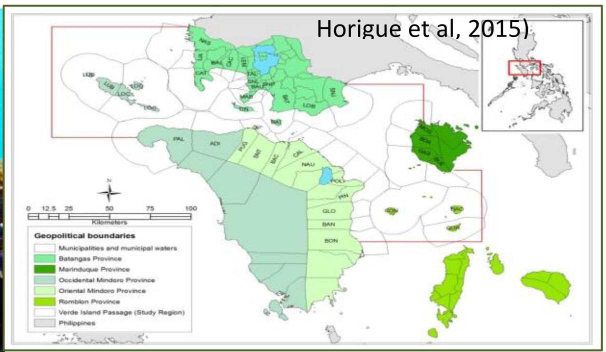
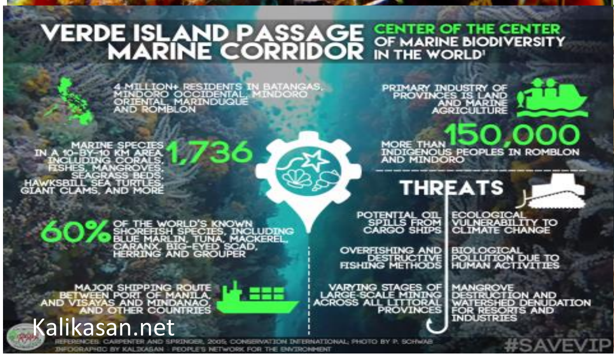
Developing Ecosystem Account for Verde Island Passage Marine Corridor, Philippines





MSc Thesis in Urban Environmental Management

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EXECUTIVE SUMMARY

The coastal and marine habitats of the Philippines were once concrete evidences of nature's immense contribution. However, increase in population with unsustainable use of resources has resulted in the depletion of these natural treasures. With all the challenges and threats such as population expansion and urbanization, unsustainable land conversion and deforestation several initiatives from public and private sector have been achieving to address the issue and save the once proud marina. On November 2006, in the National Biodiversity Conference, an executive order was created focused on managing the biological diversity particularly in the Verde Island Passage Marine Corridor. It is known to be as the "centre of the centre of marine shore fish biodiversity" as determined by some well-known marine biologists. Since then, many studies were conducted in VIPMC such as coral fish species baseline assessment, coastal integrity, physical oceanography assessment, sensitivity analysis etc.

Coastal and marine habitats particularly coral reefs are considered to be a main source of various goods and services such as fisheries, tourism, coastal protection and carbon storage. For instance, tourism industry within VIPMC greatly depends on the quality of coastal and marine habitats particularly coral reefs such as diving, snorkelling and swimming activities. Batangas province (1 of 5 provinces within VIPMC) is known as one of the dive spots in the Philippines and many people are depending in tourism industry. Coral reefs also support fisheries sector and provides livelihood to 31 coastal municipalities and 2 cities. It also serves as barrier and protection from risks and natural hazards.

Indeed, studies focusing on the potential of utilizing coastal and marine ecosystems are thus needed. Ecosystem accounting is one approach that determine both physical and monetary terms of the services that ecosystems are generating. It is important to know the usage of an ecosystem and valuable in developing policy interventions from protection and conservation. Two pilot sites on ecosystem accounting were developed already in the Philippines (Laguna de Bay Basin and Southern Palawan) however, little attention was paid to costal and marine resources. As the objective of this study to develop ecosystem account for VIPMC and how this information support policy decision making, it also aims to monitor the trends of resources and perceived changes of its assets.

This study was developed over a period of seven months (September 2017 to March 2018) and ecosystem account comprises the following:

Mangrove and Coral Reef Extent, focusing on the changes of the extent

Ecosystem Condition Account, focusing on biophysical, environmental and ecosystem state indicators related to coral reefs

Ecosystem Services Supply Account, focusing on fisheries, tourism, carbon stored and coastal protection

Ecosystem Asset Account, limited analysis focusing on the fish production, tourism and carbon storage

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Chapter 1. Introduction

1. INTRODUCTION

Ecosystem Accounting is defined as "a coherent and integrated approach to the assessment of the environment through the measurement of ecosystems and measurement of the flows of the services from ecosystems into economic and other human activities" (UN et al. 2014b). It measures not just the goods and services that ecosystems provide, but also the economic and anthropogenic activities affecting the ecosystems and its capacity to supply ecosystem services. Ecosystem Accounting is an integrated statistical framework formally called System of Environmental-Economic Accounting-Experimental Ecosystem Accounting (SEEA-EEA). SEEA-EEA is developed by the UN Statistics Commission under auspices of the UN Statistical Division. It is anchored to the Systems of National Accounts (SNA) and the SEEA Central Framework of measuring environmental assets with respect to the information regarding ecosystem stocks and flows (UN et al. 2014a). The latest update for SEEA-EEA is under the SEEA-EEA Technical Recommendations, which takes into account the detailed explanation and description as well as the perception of ecosystem capacity, definition and associated measurements considerations.

The importance and significance of coastal and marine ecosystems have long been undervalued and unrealized (Lange & Jiddawi, 2009). It is being exploited globally, including estuarine and coastal wetlands, marshes and mangroves, sand beaches and dunes, sea grass beds and coral reefs (Barbier, 2011). It is worthwhile to pursue ecosystem accounting for the coastal and marine resources in the Philippines, since coral reef ecosystems are considered to be a main source of various goods and services with economic value such as tourism, e.g., diving and snorkelling; fisheries, and coastal protection (Mumby, et. al., 2014). Coral reefs also serve as protection to coastal and marine hazards such as storm surge and tsunamis. For the globe, the importance of coral reefs cannot be dismissed. Coral reefs house the largest source of marine biodiversity in the planet (Jörgensen, 2016). Lately, it has been discovered that coral bacterial symbionts are important in primary production and that they are the main sources of organic nitrogen and fixed carbon on Earth (Rodriguez and Ho, 2016). As such, coral reefs serve as an important environmental component, especially in this time of climate change and rising global temperatures. Studies focusing on the potential of utilizing coral reefs in environmental as well as in economic and community problem solving are thus needed.

Based on a study done by White and colleagues (2000), coral reef fisheries contribute to almost US$ 1 billion yearly in the country's economy with more than one million small-scale fishermen. However, Philippines is one of the countries benefiting and contributing to the rapid decline of coastal and marine resources such as coral reefs (Alcala and Russ, 2002). It has approximately 36,289 km coastline, about 226,000 km^2 coastal waters with 64 coastal provinces (out of 79 total provinces) and 822 coastal municipalities (out of 1502 total municipalities) (PSA,2017). As an archipelago, an important source of livelihood in the country is coral reef fishing. The country has an approximately 25,000 km^2 coral reefs, which provide an estimated 15 metric tons (mt)/km^2/year of fish yields with potential annual production of about 350,000 mt if managed properly and appropriately (Alcala and Russ, 2002). Moreover, other coastal and marine habitats that play an important role in the country's economy and ecological condition are seagrass beds and mangroves. Around 20-30% of the seagrass beds in the Philippines deteriorated from its original state and merely 120,000 hectares of 450,000 hectares of mangroves are intact (White et al, 2002).

Considering time limitations of this study and availability of the data, however, the scope of an ecosystem accounting study can only focus on a specific site. In the Philippines, under the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) project, two pilot test sites on ecosystem account were developed (Laguna de Bay Basin and Southern Palawan) using the SEEA-EEA framework. As stated by Phil-WAVES TWG Southern Palawan (2015), “although experimental in nature, the account is replicable across time and geographical scales (national)”. In this study, a further pilot ecosystem account will be introduced and developed. The ecosystem account will cover the Verde Island Passage Marine Corridor (VIPMC), which was promulgated under the resolution No. 2007-02 Presidential Commission for the Integrated Conservation and Development of the Sulu and Celebes Seas (PCICDSCS). In the two WAVES case studies in the Philippines relatively little attention was paid to coastal and marine resources. Studies focusing on the potential of utilizing this ecosystem in environmental as well as in economic and community problem solving are thus needed.

1.1. Study Area

The Philippines is one of the three countries under the Sulu-Sulawesi Marine Ecoregion (SSME) together with Indonesia and Malaysia. It is located at the apex of the Coral Triangle which is known as the “world’s centre of marine biodiversity.” Within the SSME, Verde Island Passage (VIP) is located covering five provinces of Luzon Island namely; (1) Batangas, (2) Mindoro Occidental; (3) Mindoro Oriental; (4) Marinduque and (5) Romblon. Based on the study conducted by Carpenter and Springer (2005), VIP Marine Corridor was shown to be the “centre of the centre of marine shore fish biodiversity.” Therefore, VIPMC was selected as the study area of this study.

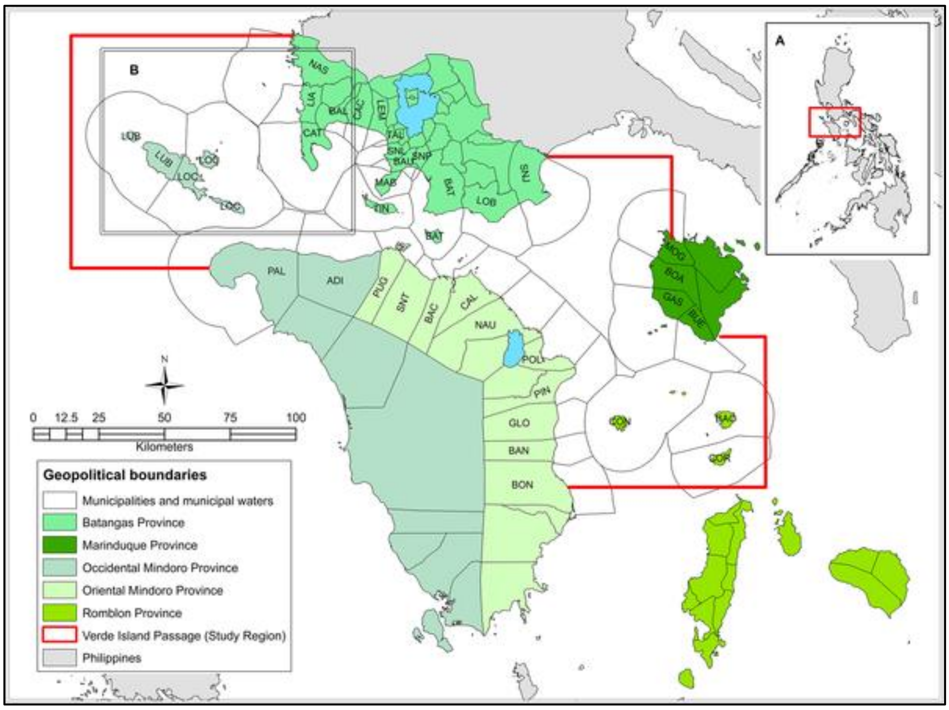


Figure 1. Geopolitical Scales within the Verde Island Passage Marine Corridor (Source: Horigue et al, 2015)

VIPMC covers an area approximately 1.4 million hectares, comprising of a total reef area of approximately 8,128 hectares. As the strategy for sustainable development of coastal and marine resources, the government has initiated the creation of Executive Order entitled "Establishing the National Policy on Biological Diversity, Prescribing its Implementation Throughout the County, Particularly in the Sulu Sulawesi Marine Ecosystem, and the Verde Island Passage Marine Corridor." It adopted the national government project called "Integrated Coastal Management (ICM)" (DENR & CI, 2009).

