▪ PSB Rc16 ▪ PSB Rc24 ▪ PSB Rc70 ▪ UPL Ri7 ▪ UPL Ri5	Less water/drought, dry seeded varieties and also suitable for upland and rain fed type of farming.
▪ PSB Rc8 ▪ PSb Rc6	Short stand varieties, more resilient to strong winds

The most vulnerable rice growers are the ones located in the 9 coastal areas (see Fig. xx).18). There are 211 rice farmers in these areas tilling a total of 205.75 hectares. However, extreme events such as strong typhoons (120km/hr or more) will make all the agricultural production vulnerable to damage and losses. In recognizing this scenario, the investments and actions for preparedness, adaptation and systematic agricultural recovery programming, therefore, become a major concern.

Also the existing irrigation systems in the city are in danger of being destroyed in the event of extreme cyclones and prolonged monsoon rains, which could further put a strain on the agricultural production.

Nine irrigation systems serve 1,332 hectares of rice land though most of the systems need repair and upgrading. The old and partially damaged irrigation systems in the city put more pressure on the vulnerability of the rice growers, especially during the rainy and typhoon season (September to January).

- **Fisheries**

Sorsogon City is endowed with a wide array of fishery and aquatic resources being blessed with two (2) diverse seas: the Pacific Ocean in Bacon District and China Sea in Sorsogon District. Major fishing grounds include marine waters of Albay Gulf and Sugod Bay for Bacon District and Sorsogon Bay for Sorsogon District. Both Districts in addition to the above mentioned marine waters are rich in rivers and inland fisheries where fresh and brackish water aquacultures are tapped to supplement fishery production.

These resources, however, are threatened by manmade and natural ecological destruction and are also hard to come by in times of typhoon when fisherfolk are compelled to temporarily desist from their fish farming activities. Likely impact of climate change includes destruction of aquaculture sites and fishing capital such as fishing boats that are mostly traditional and small (less than 1 ton capacity).

Moreover, disasters could also alter fish, fisheries and aquatic resource distribution, diversity and production, in turn affecting the socio-economic condition of the people.

Capture fishery activities include the gathering of carpet shell (Baduy), Kapiz shell (Placuna placenta), and blue crabs. A majority of the mentioned products are highly valued for export except for the green mussel thriving in Sorsogon Bay due to high fecal coeliform contamination (REA by Ubitech, 1994) and is highly vulnerable to extended red tide contamination. (BFAR Shellfish Bulletin: Sept. 2006-present). Local authorities and local experts attribute the prolonged incidence of red tide to massive soil run off and flooding brought by the 2 cyclones in the last quarter of 2006 (climate-induced hazards). However, no studies yet have been conducted to scientifically analyse the reltionship between red tide and climate change. In addition to this, aquaculture production covers a total area of 227.33 hectares and the average annual production per year per hectare was monitored at 44,268 kilograms. Aquaculture activities include that of Tilapia culture in freshwater fishponds, prawn, mud-crabs, milkfish, and shrimp culture in brackish water fishponds. Mariculture activities include that of Seaweed (Kappaphycus alvarezii) culture and Green Mussel (Tahong) culture in Sorsogon Bay. These are highly prone to typhoon, storm surge and flood damage.

There are 4,304 fisherfolks in the city. These fisherfolks use small fishing boats- using motorized and non-motorized boats. Average daily fish catch is low - recorded at 2.75 kilos and the average number of boats unloading on a daily basis in the whole city is 1,530. This means that not all of the fisherfolks have their own fishing boats. Most fishing households are below the poverty threshold, making them more vulnerable to day-to-day shocks and to climatic-induced hazards. The hazard mapping of the City and the CC-TWG has identified a total of 1,291 fisherfolks in 9 villages to be the most vulnerable to multiple hazard exposure. Furthermore, there are also 211 fish vendors (Bacon District) whose livelihoods are likely to be disrupted particularly during extreme events and the majority of these vendors are women.

