CREATING CLIMATE-DISASTER RESILIENCY IN CALAMIANES GROUP OF ISLANDS (BUSUANGA, CORON, AND CULION)

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ABSTRACT

Deemed to be the "hotspot" and the country's last ecological frontier, the Calamianes Group of Islands (Busuanga, Coron, and Culion) of Palawan, are reliant on farming and fishery resources for livelihood and food security. Climate change and variability, including climate hazards (e.g. tropical cyclones, flooding, sea-level rise, and drought), impact the farming and fishery systems and the vulnerability of dependent communities. This project aims to investigate the worst-case scenarios that happened to these islands, which include biophysical and socio-economic stresses as well as psychological dreads and secular activities. It also contributes to improving community adaptation schemes by characterizing, assessing, and predicting the future of food resources using the simplest and uncomplicated approach – the Track-Risk-Impact-Policy (TRIP) to Resilience framework.

Focusing on adaptation elucidations and strategies for enhancing climate resilience at the local level contributes to capacity development and local empowerment. Integration of natural, social, and economic studies identify a range of options for management and policy reform. These alternatives are delivered as briefing materials to managers and decision-makers in communities and society at large in the Islands.

The strong partnership with the Local Government Units and other stakeholders (community of farmers, fisherfolks, indigenous people, NGOs, academe, church, women, youth, private sector), provides strong scientific and political support for the development of effective science-based governance approaches, which are needed to position vulnerable communities for an improved future.

Keywords: Climate change adaptation, track, risk, impact, policy

I. INTRODUCTION

The agricultural sector (e.g. farming and fishery) are also among the most dynamic natural environments on earth, providing a range of goods and services that are essential to human social and economic well-being. Many people have settled in coastal zones and others settled in the farming areas to take advantage of the range of opportunities for food production, transportation, recreation and other human activities provided there.

The Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) noted that climate-related change represents potential additional stress on systems that are already under intense and growing pressure in coastal zones. It confirms with 90 % certainty the anthropogenic origin of the increase in global temperatures, an increase that is predicted to reach 1.8 to 4 degrees Celsius before 2100 (IPCC, 2007). Of these changes, accelerated sea-level rise of 18 to 59 cm for the next century, has received much attention and may entail elevated tidal inundation, increased flood frequency, accelerated erosion, rising water tables, increased saltwater intrusion, and other ecological changes. These biophysical changes are expected to cause various socioeconomic impacts, including loss of land infrastructure and coastal resources as well as declines in associated economic, ecological, cultural, and subsistence values.

These impacts from climate change and sea-level rise are particularly important for coastal communities where flooding and erosion are predicted to increase. In the Philippines, which is rich in coastal ecosystems such as reefs, sea grass bed and mangrove forests, certain parts are particularly vulnerable to storm surges and sea-level rise. According to the storm surge prediction model developed by Lapidez et al in 2015, Palawan, which might experience a 6.71 m height of storm surge, is one of the most susceptible areas to this climate hazard. Due to its shape and characteristics of the coast, it contributes to the potential to generate high storm surges.

The Calamianes Group of Islands (Calamian Islands) in Palawan, which are coastal communities, figure among the most vulnerable of all environments to global climate change (IPCC, 2007). Many of its coastal communities suffer from flooding and coastal erosion related to storm surges that have hit the area since the communities of people have been established over the last centuries. Climate change and sea-level rise have the potential to increase the frequency and severity of these events and the related impacts.

In 2013, a storm surge event brought by Super Typhoon Haiyan, “Yolanda” resulted in over billions worth of damages and losses. Fatalities were reported as having drowned, hit by falling trees and debris, electrocuted, and crushed by collapsing walls. Water supply, electricity, phone connections, and access to ports were cut off (NDRRMC, 2013). Fishery and agriculture, which are the main sources of income of the communities, were also devastated. Infrastructure such as irrigation systems, roads, bridges, residences, and other facilities were destroyed. Aside from these negative impacts, indirect effects on residents’ health and safety, the displacement of local populations or changes to the natural habitat were also felt.

According to the Provincial Disaster Risk Reduction and Management Council (PDRRMC) of Palawan, eleven (11) municipalities were under the State of Calamity after the mutilated visit of Super Typhoon Haiyan or “Yolanda”, the list of these affected municipalities is shown: Agutaya, **Busuanga, Coron, Culion**, Cuyo, El Nido, Linapacan, Magsaysay, Roxas, San Vicente, Puerto Princesa. Among the 11 municipalities, **Busuanga, Coron**, and **Culion** were heavily damaged.

Population

Three of these municipalities namely **Busuanga, Coron,** and **Culion** are chosen as the target areas for the study. Twenty thousand three hundred eight (20,308) individuals were affected (NDRRMC, 2014).

Houses (Totally and Partially Damaged)

There were about 9,410 (totally damaged) and 9,351 (partially damaged) houses in the 11 municipalities. And they are as follows: Agutaya – 1,640; **Busuanga – 4,187; Coron – 8,325; Culion – 3,000;** Cuyo – 448; El Nido – 32; Linapacan – 567; Magsaysay – 554; Roxas – 4; San Vicente – 1; and Puerto Princesa – 3 (NDRRMC, 2014). The three research areas (**Busuanga, Coron, and Culion)** suffered the most.

Agriculture and Fishery

For rice and corn, there was an estimated value of Php 43,941,240 worth of damages and losses. Php 393,400.00 for livestock; Php 1,004,634,300.00 for fishery; and Php 1,910,000.00 for agricultural facilities and equipment were also assessed. The total agriculture and fishery damages and losses that were estimated in the 11 affected municipalities in Palawan were Php 1,050, 878, 940.00 (NDRRMC, 2014).

Having mentioned all these social, biological, and geophysical systems that are vulnerable to climate change, it is a must that the degree of their vulnerability and the adverse impacts has to be addressed. A focus on resiliency is meant to help policy-makers and the stakeholders assess the level of risk and design pertinent response strategies for the long-term scenarios.

The main objective of the study is to create climate-disaster resiliency model municipalities (Busuanga, Coron, and Culion) in Calamianes Group of Islands.

- To determine the climate trends and projections using global climate models
- To conduct an in-depth risk assessment and management using the globally accepted framework and policies
- To undertake impact assessment using social science models and participatory approaches (e.g. biophysical, socio-economics, psychological impact assessment, policy analysis, and religiosity/spiritual activities)
- To provide climate change adaptation (CCA) and disaster risk reduction and management (DRRM) schemes, trainings, and capacity development pertinent to farming and fishery sector
- To train the communities and stakeholders through project development and scientific capacity/capability building.

II. METHODOLOGY

This research study is divided into two phases as shown in Figure 2.1.

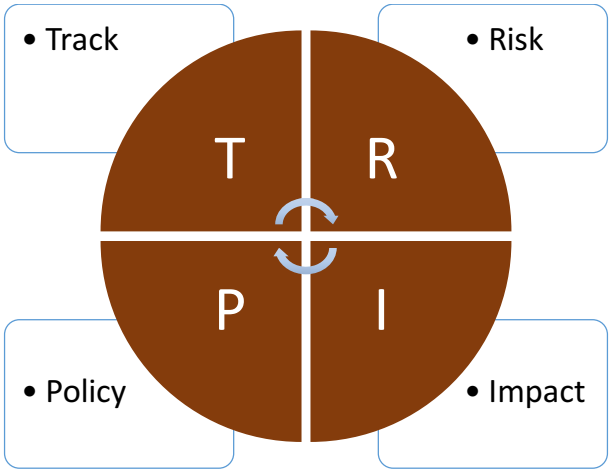


Figure 2.1 Track-Risk-Impact-Policy Framework

Phase 1: Track Assessment

Rainfall (mm), Temperature, and Sea-Surface Temperature (SST) for the next 90 years were determined using global climate models.

Phase 2: Risk Assessment

Risk was assessed using the United Nations Intergovernmental Panel on Climate Change (UN IPCC) and United Nations International Strategy for Disaster Risk Reduction (UN ISDR) Framework – risk as a function of hazard, exposure, and vulnerability.

$$\mathbf{R = f\ (H, E, V)} \qquad (1)$$

Phase 3: Impact Assessment

Five (5) impact assessments were conducted using *Participatory Action Research (PAR)*

a. Biophysical Assessment
b. Socio-economic Assessment
c. Psychological Impact Assessment
d. Religiosity and Spirituality Analysis

Phase 4: Policy Analysis

Climate policies at the local level were created using multi-stakeholders approach. Programs and projects were developed by the stakeholders.

Methods that were used in the study:

1. *Technical Methods*

➢ *Markov Chain Monte Carlo Simulation/Modeling*

Monte Carlo Modeling/Simulation was used for the quantifications of the optimal risk as a function of hazard, exposure, and vulnerability

➢ *Nodebo Quantum Geographic Information Systems (Nodebo QGIS)*

Nodebo Quantum Geographic Information Systems (Nodebo QGIS) was used for Risk Models– Hazard Model (HM), Exposure Model (EM), Vulnerability Model (VM)

➢ *Global Climate Modeling using the CMIP 5 Models*

There were forty-eight (48) CMIP5 Models that were used in the research. The climate variables that were modeled using the 1^0 by 1^0 are as follows:

a. Rainfall or Precipitation in (mm)
b. Temperature in (^{0}C)
c. Sea Surface Temperature in (^{0}C)

Historical Analysis: 1900 –present
Climate Projection: every 30 years (2020 to 2100)

Note: The use of the 48 CMIP 5 Models is very significant to evaluate how realistic the models are in simulating the past and future scenarios.

2. Social Science Methods

➢ **Participatory Action Research (PAR)** was performed in the study in order to further validate the technical output of the research.

Surveys, interviews, and focus group discussions (FGDs) with the people who are living in the vulnerable areas were incorporated in the study. Community-Based Monitoring System (CBMS), Comprehensive Land Use Plan (CLUP), Comprehensive Development Plan (CDP), and tools such as seasonal calendars, community-based mapping and other related activities were used.

Participatory Tools for PAR

These are the tools that were used in the participation of the different stakeholders.

➢ *Participatory Stakeholder Analysis:*

(a) Identify stakeholders relative to specific problems, situations, and issues;
(b) Stakeholder analysis in relation to project outcomes or solutions;
(c) Compilation of problem and solution tables; and
(d) Analyzing the importance and roles of stakeholders in relation to a project.

➢ *Participatory Rural Appraisal:*

(a) From the perspective of local people, generate socio-demographic information;
(b) Participatory Community Resource Assessments; and
(c) Comparative Assessments

➢ *Participatory Appraisals as Sustainability Mechanisms:*

(a) Awareness and advocacy through community presentations and
(b) Conscientization through assessment mapping and presentation.

III. RESULTS AND DISCUSSION

Phase 1: Track Assessment

Climate Scenarios and Projections

Global climate models (GCMs) predict that the three Municipalities (Busuanga, Coron, and Culion) of Palawan will experience higher temperatures, more heat waves in summer, sea-level rise, shorter recurrence of severe tropical cyclones, and increase frequency of flooding and drought. These climate shifts are likely to simultaneously threaten food security, and water supplies, augment energy demand, and directly and indirectly affect public health. These concurrent and interactive impacts can have national and international implications: because these Municipalities of Palawan are the major sites of tourism capital and labor flows, climate change impacts are not limited to the boundaries of municipalities. For instance, a major climate-related disruption in Coron would have reverberating impacts on the socio-economic and financial markets. Thus, transforming the management paradigm to better prepare for climate change will safeguard negative feedbacks around the world.

Climate change may be the ultimate stress on Busuanga, Coron, and Culion where dense population puts tremendous demand on land and water resources. These municipalities with approximately 100,000 are the quintessential rural agglomeration in the province of Palawan as shown in Table 3.1.

Table 3.1 Population of Calamianes Islands

Calamianes Group of Islands (CGI) Municipality	2015 Population (PSA Data)	2020 (3% Growth Rate)	2050 (3%Growth Rate)
Busuanga	22,046	22,834	27,562
Coron	51,803	60,665	113,837
Culion	20,139	20,735	24,311

Climate and Potential Change

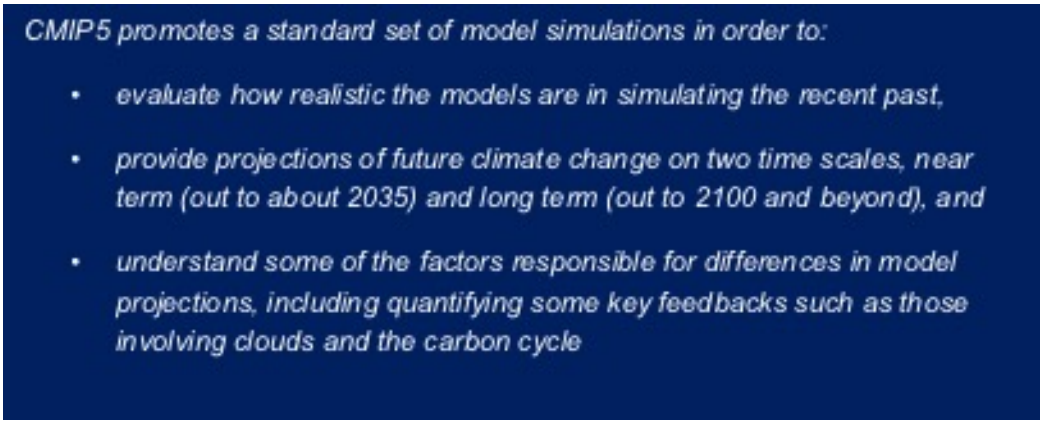
Based on the assessment, historical climate trends, current climate extremes, and future climate scenarios were performed in order to study future climate interactions. Future climate change scenarios were based on current climate trends and projections of global climate models (GCMs). These scenarios were defined as plausible combinations of climatic conditions that were used to project possible impacts created by climate change. In this case, 48 Models of Coupled Model

Intercomparison Project Phase 5 (CMIP5) of the World Climate Research Programme (WCRP) were utilized.