1.2 Scope and Limitations of the Study

A full set of ecosystem accounts (from ridge to reef) would have been relevant to Verde Island Passage Marine Corridor, however, due to time and data constraints, this study will focus on coral reef ecosystem accounting only. The coral reef ecosystem has been selected because specially in tropical and subtropical countries, coral reefs are key in all aspects of nation-building and daily life. However, despite the known use and importance of coral reef ecosystem in coastal and environmental sustainability, anthropogenic activities and development, combined with inefficient implementation of policies for protection, cause the continuous and rapid decline of coral reef ecosystems. (Jörgensen, 2016).

This study has adopted the SEEA EAA technical recommendation framework to determine the relationship/link between biophysical characteristics and its socio-economic benefits. This study on coral reef ecosystem accounting will provide a comprehensive representation of the significance of this ecosystem, the services and benefits it can provide, how it is being utilized and the capacity to withstand these services for the future use. Hence, the initial ecosystem account of VIPMC includes the concepts as explained in Table1:

Table 1. VIPMC Ecosystem Accounts' Description and Focused Area Application

ACCOUNT	***DESCRIPTION***	***APPLICATION TO VIPMC***
Mangrove and Coral Reef Extent Account	Ecosystem extent measures the account in physical terms usually in hectares (UNEP et al, 2015) .	The coral reef extent account is created for the whole Verde Island Passage Marine Corridor
Coral Reef Condition Account	As described in SEEA-EEA Technical Recommendation, ecosystem condition account uses different indicators for the selected characteristics accumulated in physical terms.	The coral reef condition will be applied in the whole Verde Island Passage Marine Corridor.
Coral Reef Ecosystem Services Supply and Use Account	It will measure the "flows of ecosystem services supplied by the ecosystem assets and used by economic units during an accounting period" (UNEP et al , 2015). With these, the following services have been selected for this research study based on the capacity and readiness of the data.	
• ***Provisioning -Fisheries (Fish Production)***	It will focus merely on the actual fish production (excluding the aquaculture)	This is limited to Batangas Province only because a resource rent survey has been conducted, and only Batangas is the most

		accessible to reach among all the provinces.
• ***Regulating: Coastal/Shoreline Protection***	This service serves as natural barrier, since, the area is vulnerable to natural hazards. Also, the cost of the artificial structures for the protection of the shoreline costs billions of dollars if these natural barrier will be removed (White and Trinidad, 1998)	Coastal Protection will be applied in the whole VIPMC using the data on shoreline and coral reef areas
• ***Regulating – Carbon Account***	It will discuss information on carbon sequestration.	Carbon account will be applied to VIPMC
• ***Cultural – Tourism and Recreation Account***	Coral reef ecosystem is considered to be the source of various goods and services with economic value such as tourism, *e.g.*, diving and snorkelling (Mumby, *et. al.*, 2014).	This will be limited to Batangas Province since diving and snorkelling activities are stressed and predominantly to this area.
Asset Account for the selected Ecosystem Services	Limited analysis of ecosystem asset account using the Net Present Value of the selected coral reef ecosystem services	

1.3 Research Objectives

The objective of this research is to develop a pilot ecosystem account of Verde Island Passage Marine Corridor (VIPMC). The account includes extent, condition and services supply, plus limited analysis of ecosystem assets. There is a focus on coral reefs, but in some of the accounts also other ecosystems are considered as specified below. In the future, the account can serve as reference for monitoring purposes, perceive the changes of its assets and support policy making and analysis. Lastly, the output can be incorporated to the national governments' – Coastal and Marine Ecosystem Management Program (CMEMP) with the program goal to "comprehensively manage, address and effectively reduce the drivers and threats of degradation of the coastal and marine ecosystems in order to achieve and promote sustainability of ecosystem services, food security and climate change resiliency for the benefit of the present and future generations".

1.4 Research Questions

The main research question addressed by this study is:

How can an ecosystem account be compiled for the Verde Island Passage Marine Corridor; and how can the information in the account support policy decision making?

Specifically, these questions are investigated:

1. What are extents of coral reefs and mangrove ecosystems in VIPMC?
2. What is the condition of coral reefs ecosystem in VIPMC?
2. Through its extent and condition, what is the flow of coral reefs to generate ecosystem services?
3. What are the values of the coral reef ecosystem services to fisheries, carbon sequestration, coastal/ shoreline protection and tourism in VIPMC?

Chapter 2. Methodology

2.1 SEEA – Experimental Ecosystem Accounting

In the Philippines, the Wealth Accounting and Valuation of Ecosystem Services (WAVES) Project led by World Bank global partnership aims to "promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts." The WAVES Project established two pilot ecosystem accounts (Southern Palawan and Laguna De Bay) with mangrove and mineral accounts currently underway (WAVES Philippines, 2017 https://www.wavespartnership.org/en/philippines). Hence, developing ecosystem accounts focusing on coral reefs could be worthy to value to areas such as the Verde Island Passage Marine Corridor, the "world's centre of marine biodiversity". This will be the first ecosystem account in the Philippines that will highlight the coral reef ecosystem.

This ecosystem accounting of VIPMC will follow the System of Environmental-Economic Accounting (SEEA)- Experimental Ecosystem Accounting (EEA). SEEA-EEA measures both the assets and services and its connection. It is a tool that gives overall understanding of the "ecosystems' condition, interaction and connections such that suitable recommendations can be formed" (UNEP, 2015).

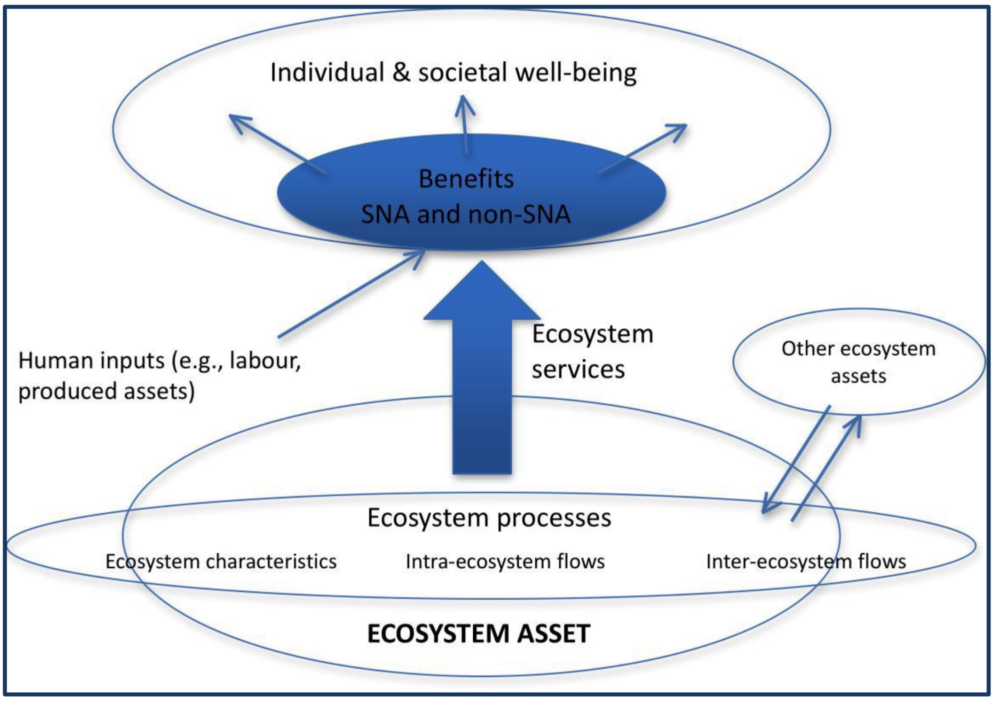


Figure 2. Ecosystem Account Model
Source: SEEA EEA: Technical Recommendations Figure 2.1 Ecosystem Accounting Model, UN et al, 2015

SEEA-EEA includes wide-range of data for the analysis of the environmental and economic concerns. It includes a summary of valuation which highlights the difference between the exchange and welfare values (Power, 2014). The ecosystem services and assets being valued in monetary terms will follow the valuation principles of the System of National Accounts (SNA) (UN, 2009). Both maps and tables are being used to analyse this ecosystems accounting.

Based on the Philippines National Account (Philippine Statistics Authority, 2018), an estimate of 19% of the total GDP growth are from coastal and marine, minerals and cropland resources. Indeed, the coastal and marine ecosystem contributes to the national account of the country. Hence, a more integrated and holistic approach of integrating the link between environment and economy is looked-for by the decision makers. This ecosystem accounting of VIPMC may be integrated into government reporting, monitoring and evaluation and advanced decision making. This can also provide information, education and awareness, while providing an appraisal measure of progress or changes and priory setting of the area.

2.2 Accounts Included and Units

Table 2. Indicators and units included

ACCOUNT	*INDICATORS*	*UNITS*
Coastal Habitats Extent Account	Percentage area of the extent of Mangroves (historical data, 2003 and 2010) and Coral Reefs (2002 and 2008)	Hectares
Coral Reef Condition Account	***Biophysical***	
	Length of Fault line and active seismic	Depth (meters)
	Bathymetric	Depth (meters)
	Coastal Vulnerability (including vulnerability factors such as sea surface temperature, fault and seismic, tsunami area, % area of mangrove and corals, water quality, marine protected area, key biodiversity areas, other national and local management and initiatives)	Normalized index 0-1
	Environmental State	
	Water Quality	DENR Administrative Order (DAO) 1990-34 and DAO 1997-23 Coastal and Marine Waters Classification Class SA, Class SB, Class SC and Class SD *(see ecosystem condition account methodology)* with water quality parameters (faecal coliform, total coliform and DO)
	Condition	
	% cover of coral reefs	Percentage cover category of coral reefs
Coral Reef Ecosystem Services Supply and Use Account	Fisheries	Fish production (ton/year) Fish production value (US$/year) Fish production, resource rent generated (million pesos/year)
	Coastal/Shoreline Protection	Coastal Risk Damage Costs
	Carbon Fixation	Carbon Sequestration, (tons of C/year) Social Cost of Carbon (SCC), US$/year
	Tourism	Tourism Value, US$/year Tourism Value, resource rent generated (diving operators and resorts) ,US$/year

2.3 Coastal Habitats Extent Account

Understanding the ecosystem extent account may be used in the monitoring future developments. UNEP et al (2015) enumerated four significant reasons in conducting this stage "(1) a balance between scale of analysis; (2) good entry point for establishing the national level spatial infrastructure; (3) gives clear indication of the nature of accounting for assets in a SEEA context; and (4) provides a clear base for the development of the other ecosystem accounts".