Table 16: Aquaculture, 2007

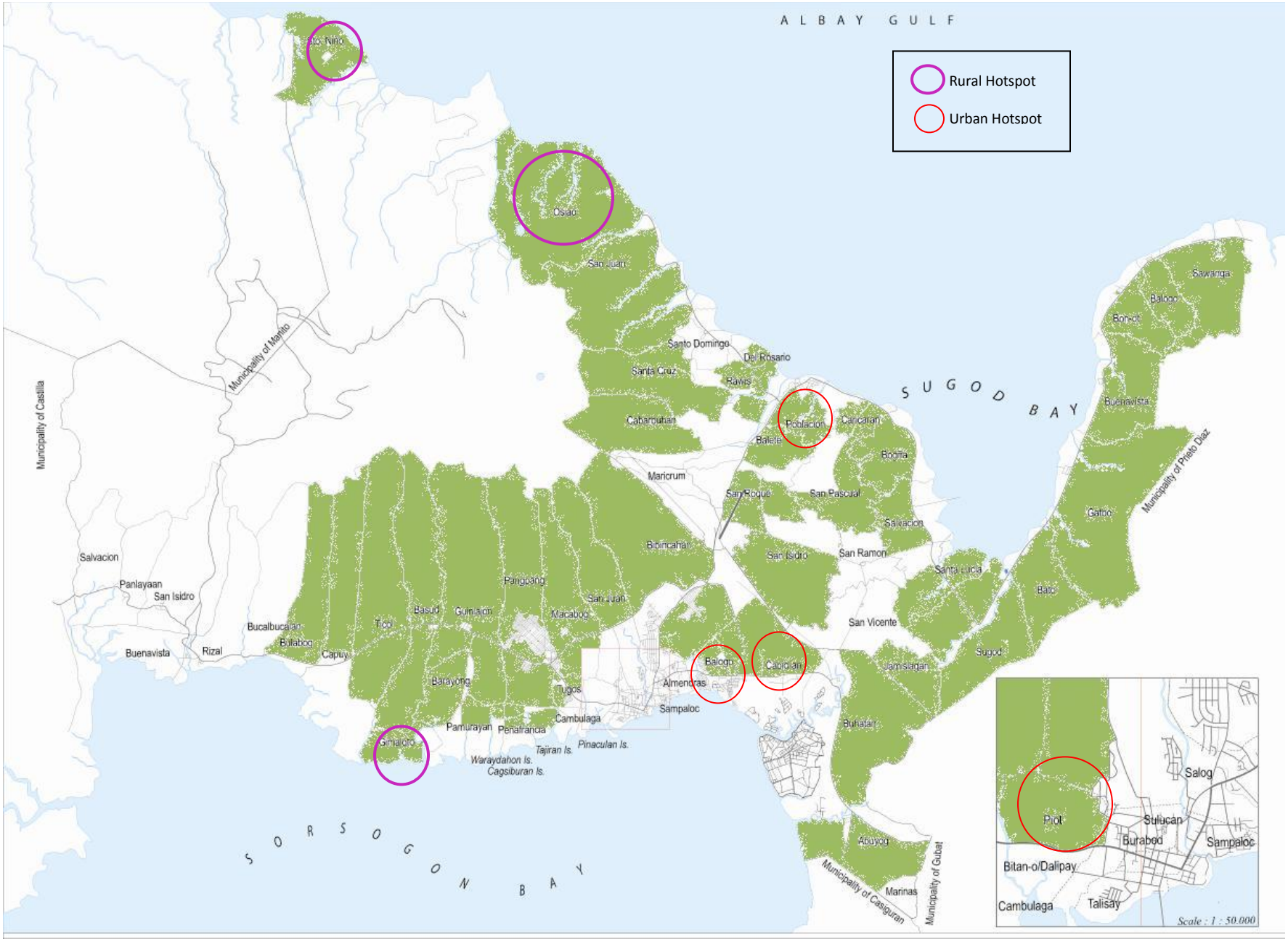
Fish production	
Municipal fishing	754.348 kg.
Backyard fishpond	123.4 kg.
Tilapia culture	123.4 kg.
Seaweeds (east and west dist)	11470 MT

Source: City Agriculture Office

Small-scale processing plants produce semi-processed seafood for export. Post-harvest processing comes in a variety of forms which include preservation of fishery and aquatic products in different methods including icing, drying, freezing, glazing, smoking, and to some extent processing them into value-added products like fish balls, fish crackers, and the like. Of the above- mentioned post harvest techniques, icing, freezing, and glazing are the common methods adapted by one small processing plant existing in the city. These fishing-related business and livelihood activities will likewise be affected by the effects and impacts of climate change in the future.

