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Veröffentlichungsversion / Published Version
Konferenzbeitrag / conference paper

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
SSG Sozialwissenschaften, USB Köln

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Land, Livelihood, Poverty:

Assessment of Selected Socio-economic Factors Influencing Community Adaptive Capacity to Climate Change

Paper presented at the ESF-UniBi-ZiF research conference on 'Environmental Change and Migration: From Vulnerabilities to Capabilities', Bad Salzuflen, Germany, December 5-9, 2010

COMCAD Arbeitspapiere - Working Papers
No. 94, 2011

Series on Environmental Degradation and Migration
Editors: Jeanette Schade and Thomas Faist

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Editorial

The conference "Environmental Change and Migration: From Vulnerabilities to Capabilities" was the first of a new conference series on "Environmental Degradation, Conflict and Forced Migration". It was organised by the European Science Foundation, the Bielefeld University and its Center for Interdisciplinary Research. The Center on Migration, Citizenship and Development (COMCAD), the Universities' unit responsible for scientific content and quality of the conference, has launched a COMCAD Working Paper Series on "Environmental Degradation and Migration". The new series intends to give conference participants the opportunity to share their research with an even broader audience.

The symposium focused on how environmental change impacts the nexus between vulnerabilities on the one hand and capabilities on the other hand, and how this relationship affects mobility patterns. Although the conference organizers chose to include all kinds of environmental change and types of migration, climate change figured prominently among the submissions to the conference. Therefore, the conference aimed to bring together the perspectives from climate change, vulnerability, and migration studies, and to draw conclusions about the political implications of the knowledge scientists currently have available. Toward that goal, the conference was structured along three pillars. The first concentrated on climate change and the vulnerability of certain regions and groups. It covered case studies as well as different approaches for making climate change projections and assessing the likelihood of vulnerability. The second pillar focused on empirical research on environmentally induced migration from a vulnerabilities perspective, but acknowledged the occasionally strong elements of capability within it. In this way, the aim was to learn about approaches and options to support existing capabilities. The third pillar was concerned with the opportunities and pitfalls of policy options in dealing with the future challenge of climate induced displacement, and with the analysis of dominant public discourses within the field.

The researchers invited represented a wide range of disciplines, including sociology, social anthropology, migration, conflict, gender and development studies, geography, political science, international law, and climate and environmental science. The conference was also well balanced in terms of geographic origin, gender, and academic status of the participants. The conference programme and full report can be found at www.esf.org/conferences/10328.

Bielefeld, February 2011 Jeanette Schade and Thomas Faist

Butardo-Toribio, Maria Zita: Land, Livelihood, Poverty: Assessment of Selected Socio-economic Factors Influencing Community Adaptive Capacity to Climate Change
Bielefeld: COMCAD, 2011
(General Editor: Thomas Faist, Working Papers – Center on Migration, Citizenship and Development; 94)

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Abstract

This study provides insights on selected socioeconomic factors that influence community vulnerability to climate change variability and extremes in the Philippines, with particular focus on data generated from the vulnerability assessment conducted in Bayawan City, Negros Oriental, Philippines. The city government of Bayawan has invested financial resources in physical infrastructure and environmental mitigating measures, and has established a working system for disaster preparedness, rescue and relief. Current socio-economic conditions, however, hamper the ability of some members of the coastal communities in this city to effectively adapt to immediate and long term risks posed by climate change without external support from the local government and other organizations. Despite yearly risks from flooding and effects of strong typhoons that threatened their health, lives and properties, families that are landless, marginalized and impoverished continued to settle illegally on river easements and other public lands along the coasts. The pattern is to evacuate the area when exposure to risks is high, and then returning to the land after a disaster event passes. In many other areas in the Philippines, marginalized, resource poor families have few options but to settle illegally in disaster prone public lands in coastal and upland areas where they are exposed to hazards and risks associated with climate change. With limited access to sustainable, alternative livelihoods and economic means, their capacity to adapt to climate variability and extremes is low. Climate change vulnerability assessment studies should, therefore, should incorporate systematic approaches to assess the prevailing socio-economic conditions of communities, particularly with respect to the interrelated problems of “landlessness”, lack of alternative livelihood, and poverty which constrain their adaptive capacity. Climate change adaptation and disaster risk reduction programs should consider these factors to enhance the long term effectiveness and efficiency of these efforts. The present study also shows how good governance has enabled a local government unit to implement mitigating and adaptation measures that reduce community vulnerability to potential impacts of climate change, even though the communities themselves have low adaptive capacity due to their marginal conditions.

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1. Introduction

Ironically, while the Philippines is a minor emitter of greenhouse gases as it accounts for only less than 0.3% of global GHG emissions (DENR, 2010), it is among the countries at high risk from impacts of a globally changing climate. Apart from the country's geographic attributes[1], the geographic location [2] of most of the populace and the limited resources available in government to fund adaptation requirements (let alone achieve the 2015 MDGs)[3] contribute to the vulnerability of the country to natural disasters[4]. Climate change further exacerbates the country's vulnerability to natural hazards as observed by the World Bank and the National Disaster Coordinating Council in the document "Country Disaster Management Note" (reference: http://gfdrr.org/ctrydrmnotes/Philippines.pdf):

> "In the last 15 years alone, the country has recorded the strongest typhoon, the most destructive typhoons, the deadliest storm and the typhoon with the highest 24-hour rainfall. These climate trends seem to fit the scientific evidence that rising sea surface temperatures enhance the destructiveness of tropical cyclones. The Philippines is expected to experience substantial rise in sea levels, making 70 percent of the 1,500 municipalities located along the coast vulnerable to this phenomenon. The country is also witnessing longer episodes of drought or El Niño, causing a large drop in the volume of agricultural production and sharp declines in GDP".

Key trends in Philippine climate presented in Annex 1 suggest that climate change may already be occurring in the country.

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1 This archipelagic country composed of more than 7,100 islands lies in the western rim of the Pacific Ring of Fire- a belt of active volcanoes, major earthquake faults, and tsunamis (DENR, 2010); moreover, the country has 220 volcanoes 22 of which are considered active; it is also found along the Western North Pacific Basin where sixty six tropical cyclones yearly enter or originate from (http://gfdrr.org/ctrydrmnotes/Philippines.pdf).

2 An estimated 57 million or 62% of the country's population live along its 36,289 total stretch of coastline. As early as the 1980s, an estimated 17.8 million people live (Cruz et al 1988) on the fragile and marginal uplands. Around 20 to 24 million people, nearly one-third of the country's total population, now inhabit the uplands of many watersheds (Lasco, et. al. 2010). The coastal areas are vulnerable to sea level rise and damage from strong typhoons. The country's upland areas are prone to landslides and erosion.

3 The funding gap from 2012-2015 to achieve the Millennium Development Goals by 2015 is estimated at around $11.5 billion (Business World, October 19, 2010 issue, p. S1/1), the amount does not include yet estimates of needed funds for education. An estimated $7.9 billion (or 67% of the total funding gap) is needed to implement project related to MDG 1 or the eradication of extreme poverty and hunger.

4 The Philippines ranked 8th in World Bank's natural disaster hotspot list of countries most exposed to multiple hazards (Philippines Country Disaster Risk Management Note, found on http://gfdrr.org/ctrydrmnotes/Philippines.pdf). At least 60% of the total land area of the country exposed to multiple hazards and 74% of its population vulnerable. A third of the 807 natural disasters that occurred in Southeast Asia from 1990-2009 occurred in the Philippines (EM-DAT: The OFDA/CRED international Disaster Database www.embat.be-University Catholique Louvain-Brussels-Belgium cited on http://gfdrr.org/ctrydrmnotes/Philippines.pdf).

Practically all regions in the Philippines are climate-related hazards hotspots, with drought, floods, cyclones, and landslides as the dominant types of hazards (Yusuf and Francisco, 2009). The average annual damage caused by disasters is equivalent to an average of 0.5% of GDP each year, since about 85% of the country's annual Gross Domestic Product (GDP) is found in risk areas (World Bank 2008). In 2009 alone, the three typhoons Ketsana, Parma, and Mirinae which occurred from September to October affected more than 10 million people (http://www.irinnews.org/report.aspx?ReportID=88572, accessed October 21, 2010).

While people are not passive actors and, hence, can be expected to evolve strategies that will lower their exposure to or evade risk, the heterogeneity of socio-economic conditions among major income and livelihood groups means that the ability to cope with and respond to climate change- related risks and impacts can also vary within the same community exposed to the same risk conditions. This realization is particularly relevant for the Philippines where income inequality persists, and the majority of the population continues to be poor[5].

Given that resources are limited, vulnerability assessment plays an important role in identifying and prioritizing localities that need help to cope with climate change impacts. One important determinant of vulnerability[6] is adaptive capacity. Demographic and socio-economic variables such as population density, Human Development Index (HDI), income equality, and poverty incidence, which are generally measureable at the national and regional levels, are some of the commonly used indicators of adaptive capacity (e.g., DENR, 2010; Yusof and Francisco, 2009).

To be more useful for adaptation planning at the community or local government unit level, this study suggests that vulnerability assessments should consider the heterogeneity of im-

[5] As of 2003, high income class families comprised only 0.20% of total families in the Philippines, middle income class, 20%, and low income class 80%. In 2006, the Gini coefficient has slightly improved from 0.4605 in 2003 to 0.4564 in 2006, indicating an income distribution that is getting slightly more equitable. A Gini coefficient ranges from 0 to 1, with 0 indicating perfect income equality among families, and 1 indicating absolute income inequality. The upper 50% of families earned 81 percent of total income while the lower half earned 19 percent in 2006 . 174 thousand The 174,000 'top 1 percent' families earned the equivalent of what 5.2 million 'bottom 30-percent' families collectively earned in 2006 (http://www.nscb.gov.ph/headlines/StatsSpeak/2007/121007_rav_poverty.asp; http://makuhari.wordpress.com/2007/08/13/3-ways-of-looking-at-the-income-distribution-of-the-philippines/)

[6] According to IPCC (2007) vulnerability to climate change impacts is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity). Exposure refers to the nature and degree to which a system is exposed to significant climatic variations. Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Adaptive capacity measures the ability of a system to adjust to climate change, to moderate the potential damage from it, to take advantage of its opportunities, or to cope with its consequences.

pacts and responses among the different cross-sections of communities exposed to the same climate variability and extremes. Specifically, the context-specificity of climate change impacts on the poor should be considered (African Development Bank, et. al, undated). In addition, there is also a need to look at poverty beyond official income statistics and to examine how its different dimensions and effects on access[7] (e.g. livelihood, land, access to resources and basic services) influence the varying ability of households and communities to adopt measures that will lessen their exposure and sensitivity to climate risks.

This study generally aims to contribute to existing knowledge on how the interrelated problems of poverty, poor resource access (particularly landlessness) and livelihood limitations influence community vulnerability to climate change. This has the following interrelated specific objectives:

1. Determine the socio-economic impacts of climate variability and extremes on selected resource-poor and marginalized communities;
2. Assess the various coping/adaptation strategies of resource- poor marginalized communities to climate change variability and extremes;
3. Examine how the interrelated factors of poverty, landlessness, and lack of alternative livelihood affect community adaptation to climate variability and extremes.

Both the upland and coastal areas of the Philippines are vulnerable to climate change. This study, however, has primary focus on coastal areas and coastal communities.

Philippine coastal areas are extremely vulnerable to climate change particularly from the effects of sea level rise and strong typhoons (Perez et al., 1999; DENR 2010). Since more than 60% of the country's population live along the coast[8] and coastal areas have higher density populations (286 persons/km²) than non-coastal areas (229 persons/km²) (Arc Dev, 2004) climate change will have major consequences for coastal dwellers. Moreover, the heavy dependence of more than 60% of the coastal population of the country on the coastal and marine resources for livelihood makes them highly economically susceptible to climate change impacts. According to DENR (2010) the risk of livelihood loss and occupational hazards to

[7] For instance, In her work Poverty in the Philippines: Income, Assets, and Access, Schieleg (2005) took a more multidimensional approach to access by the poor by examining human, physical, natural, social, and financial capital and by building on the sustainable livelihoods approach with vulnerability as a central concept.

[8] 82% of the country's 79 provinces, more than half of its 135 cities and 70% of its 1,512 municipalities are coastal.

coastal and marine stakeholders will be amplified by harsh weather condition, alteration in the distribution and range and seasonal patterns of fish stocks, and reduction in the availability and quality of fisheries products. Coastal fishers and households also suffer from very high poverty incidence. Fishing households earn an average annual income equivalent to only half of the national average (WB, 2005). In 1996, it was estimated that 80% of coastal households were living below the poverty threshold (DENR et.al, 2004). The most recent poverty data from the National Statistical Coordination Board (NSCB) reveals that fishermen, together with farmers and children comprised the poorest three sectors in 2006. In addition, not only are the country's fishing households poorer, they are also less literate, and have less access to basic necessities like good shelter, safe drinking water, toilet facilities and electricity as compared to non-fishing households (Israel, 2004 cited in Meńez and Toribio, 2010). Unfortunately, despite the fishery sector's high vulnerability to climate change risk and the largely undocumented chronic poverty within the sector, there is insufficient socioeconomic statistics gathered and vulnerability assessment done for this sector (DENR 2010).