In developing the extent account of mangroves within the Verde Island Passage Marine Corridor, data from 1950, 2003 and 2010 were obtained from Biodiversity Management Bureau (formerly Protected Areas and Wildlife Bureau) under the Philippines government's Department of Environment and Natural Resource (DENR). However, the data was originally from the national mapping agency, National Mapping and Resource Information Authority (NAMRIA) and can be accessed and viewed in www.geoportal.gov.ph, the shape file used for mapping is upon request based on the protocol of the agency. The latest data on mangrove cover published by NAMRIA was 2010. Hence, the data trend of mangroves within VIPMC from the years 1950, 2003 and 2010 were processed analysed and laid out using Geographic Information System (GIS) software. The map produced was projected to Universal Transverse Mercator Zone (UTM) 51N and Luzon (Philippines excluding Mindanao) geographic data coordinate system.

The coral reef extent data was obtained from compilation of data from both published and grey literature. There's no official coral reefs cover data yet from DENR. However, currently a national baseline assessment and mapping of coral reefs is on-going by DENR-BMB under the Coastal and Marine Ecosystem Management Program. Hence, the data used in this study were from National Aeronautics and Space Administration (NASA) archive for 2002 data and Conservation International Philippines for the latest assessment of coral reefs in VIPMC which was on 2008. Also, coral reefs cover was processed, analysed and laid out using GIS software. No ground truthing was done in this extent account.

2.4 Coral Reef Condition Account

An ecosystem condition account is a "central feature of ecosystem accounting" with several physical characteristics and its indicators to describe structure and condition of an ecosystem (UNEP, 2015). Also it provides a complete picture to the ecosystem and link to ecosystem services supply account. In this study, the coral reef condition account is categorized into three group namely (1) biophysical indicators; (2) environmental state indicators; and (3) ecosystem condition indicator.

2.4.1 Biophysical Indicators

Biophysical characteristics of an ecosystem is described as both the biological and physical processes to be able to understand the biophysical elements to be incorporated in an ecosystem accounting. As stated in SEEA-EEA Technical Recommendation, biophysical modelling is important in "recognising the nature connections between ecosystem service flows and the condition of the relevant ecosystem assets". Herein, biophysical indicators included are ***(1) Faults and Seismic***, based on the UP-MSI (2017) under the Philippine Coral Reef Resources Assessment & Conservation Program (PhilCore) project, Philippines is part of the subduction zones which has active volcanism and fault lines contributing to its fault and seismicity. With these "it can lead to vertical land motions and tsunamis that can alter the coastal stability of the sites resulting to high potential for tsunami inundation," Also, geological activities such as earthquake and volcanoes can support in understanding the impacts of large- scale disturbances (Wilkinson et al, 2003); ***(2) Bathymetric***, it indicates the depths of the coast in which the coral reefs are located (Vanderstraete et al, 2003); and (3) Coastal Vulnerability Index , serve as guidance in action planning and decision making particularly in highlighting the most vulnerable area or region (Ramieri et al, 2011).

These biophysical indicators do not change easily over time. However, it is significant to know the physical condition of an area, as it is part of the an ecosystem accounting. On the other hand, Coastal Vulnerability in this study will focus to climate change hazards at provincial scale. It includes several vulnerability factors which are categorized into exposure, sensitivity and adaptive capacity. These factors such as *fault and seismicity, sea surface temperature, tsunamis, % cover of coral reef and mangrove, water quality, and management initiatives* have its functional relationship with vulnerability.

Active fault lines in the area will be identified from the official fault line maps of the Philippine Institute of Volcanology and Seismology (PHIVOLCS). The length of the fault lines are calculated by clipping into the 'study' area. Bathymetry of the area will be generated from interpolated water depth point measurements in the area generated by PhilGIS (Free Philippine GIS data for educational and non-profit use). It was processed, analysed and laid out using the Geographic Information System (GIS) software.

Coastal Vulnerability used Spatial Multi-Criteria Method which as stated by Andalecio (2009) as “useful in improving the decision-making process, leading to public acceptance of suggested options”. The steps are as follows:

1. Indicator Selection for exposure, sensitivity and adaptive capacity;	Indicators were identified based on its functional relationship with coastal vulnerability towards climate change hazards.
2. Assigning Scores of each of the indicators using statistical classification;	Assigning and weighing scores were done using 10 different concerned stakeholders. Characteristics of these stakeholders are attached in Annex 1. It is derived from the stakeholders’ preference on the indicator categories. Also, equal weights of each of the vulnerability factors were measured.
3. Combining scores of indicators;	It is done through combining the scores and the weight of each of the vulnerability factors (indicators). Two options were made to get the overall vulnerability index of each of the provinces; (1) combine score using the stakeholders weighted combined score; and (2) equal weighted combine score. The calculation of an overall score for each of the vulnerability factors is performed. The overall preference score (Si) of option i is the sum of all weighted average scores on each factors. $Si = W1Si1 + W2Si2 + \ldots\ldots. + WnSin = \sum_{j=1}^{n} WjSij$ Where,

		wj = weight for vulnerability factor sij = score on factors for different provinces n = amount of vulnerability taken into account
4. Overlay using ArcGIS		It was processed, analysed and laid out using the Geographic Information System (GIS) software

2.4.2 Environmental State Indicator

Brown and colleagues (2017) described that poor water quality has resulted to low coverage of sediments-sensitive coral genera. In the case of Great Barrier Reef (largest coral reef ecosystem in the world), water quality is a regional driver of coral and microalgae biodiversity. Some of the factors such as nutrients and sedimentation, which can be measured by water quality tests, can result to the deterioration of coral reefs ecosystems (De'ath and Fabricius, 2010). Hence, water quality was selected as an environmental state indicator in this study. Environmental state indicator is considered as an "enabling factor" which is important in measuring and analysing regulating services (UNEP et al, 2015). The data of the water quality classification was obtained from DENR under the Environmental Management Bureau (EMB) which has the mandate to clean and maintain the water quality in the country.

2.4.3 Ecosystem Condition Indicator

The ecosystem condition indicator used in this study was the coral reef percentage cover. The data was derived from the assessment conducted by Conservation International Philippines. It was evaluated as showed in Table 3 using the coral reef condition category under the DENR Administrative Order No. 12, series of Guidelines for the Implementation of the Sustainable Coral reef Ecosystems Management Program (SCREMP).

Table 3. Coral Reef Condition Category by DENR

Category	%
1 (|Poor)	>0-10
2 (Fair)	11-30
3 (Good)	31-50
4 (Very Good)	51-75
5 (Excellent)	76-100

2.5 Coral Reef Ecosystem Services Supply and Use Account

UN (2014a) defined ecosystem services as "a contributions of ecosystems to benefits used in economic and other human activity." White & Cruz-Trinidad, A. (1998) enumerated fisheries, tourism and shoreline protection as some of the many uses of reefs products and their values. Lately, it has been discovered that coral bacterial symbionts are important in primary production and that they are the main sources of organic nitrogen and fixed carbon on Earth (Rodriguez and Ho, 2016). Hence, these indicators were selected for ecosystem accounting and described below are its units for ecosystem services' flow.

2.5.1 Fisheries

Two approaches were used for analysing the physical and monetary terms of ecosystem service supporting fisheries. These were data on fish production expressed in metric ton/year from marine municipal and commercial fisheries (excluding aquaculture) and their corresponding market value (Philippine Pesos/year) from 2013-2015 based on published online data from Philippine Statistics Authority (PSA) and using resource rent as a value indicator. The fisheries account will only be limited to Batangas Province including 14 municipalities and 1 city.

Resource rent method as a value indicator is defined as *"method derives the value of the ecosystem service as a residual after the contributions of other forms of capital have been deducted from the operating surplus. Since the residual reflects the return to the ecosystem asset that is used in production of marketed goods, it is consistent with exchange values"(*Obst et al, 2016). Below is the formula to compute the resource rent (RR):

RR = Gross Sales (GS)- Consumption of Fixed Capital (CFC) – User Cost of Fixed Capital (UCF) – Labor Cost (LC) – Intermediate Cost (IC)

A survey questionnaires was prepared for the fishermen to calculate the resource rent (See Annex 3. Sample Survey Questionnaire). A total of 31 fishermen were interviewed randomly. Each of the municipalities and city has two respondents. The accomplished survey questionnaires were compiled and analyzed using Excel format and IBM – Statistical Product and Service Solutions (SPSS).

Subsequently, the Net Present Value (NPV) of the resource rent of the expected flow of ecosystem service was calculated. It is mentioned in the UN Guidelines that monetary assets account can be presented through NPV calculation of the resource rent. The Net Present Value (NPV) is "the amount by which it increases net worth in present value terms" (Perman et al., 2003). Assumptions made for calculation of NPV was an interest rate or discount rate of 5%, 10% and 15%. Normally 5% discount rate is being used to get the NPV, however due to more uncertainties in the future, the value of the money might decrease faster than we predict, so 10% and 15% discount rates were considered to show its value. Another consideration is based on the Philippine government's National Economic and Development Authority's (NEDA) shadow discount rate which is estimated to be 15% (Southern Palawan Technical Group, 2015).

It is calculated as follows:

$$NPV = \sum_{0}^{T} \frac{N_t}{(1+i)^t}$$

Where N refers to the net benefits, i stands for the interest rate and t represents the year.

2.5.2 Carbon Sequestrations

The value of carbon sequestration services of coral reef will be based on the marginal social damage cost estimates. Tol (2008) defined that estimating marginal damage cost is important aspect in the assessment of any climate change related decision making. Specifically, the carbon sequestration will be valued using the "social cost of emitting a ton of carbon" (Sumarga et al, 2015). The Social Cost of Carbon (SCC) refers "to as the monetary value of the damage done by emitting one more tons of carbon at some point of time" (Pearce,2003).

Among all the ecosystem type including mangroves, algal, estuaries, upwelling zone, shelf water and open ocean, coral reefs have the highest primary productivity with 1800- 4200 grams carbon/m2/year (White & Cruz-Trinidad, 1998). Since there is wide net productivity range in accounting carbon, minimum median and maximum were considered in computing the total carbon sequestration value using social damage. The formula is as follows:

Coral Reef Carbon Sequestration Value (€/yr)= Minimum/Maximum/Median Productivity Range (tons of C /ha/yr) (Area of Live Corals + 1/3 of the mixed type) (ha)* Social Cost of Carbon (SCC) value (€/tons of C)*

Also, NPV was computed to get the monetary assets account. A social discount rate of 3% will be applied subsequent to the Interagency Working Group on Social Cost of Carbon and United States (2013) (Sumarga et al,2013). "Discount rate is used to calculate the present value of the stream of benefits or damages in the year when the additional unit of emissions was released" (Greenstone et al, 2013).

2.5.3 Coastal Protection

Damage Cost Avoided (DCA) was used to account the coastal protection in this study. It is defined as "services allow society to avoid costs that would have been incurred in the absence of these services"(de Groot et al, 2002). Initially, the household population of the coastal barangays within VIPMC were obtained using the Philippine Statistic Authority's (PSA) updated data. Two kilometres buffer was used in developing the Coastal Risk Map density showing number of households per hectare in built-up areas per coastal barangay. The household population was laid-out, analysed and processed through ArcGIS.