As in the case of farmers, those depending on fishing for livelihoods should expand their practices and technologies to be more adaptable to the potential impacts of climate change. The Bureau of Fisheries and Aquatic Resources (BFAR) and the local universities (Bicol University & Sorsogon State Colleges) could provide services in areas of research and extension work. As the current fishing methods in the City are of conventional and traditional type (with only minimal average daily fish catch of 2.75 kilos per fisherfolk), there is an increasing need to look for adaptable technologies that will enhance the economic and food security of the fishing communities. Extreme events such as strong typhoons (e.g. Sisang, Milenyo & Herming) and storm surges have in the past, greatly affected the fishing activities in the city. Common types of damage include the impairment of fishing boats, loss of fishing gears and nets, and damaged fish ports and aqua-culture plots. The current red tide in Sorsogon Bay after the cyclone Milenyo in 2006 has likewise disrupted the employment and incomes of at least 245 households that are dependent on “green mussel” culture with an estimated production of 141.8 metric tons in 2006 (prior to Typhoon Milenyo).

Figure 22: Rice Production Areas and Identified hotspots



3.1.4 City Adaptive Capacity: People and Institutions

In initiating a quantitative assessment of adaptive capacity, the city used selected socio-economic indicators and proxy indicators for technology and infrastructure as measures of capacity. The chosen dimensions and indicators are presumed to be key resources or assets towards developing responses to climate change at the individual or community level. Weights were defined based on the judgment of the assessment team relative to the indicators' degree of importance in off-setting negative climate change impacts. The results show that from the highest possible value of 1, the city's adaptive capacity is found to be higher than the mid-point of being able to adapt as it registered with a 0.61 rating.

QUANTITATIVE ASSESSMENT OF SORSOGON CITY CC ADAPTIVE CAPACITY

DIMENSIONS, INDICATORS AND RATINGS TO BE USED				CITY ADAPTIVE CAPACITY ASSESSMENT				
						Score	Wtd Score	Total Score
Socio-economic Dimension			**0.50**					**0.32**
HH above Poverty Threshold		*0.40*				0.57	0.23	
HH with secure tenure		*0.20*				0.46	0.09	
Literacy Rate		*0.20*				0.93	0.19	
PO/CBO/MFI membership		*0.20*				0.7	0.14	
							0.65	
Technology Dimension			**0.25**					**0.19**
Access to telecommunications		*0.30*				1	0.3	
Access to electricity		*0.30*				0.94	0.28	
Functional DRR Plan		*0.40*				0.5	0.20	
							0.78	
Infrastructure Dimension			**0.25**					**0.10**
HH with safe water access		*0.25*				0.72	0.18	
Paved Road		*0.25*				0.60	0.15	
Protective Infra		*0.50*				0.21	0.10	
-Sea Wall	*0.5*			0.7	0.35		0.43	
-Safe Housing Unit	*0.5*			0.16	0.08			
					0.43			
			1.00					**0.61**

Legend:

Assumed Weight per indicator
Total weight of indicators for the dimension
Score for poverty incidence is the % of households (HH) above poverty threshold/100
Score for informality is the % of HH with secure tenure/100
Score for literacy rate is literacy in the city/100
Score for PO/CBO/MFI membership is the % of HH (est) who have membership to associations (proxy of social capital)/100
Score for telecom is the % HH with access to communications (celphone, etc)/100
Score for electricity is the % of HH with electricity connection/100
Score for DRR is rated at 50% (based on judgment)/100
Score for safe water access is the % of HH with access to water/100
Score for paved road is the assumed % of road that are paved/100
Protective Infra is further divided by 2 sub-indicators: Sea wall where score is assumed rate of sea wall functionality/100; and safe housing where score is the % of HH estimated to have housing that were not affected during the last super typhoons
Wtd score = score x indicator weight
Sum of weighted scores
Dimension total score= sum of weighted score x Total weight of indicators for the dimension
Total Adaptive Capacity Score = Sum of Dimensions Total Score

The discussion below looks at the role and capacity of the city goverment and as an institution to promote resilience from negative impacts of climate change. The city goverment, as the provider of policies, framework and services that facilitate functionality in local systems and process in time of economic and natural distress, is deemed to be the core of the overall adaptive capacity of the city.