2. Study Framework

The theoretical framework used for this study is presented in Figure 1. Climate change impacts on people in two major ways. The first is through its effect on the quality and functioning of ecosystems that provide goods and services that support peoples' livelihoods (African Development Bank et al, no date). Secondly, climate change intensifies the effects of non-climate environmental stressors such as pollution and overexploitation, which, in turn, reduces the resiliency of ecosystems to the onslaught of climate change and the processes by which these ecosystems recover from both climate and non-climate stresses. The impact of climate change on the quality of the natural resource base and the provisioning of ecosystems goods and services can reinforce chronic poverty by encouraging more short-sighted and more exploitative use of the natural resources, such as dynamite fishing and fishing using poisonous substances in the case of fishing communities.

Vulnerability of people and of ecosystems to climate change can vary depending on their exposure, sensitivity and adaptive capacity (IPCC, 2007). In the case of natural ecosystems, the concepts of regenerative capacity, thresholds, carrying capacity, and resilience are some of the relevant concepts in determining sensitivity and adaptive capacity. In the case of the social system, the degree of vulnerability will be influenced by several factors such as the people's geographic location (which determines exposure to risks and hazards), socio-economic conditions (as a measure of adaptive capacity), and demographic characteristics such as sex and age (which influences sensitivity). Cultural characteristics, the priorities and

concerns of people, and institutional and political constraints also affect vulnerability (African Development Bank et al., undated).

Based on the above considerations, the country's rural and urban poor which comprise a third of the total population are the most at risk[9]. Most of the poor in the country reside in rural areas[10] where limited livelihood options make them depend heavily on low output fisheries, agriculture, and forestry-based income sources[11]. Because almost a third of the employment in the Philippines is agriculture-based, natural and climate change- induced disasters have contributed to rising rural poverty incidence (Philippines Disaster Management Note, found on http://gfdrr.org/ctrydrmnotes/Philippines.pdf). Moreover, in their study of the distributional impacts of the 1997 economic crisis in the Philippines, the World Bank (2000) found that El Niño has not only contributed the largest share of the total impacts on measures of incidence, depth and severity of poverty than the financial crisis, but that the impact of this natural phenomenon was also regressive or increasing inequality. Disasters reinforce pre-existing socio-economic divide among Filipinos, not only by damaging natural resources that support the poor's long-term livelihood prospects and destroying their current produce, but by repeatedly rendering the poor homeless (Philippines: Country Disaster Risk Management Note Available on: http://gfdrr.org/ctrydrmnotes/Philippines.pdf) and destroying whatever little material possessions they might have. Not surprisingly, the three big typhoons (Ketsana, Parma, and Mirinae) that occurred in 2009 contributed to poverty shocks in the country in that year (Balisacan, 2010). Worse, the increasing frequency and magnitude of extreme climate events allows for shorter periods of socio-economic recovery before another disastrous event strikes, and the poor are again affected. To illustrate ENSO-droughts have

[9] Based on the 2006 official poverty statistics 33 percent of the population, or roughly 27 million Filipinos, are considered poor or living on incomes below the poverty threshold (NSCB website). Extreme poverty (assessed by inability to buy sufficient food) as well as the broader measure of poverty (assessed by inability to buy food and other basic essentials) increased from 2003-2006. The number of people who rate themselves as poor in social surveys exceed official poverty statistics and applying constant (in real terms) poverty threshold Philippines means poverty is more prevalent than officially reported (Balisacan, 2010). The country's 2010 HDI of 0.638 gave it rank of 97th out of 169 countries, which is an improvement over its previous HDIs. However, while the country's HDIs in 1980, 1990, 2000, and 2005 used to be higher than the average for East Asia and the Pacific, its HDI growth from 1980 to 2010 is below the average rate for this region (Esplanada, 2010, found on Philippine Daily Inquirer. Philippines 97th out of 169 nations in quality of life report, November, 2010, p A6.

[10] About three-fourths of the country's total poor live in rural areas, typically the landless agricultural workers and tenants, fishermen, forestry workers, and indigenous peoples. Rural poverty incidence was estimated to be 41.5 percent in 2006 compared to only 14.4 percent in urban areas (National Statistical Coordination Board).

[11] Fisheries and coastal resources suffer from illegal and destructive fishing, overfishing, land and marine-based pollution, and others (Meñez and Toribio, 2010); agricultural lands are threatened by land degradation, conversion to other land-uses (Angeles, 2010), while the forests have reportedly expanded in area due to tree plantations, protected areas establishment, and rehabilitation activities they continue to be threatened by illegal harvesting, conversion to non-forest uses, etc (Tesoro. 2010).

occurred every two years in the 1990s compared to the almost every four year interval in the 1970s and 1980s (Philippines: Country Disaster Risk Management Note Available on: http://gfdrr.org/ctrydrmnotes/Philippines.pdf).

Climate-change induced natural disasters can particularly increase vulnerability and perpetuate the deprivation and marginalization of the poor who live in calamity-prone areas such as riverbanks, those in flood-prone coastal areas and on steep slopes in upland areas (http://gfdrr.org/ctrydrmnotes/Philippines.pdf). In the Philippines, landlessness forces marginalized, resource poor families to settle illegally in hazard and disaster prone public lands[12] in both urban and rural areas, where they have limited access to sustainable, alternative livelihoods and have poor access to basic government services. According to the Country DRM Note, "Rapid urbanization in the country has led to urban squalor and the proliferation of unplanned, informal, and overcrowded settlements, often in hazard-prone areas. As of 2002, the country had about 1.2 million families of informal settlers who were vulnerable to typhoons and flooding. Demographic growth and urbanization have also affected the provision of basic services, resulting in deteriorating solid waste management and siltation of rivers and drainage channels, which are aggravating flooding in urban areas".

While climate change can force people to modify livelihood strategies, the impact on the poor could vary depending on economic diversification and presence of alternative income opportunities (African Development Bank et al., undated). Coupled with other socio-economic conditions, as well as cultural, and governance/institutional factors, lack of control and access over natural resource assets such as land, crops, fisheries, trees, etc, can limit livelihood adaptation options for marginalized people. For instance, in their pioneering study of vulnerability and impacts of climate change variability and extremes in the Pantabangan-Carranglan Watershed in Northern Luzon, Philippines, Lasco et al (2010) observed that while the communities in the watershed are generally vulnerable to climate variability and extremes

[12] Under PD 705 (Revised Forestry Code), the following areas are considered part of the inalienable land of the public domain and therefore cannot be privately appropriated/titled and may be disposed of only by lease: a) "Twenty-meter strips of land along the edge of the normal high waterline of rivers and streams with channels of at least five (5) meters wide subject to the easement for public use as provided in Article 51 of PD 1067 (Water Code); b) Strips of mangrove or swamplands at least twenty (20) meters wide, along shorelines facing oceans, lakes and other bodies of water, and strips of land at least twenty (20) meters wide facing lakes subject to the easement for public use as provided in Article 51 of PD 1067. Article 51 of PD 1067 states that "The banks or rivers and streams and the shores of the seas and lakes throughout their entire length and within a zone of three (3) meters in urban areas, twenty (20) meters in agricultural areas and forty (40) meters in forest areas, along their margins, are subject to the easement of public use in the interest of recreation, navigation, flotage, fishing and salvage". These areas mentioned in Article 51 of PD 1067 correspond to the foreshore and salvage zone of the coastal zone and portions of the riparian area, which similarly cannot be privately titled.

by virtue of their geographic location, their degree of vulnerability varied with socioeconomic circumstances as well as the broader sociopolitical and institutional contexts. More specifically, Lasco et al (2010) found that the well-off sector of the community has better access and control over productive resources and has the option to live in safer places and fund more effective adaptation strategies which put them in a less vulnerable situation. They are also more inclined to capture most of the benefits from the different development projects due to better association and linkage with institutions that implement these projects.

The small farmers were the most vulnerable in the surveys conducted by Lasco et al (2010), since most of them have very low educational attainment, do not own a parcel of land, have very meager income, have no capital, live in more vulnerable areas, and do not have access to other productive resources. Freshwater fishermen, farmers with small land and little capital, owners of small enterprises, craftsman and employees who are better educated than small farmers and have more access to productive resources such as land, capital, and technology were found to be moderately vulnerable. The least vulnerable constitutes the families of overseas workers and the rich farmers, who are in general, the most educated among the study groups and usually have large farmland, own farm machineries and tools and have capital to invest. Lasco et al (2010) moreover, found five variables significantly related with households' vulnerability. These were: sex and ethnic affiliation, membership in organizations, land ownership, and farm distance to market. This supports World Bank's (2000) findings that certain household and community characteristics influence the degree of the impact and that diversity in occupational sources help mitigate the adverse impacts of El Nino.

Climate change can also have direct physical impact on vulnerable groups. For instance, inundation of coastal areas due to sea level rise could threaten human settlements and coastal structures due to coastal land loss. This can trigger relocation of settlements to inland areas or force the migration of those affected to outside localities. Migration as a response to either or both economic (livelihood) and physical displacement is a product of complex decision-making that can be influenced by many factors (Barker 2008). The decision when to migrate whether short-term, long-term, permanent, as well as where to migrate- short-distance, rural to urban, rural to rural, urban to rural, long-distance, etc can be largely affected by economic factors. For instance, Haug (2002) cited by Barker (2008) found that some of the poorest people who did not have access to sufficient number of animals for migration were forced to stay behind during migratory movements. Findley (1994) cited by Barker (2008) explains that the reason for the weak link between drought and long-distance migration is that during drought times, households no longer have the capability to fund long-

distance movement. As rational individuals, people are also expected to decide based on perceived net gains from migration and whether the conditions (e.g. livelihood, social, environmental risks) in the area to which they migrate are sufficiently better than where they are presently residing. Migration is seen as a form of adaptation to climate change (Warner and Laczko, 2008) although it entails high social costs (IPCC, 2007). Barker (2008), however, excludes migration from the definition of adaptation to clearly distinguish between actions that enable people to cope with changes where they are located and actions that involve moving away.

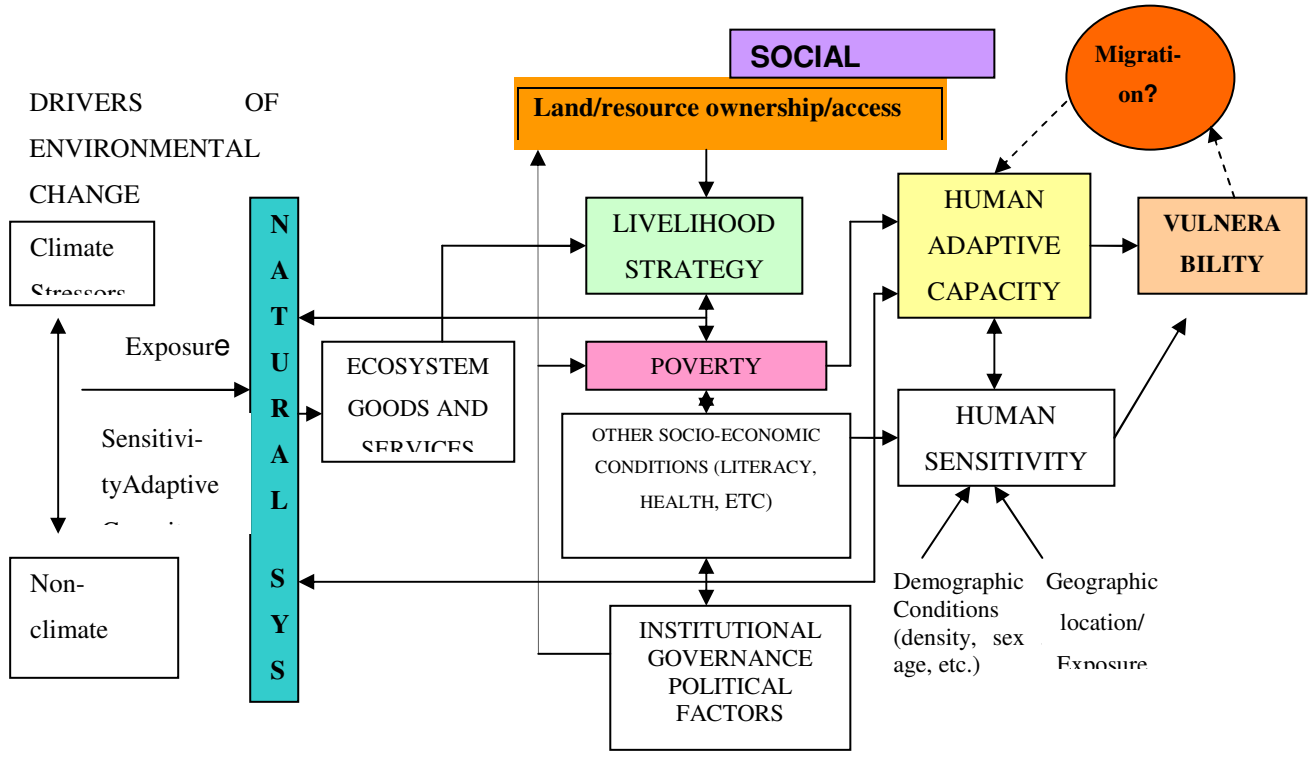

Fig. 1. Conceptual framework showing the relationship between the natural system and the social system in determining human vulnerability to climate change

3. Method and limitations

Data for the case study in Bayawan City was drawn from focus group discussions (FGD), key informant interviews (KIs), field observation, and secondary sources that were implemented as part of the quick community-based vulnerability assessment study. The vulnerability as-

sessment is an on-going activity of the officials and staff of Bayawan City with technical assistance from the United States Agency for International Development (USAID)-funded Philippine Environmental Governance Project (EcoGov)[13] which started in May 2010. The core informants included farmers and fishers' organization representatives, village officials, elderly and women community members. The FGDs were held in pre-selected coastal sitios[14] of three coastal barangays of Pagatban (Sitio Lapacon), Banga (Sitio Cambulo) , and Villareal (Sitio Punong and Sitio Camote).