Damage costs used construction per house from Haiyan Typhoon Study, one of the strongest typhoon impacted the Philippines in the year 2013. In the reconstruction project in the areas affected by the typhoon, an estimated amount of 244,000 PhP was accounted for the construction per housing unit developed by Philippines' National Housing Authority (NHA) (Arroyo, 2013). The processing tools used was "Point Density Tool ArcMap.

2.5.4 Tourism

Since Philippines is consist of 7,107 island, diving and snorkelling are considered as part of tourism industry (Greenfins,2017). Several recreational activities are linked coral reef ecosystem such as scuba diving, snorkelling, swimming/wading etc (van Beukering, 2007). Providentially, Batangas Province is one of the Philippine Dives Sites Destination together with Cebu, Mindoro and Palawan (Department of Tourism,2017). Hence, the scope of this study will only cover Batangas Province. The tourism account will focus on diving industry and resorts, since it is the main reason of the tourists to visit the area.

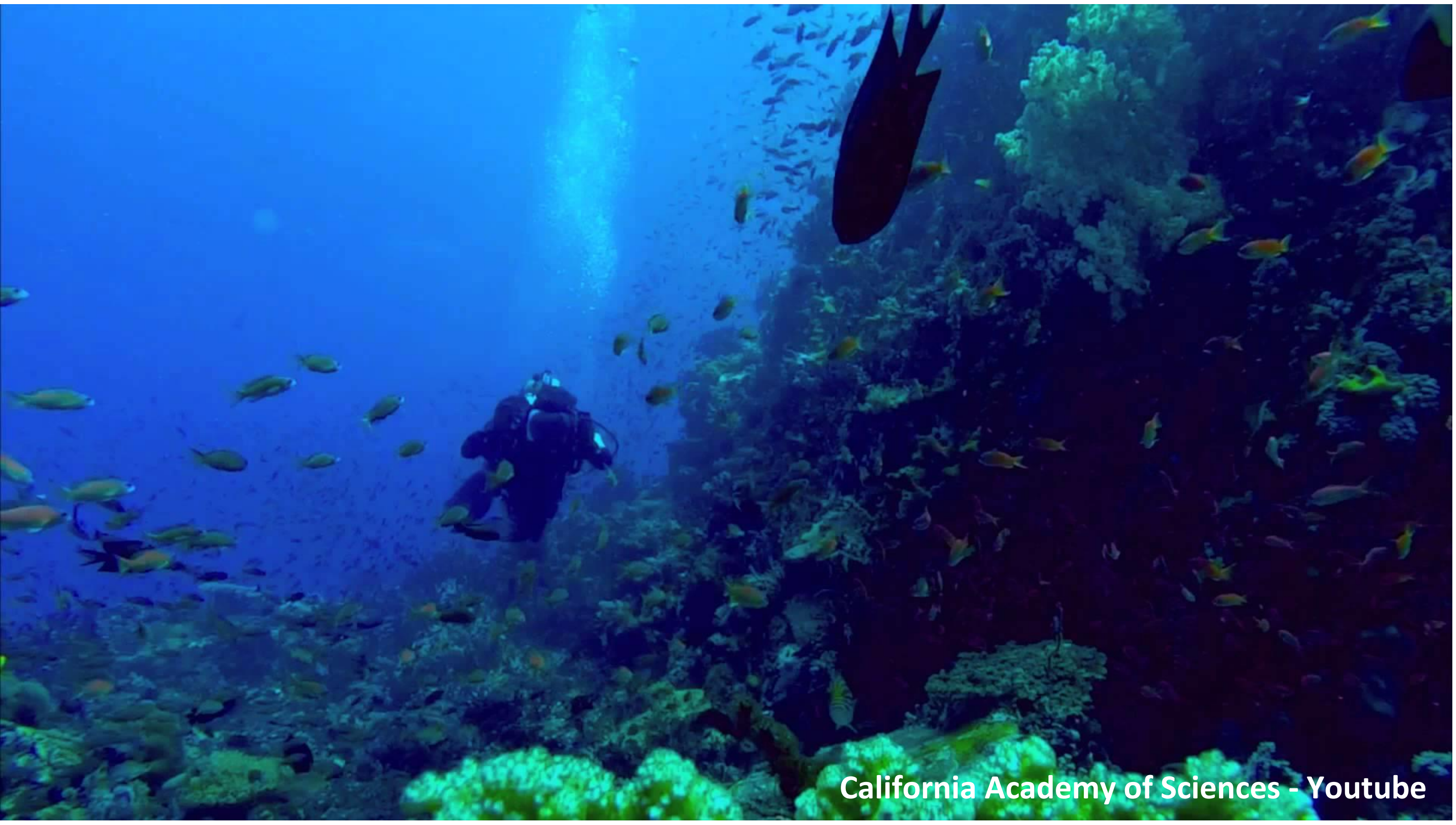
Two approaches were used for analysing both physical and monetary terms of ecosystem service supporting tourism. Data on the number of tourist (foreign and domestics) with their average daily expenditures and length of stay expressed in Philippine pesos/year from years 2013-2015 based on published online data from Philippine Statistics Authority (PSA) and using resource rent as a value indicator focused on diving operators and resorts. Below is the formula to compute the resource rent value for tourism:

$$RR = TR-(IC+LC+CFC+UFC)$$

Wherein: TR- Total Revenue
IC- Intermediate Consumption
LC- Labour Cost
CFC- Consumption of Fixed Capital
UFC- User Cost of Fixed Capital which assumed to be 10% of the total Fixed Capital

RR was generated using (1) overall tourism data based on provincial and national level data from PSA; (2) diving operators; and (3) resorts. For RR 2 and 3, two survey questionnaires were prepared for the diving operators and resorts. A total of 12 respondents were interviewed randomly (See Annex 6. Sample Survey Questionnaire). The accomplished survey questionnaires were compiled and analyzed using Excel format and IBM – Statistical Product and Service Solutions (SPSS). Also, NPV was computed to get the monetary assets account. Assumptions made for calculation of NPV was an interest rate or discount rate of 5%, 10% and 15%. This is also the same reason as written under section 2.5.1.

Chapter 3-5. Results

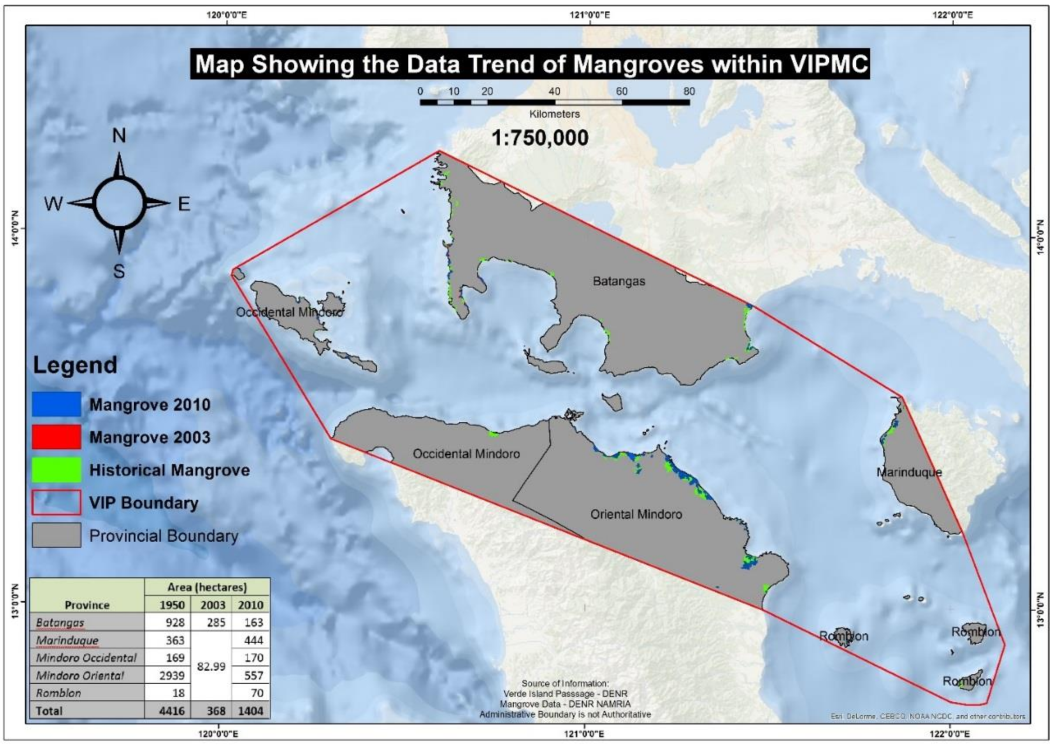


CHAPTER 3. Coastal Habitat Extent Account

The coastal and marine habitats of Verde Island Passage Marine Corridor are composed of rich mangrove and coral reef ecosystems which are important for the ecological and socio-economic health of the nearby locations. They serve as natural barriers from typhoons, storm surges, tsunami occurrences and high winds. Moreover, mangroves serve as food and shelter to many species such as fishes, birds, shells and crustaceans (PAWB-DENR, 2009). Coral reefs are the primary habitat in VIPMC, and it is estimated to be comprising of 319 coral species which belongs to 74 coral genera (Boquiren et al, 2010). The VIPC has the highest diversity and considered as the centre of the centre of marine shore fish biodiversity in the world. However, in the past few years an estimated range of 0.7% to 1.6% coral diversity has been lost is nthe area due to a variety of factors (Boquiren et al, 2010).

3.1 Mangrove Extent

There are 18 mangrove species and 17 associated mangrove species within the VIPMC. The dominant species present in mangrove areas are *Aegiceras floridum*, *Avicennia marina*, *A. officinalis, Nypa fruticans, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba*, and *Sonneratia caseolaris*. Figure 3 shows that there is a drastic loss of mangrove cover from 1950 (historical data) to 2010 data. The extent of such loss falls to an approximately 3,000 hectares of mangrove cover. Both anthropogenic and natural causes were identified in the Verde Island Passage Framework Plan by the Philippine government's DENR. These include mangrove destruction for livelihood purposes, uncontrolled development of ports and shipping navigation and an increase in tourism and unsustainable land use.



Province	Area (hectares)		
	1950	2003	2010
Batangas	928	285	163
Marinduque	363	82.99	444
Mindoro Occidental	169		170
Mindoro Oriental	2939		557
Romblon	18		70
Total	**4416**	**368**	**1404**

Figure 3. Map showing the Location of the Mangrove in 1950s, 2003 and 2010

3.2 Coral Reefs Extent

The map and the table presented in Fig. 4 show the results of coral reef cover change between 2002 and 2008. A total of 17,818 hectares of coral reefs extent was estimated based on the consolidated data from NASA archive under its Millennium Coral Reef Mapping Project. No field validation was done during this year. Coral gathering, illegal transport of corals, destructive collection/practice in fishing, biological pollution, tourism and unsustainable development were some of the threats identified within the VIPMC (PAWB-DENR,2009).