A. Governance

Decentralization of governance in the Philippines came upon the approval of the Local Government Code (LGC) of 1991. Politically and administratively, LGUs are categorised further into three sub-levels: the provinces at the highest level, followed by the municipalities or cities at the intermediate level, and the barangays (villages) at the lowest level. Each lower level LGU is under the administrative control of the next higher level LGU.

The central fiscal transfer system in the Philippines is classified into two major parts. First is the "revenue share" composed of Internal Revenue Allotment (IRA) and the Special Share in National Wealth/Taxes. The IRA is the share of sub-national governments (LGUs) in the internal tax revenues of the national governments, which include taxes on income and other levies imposed by the Bureau of Internal Revenue. The second is called the "categorical grant", which covers Municipal Development Fund (MDF), Countrywide Development Fund (CDF), Calamity Fund and other miscellaneous purposes. Under the LGC, the vertical sharing of the IRA is as follows:

Provinces	=	23%
Cities	=	23%
Municipalities	=	34%
Barangays	=	20%

The LGC has paved the way for LGUs to be responsible in planning for and managing local resources. The LGC further requires the LGUs to prepare comprehensive land use plans (CLUP) and comprehensive development plans (CDP). The compliance in the development of the CLUPs is regulated, monitored, and approved by the Housing and Land Use Regulatory Board. CDP's on the other hand are discussed and approved by the city and regional development councils (CDC and RDC) under the direct supervision of NEDA.

City classification in the Philippines:
Highly Urbanized Cities - Cities with a minimum population of two hundred thousand (200,000) inhabitants, as certified by the National Statistics Office, and with the latest annual income of at least Fifty Million Pesos (P50,000,000.00) based on 1991 constant prices, as certified by the city treasurer. There are currently 33 highly urbanized cities in the Philippines, 16 of them located in Metro Manila.
Independent Component Cities - Cities whose charters prohibit their voters from voting for provincial elective officials. Independent component cities are independent of the province. There are five such cities: Dagupan, Cotabato, Naga (in Bicol), Ormoc and Santiago.
Component Cities - Cities which do not meet the above requirements are considered component cities of the province in which they are geographically located. If a component city is located within the boundaries of two (2) or more provinces, such city shall be considered a component of the province of which it used to be a municipality.

There are three classes of cities in the Philippines: the highly urbanized, the independent component cities which are independent of the province, and the component cities which are part of the provinces where they are located and subject to their administrative supervision. Not having met the criteria for a highly urbanized city and without the prohibiting charter of an Independent Component City, The City of Sorsogon is classified as a component city of the Province of Sorsogon.

By looking closely into the institutional structure of the City Local Government, the key and critical Departments that could be tapped relative to climate change adaptation and mitigation actions are

the following: City Environment and Natural Resources Office (CENRO); City Planning and Development Office (CPDO); City Engineering Office (CEO); City Social Welfare & Development Office (CSWDO); the City Health Office; City Agriculture and Fisheries Office; and the City Disaster Coordinating Council.

Results of the LGU assessment however revealed the following critical factors constrain governance/institutional aspect of Sorsogon City in pursuing actions towards climate change mitigation and adaptation:

- limited technical capacity of city government staff in Environmental Planning and Management;
- limited knowledge of climate change projected impacts at the global, national, and local levels;
- lack of important hardware such as Geographical Information System that could support the environmental and development planning processes
- lack of information management system;
- absence of a city shelter plan and appropriate governance structure that will focus on the needs and action for the shelter sector;
- weak disaster preparedness and contingency plan.