This preliminary study primarily aims to call attention to landlessness, lack of alternative livelihood and poor access due to extreme poverty as important dimensions of adaptive capacity of communities exposed to climate change risks. Further and more detailed data collection method involving analysis of statistical significance on specific socio-economic variables at finer scales (e.g. village and sub-village level) and involving more study areas will help firm up the findings of this study.

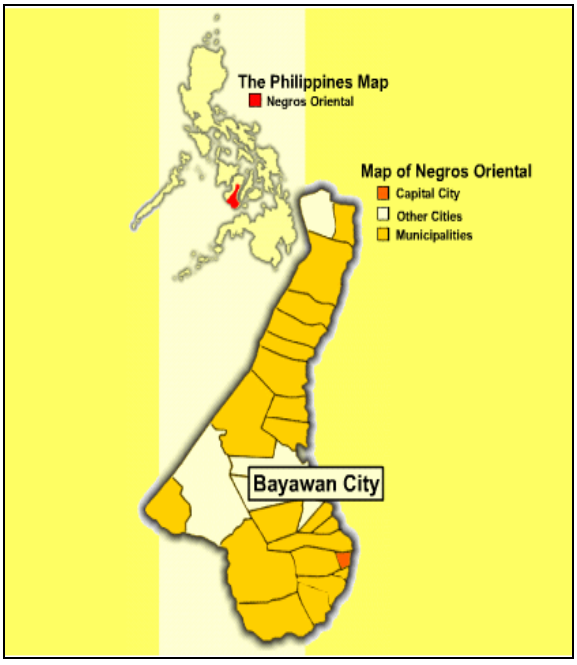

Fig. 2 Location of Bayawan City, Negros Oriental, Philippines

Source of Map: Local Initiatives on Watershed Management LGU Bayawan City (powerpoint presentation by Mayor German P. Saraña, Jr., no date)

[13] EcoGov is a collaborative effort between the United States Government through the USAID Mission to the Philippines and the Government of the Philippines through the Department of Environment and Natural Resources that aims to conserve biodiversity by improving environmental governance, improving the management of forests and forestlands, coastal areas and solid waste and promoting local government investment in sanitation facilities.

[14] Each barangay is composed of several sitio or purok (equivalent in English is sub-village).

4. Case Study: Bayawan City

4.1. Location and General Environmental and Socio-Economic Profile

Bayawan City is a 2nd income class[15] city situated in the province of Negros Oriental[16], Philippines (Figure 2). It is fronted by the Sulu Sea, a marine ecosystem noted for its rich marine biodiversity as it is connected through the Bohol Sea to the South China Sea and the Pacific Ocean (Alcala, 2008). The city, moreover, is part of Southwestern Negros, a terrestrial key biodiversity area (KBA), an important bird area (IBA) and therefore, a priority area for biodiversity conservation in the Philippines. There are two distinct seasons: relatively dry from January to May and wet from June to December. Typhoons usually occur between May and November. The average annual rainfall is1870 mm.

Bayawan City is unique since the urban areas constitute only a minuscule two percent (1,573 hectares) of its total land area of 69,908 hectares. Only seven of the 28 barangays[17] (village) are classified as urban. Urbanization tends to concentrate along the coast, with five of the seven urban barangays being coastal. Figure 3 shows the location of the different barangays within the city's six watersheds and relative to its four major rivers. The overflowing of the river banks during typhoons contributes to the city's worsening seasonal flooding problems.

Around 30% (20,245 hectares) of the city's total land area is classified as forestland[18], however, only 15% of the forest land remains covered by forest vegetation. The establishment of commercial sugarcane plantations by large landowners in the 1980s has led to massive conversion of forests to agriculture land use (Aragon, 2010). At present, more than 35% of the city's 46,707 hectares (67% of the total land area) of land placed under agricultural land use

[15] The Philippines' Department of Finance categorizes local government units into six income classes, based on the local incomes they generate, as a measure of their financial capability. Considered as poor LGUs are the fourth through sixth income brackets. These LGUs are primarily dependent on funding from the national government as well as external grants and loans to undertake infrastructure and long-term development programs.

[16] DENR (2010) rates the host province of Bayawan City of Negros Oriental as moderately vulnerable to climate change. It is moderately sensitive to climate change based on elevation, slope and terrain conditions and has moderate adaptive capacity based on parameters of population density and HDI.

[17] Barangay or village is the smallest political unit in the Philippines.

[18] Forestland is among the four legal classifications of lands in the Philippines. It covers roughly half (15.8 million hectares) of public domain lands and comprises established timberland, watershed areas, public forest, permanent forest or forest reserves, and military reservation areas. The other categories of public domain lands are national parks, mineral lands, and agricultural lands. Only the agricultural lands can be subject to private ownership (DENR-FMB, 2007).

is located on forest lands. Upland forest denudation is aggravated by timber poaching, fire-wood gathering, charcoal production, illegal hunting, and forest clearing for settlement (ibid). Improper land uses and unsustainable crop production practices that involve raising sugar-cane, rice and corn on hill slopes of erosion-prone rural barangays are among the non-climate environmental stressors in the city.

According to its Status of Development Report in 200919, the city performed poorer than the national average in all economic areas assessed- unemployment and under employment rates, income per capita per year, poverty incidence, and non-ownership of house (refer to Table 1). The state of social development was assessed as "low" due to the very low literacy rate, low elementary school participation and completion rate, as well as the poor technical and tertiary school completion rate in the city.

In 2007, the city's rural households earned only half (Php 18,040/year or USD 414.71)) of what urban households have earned (Php 41,427/year or USD 952.34). For lack of job opportunities in the rural areas and to gain better access to government services, people had relocated closer to the predominantly coastal urban areas of the city (Bayawan City, 2007). Thus, there are roughly 14 times more people living per hectare of land in the urban areas than the rural areas in the city.

19 LGUs prepare their State of Development Report as part of the Department of the Interior and Local Government's (DILG) Local Government Performance Management System (LGPMS).

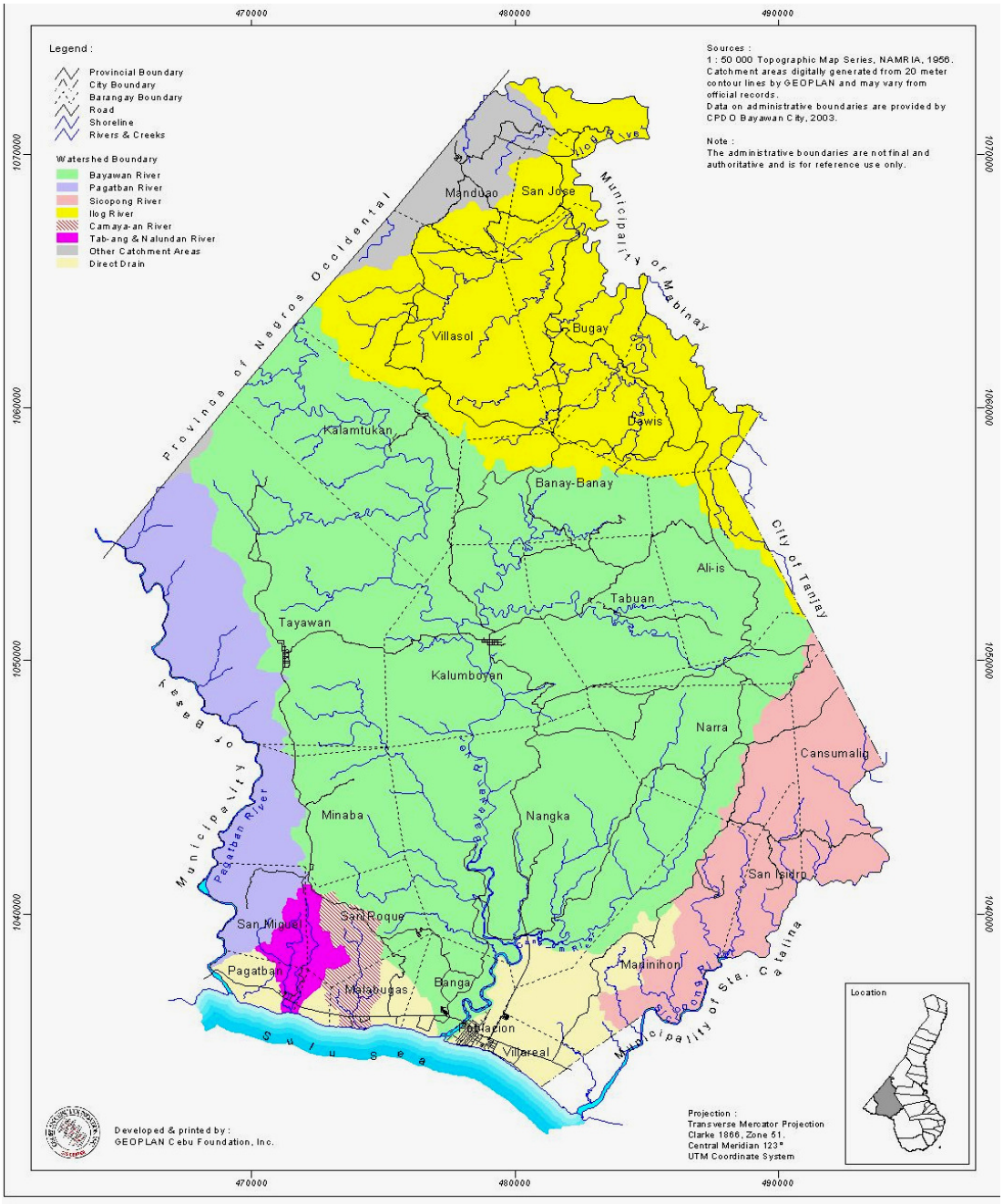

Figure 3. Watershed map of Bayawan City showing the location of the major rivers and the 28 barangays

Table 1. Selected Key Indicators of Economic and Social Development Status of Bayawan City

Economic Development		**Social Development**	
Indicator	*Status (Rating Scale Range)*	*Indicator*	*Status (Rating Scale Range)*
Unemployment rate	6-7% National Average: 6.3%	Elementary School Participation Rate	Below 85% (intolerable) National Average: 83.2%%
Underemployment Rate	16%-20% (evident but within tolerable level National Average: 18.1% (NSO, Oct. 2007)	Elementary School Completion Rate	Below 70% (extremely low) National Average: 72% (World Bank, 2008)
Income per capita	Below P20,000 (extremely low) National Average: P34,600 (NSO, 2006)	Simple literacy rate	Less than 85% (extremely low) National Average: 92.8% (2000 census)
Poverty Incidence of LGUs outside Metro Manila and non-HUCs	35-50% (high, many families live below poverty threshold) National Average: 26.9% (2006 poverty statistics)	Technical or Tertiary Education Completion	Low
% of house-non owner households	More than 50% (extremely high) National Average: 33.5% per 10,000 population (NSO Poverty indicator survey)		
% of squatters or informal dwellers	Above 30% (prevalence is unbearable)		
% of households with makeshift houses	2% of households National Average: 2.04% (PIDS)		
% of households with electricity for LGUs outside Metro Manila and non-HUCS	Below 60% (very low) National Average: 79% for rural areas (NSO Poverty Indicator survey)		

Source: Bayawan City. 2009. State of Local Development, Electronic Report, Bayawan City, PY 2009. Available on http://www.blgs.gov.ph/lgpmsv2/appshome/report/rpt_eSLDR.php?frmIdLgu=1105&frmIdDcfCode=6.

High poverty correlates with high malnutrition rate of around 11%, which made the city rank second among the LGUs with the highest malnutrition prevalence rate in the province of Negros Oriental in 2009 (Sunstar Dumaguete. 2010).

Available health care facility and personnel is not ideal for the size of the city's population. For instance, there are only two hospitals, 14 doctors and 50 hospital beds for the projected population of more than 114,000 in 2010. Rural areas have more difficult access to medical care because of transportation problems. All seven urban barangays and 12 rural barangays

are served by electric power supply. However, because of the very high poverty incidence, only 17% of the total number of households in the city have legal connections to electricity. In addition, poor road accessibility hampers the installation of power infrastructure in more interior barangays. Land telecommunication facility and internet accessibility are possible only in urban parts of the city.