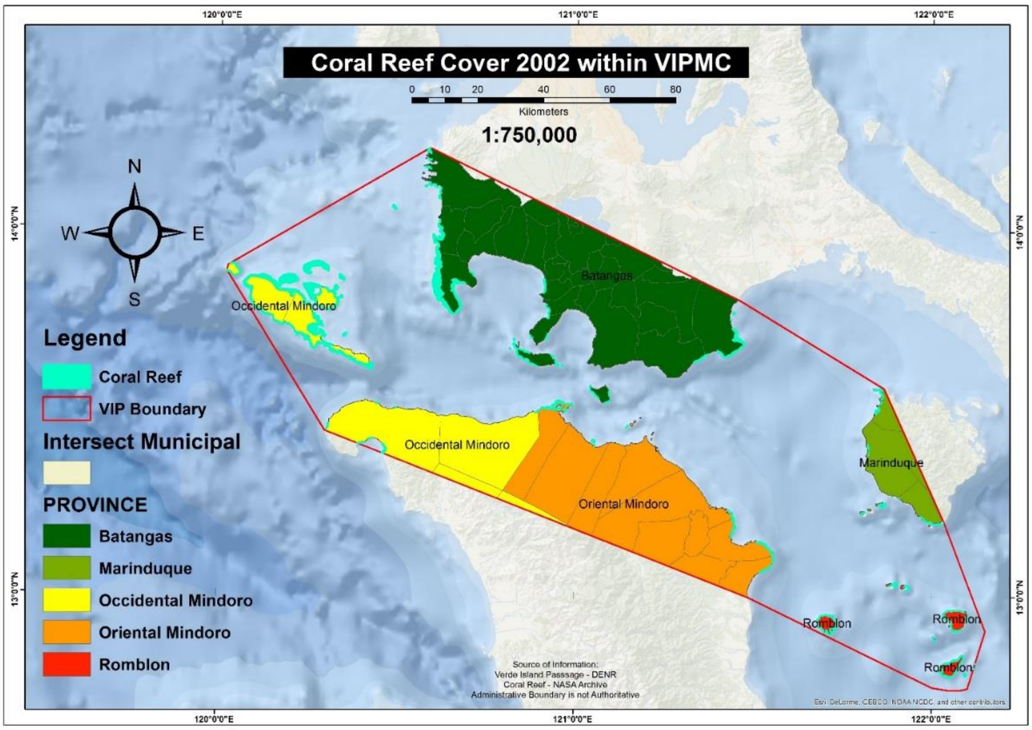


Figure 4. Consolidated Data of Coral Reefs within VIPMC (2002)

Conservation International Philippines conducted a comprehensive coral reef survey of the municipalities surrounding the Verde Island Passage in 2008 using video and photo transect methods. The coral reefs were categorized as (1) live corals; (2) Mixed (live corals + dead corals with algae +rock); (3) Overgrown (dead corals + rock) and (4) Abiotic (sand + corals). This study was so far the most updated assessment of coral reefs within VIPMC available in the literature.

Table 4. Area (ha) of coastal habitat in VIPMC (2008)

Bay Area	*Live Corals (hectares)*	*Mixed LC+DCA+RCK (hectares)*	*Overgrown DCA+RCK (hectares)*	*Abiotic S+R (hectares)*	*Total Area (hectares)*
Lubang Island (Occidental Mindoro)	572	1118	759	189	2638
Calatagan (Batangas)	560	802	670	146	2178
East Calumpan (Batangas)	16	7	0	23	46
Batangas Bay (West) (Batangas)	2	0	0	8	10

Batangas Bay (East) (Batangas)	172	168	60	93	493
Maricaban Island (Batangas)	20	10	2	35	67
West Marinduque (Marinduque)	7	10	0	1	18
Wawa-Paluan (Occidental Mindoro)	121	104	27	147	399
Puerto Galera-Naujan (Oriental Mindoro)	248	174	48	565	1035
Naujan-Gloria (Oriental Mindoro)	49	68	3	27	147
LC- Live Corals; DCA – Dead coral with algae; RCK- rock; S- sand; and R – rubble					

Source: (Boquiren et al, 2010).

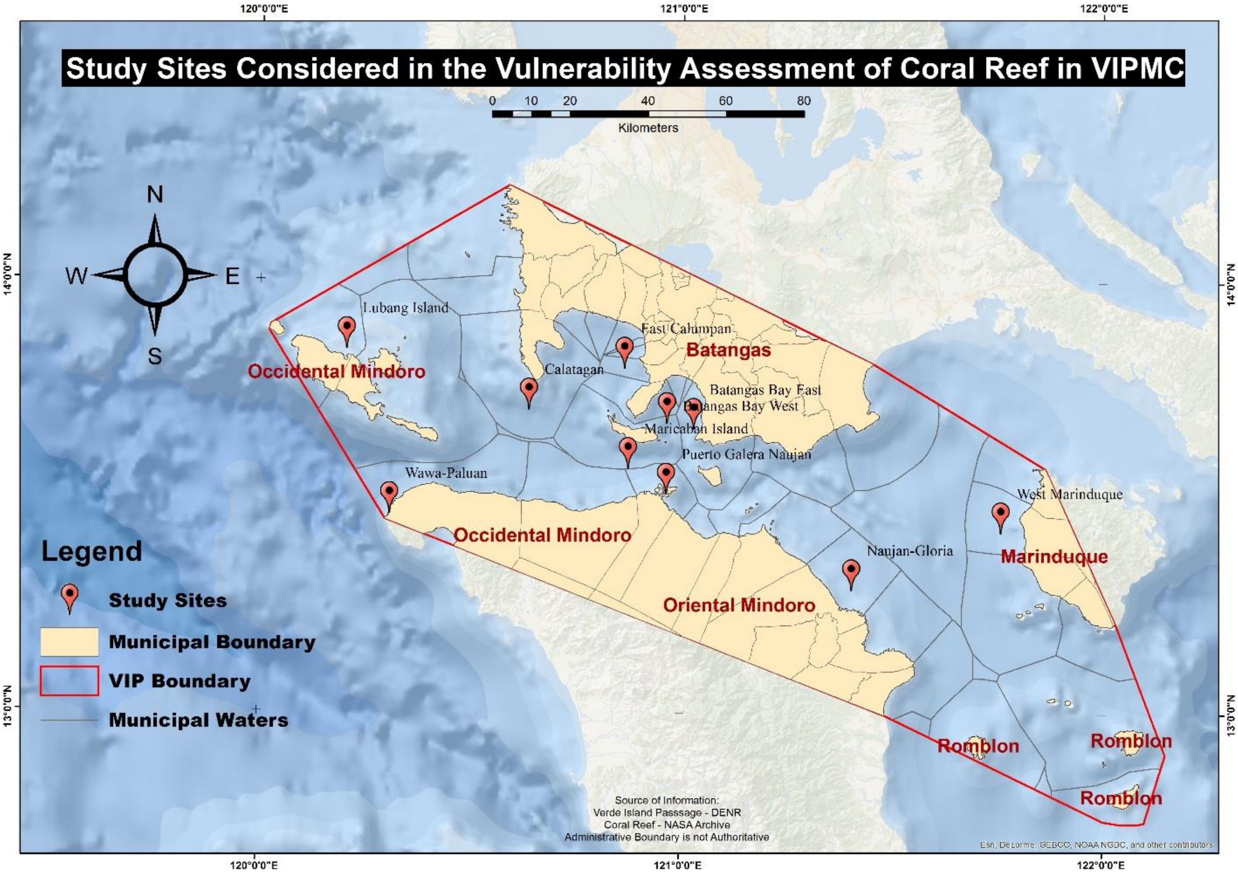


Figure 5. Study Sites considered in the Vulnerability Assessment of Coral Reefs in Verde Island Passage Marine Corridor

Most of the mangrove and coral reefs areas in the Philippines are under national or local management. Marine Protected Area (MPA) is one of the management instruments to protect and conserve these resources. It is governed by any laws, policies, guidelines or rules to protect and conserve a part of the coastal and marine environment. The MPAs' ecosystem protected within VIPMC is majorly of coral reefs. This is one of the reasons for international recognition, e.g., UNESCO's Man and the Biosphere Programme with the aim to "innovate and demonstrate approaches to conservation and sustainable development (PAWB-DENR, 2009).

Table 5. Marine Protected Areas established in VIPMC

Provinces	*Number of MPAs locally managed*	*Ecosystems Protected (Habitat Type)*	*Year Established (from-to)*	*Total Area (hectares)*
Batangas	45	Coral Reef + Artificial Reef (36); Mangrove (7); Seagrass beds (6)	1999-2011	2,077
Oriental Mindoro	31	Coral Reef (19); Mangrove (1); Seagrass (3); Coral Reef + Seagrass (4) ; Coral Reef+Seagrass+Mangroves (3); and Sea Turtle Nesting Ground (1)	1999-2015	6,297
Occidental Mindoro	15	Coral Reef (11); Coral reef+Seagrass (4);	2007-2010	14,719
Marinduque	8	Coral Reef (12); Coral Reef + Seagrass (3) ; Coral Reef+Seagrass+Mangroves (3)	1997-2016	8,779
Romblon	44	Coral Reef (19); Mangrove (1); Coral Reef + Seagrass (13) ; Coral Reef+Seagrass+Mangroves (12); and Sea Turtle Nesting Ground (1)	1999-2011	1,348

Source: State of the Coast report of the provinces covered submitted to DENR (unpublished) (Annex)

Chapter 4 Coral Reef Condition Account

Ecosystem condition account is the "central feature of ecosystem accounting." In this system, several physical characteristics and indicators are used to describe structure and condition of an ecosystem (UNEP et al, 2015). It provides a complete picture of the ecosystem and its ability to generate services. Hein et al (2016) pointed that "the current ecosystem condition means that the capacity is measured for an ecosystem as it is now not in relation to what its condition might be under alternative situations". This section of the study will focus on the present conditions affecting coral reef health indicators. It is categorized into three groups namely: (1) biophysical indicators; (2) environmental state indicators; and (3) ecosystem condition indicators.

4.1 Biophysical Indicators

Biophysical characteristics are described as both the biological and physical processes of an ecosystem. To be able to understand its biophysical elements, this has to be integrated with an accounting system. Biophysical modelling is important in "recognising the nature connections between ecosystem service flows and the condition of the relevant ecosystem assets"(UNEP et al, 2015). Biophysical indicators included are fault and seismicity, bathymetry and coastal vulnerability index with its vulnerability factors.

Based on UP-MSI (2017) under the Philippine Coral Reef Resources Assessment & Conservation Program (PhilCore) project, the Philippines is part of the subduction zones which has active volcanism and fault lines contributing to its fault and seismicity, "it can lead to vertical land motions and tsunamis that can alter the coastal stability of the sites resulting to high potential for tsunami inundation". Geological activities such as earthquake and volcanoes can cause harm to coastal habitats particularly the reefs (Wilkinson et al, 2003). On the other hand, bathymetry indicates the depths of the coast in which the coral reefs are located (Vanderstraete et al, 2003). Lastly, coastal vulnerability index serves as guidance in action planning and decision making particularly in highlighting the most vulnerable area or region (Ramieri et al, 2011). The indicators must be recognized by decision makers.