Despite the constraints mentioned above there are facilitating factors and opportunities within the City governance structure that could prove to be assets in pursuing local actions towards addressing impacts of climate change. This facilitating factors and opportunities include:

- Commitment by the local chief executive and the city council to face climate change issues by (a) learning from and partnering with external partners, (b) engaging stakeholders in the discussions, and sharing available resources (human, technical, financial) in pursuing appropriate actions;
- Interest and commitment of LGU staff to learn and improve their technical capacities in Environmental Planning and Management;
- Acknowledgement of both the elected officials and the technical staff that they are highly vulnerable to climate change impacts; and
- There are already local policies issued that are aligned with climate change mitigation and adaptation that could be utilized as spring-board(s) to creating a more focused or programmatic action.

B. Disaster Risk Reduction: Organizational Responses and Mechanisms

Disaster preparedness is at the core of the city's development agenda. It is in the hands of the City Disaster Coordinating Council (CDCC). In times of natural catastrophe and other man-made hazards, the city carries out its disaster preparedness plans and contingencies through the City CDCC headed by the City Mayor. The CDCC is mirrored at the barangay/village level with the existence of the BDCCs headed by the Punong Barangay. Assisting also are the volunteers of the Sorsogon Emergency and Rescue Team and the Philippine National Red Cross for relief operations.

After the Super typhoon (2006): CDC at work

The CPDO provides data and information to CDCC with regard to risk reduction policies, strategies and plans.

These include zoning ordinances; natural hazard maps (flood, landslide, storm surge); demographics and logistics and other facilities that could be used by the city to enhance its risk reduction planning and programs. Through CDCC, the local government has prepared its City Disaster Profile (Office of the Mayor, 2008). The document presents basic information including a physical and demographic profile; the location of environmentally constrained areas relative to natural hazards; an inventory of available relief and emergency goods that will be readily available during or immediately after disaster. Parallel to this, the City has also developed its Disaster Risk Management Plan for the fiscal year 2008-2009. The plan focused on two major components namely (1) Disaster Preparedness and Risk Reduction and (2) Mitigation Measures.

With regard to Disaster Preparedness and Risk Reduction, the document formulated specific activities that have been lined for implementation:

- Activation and strengthening of the CDCC
- Identification of hazard-prone areas
- Identification and assessment of evacuation centres per village
- Public awareness campaign on disaster preparedness, prevention and mitigation including dry run and drills
- Organization of community volunteers
- Inventory of Equipment, Relief Goods and Personnel Resources
- Provision of engineering services especially in hazard-risk areas and rehabilitation and
- Constant monitoring and dissemination of the location and the possible direction of cyclones

Integrated into this plan are mitigation measures that emphasize actions on relocation of communities located in hazard prone areas; clearing of clogged water ways; inspection of infrastructure, reforestation programs and other institutional strengthening projects.

Furthermore, the CDCC has also identified its current institutional capacities and limitations as presented in the table below.

Table 17: The CDCC's Capacities and Gaps in Implementing Disaster Risk Management

Concerns	Capacities	Gaps
Response Plans and Strategies	• Active CDCC/BDCCs and presence of LD Composite Response Teams • Continued conduct of refresher courses for frontliners • Trainings and seminars for new volunteers in the barangays • Inventory of supplies and equipment before onset of calamities	Lack of some equipment -- • service vehicle assigned to barangay affairs • harnesses • hard hats with search lights • life vests • rubber boats • chainsaw • wet suits
Capacity to Implement	• Proper networking with concerned agencies in the conduct and implementation of the	

Concerns	Capacities	Gaps
	program • Active CDCC Task Units and physically fit Ligtas Disaster Composite Team	
Operational Support	• General Fund and 20% Development Fund • Active CDCC Task units	
Coordination Mechanism	• Established Action Center with satellite radio equipment for easy dissemination of information • Active and well-informed BDCCs/Volunteers • Use of trimedia, cellphones, landline, etc. in coordinating from the Action Center to the barangays • Established coordination strategies with the BDCC and other agencies and private group of volunteers of Composite Response and Rescue Team (CRRT) • Trained frontliners (Department of Education City Division) • Identified evacuation centers • Meeting of CDCC as a policy measure in case of natural disasters for the following purposes: • Deployment of different communities in their respective tasks • Actual identification and assessment of affected areas • Deployment of response teams per priority area • Consolidation of data in affected areas • Distribution of relief assistance	Insufficiency of communication equipment in some barangays like Osiao and Sto. Niño and their sitios, especially where there's no cellphone signal