Over the past decades, an average decadal temperature has increased 26.34^0 C in the three municipalities. The municipalities absorb heat during the day and release it at night, making the municipalities warmer than surrounding areas. Warming since 1900 may at least partially be attributed to the anthropogenic increases in greenhouse gases (GHGs). Precipitation levels have slightly increased – an average of 206.99 mm per decade for the last one hundred (115) years. This period saw striking examples of the impacts of climate extremes, including heat waves, droughts, and flooding.

Climate Scenarios (Temperature, Rainfall/Precipitation, and Sea Surface Temperature)

Climate change projections were derived from the global climate models. These mathematical models simulate future temperature and precipitation changes. The 48 CMIP5 Models responded at relatively-coarse scaled resolutions (1^0 x 1^0), from which global scenarios were linearly interpolated. Time periods for the analysis are the 2020s, 2050s, 2080s, and 2100s. Projected changes in the three Municipalities decadal temperature and precipitation for the CMIP5 models and for continued current trends are shown.



The GCM projected temperature changes are increasing because the GCM scenarios account for increasing feedbacks from greenhouse gases that warm the atmosphere. The models denoted that there would be a temperature escalation from 0.14 to 0.43 in Calamianes Group of Islands as shown in Table 3.2. Figure 3.1, 3.2, and 3.3 show the results of the simulation estimates.

Temperature

Average Decadal Temperature (1900-2110)

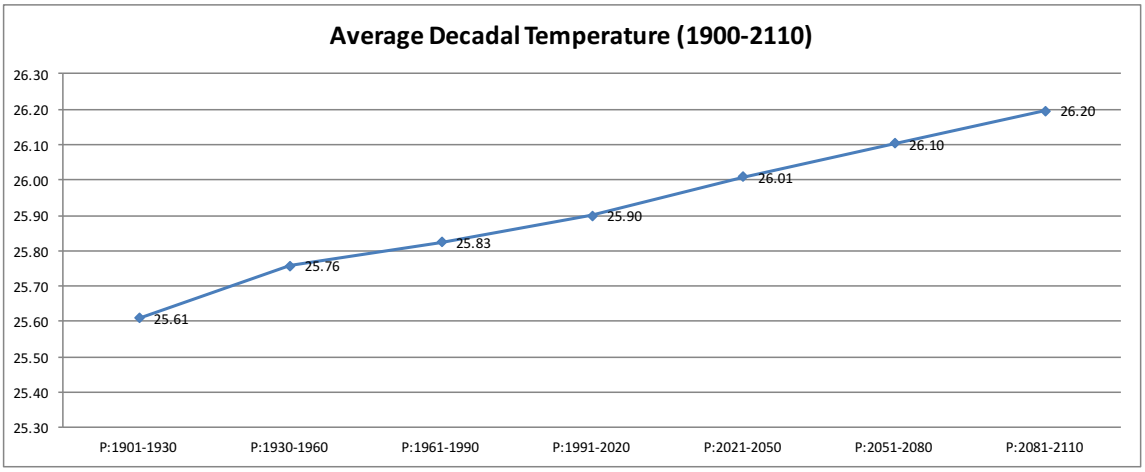


Figure 3.1 Average Decadal Temperature for Busuanga

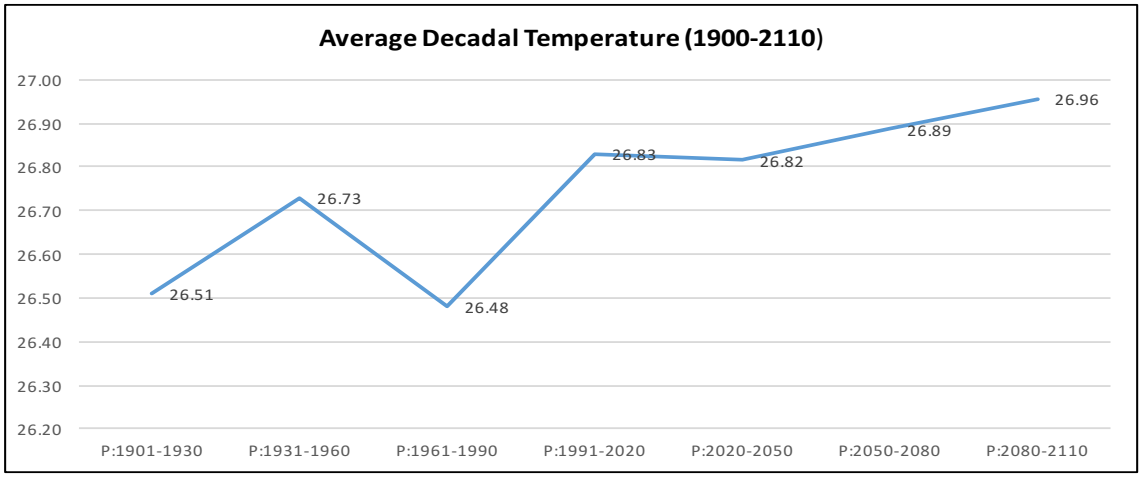


Figure 3.2 Average Decadal Temperature for Coron

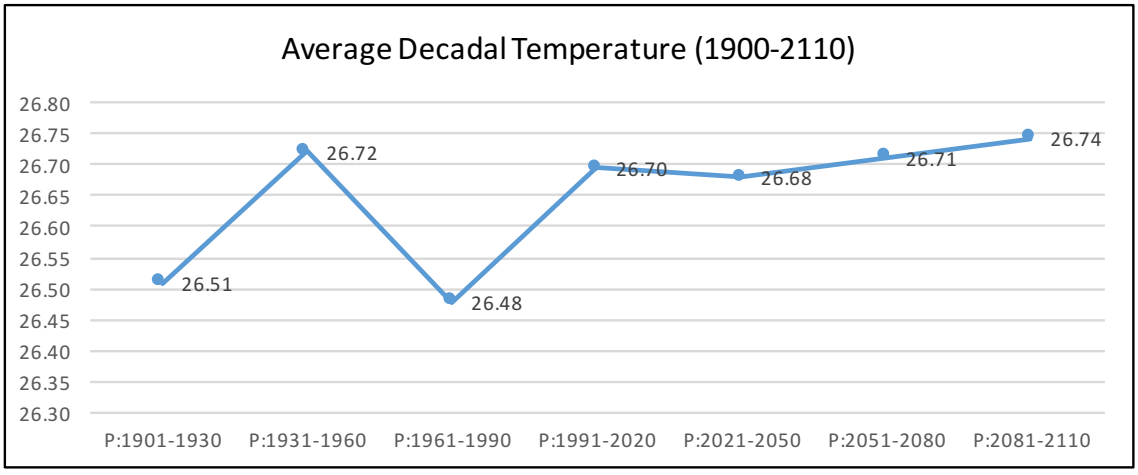


Figure 3.3 Average Decadal Temperature for Culion

Average Monthly Temperature (1900-2110)

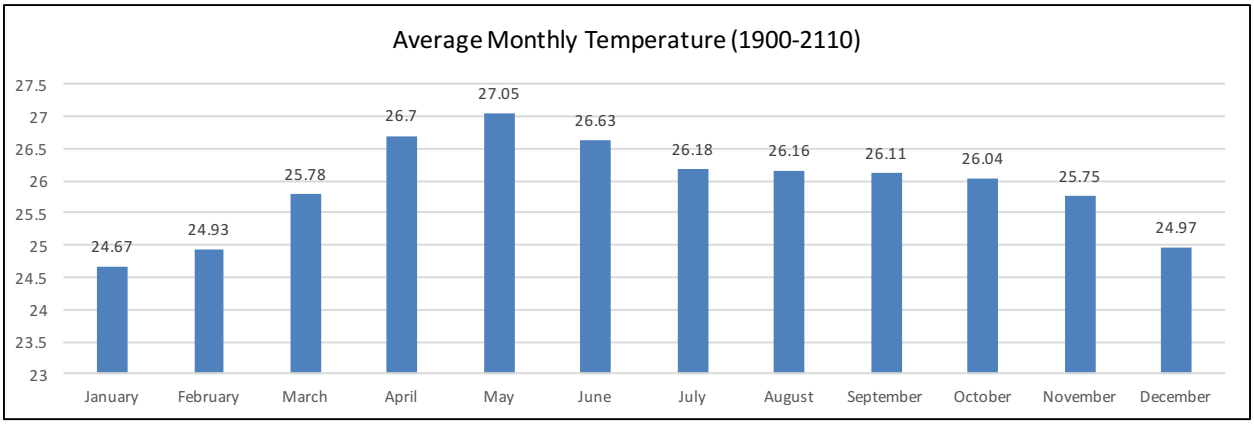


Figure 3.4 Average Monthly Temperature for Busuanga

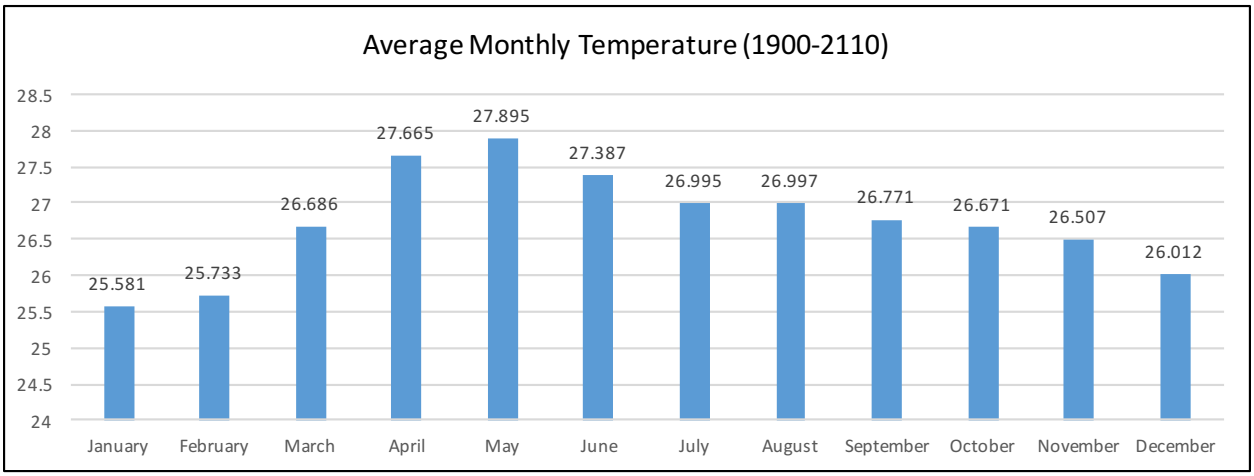


Figure 3.5 Average Monthly Temperature for Coron

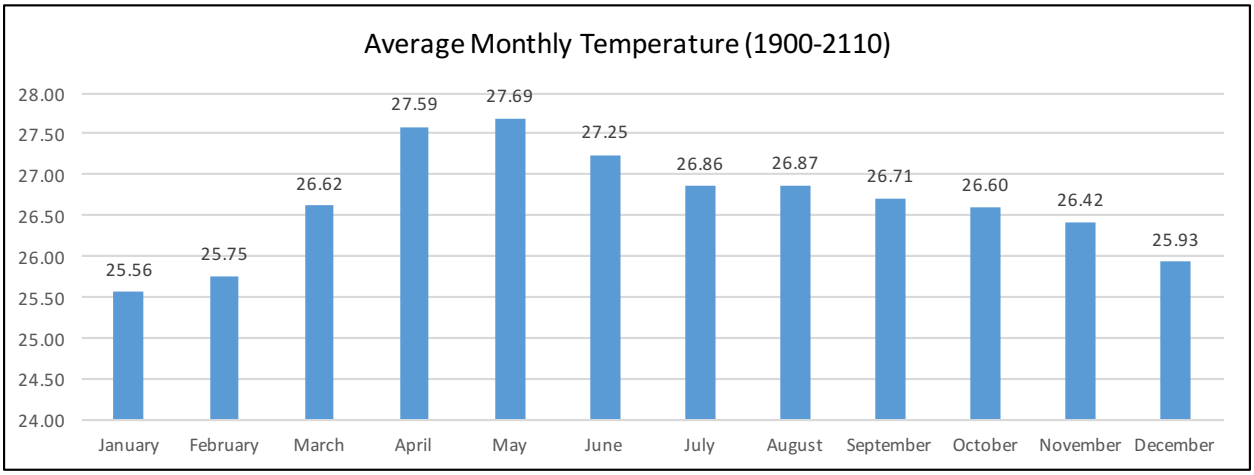


Figure 3.6 Average Monthly Temperature for Culion

Table 3.2 Average Decadal Temperature (1900-2110)

Calamianes Group of Islands (CGI)	Average Decadal Temperature (1900-2015)	Average Decadal Temperature (2020)	Average Decadal Temperature (2050)	Average Decadal Temperature (2080)	Average Decadal Temperature (2110)
Busuanga	25.77^{0}C	25.90^{0}C	26.01^{0}C	26.10^{0}C	26.20^{0}C
Coron	26.64^{0}C	26.83^{0}C	26.82^{0}C	26.89^{0}C	26.89^{0}C
Culion	26.60^{0}C	26.70^{0}C	26.68^{0}C	26.71^{0}C	26.74^{0}C

Also, the CMIP5 Models signified the monthly average temperatures of the municipalities of Busuanga, Coron, and Culion from 1900 to 2100. May is deemed to be the hottest month while January to be the coldest. Table 3.3 as shown reveals the results. Figures 3.4, 3.5, and 3.6 provide a good overview of future temperature possibilities predicted in a monthly scenario.