In this study, coastal vulnerability will focus on climate change hazards at provincial scale. It includes several vulnerability factors which are categorized as exposure, sensitivity and adaptive capacity. Fault and seismicity, sea surface temperature, tsunamis, % cover of coral reef and mangrove, water quality, and management initiatives have their functional relationship with vulnerability. It is important to know the physical condition of an area, as it is part of ecosystem accounting.

4.1.1 Fault and Seismicity

Verde Island Passage Marine Corridor is bounded to the south by Verde Passage Fault, a trending strike-slip fault (Galgana et al., 2007). This stretches northwest to Lubang fault and presumed to encompass towards the Manila Trench; and extends to the south to Sibuyan Sea Fault. Related to the fault system is the seismic activities. One of the strongest tsunamigenic earthquakes was recorded in 1994 in Verde Island Passage with magnitude 7 and an estimated run-up heights of 2-3 meters (UP-MSI, 2017). Faults and seismic activities have negative impact on the condition of coral reefs (Kumaraguru et al, 2005).Coral reefs serve as natural barriers that reduces impacts to the hazards caused by seismic activity such as tsunami and storm surges (Kunkel et al, 2006). Thus, this indicator is an important factor to understand the physical condition of coral reefs in VIPMC (See below under vulnerability factors (exposure) for the affected provinces within VIPMC)

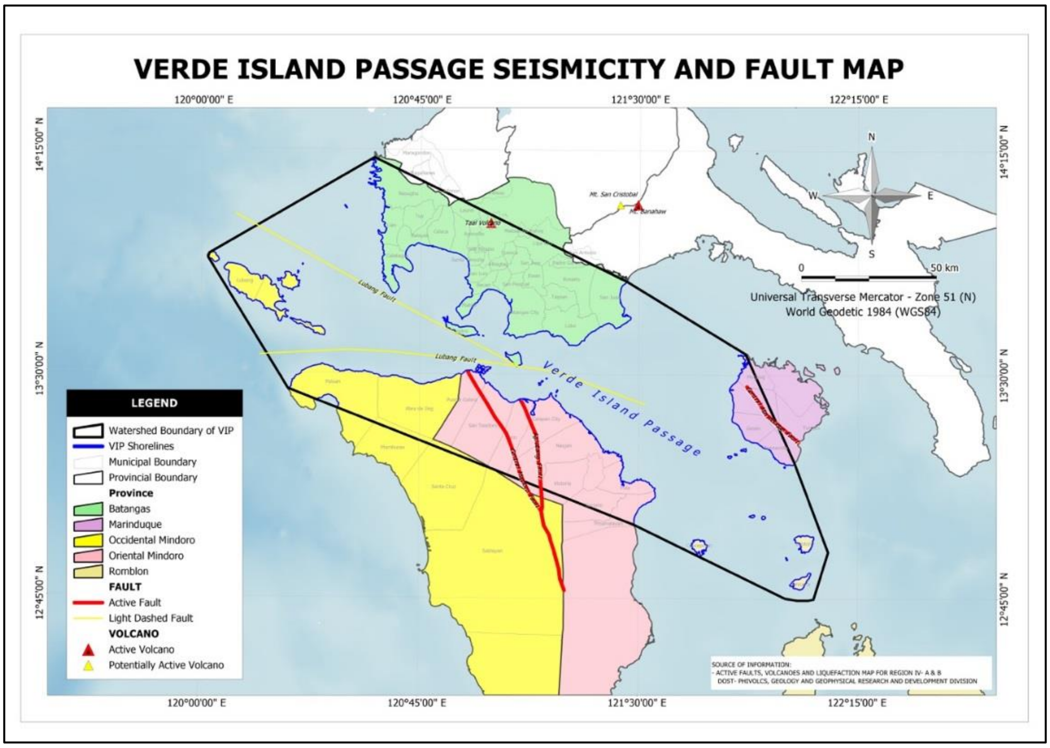


Figure 6. Fault and Seismic Map of VIPMC

4.1.2 Bathymetry

Bathymetry indicates the depths of the coast in which the coral reefs are located (Vanderstraete et al, 2003). Figure 7 shows the bathymetric map within VIPMC.

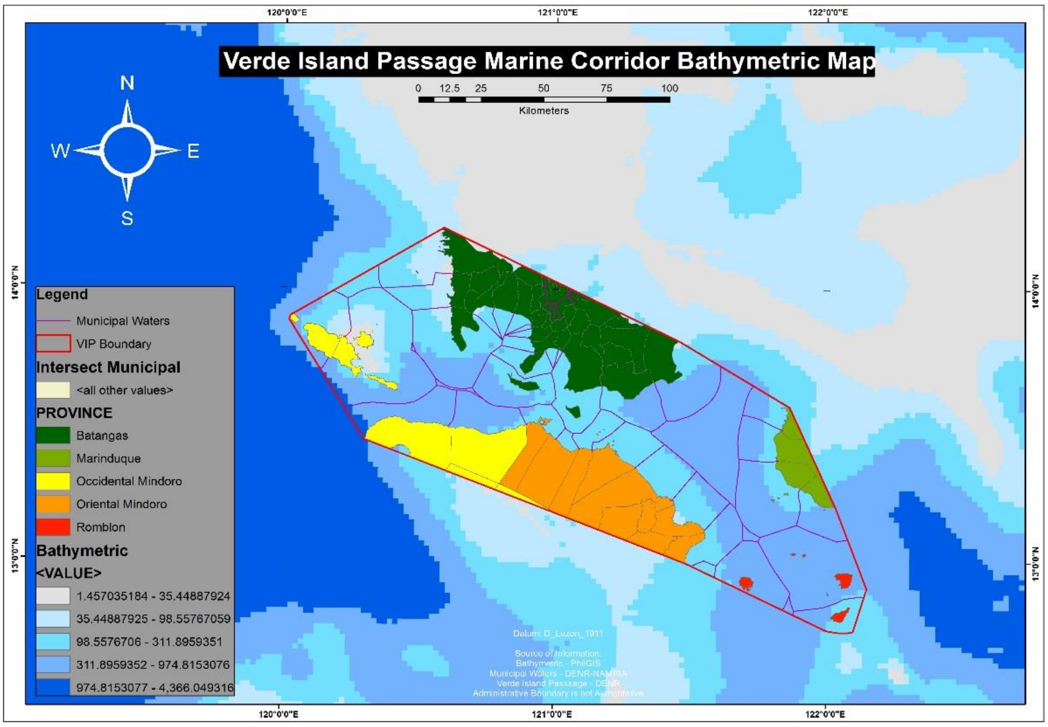


Figure 7. VIPMC Bathymetric Map

4.1.3 Coastal Vulnerability Index

IPCC (2007) highlighted that coastal areas are most vulnerable to climate change risks. Coastal and marine habitats such as mangroves and corals are highly exposed to climate variability. Coral bleaching, for example, is caused by increase in sea temperature and mangrove destruction due to sea-level rise. In developing this coastal vulnerability index to climate change hazards at the provincial scale, several factors were considered as shown in Table 5 with its functional relationship with vulnerability. It is categorized into exposure (e); sensitivity (s); and adaptive capacity (a).

Table 6. Vulnerability Factors in the assessment of coastal vulnerability in Verde Island Passage Marine Corridor. It is categorized into exposure (e); sensitivity (s); and adaptive (a).

Vulnerability Factors	*Vulnerability Type*	*Functional Relationship with Vulnerability*
a. Fault and seismic	E	Presence of faults and seismic, higher vulnerability
b. Sea surface temperature (SST)	E	High SST, higher vulnerability
c. Tsunami	E	Susceptible to tsunami, higher vulnerability
d. Coral Reef and Mangrove Cover	S	More coral reef and mangrove extent, lower vulnerability
e. Water Quality	S	Good water quality, lower vulnerability
f. Municipal Water	S	No political boundary

g. Marine Protected Areas	A	With MPA management, lower vulnerability
h. Key Biodiversity Areas	A	With KBA management, lower vulnerability
i. VIPMC Management and Initiatives	A	With management, lower vulnerability

4.1.3.1 Vulnerability Components

Exposure

There many components of climate change that can affect the coastal and marine habitats. These include the presence of fault and seismic activity, increase in sea surface temperature and presence of tsunamis. As a result, it can also affected the safety and security of human settlements in the area. The need for knowledge on the range of vulnerability to coastal areas and development of suitable adaptation measures to combat these threats are thus needed.

Sea Surface Temperature in VIPMC. The data was obtained using the National Oceanic and Atmospheric Administration (NOAA)'s graphical depiction of SST gridded product on global values. Based on Boquiren et al (2010), the Philippines SST has an average of about .025 °C increase per year mostly in the northern tip part of Luzon. In VIPMC, all the provinces covered showed extreme anomalies. Oriental Mindoro and part of Romblon Island are between 11-20 °C. The rest of the provinces show extreme high temperature of about 31 -47 °C. As obtained by NOAA SST satellite data, Philippines was observed several thermal anomalies though the years (Arceo et al, 2001). One problem posed by these anomalies is that elevated sea temperatures are strongly correlated to coral bleaching occurrences (Guest et al, 2012). Bleaching as stated by Fitt et al (2001), is a "loss of algal symbionts and/or their pigments to a variety of environmental stresses such as decrease salinity, increased temperature, exposure at low tide, sedimentation, darkness and solar radiation".

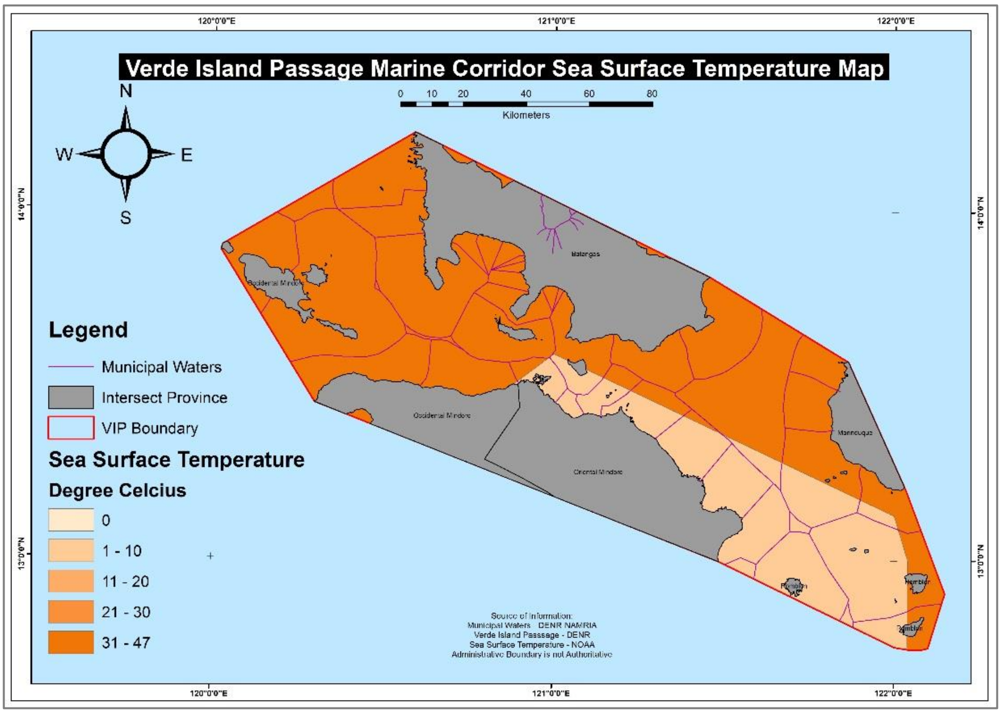


Figure 8. VIPMC Sea Surface Temperature

Presence of Tsunami. Tsunamis can transform the vulnerability of the coastal areas and induce damage to properties in the coastal community. It can cause "extensive and rapid coastal inundation, thus, global sea-level rise would be amplified" (Boquiren,2010). The table below shows the area (hectares) of the municipalities and city affected by tsunamis.