In terms of environmental development, according to its 2009 State of Development Report, the city is still challenged by the high rate of conversion of prime agricultural lands to non-agriculture use; the very low productivity (1.0-1.99 MT/ha) of the top three crops (sugar cane, rice, corn) despite higher than national average ratio of irrigated land to irrigable land; low forest and mangrove cover; illegal forestland occupancy; illegal forest cutting; declining fish catch; and incidence of illegal squatting on coastal and riverside areas (Bayawan City State of Development Report, 2009).

While the current state of environmental, economic, and social development is less than desirable at present, the city's much improved governance founded on functionality, accountability, public participation and transparency is expected to deliver more positive development outcomes in the future. To illustrate, the city had a high level of performance based on the 2009 State of Governance Report of the Department of the Interior and Local Government (DILG)'s Local Governance Performance Management System (LGPMS). It also had an excellent performance based on the Guided Self-Assessment on State of Local Environment Governance (GSA) developed by the USAID-EcoGov Project. The city has also earned the distinctions of being "Character City" (International Association of Character Cities), a pioneer "Healthy City" as certified by the Department of Health in the Philippines, and "one of the Top 10 Best Cities to Live In the Philippines (Small Cities Category)" under the Competitive Cities Survey 2007 undertaken by the Asian Institute of Management (AIM). In addition, the Institute of Solidarity of Asia (ISA) accredited Bayawan City as INITIATED under the Public Governance System (PGS) pathway.

4.2. Livelihood Profile

Farming, livestock production, aquaculture activities and marine fishing are the major revenue sources for the city. In 2000, agricultural production was estimated to have a value of Php 2.3 billion (USD 50 million), around 91% of which was contributed by crop production, 8% by livestock production, and 1% by the fisheries sector. Farming is the primary source of livelihood for seventy percent of the city's population.

Although only five percent of the total population of the city depends on fishing for livelihood, it is the primary source of income for the coastal inhabitants as well as the primary source of protein for the whole population. Non-agriculture and non-fishing livelihood options are very limited and consist mainly of wage labor, trade and business, and public and private sector employment.

The city has not yet developed its potential for tourism despite the presence of land and marine biodiversity, caves, waterfalls, and other natural sites in the various barangays. However, tourism as a potential livelihood source can be threatened by climate change. According to Alcala (2008), the risk to tourism of climate change on Negros Island, of which Bayawan City is part, include (1) flooding in the highlands due to extreme rainfalls, (2) sea level rise and storm surges, (3) saltwater intrusion, (4) deaths of sensitive marine organisms due to warming of the seas and changes in the usual water circulation, and (5) acidification of coastal waters which can reduce the production of shellfish and bring death to marine organisms.

Bayawan City has an estimated coastline length of 15 km and a municipal water area of around 225 sq. km, whose average depth is 91.44 meters (Bayawan City CRM Plan 2009-2014). Over 70% of the built-up areas are located along the city's coastline. While the seven coastal barangays cover only an aggregate land area of almost 3,000 hectares or 4% of the city's total land area, they are home to a third of the city's total population.

The condition of the mangrove resource of the city has been assessed to be 'fair to poor' in 2001 according to the City's Coastal Resource Management Plan. While efforts to rehabilitate and expand the mangrove areas have been made in recent years, lingering problems of land-based pollution, siltation and illegal cutting for firewood and housing needs have hampered the recovery of the mangrove resource. For instance, only four hectares remain of the 30 hectare mangrove plantation established through the help of a foreign-assisted project in Barangay Pagatban in 1988. At present, the city has an estimated total remaining mangrove area of 48.97 hectares in six coastal barangays (village) of Malabugas, Pagatban, Banga, Suba, Boyco and Villareal.

Another important coastal resource is the nipa palm (Nipa fruticans) which is found in Barangays Malabugas and Banga and along the Bayawan River. The residents earn income by manufacturing leaves of nipa into roof shingles. Nipa, like other mangrove species, helps stabilize soil sediments and offers protection against impacts of storm surges and flooding. The loss of the city's mangrove resource means a natural protection against climate-change impacts has been also lost.

Some seagrass beds can be found along the boundaries of Barangay Malabugas and Pagatban. Seagrasses act as feeding and spawning ground for marine species but they are sensitive to siltation and pollution.

The city's fishing ground is considered part of the "highway" for yellow fin tuna and other migratory species (Bayawan City, 2010). The seven major fishing barangays are Pagatban, Malabugas, Banga, Suba, Tinago, Boyco and Villareal. Current estimates indicate that there are 1000 fishers in the city, 70% of whom are considered full time fishers. Full-time fishers are more economically vulnerable to impacts of climate change due to the absence of alternative non-fishing and non-coastal based livelihood and income sources. Farm-owning fishing households although very few (e.g. only 2-3% of the total households in Barangay Pagatban), are better off economically since they engage in farming during off-fishing season. Some fishers also seek livelihood as farm help in nearby large sugarcane plantations owned by few rich individuals as additional source of income. But such off-fishing season opportunities are very limited and fishers would have to compete with many unemployed individuals in the city. A few coastal families continue to engage in small-scale sand and gravel quarrying, although this activity has been minimized due to the enactment of a provincial ordinance banning sand and gravel quarrying along the province's shorelines. Quarrying is another non-climate stressor that will add to the city's vulnerability to climate change since it could lead to loss of protective beach sediment deposits and can have some altering effect on beach geomorphology.

The major fish species caught in the municipal waters are tuna, jack, scad, sardines, anchovies, moon fish, and mackerel, among others. The coastal fishers also get income from bangus fry gathering. Fishing within the area is usually done using traditional fishing gear such as hook and line, gill nets, fish traps and crab pots. Catch rate for three hours of fishing using hook and line is only 1-2 kg, which the family consumes for food and/or sold. The fishers with motorized boats are able to harvest up to 12 kilos of fish per fishing trip, however, there are only a few such fishers in the city. Income from fishing activities is highly seasonal, with the typhoon months of from June to December as periods of lowest fish harvest and therefore, leanest income from fishing.

Past illegal fishing, pollution from land and marine sources, dumping of tailings from past mining activities in the nearby town of Basay, and siltation and sedimentation problems caused by upland farming and logging activities have contributed to the decline of fishery resources over the years.

Overfishing and the illegal encroachment of commercial fishing vessels have been blamed for the reduction in the number of species caught in municipal waters of from 40 to 60 species years ago, to less than 20 species today, as well as the reduction in the sizes of fishes caught by the local fishers. Other problems that affected the coastal habitats were pollution from garbage and other organic wastes due to heavy influx of residents in the coastal zone. Although the city is now strictly implementing fisheries laws and has prepared a Coastal Resource Management Plan with zoning plan and an Integrated Solid Waste Management Plan, there is no updated and sustained monitoring done that would clearly indicate the present status of its coastal and fisheries resources.

4.3. Current and Projected Climate Scenarios: Scientific and Community Evidences

The different models used by Doyle (2010) agree that the temperature in Bayawan City would rise by 1.0 to 1.5˚C by 2031-2040 (**Figure 4**). Mean temperatures including hot days and warm nights have been generally increasing while cold days and nights have been decreasing in the Philippines (PAGASA, 2001; Cruz et al., 2006; Tibig and Cinco, 2006; Lansigan, 2009). The projected increase is from 1.7 ˚C to 2.4 ˚C by 2050 across the country, with the southern part of the country becoming warmer (DENR, 2010).

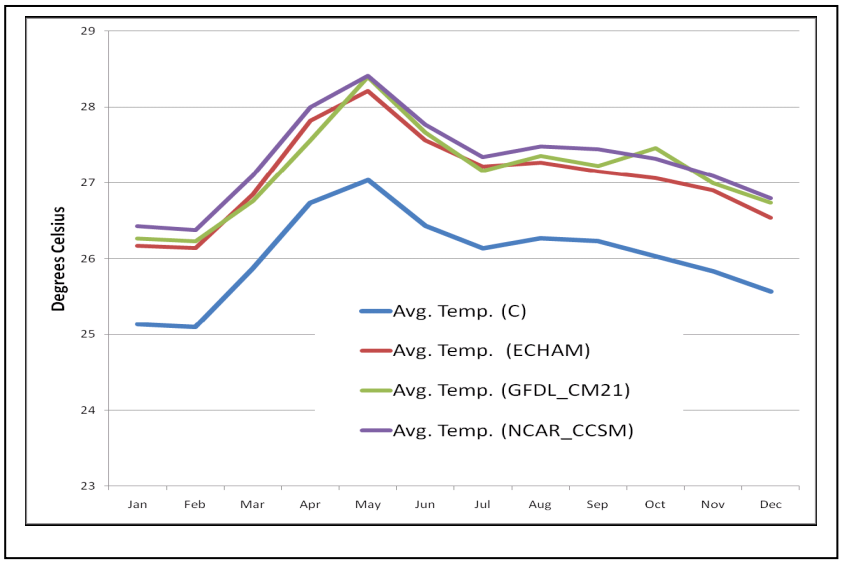

Figure 4. Projected change in average temperature in Bayawan City, 2031-2040
Source: Doyle, P. 2010. Climate Change Vulnerability and Adaptation in Bayawan City LGU

With respect to coastal areas, increased warming of sea surface is projected to contribute to more frequent and severe extreme weather events, such as coastal storms which will generate larger waves, storm surges, and increased coastal erosion (USAID, 2009). Alcala (2008)

anticipates that increases in sea water temperature will reduce fisheries productivity by: 1) drastically reducing the thickness of productive mixed layer of marine waters and preventing the circulation of nutrients for photosynthesis by plant plankton, 2) damaging coral reefs due to the loss of the symbiotic zooxanthellae and marine biodiversity upon which fishery productivity depends. Increased frequency of disturbance of coastal water by storm surges will further reduce fisheries productivity by hampering the recruitment of fish and other marine organisms.

The city has been also experiencing increasing frequency and longer episodes of El Niño that are causing a stress on farming as livelihood source. Furthermore, prolonged drought conditions during El Niño have resulted also in an increase in forest fire occurrence in the city's forestlands.

In addition to increases in temperature, more rainfall is projected in 2030s for Bayawan City (Doyle, 2010). This conforms with the observed trend of rising annual total rainfall in the Visayas area and projection of climate experts that the drier months of March-May will become drier and wet seasons (July-August, and Sept-Nov) will become wetter in the country (PAGASA, 2001; Cruz et al., 2006, DENR 2010). Typhoons are already getting stronger and increasing in frequency from only 27 during the period 2000-2003 to 39 now (Virola, 2008 cited by DENR, 2010) . An increasing trend in number of tropical cyclones in the Visayas area where Bayawan City is located is projected (ibid). More frequent rainfall events or a shift in seasonal cycle of rains is expected to produce more floods, landslides, and soil erosion in Bayawan city (Aragon, 2010).

As with most of Philippine coastal cities and municipalities, Bayawan City is at risk from sea level rise. Figures 5 - 7 present the extent of inundation projected by EcoGov if the sea level will rise one meter, three meters, and five meters from current levels. The projection is based on the elevation features of the city. Based on the figures presented, sea level rise will potentially result in loss of coastal lands together with the settlement areas, environmental resources, public utilities and infrastructure and properties and livelihood in affected coastal barangays. The extreme scenario of five-meter rise will inundate all seven coastal barangays including the inland located Poblacion, Ubos, Nangka, and Maninihon.

While there is no estimate when the projected scenarios for Bayawan City would occur, it should be noted that in the Philippines, sea level rise is occurring not in millimeters (mm) but in centimeters (Siringan, 2010). However, while there is no known scientific monitoring data collection done on sea level rise around the city, community anecdotes suggest that coastal

land loss due to inundation is occurring in the city. In some areas of Banga and Malabugas, coastal erosion was observed by the Mines and Geosciences Bureau (MGB, 2010, MGB 2006). For instance, the residents of Sitio Cambulo, Barangay Banga have observed that the sea waters have been advancing toward the inland areas ('lumalawak ang dagat'- 'the sea becomes wider', 'dati ay masyadong malayo pa ang dagat'- 'the sea used to be very far'). The key informant (KI) who has been residing in the barangay since 1945 estimated that the original shoreline was about 20 meters away. From 2000-2008 an estimated 20 houses had to be abandoned by community residents because the sea water had reached their location along the coast. In Purok Camote, Barangay Villareal, the KIs has also estimated that their coastline has retreated further inland by 20 meters. The areas now occupied by seawater used to be coconut groves, according to key informants.