Table 3.3 Average Monthly Temperature (1900-2110)

Calamianes Group of Islands	Average Monthly Temperature (^{0}C) - (1900-2100)	
Busuanga	Highest: May – 27.05^{0}C	Lowest: January – 24.67^{0}C
Coron	Highest: May – 28.90^{0}C	Lowest: January – 25.58^{0}C
Culion	Highest: May – 27.69^{0}C	Lowest: January – 26.56^{0}C

Summary of Important Findings

Because climate models are extremely detailed, they produce a fascinating array of results, which can be assessed and used for studies of impacts. Here are some important results from the simulated assessments:

- *The best estimate of the Calamianes Group of Islands (CGIs) temperature increase from 1900 to 2110 is between 0.14 and 0.43 ^{0}C.*
- *Temperatures are expected to rise rapidly.*
- *May is the hottest month and the months of January is the cooler month.*
- *Many areas will see more hot months and fewer cold months.*

Rainfall

Average Decadal Rainfall/Precipitation (1900-2110)

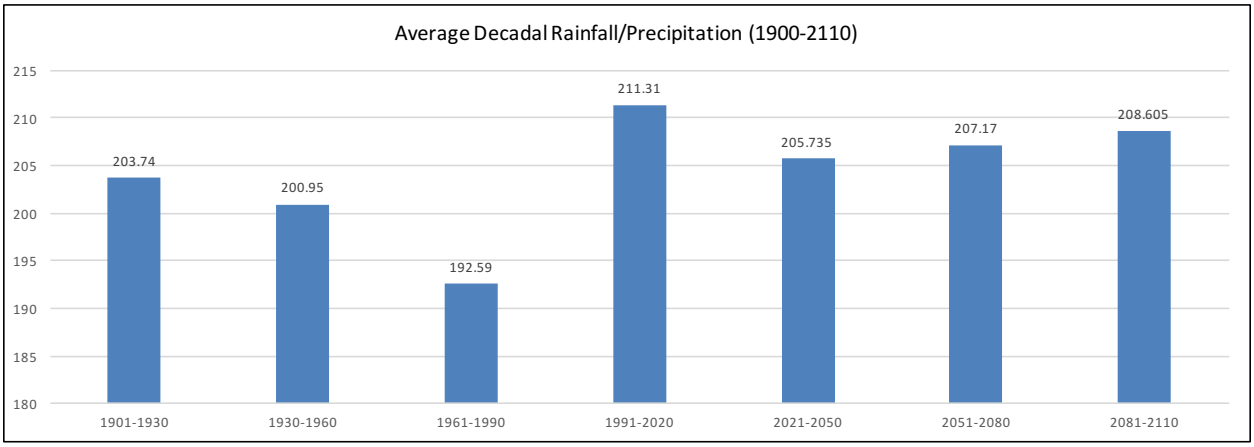


Figure 3.7 Average Decadal Rainfall/Precipitation for Busuanga

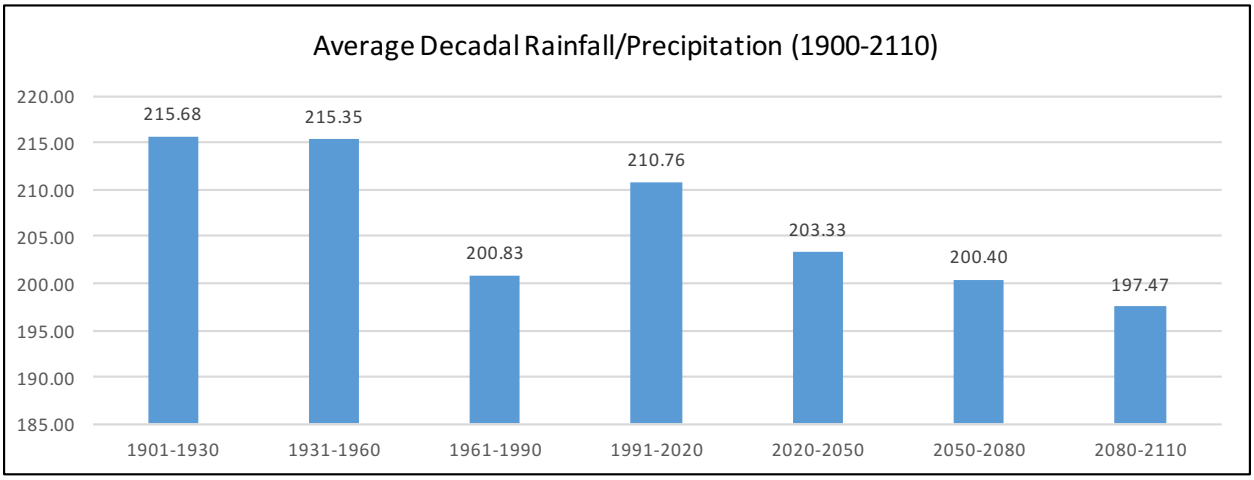


Figure 3.8 Average Decadal Rainfall/Precipitation for Coron

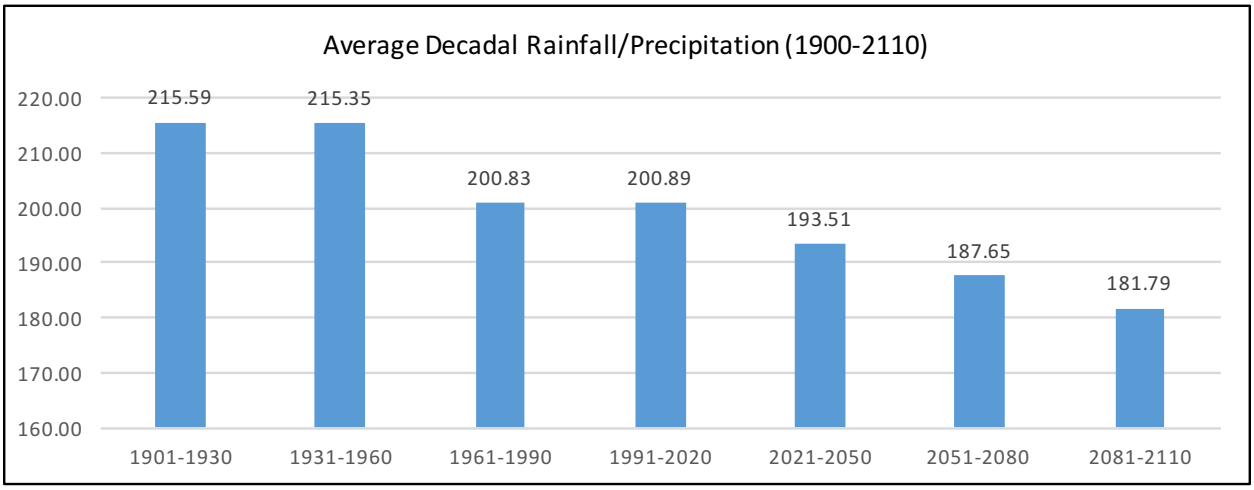


Figure 3.9 Average Decadal Rainfall for Culion

Average Monthly Rainfall/Precipitation (1900-2110)

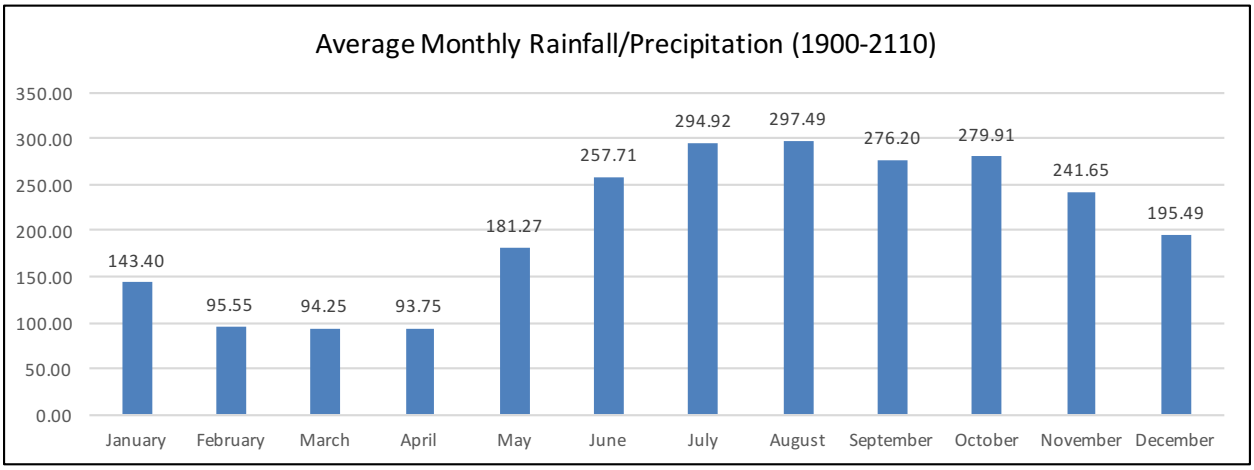


Figure 3.10 Average Monthly Rainfall/Precipitation for Busuanga

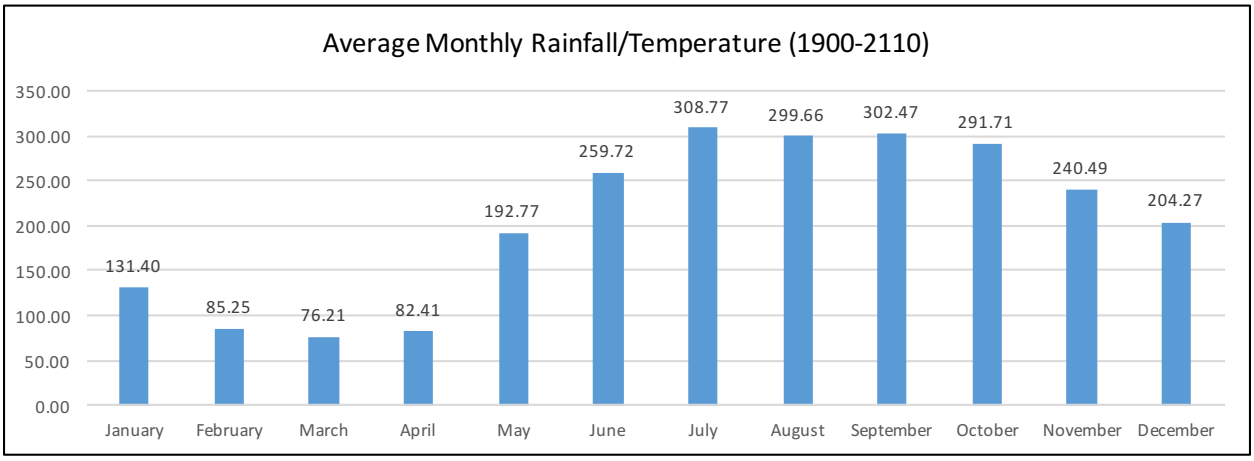


Figure 3.11 Average Monthly Rainfall/Precipitation for Coron

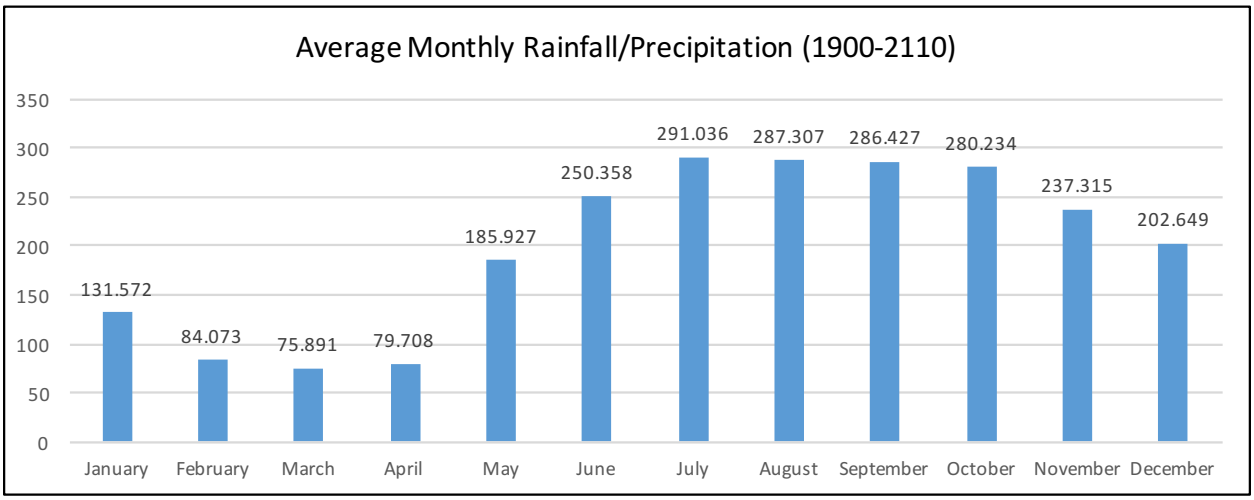


Figure 3.12 Average Monthly Rainfall/Precipitation for Culion

The CMIP5 Models also show that the average decadal rainfall/precipitation in the three Calamianes Group of Islands (CGI) will change indicating hydrological uncertainty in the future. A decrease in the amount of precipitation for Culion but an increase amount of rainfall for Busuanga and Coron in 2020 might happen. There will be a tremendous diminution in all those three islands in 2050. The shrinkage of the amount of rainfall will continuously occur until 2110 for Coron and Culion except for Busuanga, which there will be an immense rise of precipitation in 2080 and 2110. Table 3.4 as shown indicates the change in precipitation concentration. Figures 3.7, 3.8, 3.9 show the simulated results.