Identified Evacuation Centers

Table 18: ECs in Bacon District

Barangay	Evacuation Centers
Balete	Central School Bldg., Chapel, Brgy. Hall, DCC
Balogo	Elementary School Bldg., Chapel, Brgy. Hall
Bato	Central School Bldg., Chapel, Brgy. Hall, DCC
Bogña	Elementary School Bldg., Chapel
Bon-ot	Elementary School Bldg., Chapel, Brgy. Hall
Buenavista	Elem./HS Bldg., Parish Church
Cabarbuhan	Elementary School Bldg., Chapel, Brgy. Hall
Caricaran	Poblacion Parish Church, Poblacion DCC/Brgy. Hall
Del Rosario	Brgy. Hall, DCC, Chapel
Gatbo	Elem./HS Bldg., Chapel
Jamislagan	Elementary School Bldg., Chapel
Osiao	Elem./HS Bldg., Chapel
Poblacion	Parish Church, DCC, Brgy. Hall
Rawis	Elem./HS Bldg., Chapel
Salvacion	Elementary School Bldg., Chapel, Brgy. Hall
San Isidro	Elem./HS Bldg., Chapel
San Jose	Elementary School Bldg., Brgy. Hall, Chapel
San Juan	Elementary School Bldg., Chapel
San Pascual	Elementary School Bldg., Brgy. Hall, Chapel
San Ramon	Elementary School Bldg., Brgy. Hall, Chapel
San Roque	Elementary School Bldg., Parish Church Brgy. Hall
San Vicente	Elementary School Bldg., Chapel
Sawanga	Elem./HS Bldg., Brgy. Hall, Chapel
Sta. Cruz	Elementary School Bldg., Chapel
Sta. Lucia	Elementary School Bldg., Chapel
Sto. Domingo	Elementary School Bldg., Chapel
Sto. Niño	Elementary School Bldg., Chapel, DCC, Brgy. Hall
Sugod	Elem./HS Bldg., Chapel

Table 19: ECs in East and West Districts

Barangay	Evacuation Centers
Abuyog	Elementary/HS Bldg.
Almendras-Cogon	SNHS/SCC Bldg.
Balogo	Elementary School Bldg., Brgy. Hall
Barayong	Elementary School Bldg., Brgy. Hall
Basud	Elementary School Bldg., Brgy. Hall
Bibincahan	Elementary School/ SNHS/SCC Bldg.
Bitan-o/Dalipay	Elementary School Bldg., Provincial Gymnasium
Bucalbucalan	Elementary School Bldg.
Buenavista	Elementary School Bldg.
Buhatan	Elementary School Bldg., Brgy. Hall, Soreco II Bldg.
Bulabog	Elementary School Bldg., High School Bldg.
Burabod	Elementary School Bldg., PAFC Bldg.
Cabid-an	Elementary School Bldg., Brgy. Hall NFA/BAI Bldg./Seabreeze Church
Cambulaga	Elementary School Bldg.

Barangay	Evacuation Centers
Capuy	Elementary School Bldg., NFA Bldg., Brgy. Health Care
Gimaloto	Elementary School Bldg.
Guinlajon	Elem./HS Bldg.
Macabog	Elementary School Bldg., Chapel
Marinas	Elementary School Bldg.
Pamurayan	Elementary School Bldg., Chapel
Pangpang	Elementary School Bldg., Brgy. Hall
Panlayaan	Elementary School Bldg.
Peñafrancia	Elementary School Bldg.
Piot	Provincial Gymnasium, Aemilianum College Inc.
Polvorista	SECS Bldg., Multi-Purpose Bldg
Rizal	Elem./HS Bldg., Brgy. Hall
Salog	SNHS/SCC Bldg.
Salvacion	Elementary School Bldg.
Sampaloc	Elementary/SNHS Bldg., PNP Provincial Head Quarter Pcs
San Isidro	Elementary School Bldg.
San Juan	Elementary School Bldg., Chapel, Home For The Aged
Sirangan	Sts. Peter & Paul Cathedral, SPES Bldg., SLMCS Bldg.
Sulucan	Sorsogon Shopping Center, PNP Provincial Hq.
Talisay	Elementary School Bldg., Chapel
Ticol	Elementary School Bldg.
Tugos	Elementary School Bldg., RHU Center