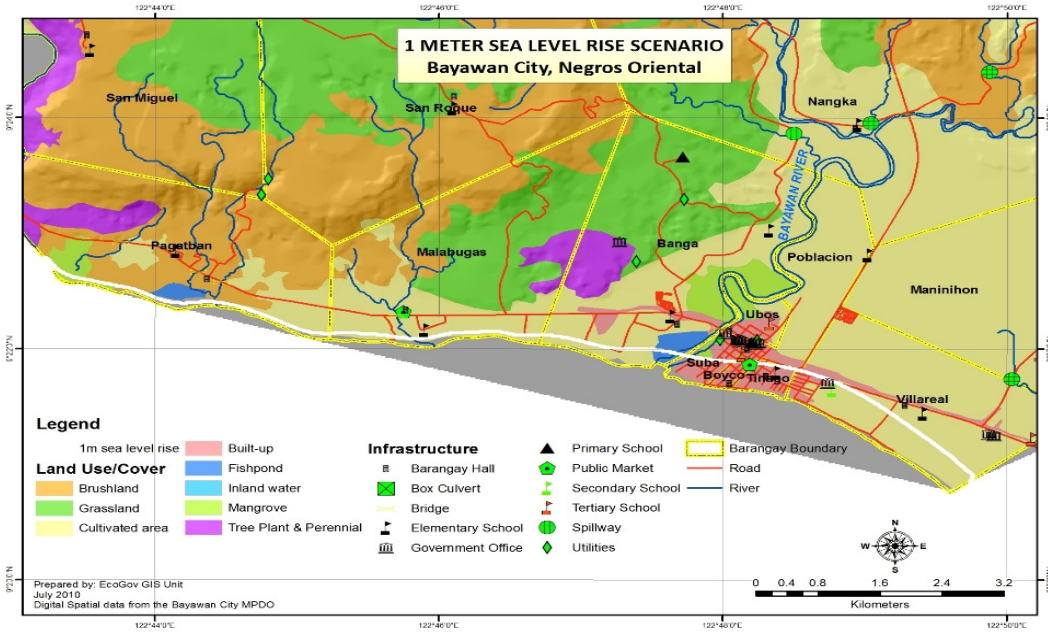

Figure 5 Map showing projected scenario 1-meter sea level rise scenario in Bayawan City Source: The Philippine Environmental Governance Project (EcoGov)

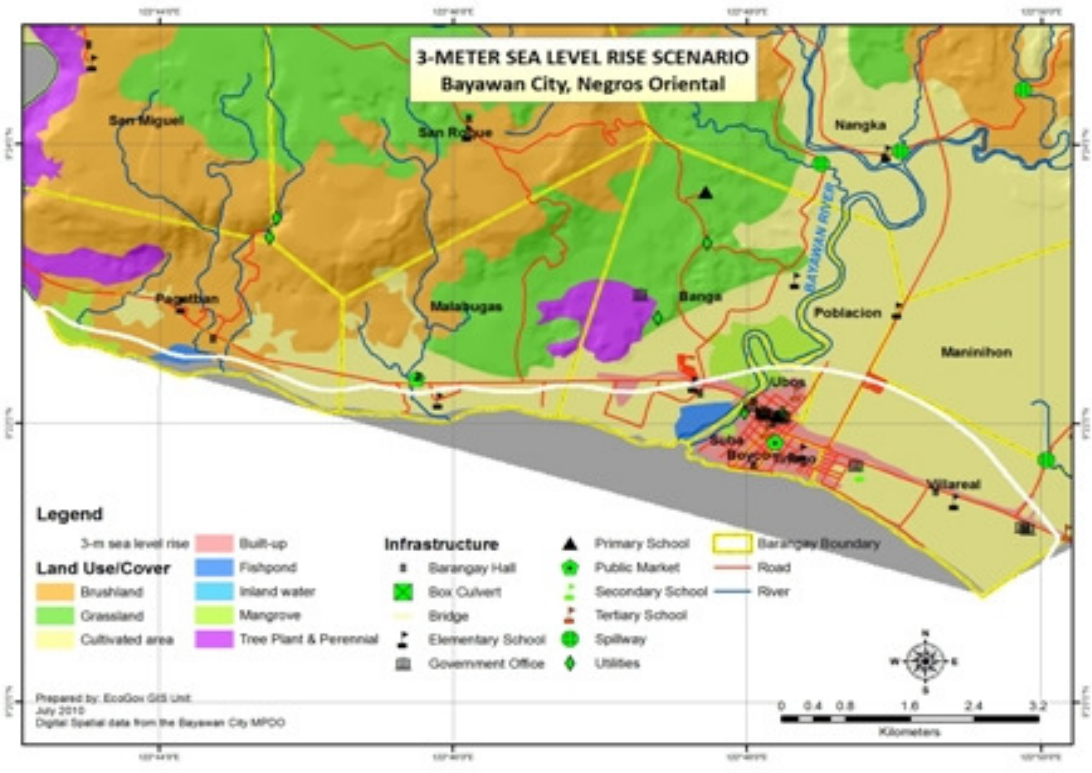

Figure 6 Map showing projected scenario 3-meter sea level rise scenario in Bayawan City Source: The Philippine Environmental Governance Project (EcoGov)

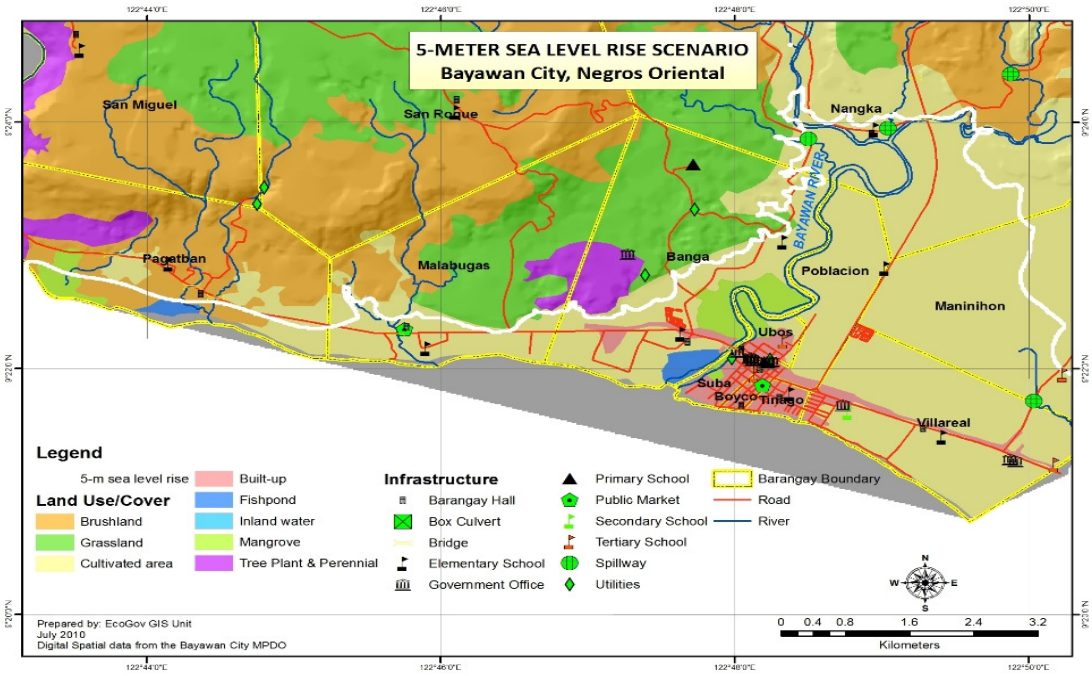

Figure 7. Projected scenario for five-meter sea level rise in Bayawan City
Source: Philippine Environmental Governance Project (EcoGov)

4.4. Impacts of Climate Extremes and Variability on Communities

Effects of Droughts

The key informants narrated experiencing El Niño almost every 4 years. The worst El Niño they experienced occurred in 1973 when the extremely dry condition lasted for almost nine months. Other extreme droughts recalled occurred in 1981, 1996, and 2010, each event lasting for six months. During the 1973 drought, the inability of farmers to plant crops and the dying of farm animals due to water shortage and diseases had resulted in extreme food shortage, malnutrition, diseases and scarcity of clean drinking water. A few families temporarily migrated away to nearby towns and provinces where they had relatives who could help them. The majority, however, chose to stay behind and relied on root crops, corn bran, and non-traditional food sources.

During the latest El Niño event in 2010, farmers using rainfed methods were unable to implement second cropping of their corn and rice crops due to water scarcity. The drought also affected income opportunities for farm laborers and fishers who are part-time farmers. According to the data kept by the City Agriculture Office, from around 951 hectares of croplands (majority are planted to rice, corn, and coconut) estimated to cost Php 14.1 million pesos (USD 324,138) were damaged, affecting 441 farming households in 12 farming barangays including the farmers in the coastal barangay of Banga. The El Niño also affected local inland aquaculture fisheries, particularly crab fattening and tilapia growing. There was little effect on capture fisheries, however, with some fishers even reporting better fish income due to longer fishing season (absence of typhoons) and better fish catch per unit effort. Income from bangus fry gathering has also reportedly improved during the 2010 El Nino event. The key informants shared also that the prolonged drought this year has changed the timing of the appearance of anchovies which enabled them to harvest this fish from May to June instead of the normal harvest season of around November, thus, their income from this fish increased. While there has been no scientific study to support community observations, this information shows that in some instances, climate variability and extreme has led to patches of short-term positive effects.

There was no significant shortage in the supply of water from the local water district but interruptions in water supply occurred in some service areas due to reduced water pressure. The Bayawan Communal Irrigation Project (CIP), which is the biggest irrigation system in the city, was greatly affected by drought with about 65% conveyance loss, affecting 277 rice farmers according to records kept by the city. Another effect of the 2010 prolonged drought was the

hike in prices of agricultural products, with negative consequences on the food purchases of the poor.

While brushland/grassland/forest fires are regularly occurring during summer months in the upland areas, the extent of damage during the 2010 El Niño was heavy and extensive. Ten barangays were affected, with severe damage to seven mountain range barangays (Nangka, Kalumboyan, Minaba, San Roque, Tayawan, Kalamtukan and Villasol). The other three barangays affected but at a lesser degree were Narra, Banaybanay, and San Miguel. Forest/grassland fires endanger the few remaining retreat areas for the Spotted Deer in Kalamtukan, Tayawan and Minaba as well as the recovery of the forest resources which could add to ecological resiliency of the city to climate change. Some newly established plantations of permanent crops (coconut, rubber) were also damaged affecting the livelihood of upland farmers.

Effects of Strong Typhoons and Flooding

Ruping in 1990 and Ursula in 2003 were the worst typhoons that hit Bayawan City in the last 20 years, according to local key informants. These typhoons damaged houses, killed farm animals and caused the evacuation of families in all study barangays of Villareal (Lower Poblacion), Banga (Sitio Cambulo), and Pagatban (Sitio Lapacon). In Sitio Lapacon, Barangay Pagatban, Typhoon Ruping destroyed all 6 houses found in the locality, for instance. The number of houses in this sitio has now increased to more than 40, despite the risk experienced over the years. The loss of farm animals (pigs, goats, chicken, carabao, ducks) which they could sell for cash has made recovery from the disaster even more difficult because the raisers lost the opportunity to generate funds to rebuild their houses and start a livelihood activity.

The more recent destructive typhoons remembered by the focus group discussion participants were Milenyo in 2006, which according to them caused big sea waves that forced families to evacuate to safer places further inland, and Frank and Butchoy in 2008. Typhoons and the seasonal two to three days (sometimes lasting for a week according to key informants) of continuous rains periodically result in the evacuation of coastal residents, primarily women, the elderly and children, to nearby school, church and city gymnasium due to heavy flooding and storminess hazards. Healthy, adult men usually stay behind to guard the house and family properties during typhoons.

Evacuation is more difficult in parts of the coastal areas where there are accessibility and communication problems. Since Sitio Lapacon in Pagatban has no means of phone commu-

nication and because there are no land vehicles except for two motorcycles, immediate evacuation of affected families is problematic. In addition, the evacuees have to traverse a temporary wooden elevated pathwalk - which easily gets destroyed by the typhoon - in order to reach the school evacuation center, which is about 3 km away. The coastal communities are more susceptible when typhoons/flooding occur at night time, during high tide, when the floodwaters destroy the wooden pathwalk or reach the level of the highway which is the evacuation route. Despite this, however, the affected families have continued to settle in the study sitios, where their livelihoods are found and where they have familial and social roots.

Based on the quick assessment done by the Department of Environment and Natural Resources Mines and Geological Sciences Bureau (MGB) on degrees of flooding hazards in Bayawan City, eight barangays (2 are coastal and 6 are inland) are at risk from seasonal flooding of greater than 1 meter in height (Figure 8). A total of 22 barangays or around 80% of the barangays of the city, including all coastal barangays, have various degrees of flooding hazard according to this preliminary assessment by MGB.