Table 3.4 Average Decadal Rainfall (mm) (1900-2110)

Calamianes Group of Islands (CGI)	Average Decadal Rainfall (mm) (1900-2015)	Average Decadal Rainfall (mm) (2020)	Average Decadal Rainfall (mm) (2050)	Average Decadal Rainfall (mm) (2080)	Average Decadal Rainfall (mm) (2110)
Busuanga	202.15	211.31	205.74	207.17	208.61
Coron	201.65	210.75	203.33	200.40	197.48
Culion	206.99	200.89	193.51	187.65	181.79

Table 3.5 provides the summary of the average monthly rainfall/precipitation of the three islands in the period 1900-2110. Based on the analysis, the month of July indicates the highest monthly mean precipitation while March is the lowest for Coron and Culion and April for Busuanga. And the results are shown in Figures 3.10, 3.11, and 3.12.

Table 3.5 Average Monthly Rainfall (1900-2110)

Calamianes Group of Islands (CGI)	Average Monthly Rainfall (mm) – (1900-2110)	
Busuanga	Highest: July – 294.92	Lowest: April– 93.75
Coron	Highest: July – 308.77	Lowest: March – 76.21
Culion	Highest: July – 291.04	Lowest: March – 75.89

Summary of Important Findings

- *The Calamianes Group of Islands (CGI) will experience hydrological uncertainty in the future scenarios.*
- *There will be an increase amount of precipitation in 2020 (except for Culion) .*
- *There will be a continuously diminution of rainfall for Coron and Culion until 2110.*
- *There will be a precipitation growth for Busuanga from 2050 to 2110.*

Sea Surface Temperature (SST)

For the sea surface temperature, it was found out that the scenarios and projections of the sea surface temperature are similar on all the three islands. Based on the models, the sea surface temperature (SST) will continue to rise to 28.84^{0}C in the period of 2110. This means that there will be impacts for the marine food chain specifically for the coral reef building and growth. June with a mean SST of 29.77^{0}C is the warmest month while February (26.82^{0}C) is the coldest.

Average Decadal Sea Surface Temperature (Busuanga-Coron-Culion)

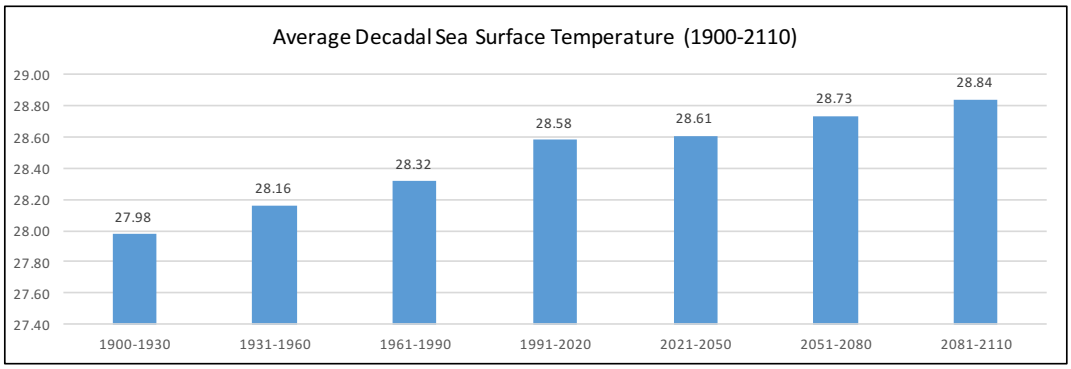


Figure 3.13 Average Decadal Sea Surface Temperature for Busuanga-Coron-Culion

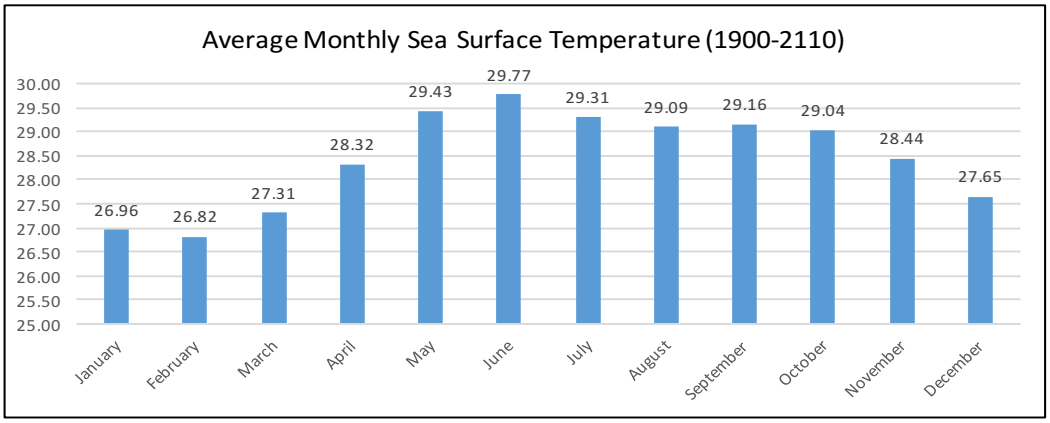


Figure 3.14 Average Monthly Sea Surface Temperature for Busuanga-Coron-Culion

*The models **(Temperature, Rainfall/Precipitation, and Sea Surface Temperature**) provide answers about the projected increases and impacts in the future. However, there will be some disagreement about these results in terms of models utilizations and interpretations. It has to be taken into consideration that there is a central finding, which is that models project large climatic changes over the twenty-first century. These findings are at the cutting edge of modern climate science, and the basic message should not get lost in the differences.*

Phase 2: Risk Assessment

In risk assessment, a robust strategy is considered to be a strategy that performs well over a range of futures. Performance was defined using a range of criteria and typically these include strategy costs and benefits. The benefits comprise reduction in risk, where risk can be defined in economic and life loss.

Some considerations are important in the analysis of risk. And they are as follows:

a. The risks from climate hazards encompass a wide variety of aspects, mostly negative impacts that are related to loss of life, human suffering, distress and discomfort, disruption and damages, and economic losses. But potentially also some positive effects may occur, including increased investments and replacement, renewal and improvement of material assets, such as climate-smart infrastructure and buildings;

b. Large variations occur in extreme weather risk across geographic locations because of the highly variable characteristics of the exposure of people and capital and their vulnerability, that is, susceptibility to harm, and the likelihood of the occurrence of climate hazards;

c. Estimates of future extreme weather risk are difficult to make, given the uncertain development of climate change, shifts in weather extremes, and economic and social development.

These estimates of the risks represent the state of the art, and they are necessary ingredient for calculating economically efficient science-based climate change policies.

There were four climate hazards that were considered in the study.

They were as follows:

a. Tropical cyclones
b. Flooding
c. Drought
d. Sea level rise

Busuanga

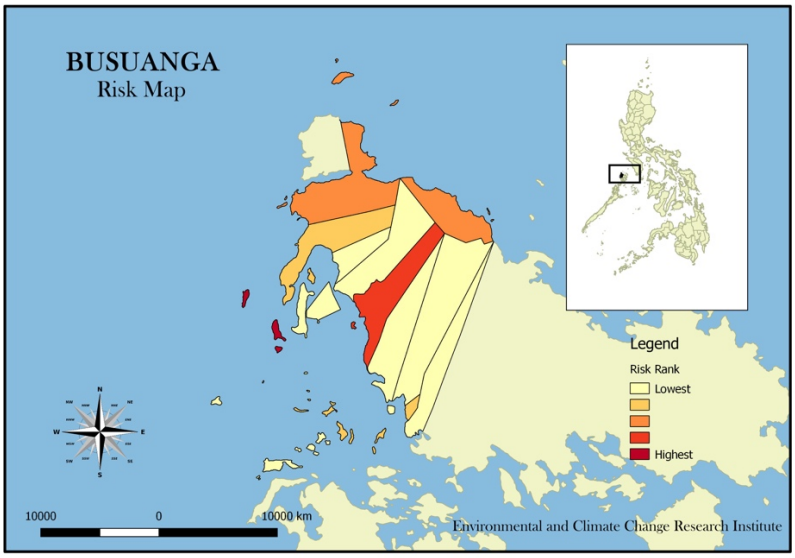


Figure 3.15 Over-all Estimation of Risk (Multi-Hazard Scenario)

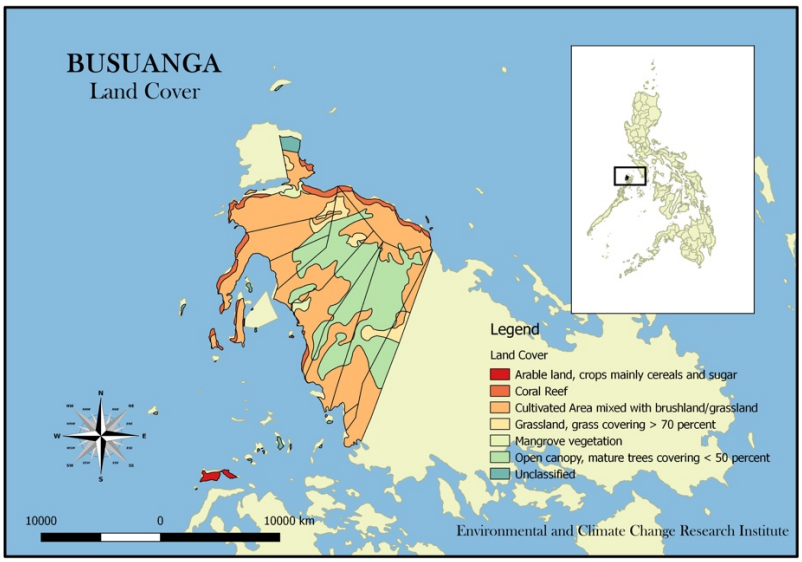


Figure 3.16 Land Cover that is at Risk

For Busuanga, drought is the most precarious climate hazard among the four. This perilous threat may affect water supply and instigate mutilation to food security of the municipality. The extent of devastation may vary depending on the intensity of the drought and the length of time an area is considered to be in famine scenarios. Tropical cyclones, which is the second climate hazard, may instigate sedimentation and siltation. Sea-level rise and flooding may affect inland erosion, sand extraction, and may increase the incidences of water-borne related/illnesses. Figures 3.15 and 3.16 present the over-all risk of the Municipality based on the multi-hazard scenario.

Coron

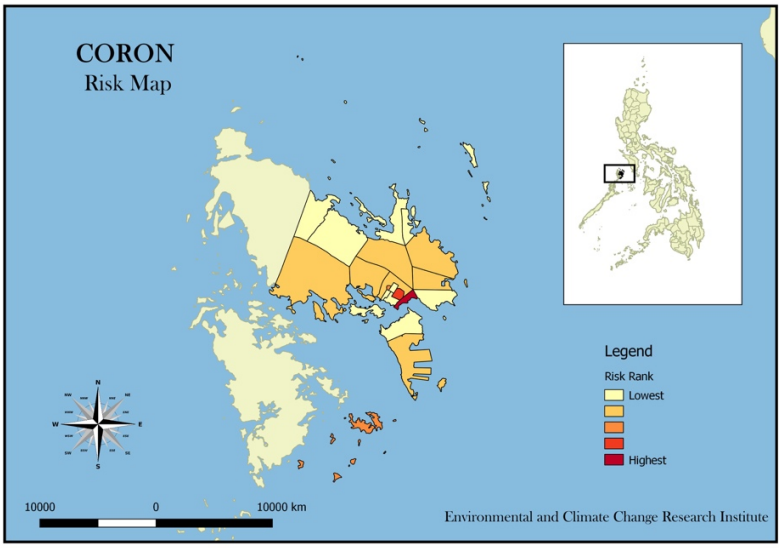


Figure 3.17 Over-all Estimation of Risk (Based on Multi-Hazard Scenario)

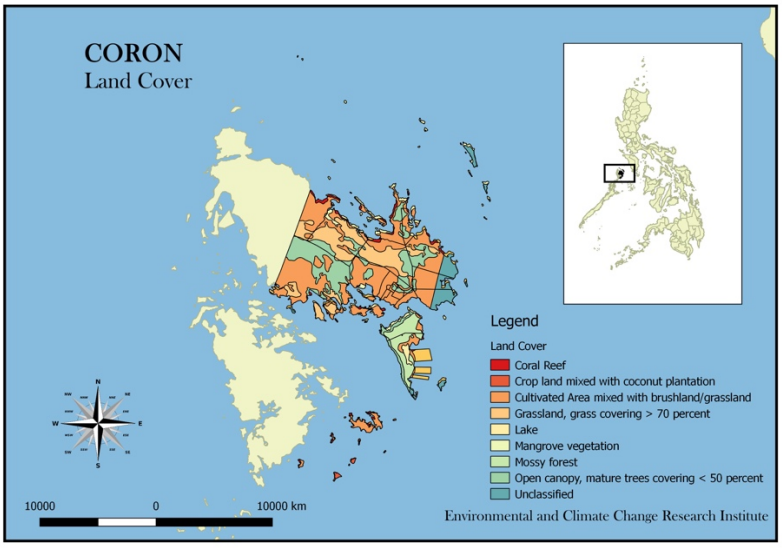


Figure 3.18 Land Cover that is at Risk

Coron is very vulnerable to tropical cyclones and drought. This entails that the municipality of Coron will experience more intense tropical cyclones in the future. Drought, which has a similar risk scenario, may trigger warmer climate and higher temperature in the next decades. Flooding and sea-level rise, the two climate menace, may cause lesser severe impacts due to municipality's physical and ecological situations. It has mangrove forests and seagrass beds that made the municipality's more resilient to flooding rather than cyclones and extreme temperature. Figures 3.17 and 3.18 provide the climate risks in the Municipality of Coron.