Table 7. Tsunami Inundation Area within Verde Island Passage Marine Corridor (hectares)

Tsunami Inundation Area	***Province***				
	Batangas (hectares)	**Marinduque**	**Occidental Mindoro (hectares)**	**Oriental Mindoro (hectares)**	**Romblon**
Abra de ilog		not prone to tsunami	634		not prone to tsunami
Baco				921	
Balayan	645				
Calatagan	2,412				
City of calapan (capital)				1,191	
Lian	1,610				
Looc			3,800		
Lubang			2,828		
Nasugbu	2,070				
Paluan			1,783		
Puerto galera				998	
San teodoro				631	
Tingloy	200				
Total	**6,936**		**9,046**	**3,742**	

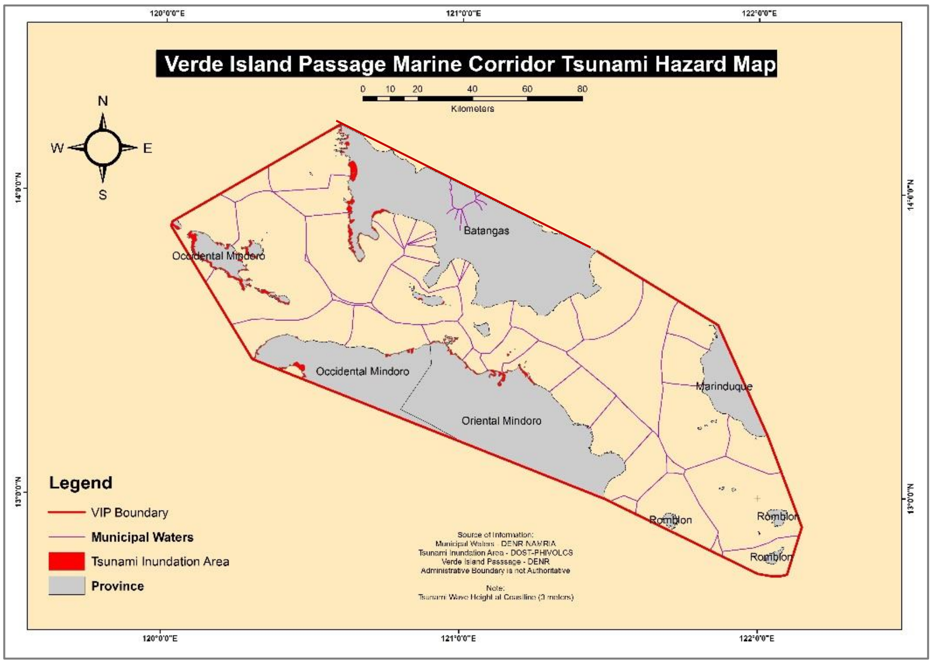


Figure 9. VIPMC Tsunami Hazard Map

Fault and Seismic Activities within VIPMC. There are three active fault lines present within the Verde Island Passage Marine Corridor, including the longest fault of Central Mindoro covering 89 kilometres. Conversely, three active volcanoes are located in the Batangas Province but not within the VIPMC's range.

Table 8. Status and Length of Fault and Seismic Activities in VIPMC

Class	*Legend*	*Length (i) meters*	*Km*
Central Mindoro Fault	Active Fault	89,334	89
Aglubang Fault	Active Fault	41,951	42
Lubang Fault	Light Dashed Fault	119,421	119
Lubang Fault	Light Dashed Fault	145,450	145
Taal Volcano	Active Volcano	-	-
Mt. Banahaw	Active Volcano	-	-
Mt. San Cristobal	Potentially Active Volcano	-	-
Central Marinduque Fault	Active Fault	28,338	28

Sensitivity

Sensitivity is the "degree to which a system could be affected by climate-related stimuli"(Torresan et al, 2007;IPCC, 2007a). It focused on qualifying the impacts of presence of fault and seismic activities; increase in sea surface temperature (SST) and presence of tsunamis to coral and mangroves. In this study, water quality was considered to identify its impacts (direct or indirect) to coastal and marine habitats. Figure 10 presents the Habitat Map in VIPMC.

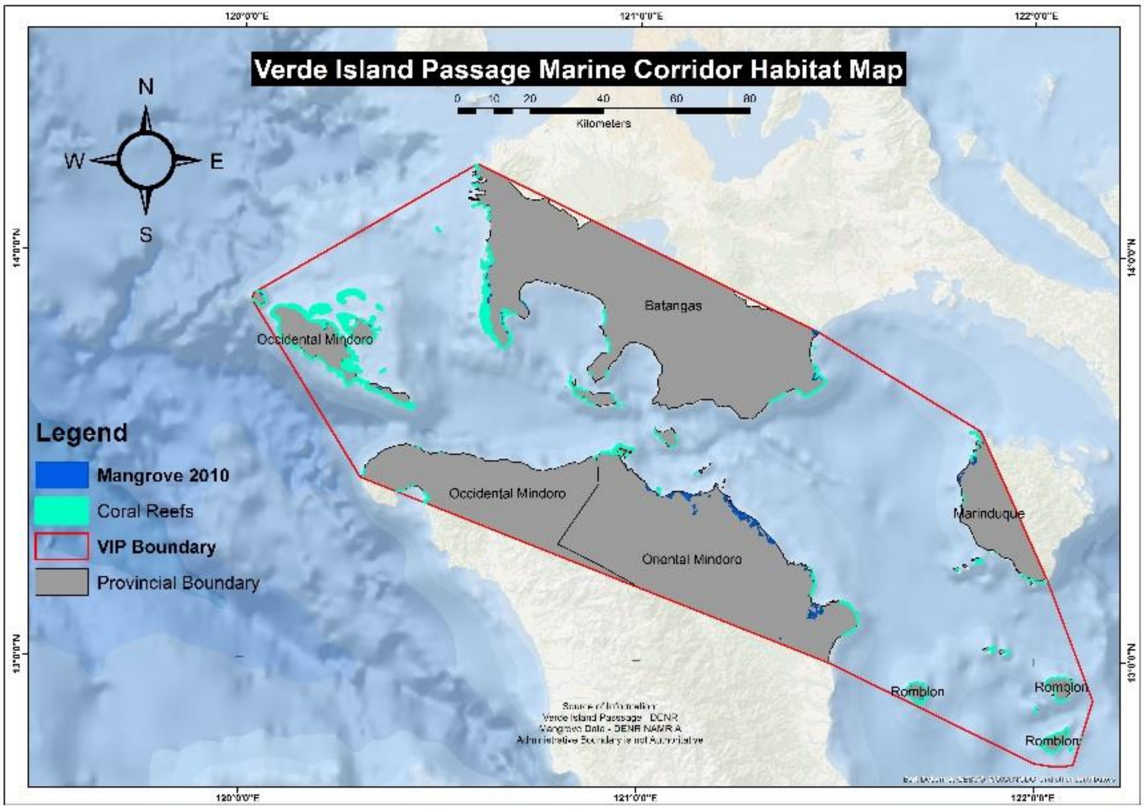


Figure 10. VIPMC Habitat Map

Water Quality. Generally, anthropogenic activities are one of the major contributor to the changes in water quality. Declining water quality can be caused by the increase of global temperatures and subsequent ocean acidification, stressing out the key species of the coastal habitats like coral reefs (Hoegh-Guldberg et al, 2007). In the Philippines, to maintain good water quality, the Department of Environment and Natural Resources (DENR) under the Environmental Management Bureau is mandated to implement Republic Act 9275, also known as the Philippine Clean Water Act of 2004. This law aims to "protect the country's water bodies from pollution from land-based sources (industries and commercial establishments, agriculture and community/household activities. It provides for comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all stakeholders" (EMB, 2018). The water quality of the country is assessed based on the modified DENR Administrative Order 1990-35 (Water Quality Guidelines and General Effluent Standards), for the coastal and marine waters, the water quality parameters are faecal coliform; total coliform and dissolved oxygen. Further discussion on the result of water quality standards will be discussed under environmental state indicators

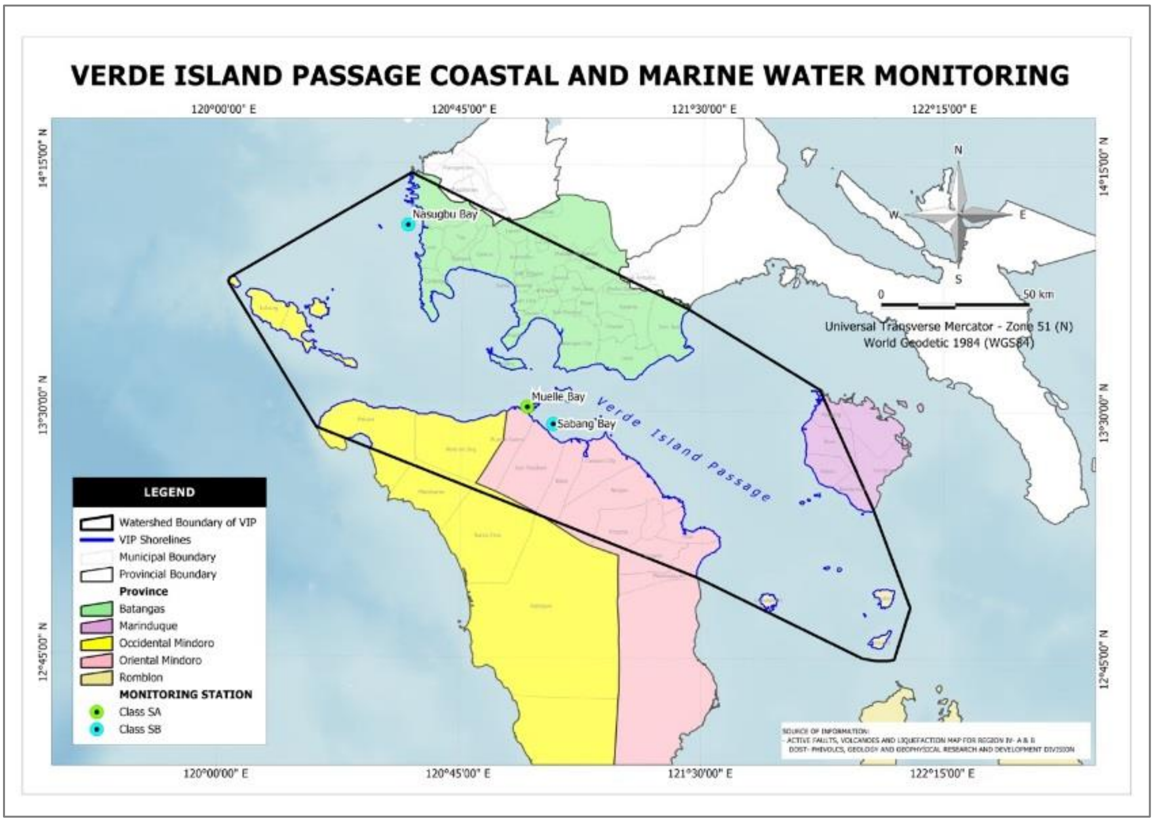


Figure 11. Coastal and Marine Water Monitoring Stations within VIPMC

Adaptive Capacity

Last among the three components is adaptive capacity. It is defined as "the ability of a system to adjust or to cope with climate change consequences" (Torresan et al, 2007;IPCC, 2007a). Coastal vulnerability will decrease if adaptive capacities are strengthened. In order to reduce the vulnerability, adaptive measures and management shall be implemented in the area. These measures include strengthened laws and policies, community education and public awareness; and improvement coastal and marine management. The vulnerability factors below shows the national, regional, provincial and local scale of management initiative within the VIPMC.