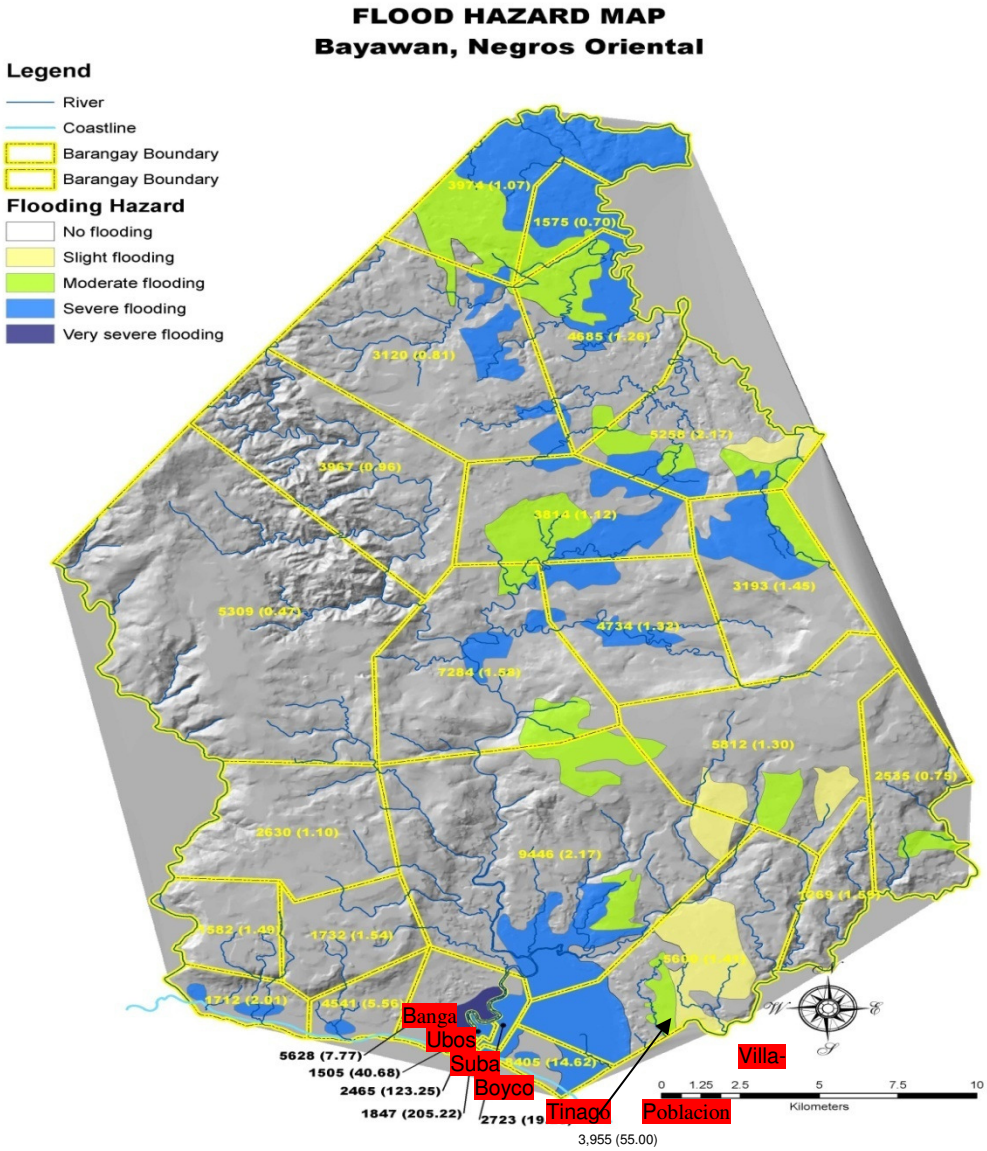

Figure 8. Flood Hazard Map of Bayawan City showing population size and density
Source: EcoGov (based on MGB Quick Geohazard Assessment data)

Bayawan City has recorded eight destructive floods from 2005-2009. The worst recent flooding events recalled by key informants occurred during typhoons Butchoy and Frank in 2008, when a total of 109 houses were damaged by flood. According to the data provided by the city, Butchoy destroyed corn fields, rice fields, cotton fields, mungbean crop, and banana plantation affecting a total of 331 farming families and resulting in agriculture losses amounting to PhP 12.2 million (USD 280,460)). Frank's damage to crop was valued at Php 1.6 million (USD 3,678)). Flooding problems in the urban areas of Bayawan have lessened after the construction by the city government of two big drainage canals.

According to the interviewed small fishing households, flooding has huge negative effects on their livelihoods (damage to crops and livestock, other income sources), properties (houses and household belongings), quality of water supply, food security, and safety, that even with the help that they get from the local government units they describe themselves as vulnerable due to their own poor capacity to adapt.

Effects of Erosion and Siltation

Soil erosion, siltation and sedimentation are major issues in the city since these cause heavy damage to farms, shorten the lifespan of irrigation dams, damage irrigation canals, and destroy coastal and marine species downstream. Immediate impacts include shallowing and overflowing of river water during heavy rains as well as diversion of water channels thereby resulting in flooding in low lying areas and destruction of marine habitats.

Bayawan River is the most heavily silted because its large catchment area is devoid of forest/permanent vegetative cover. Piled up beach sediment along the river deltas constrict river navigation. The scouring effect of seawave action on river banks during heavy flooding and strong typhoons accelerate erosion. Scouring has resulted in complete destruction of one concrete residential structure and portions of retaining wall structure along the mouth of Bayawan River in mid 2000 (Lucero and Aco, 2004).

The coastal barangays are slightly susceptible to erosion (see Figure 9). However, siltation and sedimentation from upland sources have adversely affected livelihood activities of coastal dwellers. Economically-important bivalves such as lampirong (Placuna placenta), bongkawil, bakya-bakya, agihis and tuway; some crustaceans, and fish species, have been damaged according to key informants. The key informants mentioned that mud crab fattening which is source of income for some families, seemed also affected negatively by siltation.

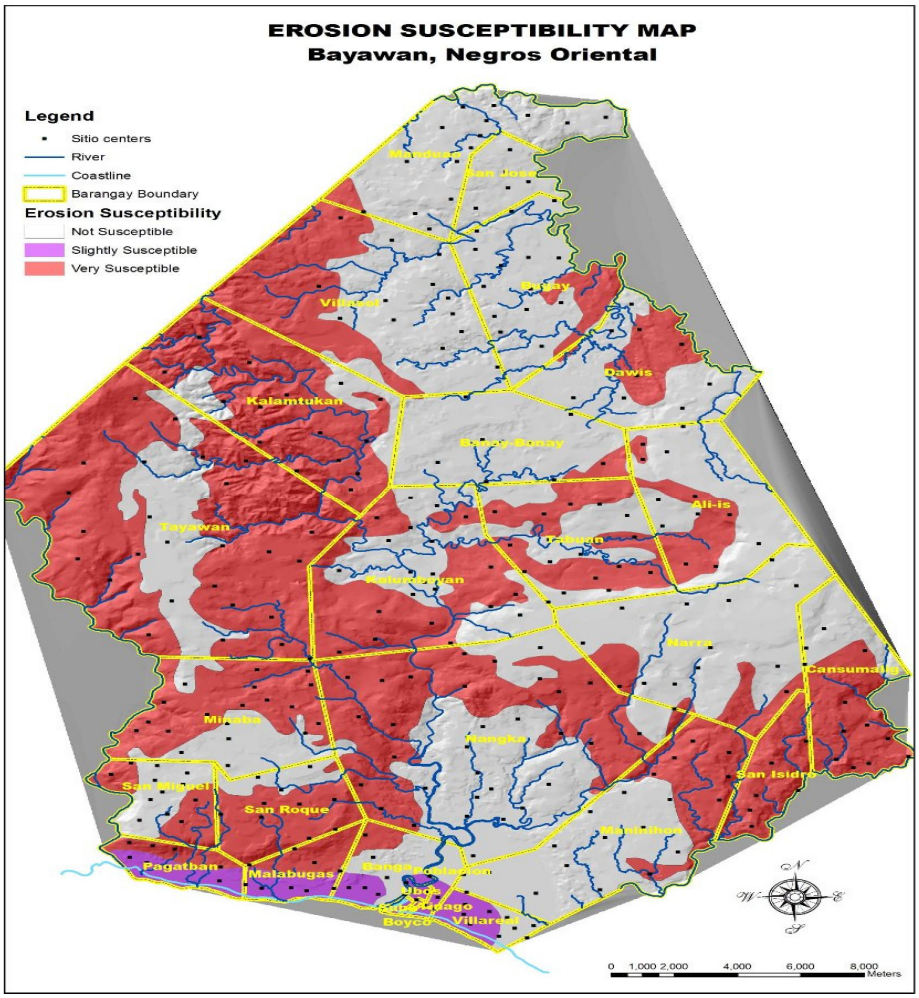

Figure 9. Erosion susceptibility map of Bayawan City
Source: The Philippine Environmental Governance Project

Effects of Landslides

The quick geohazard assessment conducted by the Department of Environment and Natural Resources' Mines and Geosciences Bureau (MGB) in early 2010 revealed that 17 (68%) of the total of 25 barangays surveyed are susceptible to landslide in varying degrees, with residents of several sitios in six barangays in need of relocation. The coastal barangays, except Banga, have been assessed to have no landslide hazard on account of their slope conditions. Landslides of varying degree of destructiveness have already occurred in the upland barangays of Ali-is, Tabuan, San Miguel, Tabuan, and Kalumboyan in previous years. Since 2004, Sitio Dita in Brgy Tabuan has already experienced three major landslides which damaged the properties and endangered the lives of 43 households. Farms, spring boxes, and schools have been also damaged by landslides. Many of the susceptible areas are inhabited, and thus, evacuation or permanent relocation of affected families was recommended by

MGB. Affected families, however, mostly evacuate only temporarily and return to their original dwelling places to continue their livelihood activities despite the continuing risks. Some families that have been permanently relocated by the city government have returned to their old farm sites. This shows the importance of livelihood in the decision of affected families to move away from a hazard prone area.

4.5. Population Growth and Movement in Natural Hazard-Prone Areas

Despite the multiple climate-related risks involved in living in the identified hazard prone areas, resource poor families along the coasts, riverbanks, and landslide prone hill slopes continue to settle in these areas. This is evident in the growth rates presented in Table 4, which shows that the two highly flood prone coastal barangays (Barangay Banga and Barangay Villareal) registered the highest population growth rates of 4.22 and 7.06 among the city's 28 barangays from 1990-2007 (Table 2). While the population density of Villareal is low due to its large land area, this barangay has the largest population in the whole city.

Table 2. Population growth rate, density, existing natural hazards and aggravating factors by barangay in Bayawan City

Barangay	No. of Families	Pop'n Density (person/ha)	Natural Hazards and Impacts	Aggravating Conditions	Growth Rate (1990-2007)
URBAN					
Banga (coastal)	1,125	7.77	Flashflood/ flooding (high), landslide (low); strong typhoons, erosion of river banks, sea level rise, effect of droughts on sugarcane, corn and rice farms	influx of migrants, forest land conversion, riverbank settlers, unregulated water pumps	4.22
Boyco (coastal)	369	205.22	Strong typhoons; sea level rise	influx of migrants, unregulated water pumps	0.37
Poblacion	544	19.88	Chronic flooding in San Ramon; strong typhoons; inundation of rice farms due to overflows from Bayawan River, damage to sugar cane, rice, corn. sea level rise	Poor drainage unregulated water pumps	3.58
Suba (coastal)	493	123.25	Coastal erosion, vulnerable crop: coconut; strong typhoon, flooding and sea level rise	influx of migrants, settlements along Bayawan River banks, inadequate sea wall, unregulated water pumps	-4.47
Tinago (coastal)	781	55.00	Sea level rise, strong typhoon	influx of migrants, poor drainage, unregulated water pumps. Vulnerable crop: coconut.	0.72
Ubos	301	40.68	Chronic flooding due to overflows from Bayawan River, sea	poor drainage, unregulated water pumps.	0.11

			level rise, srong typhoon, Threatened crops: nipa, coconut		
Villareal (coastal)	1,680	14.62	Flooding, sea level rise	influx of migrants	7.06
RURAL					
Pagatban (coastal)	342	2.01	Flooding, sea level rise, strong typhoons, vulnerable crops: sugar cane, rice, corn, fruit trees	inadequate river bank protection, poor drainage, unregulated water pumps, endangered water sources,	2.37
Malabugas (coastal)	908	5.56	Erosion of Camayaan and Naludhan River banks; flooding of Puroks 2, 3, and 4; waterlogging, Vulnerable crops: rice (138 ha), corn (19 ha), coconut (7ha)	unregulated water pumps, endangered water sources;	1.18
Ali-is	638	1.45	Landslide (high), flooding (high), Vulnerable crops: sugar cane, corn, rice, coconut	unregulated water pumps, endangered water sources	-1.50
Banaybanay	762	1.12	Flashflood/ Flooding, landslide (low), vulnerable crops: sugarcane (278.25 ha); ricefields along Cagayon Creek, grassland fire	illegal fishing (fish poisoning), unregulated water pumps, endangered water sources	2.04
Bugay	936	1.26	Flooding (high), landslide (low), drought, vulnerable crops: sugar cane, corn, rice	illegal fishing (fish poisoning), unregulated water pumps, endangered water sources.	2.00
Cansumalig	507	0.75	Landslide, Further erosion of Sicopong River banks, Overflows of Sicopong River, Vulnerable crops: corn, rice, sugar cane	unregulated water pumps, illegal fishing (fish poisoning).	0.98
Dawis	1,051	2.17	Flashflood (high), landslide (low), further erosion of Ilog River banks, , vulnerable crops: sugar cane, corn	unregulated water pumps	0.82
Kalamtukan	793	0.96	Flooding (rare), landslide (low), endangered habitat of spotted deer, further erosion of Bayawan River banks, vulnerable crops: sugar cane, rice, corn.	illegal fishing (fish poisoning), unregulated water pumps.	0.87
Kalumboyan	1,456	1.58	Flooding (rare) Landslide (high), soil erosion and flooding in Tiki, Shangri-la, and Tiamaan, grassland fire, vulnerable crops: sugar cane (166ha), rice (218ha), corn (400ha)	unregulated water pumps, illegal fishing (fish poisoning), endangered water sources	0.63
Manduao	794	1.07	soil erosion, vulnerable crops: sugar cane (209 ha), corn (170 ha)	illegal fishing (fish poisoning), unregulated water pumps.	1.17
Maninihon	1,119	1.41	Landslide (low), chronic flooding, erosion of Sicopong River banks, sea level rise, Vulnerable crops: sugar cane (108ha), corn (74ha), rice	Unregulated water pumps, illegal fishing (fish poisoning).	0.17