Culion

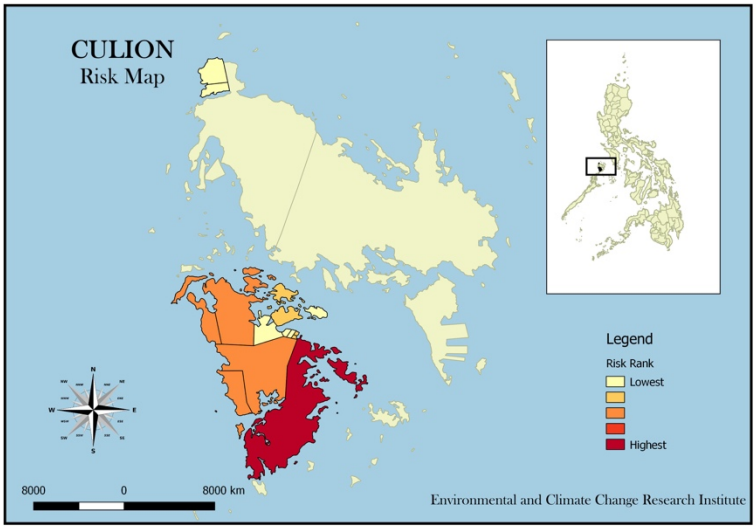


Figure 3.19 Over-all Estimation of Risk (Based on Multi-Hazard Scenario)

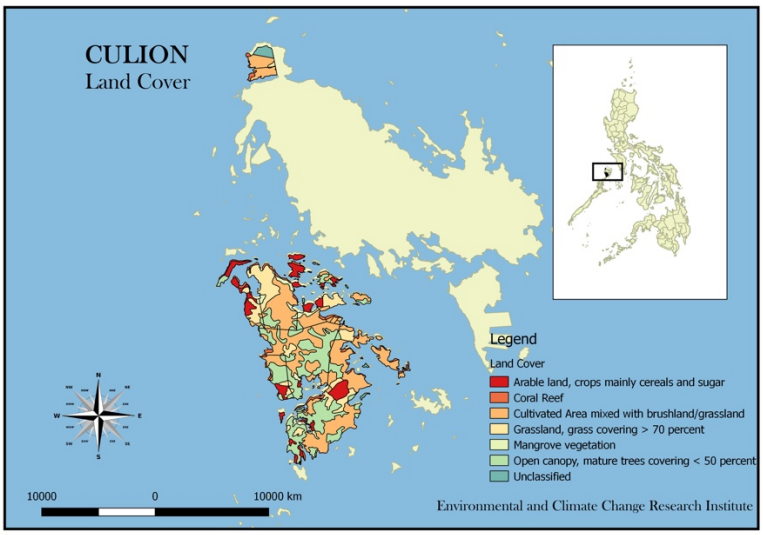


Figure 3.20 Land Cover that is at Risk

The Municipality of Culion is exposed to climate hazards. Due to its geographical condition, it is obvious that human exposure is at risk. The municipality with 20, 139 people are at risk to tropical cyclones followed by flooding and drought. Sea-level rise, which is another probable peril, may cause interferences due to evacuations and migration from annihilation of homes and properties. These four climate hazards will definitely cause loss of human lives and deterioration of health conditions owing to water and airborne diseases. Figures 3.19 to 3.20 provide the worst-case scenario that might occur in the Municipality of Culion.

Phase 3: Impact Assessment

The impact assessment using Participatory Action Research (PAR) was performed in order to validate the findings of the Global Climate Models (48 CMIP5). This is divided into five (5) categories to establish the climate-disaster resiliency of the three (3) Calamianes Group of Islands (CGIs). They are as follows:

- Biophysical Assessment
- Socio-economics Assessment
- Psychological Impact Assessment
- Religiosity and Spirituality Analysis
- Policy Analysis

1. Biophysical Assessment

Changes in Rainy Season

According to the stakeholders, rainy season usually occurs from the months of May to December. Increased rainfall activity may extend all the way to January. However, there were times when warmer temperatures were felt during these months. Aside from these unusual phenomena, minimal flooding was experienced all throughout the years. During this period, tropical cyclones were regularly experienced and it usually occurred during the months of June to December. The strongest ones occurred from September to December. Some of the most devastating tropical cyclones that they will never forget were *Undang* (November, 1984), *Ruping* (November, 1990), *Harurot* (July, 2003), and *Yolanda* (November, 2013). Among these tropical cyclones, it was Yolanda that wreaked havoc the most. Decimation of coral reefs, uprooting of mangroves, and destruction of houses and properties were some of the effects of Tropical Cyclone *Yolanda*. It was also mentioned by the stakeholders that unusual behavior of the animals specifically giraffes of Calauit Island in Busuanga running around in circles, was also noticed a few hours before tropical cyclone Yolanda made its entry. Table 3.6 provides the changes in season according to the actual experiences of the stakeholders.

Table 3.6. Seasonal Calendar for the Changes in Rainy Season

Rainy Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Before												
Now												

Note: NOW: Rainy season cannot be determined nowadays that is why all months are colored.

Changes in Dry Season and Temperature

According to the inhabitants of Busuanga, Coron, and Culion, dry season usually occurs from the months of November to May. In this period, April and May were considered the hottest months. In addition, drought was rarely experienced before. Now, drought ensues often according to the stakeholders. One stakeholder said, *"mas madalas na ang init ngayon kumpara nong mga nakaraang panahon"*. It occurred once every few years. Droughts frequently appear from the months of March to May. Also, extreme temperature is more severe compared than before. Due to this perilous effect, water crisis and shortage was experienced by the residents. Heat index was also observed to be hotter this period compared to the previous years. Aside from this exposed event, more extreme water temperatures (hot and cold) have been observed. During the wet or the cold season, the fishermen could not stay in the water for long periods of time. According to the stakeholders, *"Dati makakababad pa kami sa tubig ng walong (8) oras ng walang akyatan pero ngayon hanggang tatlong (3) oras na lang sa sobrang init"*. Table 3.7 provides the information on changes in the dry season.

Table 3.7. Seasonal Calendar for the Changes in Dry Season

Rainy Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Before												
Now												

Note: NOW: Dry season cannot be determined nowadays that is why all months are colored.

Changes in the Water Level

The shoreline of the three islands was seen to have gotten closer to the land. According to the stakeholders, *"'Yung pampang dati malayo, ngayon lumalapit na sa aming mga bahay*". There was a three to five (3-5) meter difference compared to the 1980s. This could mean that the water level is exponentially rising. Moreover, island disappearance is now being observed. One fisherfolk mentioned that the Kalanggaman Island used to have a rock about as big as a house. He said*, "Ung isla ng Kalanggaman dati may malaking bato na kasinglaki ng bahay, ngayon isang kamao na lang ang laki"*. It was discovered three to five years ago that the island has sunk and the visible part of the rock was only as big as a fist. This observation was not only recorded by the provincial government but also by the people who are living in those areas. Aside from sea level rise, saltwater intrusion and high rate of groundwater extraction also affect the pressure balance. This is quite evident in the quality of drinking water in the area. It was observed that the intrusion of saltwater has decreased and affected the quality of their drinking water.

Changes in Mangroves Population Growth

According to the stakeholders, an extensive plantation of mangroves was present in the Calamianes Group of Islands. They can be found in shorelines and brackish waters. In the island of Calauit, twenty percent (20%) of the total land area was covered by mangroves. It was also inferred that there was a seventy percent (70%) increase in the population of mangroves in Busuanga. However, in Coron, there was a decrease in the population of the mangroves caused by illegal activities and tropical cyclones.

In order to escalate the population growth of mangroves, an expert stakeholder who has been living in Coron for more than thirty (30) years mentioned that "*mangroves have large seeds and when are dropped into the water and sinks, will naturally grow. When mangroves are planted, the survival rate is nearly zero. But, if the seeds are naturally dropped from the mangroves, they will typically float and until a high tide, it moves to the upper side and when low tide comes, the seeds go down. The sands would make big holes where bundle of seeds will be stuck and eventually grow. In this way, the survival rate is higher*." Also he mentioned that mangroves are not affected by climate change. It is the civilization and the human activities that impact the condition of the mangroves in those islands. However, another stakeholder mentioned that warmer temperature affects the slow growth of the mangroves. If these mangroves do not grow in a standard height due to the changes in temperature, they become "dwarf" mangroves. Figure 3.21 as shown provides the mangroves crown cover in Busuanga, Coron, and Culion.

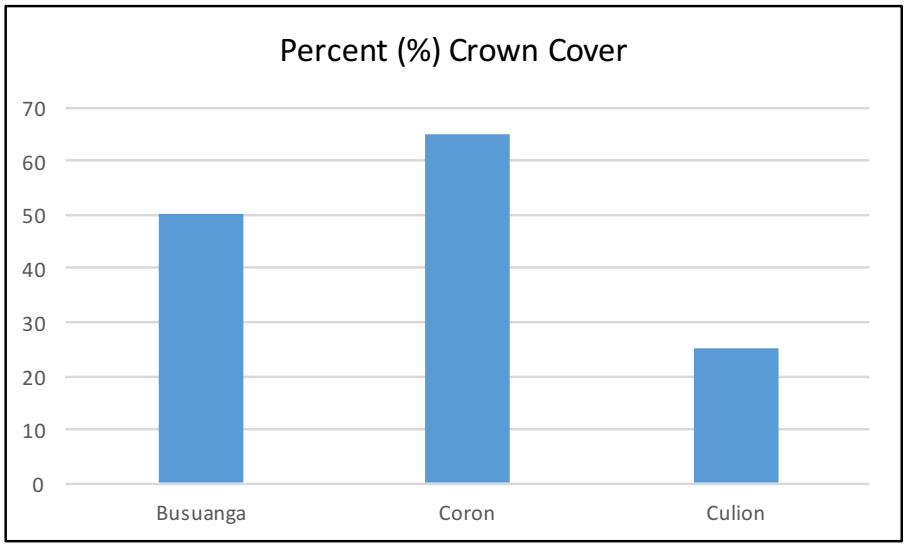


Figure 3.21 Mangroves Crown Cover

Based on this Figure, Coron has the highest mangrove cover in Calamianes Islands.

Changes in Coral Reef Growth

Coral reefs were well-preserved in Siete Picados, Bugor, and Concepcion. These places were marine protected areas. The state of the coral reefs was not only affected by man-made events but also by climate change. In some other parts of the Calamian Group of Islands, the corals were damaged or destroyed due to illegal activities and due to the effects of climate change – higher water temperature and stronger tropical cyclones. Based on the researchers' observations, there was siltation due to poor soil management such as *kaingin*. This is washed off to the river and goes to the ocean and covers the surface of the ocean thus, blocking the sunlight from passing thru to the corals. This affects the growth of coral reefs. There were instances of coral bleaching in CYC islands of Coron. The stakeholders said that *"namumuti na ang mga corals dito… siguro sa sobrang init talaga"*. One stakeholder mentioned that this coral bleaching is not coral dying. He said that *"it is just that the algae are released through the hot temperature. It so stressed out that it cannot process photosynthesis that produces the color. So it's a stress sign from the corals."* There are also signs of good coral reefs in those islands. According to some stakeholders, the percentage of good coral reefs is higher than stressed coral reefs. The presence of stock corals and parrot fish is an indication of a healthy coral reef. These corals work together in symbiotic union with other corals. Brain corals, which can also be found in those islands, are the slowest growing corals because they grow two (2) centimeters a year. Figure 3.21 provides the information of the coral reef cover in Calamianes Islands.

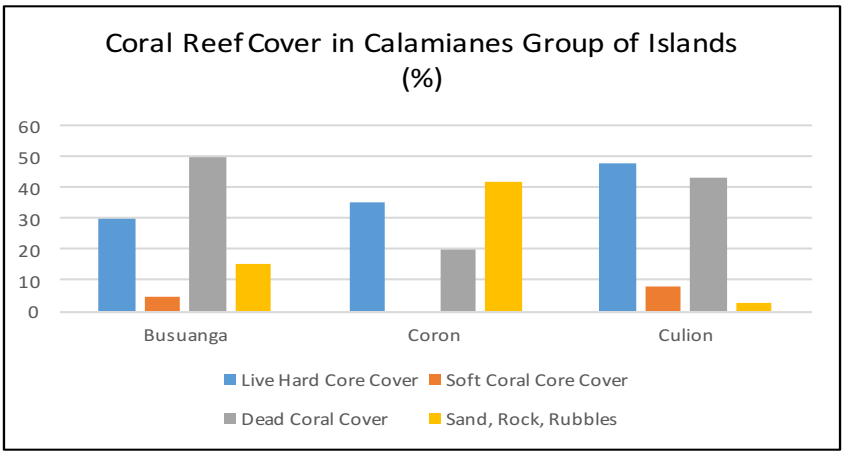


Figure 3.21 Coral Reef Cover in Calamianes Group of Islands

Source: Calamianes Integrated Fish Management Plan

Based on Figure 3.21, an average of thirty-nine and thirty-three percent (39.33%) of coral reefs are dead. This is alarming because the exponential increase of temperature and the intensity of tropical cyclones might create higher damages and losses of coral reefs, thus, affecting the food security in the islands in the future.