Source: CDCC, City Disaster Preparedness Plan

A closer look at the City Disaster Risk Management Plan shows no corresponding budget for the lined-up activities. Only the 5% Calamity Fund (5% of total City Development Fund Budget) was made available to support this plan. However, this calamity fund can be accessed only after disasters and is usually allocated for relief and emergency purposes. Thus, DRM in the city is very reactive and response oriented and so consequently misses the equally important items that contribute to disaster mitigation and preparedness. Likewise, the pre-identified evacuation centers in the whole city were not built per se to address the needs during or after emergencies or disasters.

While their locations are evenly and strategically dispersed in the city, these evacuation centers cannot be used for this purpose as they are basically public school buildings. The use of these facilities during and after emergencies disrupts the conduct of regular classes and also threatens sanitation and hygiene conditions in these areas. For instance, the past cyclone (Milenyo, 2006) disrupted the classes of the primary and secondary grades for almost a month to give way to emergency needs (evacuation and distribution hubs for food and relief items). There is therefore, the need to consider how the city and communities can address this problem (e.g. emergency evacuation) without sacrificing the main purpose of the said school buildings.

C. Local policies and legal initiatives

The following are local policies and issuances by the city Government that relate to environmental and other urban management issues/concerns.

Table 20: City Policies and legal initiatives

City Ordinances	Title/Description	Remarks relative to Climate Change (CC)
004-02	An Ordinance prohibiting the construction or establishment of fish corrals, green mussel farms and other fishing structures and paraphernalia within 500 meters parallel to both sides of the Sorsogon Pier sea ward according to the requirements of safe navigation.	Contributes to CC Mitigation
001-05	An Ordinance providing for the comprehensive and continuing development program for the urban poor sector and appropriating funds for the purpose	Contributes to CC adaptation
007-05	The Ecological Solid Waste Management Ordinance of the City of Sorsogon	Contributes to CC adaptation and mitigation
013-05	An Ordinance providing for the development, management, conservation, protection, utilization and disposition of all fish and fishery aquatic resources within the city waters.	Contributes to CC Mitigation
014-05	Fish Sanctuary Ordinance	Contributes to CC adaptation and mitigation
003-07	An Ordinance establishing the 2007 Sorsogon City Anti-Poverty and Education Program	Contributes to CC adaptation
006-07	An Ordinance mandating Green Policy in Sorsogon City	Contributes to CC adaptation and mitigation
012-07	An Ordinance prohibiting all gasoline stations, auto repair shops, car washing center, funeral parlors, etc. from disposing and pouring used oil, waste water liquid and other polluting/toxic liquid into drainage canal that flow into the creeks and unto Sorsogon River	Contributes to CC mitigation
005-08	An Ordinance adopting Zoning Regulations for the City Of Sorsogon and providing for the Administration Enforcement and amendment thereof and for the repeal of all Ordinances in conflict therewith.	Contributes to CC adaptation
006-08	An Ordinance creating the Sorsogon Rivers Council, defining its powers and responsibilities and appropriating funds for its operation.	Contributes to CC adaptation
007-08	Resolution enacting an Ordinance requiring all owners of Residential and Commercial establishments within the territorial jurisdiction of Sorsogon City to clean the sidewalk fronting their establishments.	Contributes to CC mitigation
002-08	Ordinance establishing the Sorsogon City Zoning Regulations and Creating thereby the Office of the City Zoning Administrator for the purpose.	Contributes to CC adaptation and mitigation
013-08	No smoking Ordinance	Contributes to CC mitigation

In scanning the above policies, it was gleaned that the city would need to create and develop a more responsive policy environment that would address the encompassing challenges brought by climate change risks and threats. It is expected that mitigation as well as adaptation frameworks be mainstreamed in the local governance and development planning process of the city. Policy formulation should emphasize actions addressing gaps in local implementation of the national laws such as the Clean Air Act, Solid Waste Management Act, etc. Moreover, there must be complementary issuances at the local level on the promotion of the National Climate Change Framework and Agenda.