			(46ha)		
Minaba	526	1.10	Flooding, landslide, erosion of Bayawan River banks, grassland fire, vulnerable crops: sugar cane (26 ha), corn (161 ha), rice (18ha), coconut (35ha)	settlers in forest lands, unregulated water pumps, endangered habitat of spotted deer,	-1.77
Nangka	1,888	2.17	Flooding, landslide (low), flooding in Ondol, erosion of Bayawan and Canalum River banks, drought, grassland fire, 5-meter sea level rise, vulnerable crops: sugar cane (32ha), rice (97ha), corn (38ha), coconut (4ha)	timber poaching, illegal fishing (fish poisoning), settlers and farming on forest lands, unregulated water pumps, endangered water sources	1.12
Narra	1,162	1.30	Flooding, landslide, erosion of river banks, grassland fire, drought, vulnerable crops: sugar cane, corn, rice, vegetables	unregulated water pumps.	0.89
San Isidro	254	1.59	soil erosion, drought, vulnerable crops: sugar cane, rice, corn	illegal fishing (fish poisoning), unregulated water pumps	0.70
San Jose	315	0.70	Drought, vulnerable crops: sugar cane, rice, corn	conversion of forest lands for farming and settlements, unregulated water pumps.	-0.05
San Miguel	316	1.49	Landslide (high), flooding in Sitio San Agustin, grassland fire, drought, vulnerable crops: coconut, sugar cane, rice, corn, fruit trees	unregulated water pumps, endangered water sources	-0.10
San Roque	346	1.54	Flashflood/ Flooding, landslide (low), drought, vulnerable crops: sugar cane, coconut, corn, rice	timber poaching at Purok Palcata, unregulated water pumps.	-0.33
Tabuan	946	1.32	Landslide, Flooding (rare), drought, vulnerable crops: rice, corn, sugar cane	endangered water sources, unregulated water pumps, illegal fishing (fish poisoning).	-0.34
Tayawan	1,061	0.47	Flash flood (rare), Landslide, vulnerable crops: corn, rice, sugar cane	illegal hunting of spotted deer, removal of forests for farming, unregulated water pumps.	1.29
Villasol	624	0.81	Landslide (low), drought, vulnerable crops: sugar cane, corn rice, fruit trees	conversion of forest lands for farming, unregulated water pumps.	1.71

Data Sources: Bayawan City Socio-Economic Profile, 2007
Mines and Geosciences Bureau. 2010. Quick Geohazard Assessment
Aragon, R. 2010. Climate Change Vulnerability of Bayawan City's Uplands (unpublished report)

It should be noted from Table 2 that the urban coastal barangays that have been experiencing flooding and typhoon hazards are not only generally denser in terms of population, but they are also experiencing higher population growth rates as compared with inland barangays. Increased migration into the coastal areas has started in the 1980s. The graduation of Bayawan from municipality to cityhood, in 2000 has attracted greater waves of migration into

the nearby coastal barangays of Banga, Boyco, Villareal, Tinago, and Suba. Because many migrants are resource poor families who do not have money to buy a lot, rent or construct sturdy houses, they were forced to 'squat' on foreshore, river banks, and other public lands near the city proper. The mangrove decline in Barangay Malabugas, Banga and Villareal was attributed to the unregulated growth of settlement in these areas. The other impacts of human settlement which aggravated the environmental stressors in the hazard prone-areas include illegal timber poaching, illegal mangrove cutting, illegal wildlife hunting, illegal fishing, and unregulated increase in the number of illegal water pumps which can affect the city's groundwater supply.

A key reason for landlessness in urban areas of the Philippines is the unaffordability of land. Land prices in the urban areas of the Philippines have been continuously rising at a fast pace, and have led to greater competition over land (Mendoza, 2007). According to Porio and Crisol (2004) the poor respond to the shortage of affordable land by "squatting" or informal occupation on idle, unguarded public or private property. The Philippines has more people living in informal settlements than other countries with the same per capita income (Yu and Karaos, 2004).

In Sitio Cambulo, Brgy. Banga, the influx of settlers raised the number of vulnerable households from only 10 in 1995 to more than 100 today according to key informants. Ninety percent of the families living in this sitio derive livelihood primarily from fishing, only 10% has other livelihood and a small percentage owns small farmland.

The highly flood-prone Barangay Suba which is adjacent to the Bayawan River is among the barangays that experienced increased rates of inflow of illegal settlers along river banks. The relocation of the poorest of the poor families from this barangay to a resettlement site funded by the LGU, in collaboration with the catholic charitable organization called Gawad Kalinga (GK) Community Development Foundation 20 , has resulted in the abrupt decline of its household population beginning 2005. The decline in population in six other hazard-prone barangays has been much lesser (less than 0.5% except for Minaba and Ali-is), probably because the settlers in these areas are not getting similar resettlement assistance as Barangay Suba residents.

[20] Gawad Kalinga (GK), which means to "give care" in the Philippine's official language, is a movement that targets poverty-alleviation and nation-building. It is providing land, building homes, and food and livelihood for the poorest of the poor, particularly those found in slum areas.

4.6. Characteristics and Ownership of House and Lot

Majority of the houses in the coastal barangays were recently constructed during the period 2001-2006 (Figure 9). This supports the earlier mentioned observation that the period of rapid growth in the population along the coasts coincided with the transformation of the local government unit into a city. A slight decline in the number of houses built during the period 1991-1995 (before the creation of the city) occurred in all coastal barangays, except in Barangay Pagatban, because two very strong typhoons Ruping and Basyang displaced many coastal families during this period. After 1996, a steady increase in the number of houses built along the coast occurred despite the continuing risks.

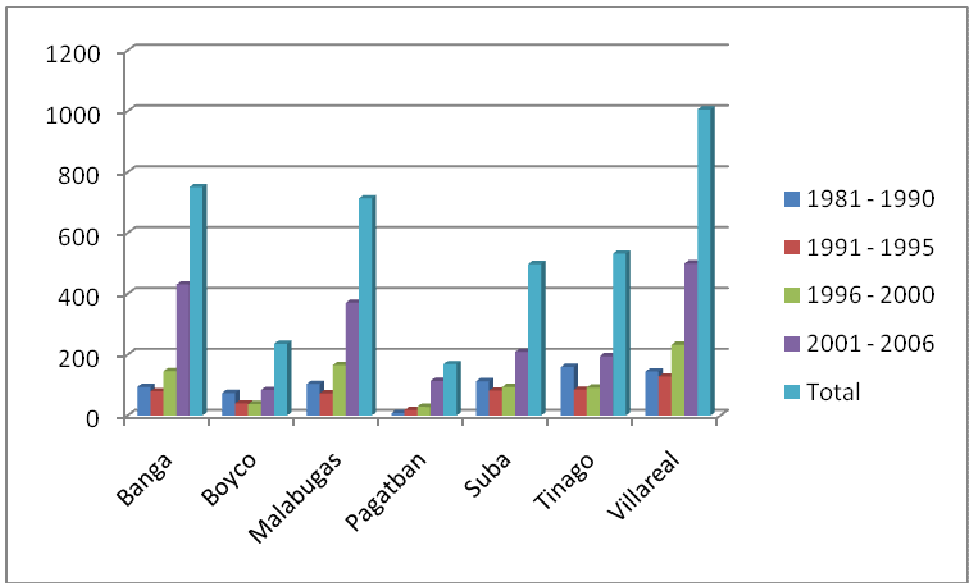

Fig. 9. Growth trend in the number of houses built in the coastal barangays of Bayawan City (Source of data: Bayawan City Planning and Development Office)

Tables 3 and 4 reveal the generally poor conditions of houses and poor access to basic water, sanitation, and power services in the seven coastal barangays. This reflects the pervasiveness of poverty among the coastal inhabitants of the city, who are prone to natural and climate-related hazards. Houses with light materials are easily damaged by floods and typhoons.

Table 3. Condition of houses in the different coastal barangays of Bayawan City

Barangay	With light wall material-grass, palm, etc. (% of total)	With light roof material-palm, grass, etc. (% of total)	With less than 10 sq m floor area (% of total)	With 20-29 sq. m. floor area (% of total)	House in good condition (% of total)
Banga	30	53	18	54	11

Boyco	1	67	15	32	36
Mala-bugas	27	64	6	47	29
Pagatban	53	40	19	40	2
Suba	14	57	16	69	5
Tinago	12	66	17	50	10
Villareal	17	69	17	21	32
Average	22%	59%	15%	45%	18%

Table 4. Access to basic utilities of households in the coastal barangays of Bayawan City

Barangay	With electricity as source of lighting (% of Total)	With no toilet facility (% of Total)	With charcoal/wood as fuel for cooking (% of Total)	With rain/ river water as source of drinking water (% of Total)	With individual metered water connection (% of Total)
Banga	48	14	85	9	11
Boyco	74	1	45	0.6	16
Malabugas	53	6	47	9	14
Pagatban	38	16	48	18	22
Suba	61	2	45	1	21
Tinago	88	4	44	0	18
Villareal	77	2	82	0.3	19
Average					

Tables 5 and 6 show the extent of house and lot ownership in the coastal areas of the city based on the results of the survey conducted by the City Planning and Development Office (CPDO) in 2006. The data reveal that around two-thirds of the coastal households either owned or amortized their houses, while half either owned or amortized their lot. About 50 households representing 1% of the total households in the coastal barangays were squatting or occupying their house for free without consent from the private owner or the government (in the case of structures found on public lands). The figure is higher at 220 households or 5% of total coastal dwellers for informal lot settlers or those that occupy their lot along the coast without consent from the owner. The percentage of lot ownership is higher among families in inland barangays than among families in coastal barangays. There were also more illegal house and lot occupants along the coasts than in inland barangays. To illustrate, while the coastal barangays constitute only one-fourth of the total number of barangays, the

estimated number of informal house and lot occupants along the coasts represent 32% and 50%, respectively, of the total number of families in the whole city that built their house or occupied lots without consent from the rightful owner.

Table 5. Tenure Status of Housing Units of Coastal Inhabitants in Bayawan City, 2006

Name of Coastal Barangay	Size of Forestlands (ha)	Total No. of Families	Not Specified	Owned/ Being Amortized	Rented	Not owned/ being occupied for free with owner's consent	Not/Owned being occupied for free without owner's consent
Banga	59.53	839	11	487	23	313	5
Boyco	0.00	329	5	152	36	113	23
Malabugas	233.22	807	5	636	7	159	0
Pagatban	120.15	187	2	77	3	105	0
Suba	0.00	644	7	328	40	268	1
Tinago	0.00	761	29	509	75	147	1
Villareal	0.00	1183	7	1011	37	108	20
Total & % for Coastal Brgys.	412.9	4750	66 (1%)	3200 (67%)	221 (5%)	1218 (26%)	50 (1%)
Total & % for non-coastal barangays	19,832.1	13603	263 (2%)	8790 (65%)	425 (3%)	4012 (29%)	108 (0.8%)
Total for the City	20,245	18,353	329	11,990	646	5230	158

Data Source: Bayawan City Planning and Development Office

Table 6. Tenure Status of Residential Lots of Coastal Inhabitants in Bayawan City, 2006

	Size of Forestlands (ha)	Total No. of Families	Not Specified	Owned/ Being Amortized	Rented	Not owned/ occupied for free with owner's consent	Not owned/ occupied for free without owner's consent
Banga	59.53	839	9	349	39	437	5
Boyco	0.00	329	5	94	41	162	27
Malabugas	233.22	807	5	33	6	459	4
Pagatban	120.15	187	2	28	3	154	0
Suba	0.00	644	4	186	30	388	36
Tinago	0.00	761	16	409	109	224	3
Villareal	0.00	1183	8	437	30	563	145
Total & % for all 7 coastal barangays	412.9	4750	49 (1%)	1536 (32%)	258 (5%)	2387 (50%)	220 (5%)
Total and % for all 21 non-coastal barangays	19,832.1	13421	277 (2)	6354 (47%)	452 (3%)	6421 (48%)	217 (2%)

Total & % for the city	20,245	18171	326 (2%)	7890 (43%)	710 (4%)	8808 (48%)	437 (2%)

Data Source: Bayawan City Planning and Development Office

The total number of informal settlers in the coastal barangays of Tinago, Boyco, Suba, and Villareal has now been estimated by the city government to be 672. Barangay Banga at present has an estimated number of informal settlers of 724 households. Barangay Ubos' informal settler size is estimated to be 37 households. Despite the yearly risks from typhoon and flooding, these families have opted to remain in their claimed areas for lack of alternative dwelling site and means to migrate to safer places with better and more sustainable livelihood.