2. ***Socio-economic Assessment***

Changes in Fish Catch

Different kinds of fish species were identified in the area. They are as follows: *tulingan, alumahan, lapu – lapu, galunggong, paru – paro, and dalagang bukid* as shown in Figure 3.22. According to the fisherfolks, the species that they caught before were still the same species they catch today. They said, *"Ung mga uri ng huli namin noon.. ganon pa rin… wala namang nagbago."*. These kinds of fish are still identifiable at present. The only thing that changes is the volume of fish catch mentioned by the fishermen. Since Calamianes Group of Islands are coastal communities, various reasons such as increase in population, growth of sanctuaries and preservation areas, and effects of climate change affect the volume of fish catch.

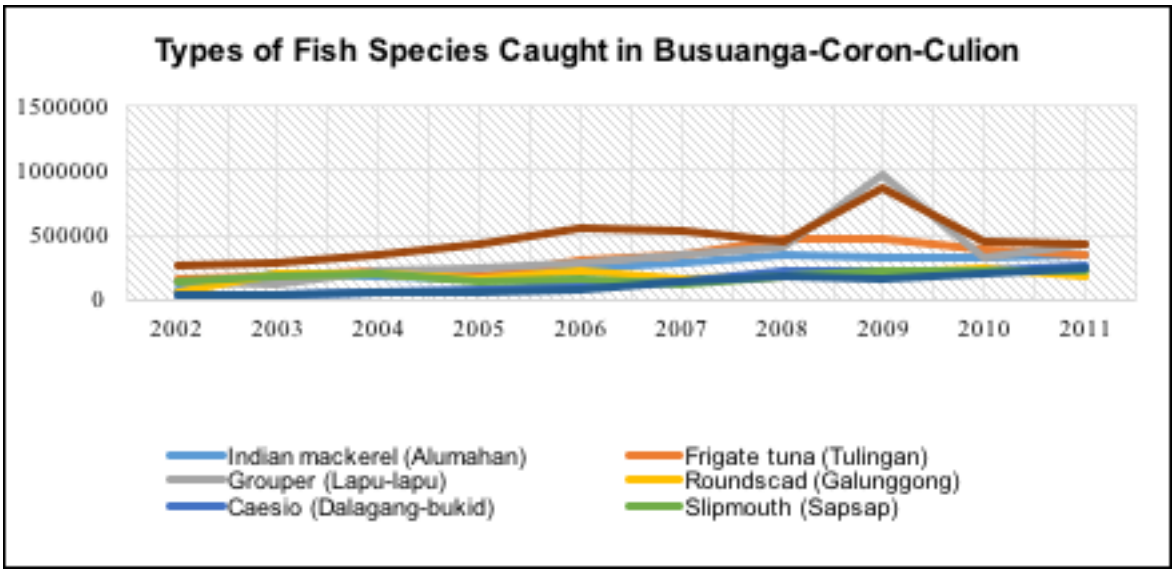


Figure 3.22 Kinds of Fish Species Caught in Busuanga, Coron, and Culion

Fisher folks' responses towards the volume of fish caught turns to be in a majority declining. In 2002, Calamianes Group of Islands fish market is recorded to supply 55% of the total volume of live fish produced in the Philippines, as well as 45% of all fish that goes to Manila (Padilla et al. 2003). As a result, employment opportunities in fishing increases producing a lot of entries of migrants from Luzon and Visayas that causes rapid population growth in Calamianes. Number of fishing boat rises and other vessels related to fishing increases. And to this, rapid increase in the demand of fish goes live in Calamianes Group of Islands up to the present.

Also, according to stakeholders, daily catch of fish eventually fluctuated. Based on their actual responses, *“Dati po nakakahuli na kami ng 20-50 kilo ng isda papunta pa lang, ngayon balikan na ang takbo naming, 5 kilo na lang na isda ang naiuuwi namin”* . It was mentioned that they used to catch 20-50 kg of fish on one-way trip but it turns to be a huge decrease down to 5 kg nowadays. Fishermen attributes this reason to climate change. They said *“dahil nga sa nagbabago na ang klima, pakiramdam namin pati ang huli namin nagbabago rin.. iba talaga ang dulot sa amin ng klima ngayon”*. In addition, some of them considered that the increase in the water temperature might be the reason why there is a massive fall on the fish catch.

Distance of Fishing Site

Distance of fishing site was intended to be a very important basis upon looking for impacts of climate change due to its direct connection to the surface of the sea where fishing takes place. Fishes usually stay in the colder surface of the ocean where they can reproduce easily, however, with the effects of climate change specifically the increase in sea surface temperature, fishes go deeper and deeper to stay at a colder surface. When water heats up, it expands thus, the most readily apparent consequence of higher temperature is a rapid rise in sea level in which the warmer water goes on top and the colder goes down where fishes usually lives in. One of its effects is that fish tends to go to unfathomable area where the colder surface is in place. This signifies that the fishermen will have to travel to a far place in order to catch these marine species. According to fisher folks*, “ang layo po ng aming pinamamalakaya.. dati po mangisda ka lang diyan sa tapat, meron na.. ngyon, kailangan mo pang lumayo at magtagal ng maraming araw para makahuli”.* The distance of fishing turns to be a lot farther now compared to the distance before. In the past, fishermen could fish just near the shore where they could spend just 1 liter of gasoline on one-way trip. Now, there is a huge difference not only on fuel consumption but also on distance fishing sites. Today, fisher folks go farther and deeper just to catch fish and they would add, *“Ang layo-layo na nga, di pa din sapat yung huli namin*.”

Figure 3.23 provides the distance of coastline per island of Calamianes.

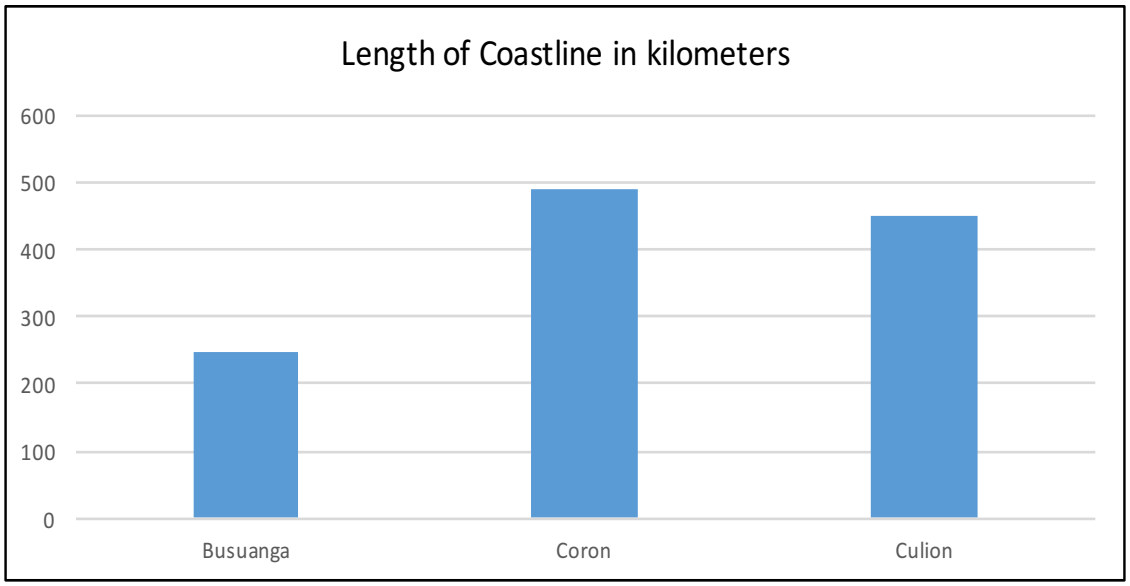


Figure 3.23 Length of Coastline of Busuanga-Coron-Culion

The fisherfolks will need to travel more or less 400 kilometers per fishing schedule. This fishing distance will be likely to increase since marine species like fish tend to stay in a much deeper level of water due to warmer water temperature or sea surface temperature.

Income Adequacy

A decrease in the income of fisher folks resulted due to changes in the volume of fish caught, prices of fishes, distance of fishing site, and the increasing number of fishermen in their community. According to the stakeholders, *"Malaki ang kita namin noon dahil maraming huli ng isda at pwede mo pang ibigay ang mga sobrang huli mo*. Their income varies depending on the kilos of fish they catch on a given expedition, lasting usually for 8 hours, fisherfolk recall getting surplus income in the past. Now, even though fishing expeditions last the whole day (or night) or, for some, even 30 days, they manage to earn an income ranging only Php 100.00. As a result of the above, there is an increased risk of incurring losses from fishing expeditions. As fisherfolk income declines, they are more unlikely to be able to recover the associated costs of fishing expeditions, primarily fuel costs. Furthermore, some of the fisherfolk venture into sea during typhoons or during the rainy season, because sea turbulence yields better harvest for them. Furthermore, rain facilitates upsurge of warm seawater from underneath the surface, which in turn convey the fishcatch. However, they observe that, recently, there is only a marginal increase in harvest during this season. Also, instead of warm seawater, the upsurge from underneath the surface has become much colder and, therefore, fends off the fishes.

Alternative Sources of Income

The income reduction made the stakeholders (e.g. fisher folks) look for alternative sources of income that mostly would either be to work as an employee in private or government agencies, to put up a *"sari – sari"* store, to serve as construction workers, some also resorted to trading of fish commodities. The young fisherfolks (*as early as 10years old*) venture into driving (e.g. van drivers, tricycle drivers) and sometimes they venture themselves as "dive masters" in lodges and resorts to feed the family.

The Role of Women

Women play an important role in augmenting the family income in the Islands of Calamianes. They are actually gleaners, nipa weavers, seaweed farmers (female farmers), and some are employed in pearl farms. According to the female stakeholders, *"kung wala ang asawa namin, hindi naman pwedeng tatanga lang kami sa bahay.. kailangan din naming maghanap-buhay para matulungan ang asawa namin… pag pumalaot sila, kami naman ay nagtatrabaho rin… kasama na rin doon ang pagbabantay sa mga bata na minsan ay sinasama namin sa aming trabaho…".* Some are left at home to safeguard their properties, children, elderly and the sick. These come over and above their regular domestic responsibilities, thus, an exacerbation of the problem of the 'double burden.'

3. ***Psychological Impact Assessment***

Impacts of natural disasters show an increasing recognition of mental health stressing with acute and posttraumatic stress disorder (Galea, Nandi, & Vlahov, 2005); somatic disorders (van den Berg, Grievink, Yzermans, & Lebret, 2005); major depression (Marshall et al., 2007). Psychological impacts are likely to be mediated and moderated by flexibility or susceptibility to catastrophes and environmental changes (Brklacich, Chazan, & Dawe, 2007), and social and cognitive factors (Leiserowitz, 2007; Weber, 2006). According to Burley (2010), farmers and fishers living in rural areas who heavily rely on natural resources for their economic well-being are likely to be strongly affected, directly or indirectly, especially populations living in areas such as coastal areas and circumpolar regions (Doherty & Clayton, 201; Swim et al. 2010, 2011).

"Trauma", Fear, Apprehension and Anxiety

Residents of Calamianes Islands mostly experienced apprehension and anxiety concerning the preservation of their wellbeing especially of the children. Association of the self with the safety of their livelihood were observed, claiming, *"mahirap din naman pong pabayaan mo lang… malaking kawalan din po sa amin nyan".* Disaster consequences such as financial loss and evacuation further aggravate disaster-related stress (Ehrenreich, 2001), though not considered a direct function of calamities. This association accounts for the devastating effects of typhoon *Yolanda* on Calamianes locals—the severity of the disaster was not expected and has never been experienced before. Human attachment to a location can be disrupted and undermined by the loss of places, people and livelihoods that are important to well-being in psychological, as well as physical terms. Different fields of work correlate geographical research with culturally specific emotional ties with the land, demonstrating the importance of place for sense of identity and well-being (Ford et al., 2010; Panelli and Tippa, 2007). The effects resulted to locals' resilience and stability for upcoming occurrences of disasters due to relative adaptation, where apparent emotional effects of disasters are rather short-term compared to those that are economic and societal in nature (Ehrenreich, 2001). Participants have claims on having post-disaster *"trauma"* though further examination argues that their circumstances do not meet the prescribed six symptoms of DSM 5 (Diagnostic and Statistical Manual of Mental Disorders, 2013) for Post-Traumatic Stress Disorder (PTSD) as their reported shock and anxiety categorizes more as a state rather than a trait, ergo do not warrant any psychopathological diagnosis. These stressful events, however, may lead to Adjustment Disorder if it continues to persist from 3 to 6 months and is encompassed by Acute Stress Disorder.

Traditional Male and Female Gender Roles and Rising Egalitarian Female Gender Roles

The fathers provide for the material needs of the family and do not evacuate to look after their belongings. The men would assume leadership as the family members vacate their areas while the females depend on males for financial needs and are expected to boost the morale of the other members. Traditionally, husbands are not expected to attend to the emotional need of their wives and children, and are mostly expected to provide for the basic needs of their families (Knox and Schacht, 2015). According to Eagly (2007), the traditional gender role for women is that they should act as caregivers for their children. Men, on the one hand, must serve as the breadwinner of the family. These set of behaviors are common and expected from each member according to societal and cultural dissimilarities. Though women are not expected to work and provide for the family (Knox & Schacht, 2015), egalitarian actions of women were found among

the families where volunteerism is implemented as they actively participate with their respective barangay programs.