Based on the strength, weaknesses, opportunities and threat (SWOT) survey conducted among coastal families in relation to the preparation of the city's Coastal Resource Management Plan in 2005, poverty, insufficient income from farming, lack of knowledge and livelihood management skills, and lack of access to financing institutions are the major socio-economic constraints among fishers and coastal dwellers. While a lot of the families have been given skills training by the city government, lack of seed capital is generally a constraint in starting new livelihood activities. Affected families evacuate to schools, churches, and city gymnasium when the risks from flooding and typhoon damage are great and return again to their dwelling places after the event. The need to evacuate and care for these families in the evacuation center has become a yearly activity and big expense item for the city government as a result.

5. Adaptation Measures

The local government unit has undertaken comprehensive preparation to address impacts of climate change. This has been through use of internal funds and by actively leveraging assistance from local organizations, national government agencies, and international agencies such as the USAID, GTZ, and AusAid. Ecological measures implemented which have climate mitigation and adaptation functions include:

- watershed rehabilitation
- reforestation
- vegetative riverbank stabilization
- reforestation

- water production area development
- agroforestry development projects
- integration of soil and water conservation in hilly land agriculture
- mangrove reforestation
- land acquisition for watershed reservation purposes
- mangrove reforestation
- implementation of coastal resource management plan
- establishment of Marine Protected Area
- establishment and maintenance of firelines to control grassland fire, and
- development of constructed wetland with leachate treatment facility to conserve water for the Gawad Kalinga social housing project.

A Shoreline Zoning Plan covering the urban coastal Barangays Suba, Boyco, Tinago and Villareal was also prepared to regulate coastal land use and development to enhance the city's resilience against climate and non-climate environmental stressors.

In line with climate mitigation objectives and to reduce the city's dependency on petroleum fuel, it is operating a pilot biodiesel processing plant capable of producing 2,000 liters daily of bio-diesel from crude coconut oil and Jatropha oil as feedstock. A Jatropha plantation of 93 hectares (City Agriculture Office, 2010) was established to be able to supply the requirements of this biodiesel plant. Moreover, it also embarks on organic agriculture as a strategy to mitigate climate change impacts in agricultural productivity.

Infrastructure measures include:

- establishment of communal irrigation project to stabilize water supply for agricultural production
- construction of bridges/box culvert/spillways
- rehabilitation of drainage canals
- construction of gabions to stabilize riverbanks, and
- sea wall for protection against potential storm charges and coastal flooding.

A reinforced concrete wharf located in Barangay Ubos and Suba along the Bayawan River with length of 326 meters presently serve as a flood control structure, by keeping high tide waters especially during strong typhoons from flowing into the City Proper. This flood control mechanism, however, needs to be improved to contain the enhanced threat from the significantly reduced capacity of the Bayawan River to hold water due to siltation and sedimentation.

The social and institutional measures that the city government has implemented include:

- conduct of disaster preparedness training and seminar
- conduct of information, education, and communication (IEC) campaign, and
- other advocacy and community awareness raising campaigns.

In 2008, the city mayor issued Executive Order No. 2008-11 which created the Technical Working Group (TWG) for Climate Change Mitigation and Adaptations. It is now in the process of conducting a climate change vulnerability assessment and adaptation planning with technical assistance from the Philippine Environmental Governance Project (EcoGov).

The city has, moreover, prepared an annual disaster preparedness plan, passed city and barangay support ordinances, has allocated annual budget and designated staff / team to support disaster and climate adaptation programs. Every barangay has an Emergency Response Team that works with the City Disaster Coordinating Council (CDCC). Because of the good performance of the CDCC, Bayawan City was awarded the Gawad Kalasag Award as Best Component City Disaster Coordinating Council by the National Disaster Coordinating Council.

The city government has also embarked on relocation of poor families situated in susceptible areas. At the Fishermen's Gawad Kalinga Village resettlement site, a total of 657 families have been permanently relocated so far from the coastal barangays of Suba, Boyco, Tinago, and Villareal. A total of 43 families have been also relocated to the Dita Housing Project for families vulnerable to landslide in Sitio Dita, Barangay Tabuan. A relocation site has also been identified for 26 families affected by landslide in Barangay San Miguel. Based on the data provided by the City Planning and Development Office, the range of assistance provided to relocated families cover health (lying-in, health center, feeding program, water system), livelihood, education (school), social welfare (relief and rehabilitation service, day care center, parks and playgrounds), safety and protective services (establishment of outpost, assignment of guards)

The city's social welfare division has been tasked to provide support to poor families in constructing houses damaged by calamities. Alternative livelihood projects have also been implemented to provide livelihood support to poor families. For fishers, livelihood projects in-

clude mudcrab fattening, fish pot, tilapia aquaculture, and seaweeds culture. Farmers and fishers have also been organized into multipurpose cooperatives to enhance their social and economic resilience. However, a lot still needs to be done in terms of livelihood and income needs for both small fishers and farmers in the city. At present, success of livelihood projects is hampered by several factors, including the low organizational capacity of people's organizations and cooperatives as well as the general poverty situation. For instance, the pig dispersal project of the city failed according to an informant from the City Agriculture Office because the beneficiaries were not able to return the borrowed capital as they used the money raised to meet basic needs of the family.

The city, moreover, has strengthened its multisectoral City Fisheries and Aquatic Resources Management Council (CFARMC) to become better partner of the LGU in coastal resource protection and management and strengthened the coordination among government agencies, non-government organization and the community, and with neighboring LGUs in the enforcement of environmental laws.

As a strategy to address insecure land tenure and close the open access conditions on forestlands, the city government has entered into a co-management agreement with the Department of Environment and Natural Resources (DENR) in 2004, following the approval of its Forest Land Use Plan (FLUP) which was prepared with technical assistance from the EcoGov Project. All forest lands in Bayawan City are now tenured to individuals, peoples' organizations and the City Government, and hence, have better prospect of being more effectively managed and utilized for sustainable production activities. In addition, Bayawan City has actively embarked on land reform program. Of the more than 14,350 hectares of land (around 21% of the total land area of the city) covered by land acquisition and land distribution program, more than 11,000 hectares (77% accomplishment) has been distributed so far to almost 6,000 farmer beneficiaries according to the Department of Land Reform Bayawan City Field Office.

Providing tenure security to fisherfolks, however, is more complicated than providing tenure security to forestland occupants. While the Philippines' Fisheries Code provides for the establishment and creation of settlement areas for municipal fisherfolks in certain areas of the public domain, specifically near the fishing grounds, this does not vest ownership rights to any fisherfolk (Mendoza, 2007). In addition, there is a problem on the availability of land for fisherfolk settlements since most of the areas that can be used as fisherfolks' settlement areas are already titled to private owners (ibid).

The study communities themselves have contributed to the effort by partnering with the city government in the implementation of government programs. The local fishers and farmers organizations claimed during the focus group discussions that they are now protecting the mangroves to sustain the protective functions of this resource against siltation, storm surges and coastal flooding, which they knew about through the city's active information, education and communication (IEC) campaign. However, the level of confidence among the interviewed groups and individuals about the readiness of poor families to face the risks and challenges of a changing climate is very low. There is general belief among the marginalized groups interviewed that they are not ready for the negative effects of climate change even with the present initiatives and assistance from the city.

6. Conclusions

Climate variability and extremes can have varying consequences for different sectors and socio-economic groups through their impacts on ecosystem goods and services upon which livelihoods are based. Poverty, absence or limited livelihood options, poor resource access, landlessness, coupled with other interrelated prevailing unfavourable socio-economic conditions may force individuals and groups to expose themselves knowingly to climate-related risks. These limiting socio-economic factors need to be considered in assessing human adaptive capacity to climate change as well as in adaptation planning.

Good governance has a key role to play in reducing both human and ecological vulnerabilities to climate change. In the case study site, the city government was able to fill many gaps in the communities' adaptive capacity by initiating a comprehensive package of interventions to address the ecological, infrastructural, social, economic, and institutional/policy needs that will help reduce the over-all vulnerability of the city and its inhabitants to impending climate change. The challenges and needs, however, are still very overwhelming, despite what have been already accomplished, as the magnitude of risks is high from the uplands, to the lowlands, and down to the coastal and marine areas. The city will have to continue mustering both public and community, and international support for its climate change mitigation and adaptation efforts. A lot still needs to be done, particularly in terms of identifying and assisting marginalized families and communities living along hazard prone areas along the coasts and river banks that are the most at risk develop and strengthen their own adaptive capacity, so as to reduce their helplessness and extreme dependency on local government unit support for adaptation needs.

Addressing landlessness and other socioeconomic limitations of poorly adaptive groups in the long term will require tackling the underlying institutional/policy and equity issues concerning land distribution and ownership, equity in resource access, a more sustainable view

of urbanization and land uses and or urban and rural interactions, a more effective poverty alleviation strategy, and effective enforcement of land and water laws, not only in Bayawan City, but at the national level.

Acknowledgement

This paper would not have been written without the valuable data provided by the City of Bayawan through its staff, particularly Mr. Joel Baterna (City Environment and Natural Resources Officer), Ms. Cindy Hisona (City Public Safety Officer), Mr. Pancho F. Villasis and Ms. Marchita P. Tuale (City Planning & Development Office), and Ms. Maricel Perocho (City Social Welfare & Development Office). Valuable information also came from the focus groups discussions and field observations conducted by the members of the coastal vulnerability assessment group, which includes representatives from various city and provincial government offices. The following consultants of the EcoGov project who formed part of the technical assistance team for the Bayawan City vulnerability assessment and adaptation planning from which important data and maps have been derived are acknowledged: Mr. Bien Dolom (Team Leader), Ms. Trina Isorena (GIS Specialist), Mr. Rudy Aragon (Upland Management Specialist) and Mr. Justin Briones (Assisting Professional). The review and editing support from the EcoGov management, particularly Mr. Arunkumar Abraham (EcoGov Chief of Party), and Ms. Rebecca Paz who provided technical advice in the conduct of the vulnerability assessment is also hereby acknowledged.

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Annex 1. Key climatic trends and impacts in the Philippines

Parameter	Current Observations	Projections
Extreme Weather events (strong typhoons, droughts, floods)	Typhoons are getting stronger and their number has increased to 39 from 2004-2007 from only 27 during the period 2000-2003 (Virola 2008 cited by DENR, 2010; PAGASA, 2001); ENSO-droughts have become much more frequent in the 1990s (2-year average recurrence interval) compared to the 1970s and 1980s (~4-year interval).	No significant trend in the number of tropical cyclones in Luzon; increasing trend in number in Visayas; decreasing trend in Mindanao; increasing trend in the frequency of tropical cyclones with typhoon intensity during ENSO events; droughts, floods and storminess will be more intense and frequent due increased temperature
Rainfall	Annual total rainfall has been decreasing in the top northern Luzon part, but increasing in the Bicol Peninsula, in the Visayas and Mindanao; increased occurrence of extreme rains (PAGASA, 2001; Cruz et al., 2006)	Substantial spatial differences in rainfall, seasonal variation largest (-35% to 45%) during June-August and March-May; seasonal variation lesser during December-February and September-November; likelihood that the drier months of March-May will become drier and wet seasons (July-August, and Sept-Nov) will become wetter; most areas in Mindanao will become drier for most seasons
Temperature	Mean temperatures have been generally increasing, hot days and warm nights have been generally increasing while cold days and nights have been decreasing from 1961-1998;observed increase in annual mean temperature of 0.011 ˚C per year in the last 50 years(PAGASA, 2001; Cruz et al., 2006; Tibig and Cinco, 2006)	Marked increase in mean annual temperatures (by about 0.9C to 1.4C in 2020 and 1.7C to 2.4 C by 2050 across the country, with the southern regions generally warmer
Sea Level Rise (SLR)	A 40-year observation of five primary tidal gauge stations in the country (Manila, Cebu, Davao, Legazpi and Jolo) indicates that sea level rise is now occurring in the Philippines, with Davao and Legaspi showing SLR above 15 cm (the lowest anticipated SLR set by IPCC at the end of the next century (Philippines Initial National Communication on Climate Change, 1999). This observation is supported by the findings of the two Global Sea Level Observing System (GLOSS)	The CRU-WWF estimated that a 30cm rise in sea-level (which may be reached by 2045) would regularly inundate over 2,000 hectares of the Manila Bay area threatening about 0.5 million people. Meanwhile, a 100cm rise in sea-level (which may be reached by about 2080) would threaten over 5,000 hectares of the Bay affecting over 2.5 million people. Projected land loss from 1 meter sea level rise range from 90,000 (The Manila Observatory, 2009) to around 130,000 hectares (NAMRIA, 1992). At least 703 municipalities and 64 out of 81 provinces will be affected by sea level rise

	sites in the Philippines (in Manila and Legaspi City) which observed a small rise in relative sea-level before the 1960s and then a more rapid increase of between 20cm and 40cm up to 1997 (CRU-WWF,1998).	(Greenpeace, 2005).

Main reference: DENR, 2010 The Philippine Strategy