Female Distress

Though accordance of the parents in the survival of the children and unity among family members were more pronounced from the data gathered, due to the expectation from women to tend to the physical and emotional needs of their husbands and children, a wife's distress due to economic challenges and dejection by material loss would cause tension between the parents, and would eventually reverberate to the offspring. Female are more predisposed to psychological effects of disasters due to *trait neuroticism* (APA, 2013) making them more susceptible to negative emotions such as anxiety, fear and distress.

Relative Adaptation

Climate-related events are anticipated to severely impact those with reduced mobility such as children and elderly (Doherty & Clayton, 2011; Swim et al., 2010, 2011) where recent interdisciplinary discussions recognize related adaptation processes as aspects of a psychological response to climate change threats (Brewer, 2008; Norgaard, 2009; Reser & Swim, 2011). Other than backgrounds of fear and gratitude for no loss of family members, children were recorded to undergo relative adaptation, the ability of an individual to adjust after undergoing comparatively cases of scenarios (Ehrenreich, 2001), quoting, *"parang nasanay na ba sila pagdating ng masamang panahon".*

Frustration towards Lack of Aid, Oppression from Local Government

Environmental stressors associated with global climate change are likely to have immediate effects on the occurrence and severity of mental health issues in affected communities and constant disturbances to the social, economic and environmental causes that promote mental health in general (Costello et al., 2009; Few, 2007; Fritze et al., 2008; Page & Howard, 2010). With natural calamities, emergency situations and disasters causing problems at the individual, family, community and societal levels, pre-existing problems of social injustice and inequalities would be further amplified at all levels depending on the actions of the government afterwards as levels of trust towards the government are inversely correlated to the proximity of the disaster and personal affliction. This suggests that the nearer the person is to the disaster and the more affected the person is, the lower the trust would be towards government officials (Hommerich, 2012). Residents show dismay in lack of service and indignation to unfair treatment in dispersion

of goods leading to loss of trust in the government, although socio-economic disparities may allow differentially experiencing these climatic events, with low-income people excessively experiencing the most negative impacts (Swim et al, 2010). Social justice implications from the people would demand consideration due to their less economic privilege and social status (Agyeman, Bullard, & Evans, 2003; McMichael, Friel, Nyong, & Corvalan, 2008). A report by the Oxford Research Group (Abbott, 2008) stress the psychosocial impact of climate change on civil conflicts, noting that when governments fail to effectively defend against natural disasters or respond to their effects, people may lose confidence and trust in civil establishments, resulting in criticism.

Oneness in the Community, a Neighbor's Concern

Occupants of the different locations show cooperation and sharing of resources *en masse* strengthening domestic bonds. Social support theory according to Cobb (1976) suggests that social interactions that provide individuals with actual assistance or relationships are perceived to be caring and readily available in time of need, especially during disasters. Supportive social relationships are beneficial for physical and emotional health where sorting severe loss of income through disaster may only be a partial explanation in the decrease of one's psychological well-being (Becchetti & Castriota, 2010).

4. Religiosity and Spirituality Analysis

Christian values towards the environment are diverse. Different traditions, for example, emphasize different aspects of the creation narratives. White's (1967) seminary work in this area focused on branches of the church that emphasize texts such as Genesis 1:26–28 (White, 1967). This states that humans were given a divine edict to have dominion over the earth and increase in number. However, other traditions, especially among liberal denominations, teach divinely sanctioned stewardship (e.g., Genesis 2:7–15) where humans are put in Eden to care for and till the earth (Greenley, 1993) To add further complexity, some contemporary movements focus on apocalyptic rather than creation narratives (Guth, 1995).

Apocalyptic beliefs are widely reported in fundamentalist and Pentecostalist movements. Guth et al. (1995) express concern that the outlook of these churches risks their members becoming disengaged from current environmental concerns as they focus on preparing for the afterlife. Fundamentalist Christian faith may even encourage individuals to welcome growing

environmental problems as positive signs of the Second Coming. In support of this assertion, a recent study found that citizens most dismissive of climate change were more likely to be Christians demonstrating a high level of religious observance (Leiserowitz, 2007).

Religion and Forms of Religious Activities in Calamianes Group of Islands

The people of Calamianes Islands are religious in nature according to the interviewees. The religion is composed of Catholics, Iglesia ni Cristo, Baptists, Sabadista, Mormons, and 7th Day Adventists. During disaster, their faith helps them to cope with peril and other forms of hazards. Their religiosity and spiritual activities are described in Table 3.8.

Table 3.8 Religiosity and Spiritual Activities

Religiosity	Religious Activities
Coping up with disasters and other forms of hazards	-Rosary Prayer -Bible Sharing -Christian Formation -Prayer Meeting -Christian Aid -Basic Ecclesiastical Community -*Pag samba* (Other Religion) -The women help in the activities of the church -Devotion to saints every Holy Weel. -Believe in miracles -Creation of Youth Organizations. -Catechisms -Holy Mass. -People are motivated to enter religious life -Participation in *Flores de Mayo, Santacruzan* -The Parish Pastoral Council is active -People participate in the Station of the Cross
Strengthening the faith in times of disasters	-Faith becomes stronger -People become more prayerful -People believe that they are more blessed -People are more active on church activities -Life's problems are easy to take -People tend to be more positive in addressing their problems -God is the source of their blessings and hope
Participation of the Church during disasters and other climate related hazards	-The church looks for solutions to help those who were affected by the calamities. -The church also provides relief effort and other in-kind goods. -The church serves as "evacuation centers"- -The church tells its members to pray. -The church and the barangay officials show unity in times of disasters. -The church also gives weather updates and information to its members. -Aside from the homily, the church also shares some important points to tackle climate change and disaster risks.

Faith as a Climate-Disaster Resiliency Measure

Faith and religion is deemed to be a major armor of the people in the islands of Calamianes. Some religious beliefs and traditional practices were evident that greatly influenced how the people believe in. Most of the stakeholders described how faith helped them to be resilient. For others, they feel blessed that they were able to survive from the chaotic experience even though they lost their assets and material possessions. For other stakeholders, religiosity was never mentioned as an act or behavior that saved them from the pandemonium.

The stakeholders mentioned that the devastation brought by Super Typhoon Haiyan or Yolanda was the most unforgettable experience. They were emotional and tearful talking about the Yolanda and their struggles to survive. It was an incredibly traumatic incident that honestly test their faith. And that actual experience they believe in was an attribution to a "spiritual trial" they need to pass. They said, *"Yung nangyari sa amin kay Yolanda.. akala namin mamamatay na kami… inisip na lang namin na magdasal at ialay ang aming buhay sa Kanya.. Kung mamamatay eh di mamamatay.. inisip na lang na panahon na namin…"*. They believed God would not abandon them in that holocaust, and if He did, they would accept that it was really part of God's unknown plan.

For an individual in particular, the very thought that he is calling his faith into question is not only emotionally draining, but physically draining. He realizes that the disaster was not specifically meant for him, but several things had gone wrong just prior to the storm and he was not in the best of health, physically or mentally to get through the storm. He wonders why God would do this to him when he was so ill prepared, and is having such a hard time now trying to cope not only with his illnesses, and with the loss of his previous life, but also with the loss of his faith. He doesn't want to lose that faith and any chance he gets he returns to where he was born and visits one of the shrines there to light a candle and ask the Lord what it is he is supposed to accomplish now.

For others, being devastated in an annual mutilated visit of the different types of disaster is considered to be a test or trial. They believe that there will always be God who will save them from wrath. And through these religious activities and beliefs, interesting perspective on what they actually believe strengthens and increases.

For other stakeholders, the Yolanda event was a plague because of massive destruction of the environment both terrestrial and marine resources. They said, *"Pinaparusahan na po kami kasi maraming gumagawa ng hindi maganda.. lalo na ung pagsira sa kalikasan.. kasama na ang pagdidinamita sa dagat… ung pagtatapon ng mga basura… at marami pang iba".* These stakeholders believe that Yolanda occurrence was a castigation act from God because of the incessant annihilation all over. And because of this belief, they accepted that there was indeed a need to be punished.

Based on the following experiences, it signifies that religiosity influenced the participants' perceptions about the relationship between humans and the environment. People spoke about human and church *"responsibility"* for environmental protection. They framed their response in terms of their theocentric beliefs, with humans having the God-given role as *"guardians"*, with responsibility to care for creation. Focus was placed on scriptures promoting harmony and stewardship. And this is supported in the scripture, Genesis 2, observing that guardianship was *"…not quite a right to rule a case of privileged position"* where humans because of their knowledge had a "unique responsibility" to care for creation (Hope, 2014).

The people understood humans to have a special duty of care for the environment because of this capacity for reason and emphasized *"responsibility"* above *"rights"* over the environment and natural resources.

In summary, the reasons and perceptions of the stakeholders for environmental concern such as climate change and other forms of disasters varied. Religious beliefs shaped concepts about the relationship between humans and the environment, with participants referring to divine creation and the God given responsibility of stewardship.

Phase 4: Policy Analysis

Programs Implemented in the Islands

The fishermen in Coron responded that there were no government programs that are in place, but environmental sanitation is practiced, with zoning effective 40 meters from the bay. Another stakeholder said, *"meron kaming 4Ps dito"* . They have the 4P's Program , which is the *Pantawid Pamilyang Pilipino Program*. However, this is not properly implemented because the officials are very selective on those who will benefit from this program. One typical example was donations, aids and relief goods were given to some beneficiaries who never affected by a strong hazard, Super Typhoon Yolanda. It was also uttered that no plans of action were done in areas that were severely damaged leaving the direct receptors in distress.

There is also a senior citizen program – the Sustainable Livelihood Program (SLP), which said to be like the "sister program" of the 4P's. It serves as an early warning program that will help the people to evacuate. According to the stakeholder of Culion, he explained that the Bureau of Fisheries and Aquatic Resources (BFAR) calls for meetings for awareness raising and information dissemination that is related to fishing but not to climate change and other related climate hazards. And in those meetings, they provide fishnets and seaweeds. BFAR also provides relevant information about the "do's and dont's" of fishing. One example is the fishing in fish sanctuaries, which is strictly prohibited. The Philippine National Police (PNP) was also mentioned that it provides rounds for evacuation, informing the people when a probable disaster is going to occur, and help evacuate the affected individuals as well. The stakeholders also revealed that there is an existing program for mangroves plantation. They said that cutting of mangroves at the sea or trees in the mountain was also prohibited. It was declared that planting of mangroves and trees were very much dependent on where the people reside. Also there was a series of trainings for climate change adaptation and disaster risk reduction and management (CCA-DRRM) but this was discontinued for no reason. The laws and ordinances, which the stakeholders are not aware of, are compiled but not accurately executed. Culprits and perpetrators are penalized or possibly jailed if they will not follow the ordinances and policies being implemented in the areas.

With regards to calamity fund, some stakeholders suggested that the funds should be increased in order to assist families or households affected by environmental chaos. The disaster calamity fund is not enough every time a disaster strikes.

Support from Partners and Other Stakeholders

One stakeholder said that NGO's, or Non-Government Organizations offer financial assistance. Red Cross, PAWS, and the Coast Guard tried to help but only ended up on meetings. Additionally, there was aid from other countries such as United States, China, Japan, France, Russia, and other countries especially when Super Typhoon Yolanda made its massive damage. However, the stakeholders mentioned that this so-called "aid" from other countries did not reach the stakeholders. They also said that the government chose the "receivers" of this aid. The stakeholders also mentioned that they got most of this help from the church. Caritas and Anakpawis were the organizations mentioned that provided some support and assistance. Their projects have been effective since the communities were better equipped with appropriate knowledge that can empower them to act on their own problems. Other non-government organizations (NGOs) and local government units (LGUs) from other municipalities also helped the devastated areas. Despite the programs provided by the LGU, conflicts still arise with People's Organizations (POs). This conflict eventually affected the effectiveness of the People's Organizations (POs) and the Local Government Units (LGUs) in community mobilization during disasters.

Calamianes Integrated Fisheries Management Plan (CIFMP) – Pilot Program

Through consultations, the Technical Working Group (TWG) developed their respective fisheries management critical pathways to address the issues of climate change and other related fishery enigmas:

1. Management of fishing effort through the promulgation and adoption of fishing effort restriction measures for fishing gears that are considered detrimental to the integrity of resources and habitats. Corollary to this, a fisher licensing system shall be adopted and inter-LGU discussions for shared fishing privileges will be developed. *"Dayo"* fishermen – denoting fishers that are not residents of Calamianes, shall be denied licenses or taxed much greater for fishing rights;
2. Protecting the sustainability of target fish stocks and intensively-fished species through the imposition of spatial and temporal restrictions such as closed seasons and closed areas to enable maturation and spawning of fish species that are intensively fished or rapidly declining;
3. Protecting coastal habitats through the establishment of Marine Protected Areas network
4. Strengthening of regional law enforcement initiatives including climate change adaptation and disaster risk reduction and management (CCA-DRRM) strategies
5. Delineation of the respective municipal water boundaries and formulation of a zoning system

It is important to note that people are located in areas that are vulnerable to various types of climate hazards. These hazards will cause more frequent and more damaging to the lives of the populace. The occurrences will engulf the existing protection measures, actions, and structures, putting the three Calamianes Group of Islands (CGI) at increased risk.

With the present scenarios, it is a must to develop new strategies focusing more on the reduction of exposure of the people in order to preempt further escalation of damages and losses. This is to explore new models or frameworks that would impede the creation of new and future risks.

Strategies for Creating Climate-Disaster Resiliency for Calamianes Group of Islands

1. ***Impacts and Adaptation Mechanisms***

   Table 3.9 provides the impacts and adaptation strategies that can be adapted by the Calamianes Group of Islands.

Table 3.9 Impacts and Adaptation Strategies

Areas	Impacts	Adaptation Options
Governance	Extreme weather events such as droughts, sea level rise, flooding can disrupt efforts to strengthen stakeholders and increase participation of marginalized groups.	Incorporate climate change adaptation and disaster risk reduction and management schemes into governance systems. Engage civil society groups or organizations in participatory fora to address their vulnerability and identify adaptations to climate impacts Examine existing laws and regulations for opportunities to improve governance and resilience to climate variables
Human Security	Increased prevalence of vector-borne diseases (e.g. malaria, dengue)	Broad scale immunizations Early warning systems and public information

	Increased risk of malnutrition due to decreased food availability and quality, and ill-health effects of reduced accessed to clean drinking water, Increased risk of death from extreme weather events Increased need for post-disaster relief and reconstruction, increased pressure on disaster management systems	Increase access to primary care and preventive care Improve disaster preparation and emergency response Capacity building of local communities to assist in relief actions Use of insurance, bonds, and other risk-sharing measures to finance relief and reconstruction Manage risk to reduce impact
Fishery	Decrease in fisheries production Climate processes and extreme weather events will increase in frequency and intensity Warming is more intense in surface waters Changes in fish distributions Shifts in ocean salinity are occurring Oceans are becoming more acidic with probable negative consequences to many coral reef and calcium-bearing organisms	Creating resilient ecosystems, human, and governance communities through (i) decreasing the exposure of the sector by increasing the aquatic systems' resilience, (ii) decreasing the communities' sensitivities to change; (iii) increasing the sector's adaptive capacity Supporting intersectoral collaboration (e.g. integrating fisheries and aquaculture into national climate change adaptation and disaster risk management (DRM) strategies and supporting integrated resource management, such as integrated coastal zone or watershed management, water planning); Promoting integrated monitoring and information systems - incorporating scientific and local knowledge sources improving general awareness of climate change within and outside the sector; Promoting context specific and community-based adaptation strategies; Avoiding "mal-adaptations" (e.g. overly rigid fishing access regimes that inhibit fisher migrations, adaptation actions that would increase fishing effort in an over-fished fishery);

		Embracing adaptive management, decision-making under uncertainty and the precautionary approach; and Promoting natural barriers and defenses rather than hard barriers that would impact the ecosystem
Agriculture	Increased temperature result in higher yields in some areas but lower yields due to higher rate of evapotranspiration and water deficits Increase incidence and range of pests and diseases, extreme weather events cause flooding, crop in loss and erosion, drought results in reduce crop yields.	Genetic improvement to produce drought-tolerant crops, translocation of crops, and changes in cropping patterns Afforestation to condition soils Improve water infiltration, and provide shade, increase water use efficiency, diversification into non-farm activities, crop insurance, and microedit schemes
Environment	Higher temperatures and drought lead to increased incidence of forest fires changes in temperature and precipitation can cause changes in flora and fauna ranges and potential losses of biodiversity, extreme weather events can damage coastal ecosystems, coral reefs and mangroves	Seawalls, beach nourishment, regulation to discourage development in coastal and other threatened areas Forest management to reduce potential for forest fires, set aside protected areas for threatened species Afforestation and reforestation Community management of forest and natural resources to ensure sustainable harvest and regeneration
Economic Growth	Damages and losses to livelihood assets, straining of traditional coping systems, increased debt burden and long-term poverty alleviation efforts, reduced foreign local investment in areas vulnerable to climate variability and change impacts	Diversification of livelihoods, local value addition, improved access to markets and finance, technology transfer, use of carbon trading opportunities to increase revenue while putting in place measures that reduce emissions
Energy	In some areas, may reduce energy demand because of higher temperatures, decreased hydropower potential due to reduced precipitation Increase energy demand for air conditioning, damage dams due to flooding	Enhance dam structural parameters, change siting of hydropower, incorporate future reduced generation capacity in design, integrated water resources and disaster management Improved energy efficiency, Widen water channels and periodic draining of vulnerable lakes

2. Disaster Risk Assessment/Management

Recognition of the linkages between climate variability, climate change, and extreme events has fostered a small but growing literature on the connections between disaster risk assessment/management and climate change adaptation. This research shows that there is a great potential for coordinated efforts towards addressing adaptation. The disaster risk community advocates using the tools, methods and policies of disaster risk assessment/management as a basis for addressing the risk aspects of climate change. Methodologies and experiences in working with vulnerable people and their needs through community-based initiatives are emerging as a cornerstone for disaster risk reduction. At the same time, the climate change community offers a growing body of research and experience on adaptation as a social process, with an emphasis on strategies and measures to reduce vulnerability and enhance the capacity to adapt to shocks and stressors. This includes initiatives aimed at building resilience through community-based adaptation. Given these overlapping areas of expertise and empirical experience, there have been numerous calls for increased collaboration between the two (O'Brien et al., 2008).

Now there is Sendai Framework for Post Disaster Risk Reduction that is being implemented not only in the Philippines but also in other parts of the world. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. It is the outcome of stakeholder consultations initiated in March 2012 and inter-governmental negotiations held from July 2014 to March 2015, which were supported by the UNISDR.

The Seven Global Targets of Sendai are as follows:

a. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015.

b. Substantially reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade 2020 -2030 compared to 2005-2015.

c. Reduce direct disaster economic loss in relation to global GDP by 2030.

d. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

e. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

f. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030.

g. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

The Four Priorities for Action of Sendai

Priority 1. Understanding disaster risk

Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response.

Priority 2. Strengthening disaster risk governance to manage disaster risk

Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership.

Priority 3. Investing in disaster risk reduction for resilience

Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment.

Priority 4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

The growth of disaster risk means there is a need to strengthen disaster preparedness for response, take action in anticipation of events, and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures.

3. Implications of Mainstreaming Disaster Risk Management at the Local Level

Most disaster risk management functions benefit from devolution of responsibilities, ideally combining both *"top-down" and "bottom-up"* approaches.

Consideration of evolving climate risks, particularly their likely impacts on agriculture, fisheries, forestry and food security issues, requires enhanced collaboration that brings together:

a. disaster risk management institutions: normally housed within the Office of the Civil Defense-National Disaster Risk Reduction and Management (OCD-NDRRMC), with strong linkages to the international humanitarian community;

b. climate change focal points: normally housed in the Department of Environment and Natural Resources (DENR), Climate Change Commission (CCC), Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) with strong linkages to national and international research institutes;

c. food security focal points and advocacy groups: to ensure that food security and livelihoods protection are addressed in climate adaptation and risk management strategies; usually housed within the Department of Agriculture (DA) and its bureaus

d. resource management agencies (agriculture, livestock, fisheries, forestry, land, water): to integrate climate change and disaster risk management into resource management planning;

e. research institute: for modelling, forecasting, crop research and technology development.

Having this broad-based collaboration in place will serve to ensure:

a. agriculture, environment and food security institutions are represented in national, provincial and local disaster risk management committees;

b. risk reduction and climate change adaptation focal points or teams are appointed and trained within food security, agriculture, fishery and forestry line departments;

c. cross-sectoral or multi-stakeholder platforms are established to identify risk reduction and climate- change adaptation priorities and ensure involvement of research institutions, civil society and the private sector;

d. sector-specific (multi-hazard) risk reduction strategies, such as national strategies for risk reduction in the agriculture sector, or cross-sectoral hazard management plans, such as national and local drought management plan, are developed and implemented;

d. risk assessments are integrated in poverty reduction strategies and national and local development plans

4. Local Climate Change Action Plan (LCCAP) to People's Survival Fund (PSF)

Since the climate scenarios and projections and risk assessment and management have been identified, it is highly recommended that the CGIs will continue to perform their responsibility in order to increase their resilience as shown in Figure 3.24.

Figure 3.24 Calamianes Group of Islands (CGI) Resiliency Framework

The CGIs Resiliency Framework requires an identification of climate change adaptation project that can be used by LGUs for local climate change action plan (LCCAP) in order to access the People's Survival Fund (PSF), a special fund in the National Treasury that finances climate change adaptation programs and projects.

Local Climate Change Action Plan (LCCAP)

Specifically, to support the islands of Busuanga, Coron, and Culion in dealing with the challenges of adapting to climate change and provide a common basis for adaptation planning, the following suggested guiding principles should be considered:

a. Increase knowledge and understanding of the hazard and climate change impacts.
b. Increase understanding of exposure, vulnerability and adaptive capacity.
c. Identify and engage relevant stakeholders
d. Build on existing policies, tools, processes and good practices.
e. Work with uncertainties.
f. Prioritize adaptation options.
g. Consider adaptation actions that are sustainable.
h. Build on partnership to reduce vulnerability and risk to climate change impacts.
i. Avoid mal-adaptation.
j. Monitor and evaluate.

People's Survival Fund (PSF)

The Calamianes Group of Islands are eligible to access the People's Survival Fund (PSF), which can be used for adaptation programs and projects. Some of the most important requirements in accessing the funds are as follows:

a. *Enhanced Comprehensive Land Use Plan (CLUP)* – an integral document/instrument for LGUs to effectively address risks, and avoid creation of new risks to people, assets and economic activities by rationalizing distribution and development of settlements, and the utilization and management of natural resources.
b. *Enhanced Comprehensive Development Plan (CDP)* – an action plan and implementing instrument of the CLUP.
c. *Risk Assessment or Vulnerability Assessment* – refers to the process of determining the nature and extent of such risk by analyzing hazards and evaluating existing conditions of vulnerability that together could potentially harm people, property, services, livelihoods and the environment.
d. *Local Climate Change Action Plan (LCCAP)* – a science and risk-based planning document for LGUs that considers assessment of climate change impacts on most vulnerable communities, areas, ecosystems and other resources within their territories and identification of priority adaptation measures.

The PSF is the Philippine Government's flagship climate finance program. It is a resultant program of the 2012 PSF Law (Republic Act 10174), which addressed the lack of climate finance provisions in the 2009 Climate Change Act (Republic Act 9729). It intends to finance climate change adaptation projects proposed by local government units (LGUs) and accredited local community organizations. By law, the Fund has an annual rolling minimum budget allocation of PHP 1 billion in the National Budget appropriated through the Climate Change Commission. This amount shall not be reverted to the National Treasury regardless of its utilization and can be further augmented through additional budget allocation or through financial grants and donations. Climate change adaptation (CCA) programs and projects to be financed under PSF should be strategically aligned with the ultimate goal of the National Climate Change Action Plan (NCCAP), which is to build the adaptive capacities of men and women in their communities, increase the resilience of the vulnerable sectors and natural ecosystems to climate change, and optimize mitigation opportunities towards gender-responsive and rights-based sustainable development.

IV. CONCLUSION

Using the climate change scenarios, potential impacts on these three Calamianes Island were analyzed. The two interacting elements (people, which is based on socio-demographic conditions and place, which is the physical system) were assessed in order to react and respond to climate variability and changes. These entail that climate change impacts will be simultaneous, multidimensional, and interactive. The rise in sea-level associated with global warming will result in widespread impacts on the three municipalities because of their water-land interface. According to the observations of the Intergovernmental Panel on Climate Change (IPCC), the global sea-level will continue to rise from 28 to 34 cm in 2100. These results are consistent with findings of Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) that sea-levels in the Philippines are projected to rise from 27 to 48 cm by the end of the century. Its vital threat is its effects on storm surges. Heightened storm surges associated with future intense tropical cyclones will cause more significant damages and losses. Given the projected rates of sea-level rise and under the worst-case scenarios, most intense tropical cyclones and 100-year flooding could occur 3-4 years in a more extreme and uncertain estimates. A 500-year flooding event could also occur every 50 years (Gornitz, 1995). Many of the islands most significant coastal marine resources will be at increased risk to damage resulting from augmented storm surges. The default public policy of placing necessary yet locally unwanted land uses on marginal lands may engender some intended consequences, such as the increased disruption of key components or the need for relocation. For hydrological systems, there is uncertainty in how the total amount of precipitation might change in the future. In addition, there will be greater hydrologic variability. The potential for extended droughts followed by rainy periods is present in many of the climate scenarios. Finally, expected sea-level rise is likely to interact with water-supply. Pumping stations, water quality treatment facilities, and intake and outflow sites are vulnerable to storm surge flooding. There is also increased threat on salt-water intrusion into groundwater supplies and at surface-water withdrawal sites. These water systems should be able to respond to the expected increases in the annual temperature and on the effects on the water supply as well as greater variability in rainfall in the near term. Responses to the projected salt-water intrusion need further study. Population will also experience increased exposure to heat stress conditions, greater potential of water borne or vector-related diseases outbreaks, and higher concentrations of pollutants, resulting in higher frequency of respiratory ailments and attacks. Populations currently at risk, the elderly and the very young, will be the most vulnerable. For psychological impacts, significant responses were noted where locals most often encounter apprehension on the self, observe traditional male gender roles and egalitarian gender roles between family

members, children carrying out relative adaptation, expressed frustration towards local government's lack of aid and community's oneness with its neighbor. Data gathered from the participatory action research provided recognition and awareness of the different psychological effects from climate change disasters. The post-traumatic growth and higher level of spirituality will be the shield from this environmental peril and other types of climate-related hazards. Climate change adaptation and disaster risk reduction management (CCA-DRRM) schemes, which include establishing local climate change action plan (LCCAP) and accessing climate financing policy mechanism – the People's Survival Fund (PSF), will be the ultimate solutions that will truly create a climate-disaster resiliency in the Calamianes Group of Islands – the Last Ecological Frontier of the Philippines.

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