Key Biodiversity and Protected Areas. One of the most important adaptive measures initiated by the national government is the establishment of the protected areas under the RA 7586 known as the National Integrated Protected Areas System Act of 1992. It states that "it should encompass outstanding remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, biogeographic zones and related ecosystems, whether terrestrial, wetland or marine, all of which shall be designated as protected areas". There are four protected areas (terrestrial) within the jurisdiction of VIPMC namely Taal Volcano Protected Landscape; Naujan Lake National Park; Mt. Calavite Wildlife Sanctuary and Marinduque Wildlife Sanctuary. To increase and improve the management effectiveness, DENR established several Key Biodiversity Areas. Under VIPMC are six terrestrial KBA and six Marine KBA namely Balayan Bay, Western Calatagan, Puerto Galera, Lubang Island, Tingloy and part of Lobo to San Juan coastal areas. These protected areas are managed by DENR Offices supervised by a Protected Area Superintendent (PASu).

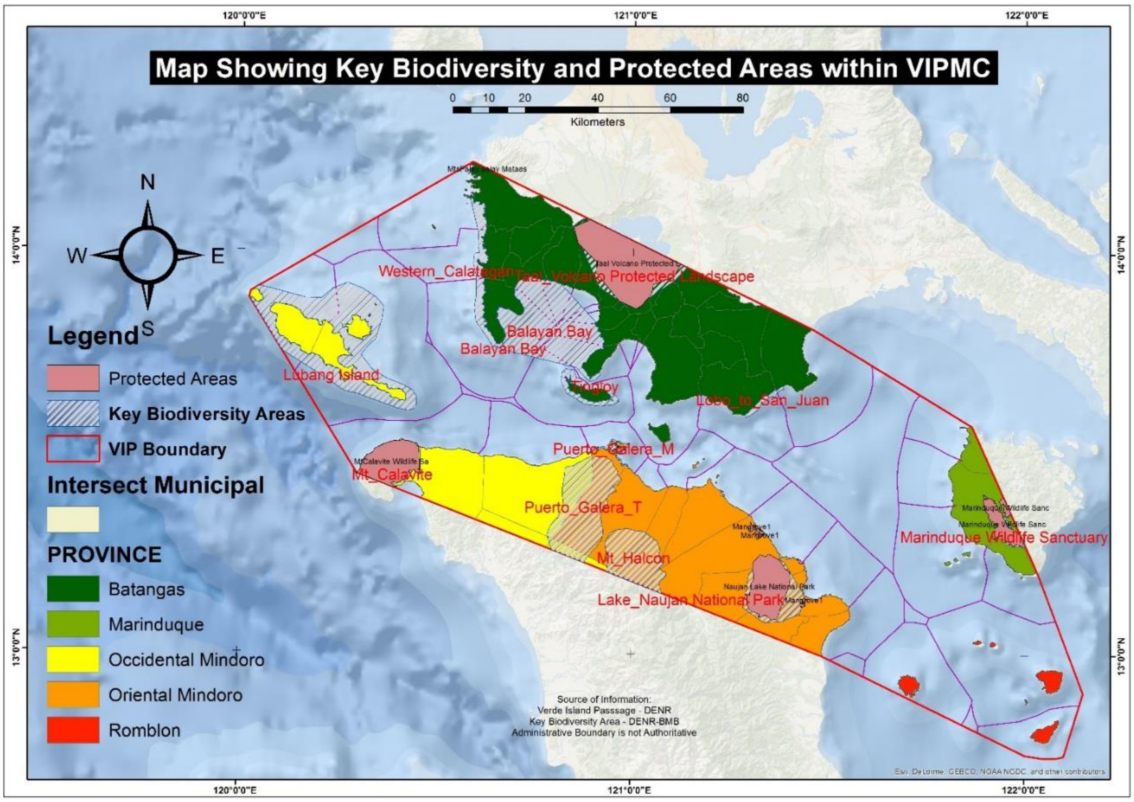


Figure 12. KBAs and Pas within VIPMC

Management Initiatives. Figure 12 shows the consolidated management initiatives within the VIPMC. Several management initiatives were carried out when the area was identified as the "centre of the centre of biodiversity in the world", such initiatives are for climate change and disaster risk preparedness program, local biodiversity conservation/habitat protection program, improved governance on coastal resource management (CRM), information education and communication campaign, livelihood intervention, national to local enforcement and capacity building enhancement.

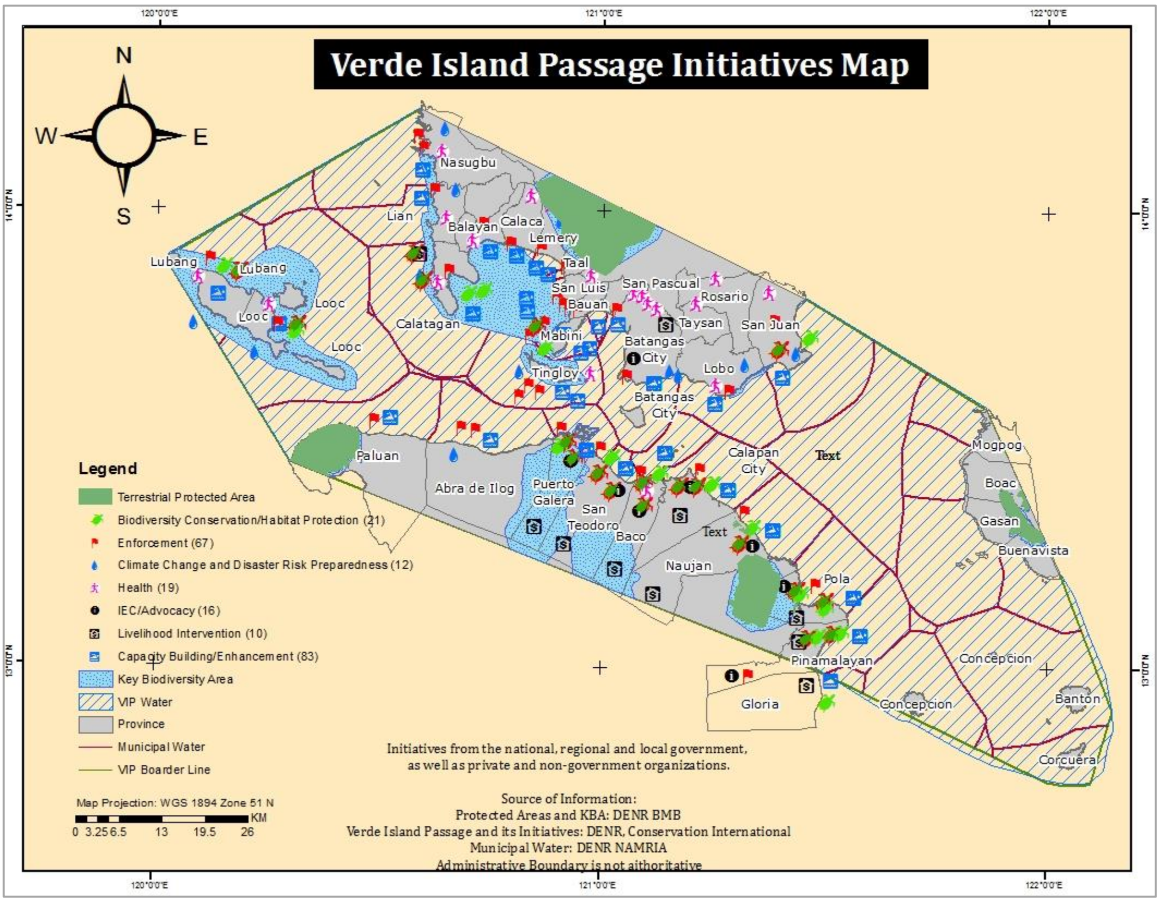


Figure 13. VIPMC Initiatives Map

4.1.3.2 Scores Applied to Vulnerability Factors in VIPMC

The next step is classing and scoring the vulnerability factors used in VIPMC to assess and estimate the vulnerability of the provinces within VIPMC. For instance, higher scores were assigned to presence of protected areas and key biodiversity areas which are initiated by the national and local government. However, lower scores were applied (i.e. presence of active fault and seismic activities and tsunami).

Table 8. Scoring Scale

Evaluation	*Score*
Very High	**1**
High	**0.75**
Medium	**0.5**
Low	**0.25**
Very Low	**0**

Table 9. Classes and Score applied in the Vulnerability Factors

Vulnerability Factor	***Class***	***Score***
Fault and seismic	- Presence of active fault and volcano - Presence of light dashed fault - Absence	0 0.5 1
Sea surface temperature (sst)	- 0 - 1-10 - 11-20 - 21-30 - 31-47	0 0.25 0.5 1 0
Tsunami	- Not prone - Prone (2-4 municipalities) - Prone (5-10 municipalities)	1 .5 0
Coastal Habitat Cover	With coral reefs (Percentage Cover %) • 0-10% • 11-30% • 31-50% • 51-75% • 76-100% With Mangroves (in hectares) • 1-120 • 121-240 • 241-360 • 361-480 • 481-600	0 0.25 0.5 0.75 1 0 .25 .5 .75 1
Water Quality	- Class SA - Class SB - Class SC - Class SD - No water monitoring	1 .75 .5 .25 0
Municipal Water	- With conflict - Without Conflict	0 1
Terrestrial Protected Areas	- Presence - Absence	1 0
Key Biodiversity Areas	- Presence - Absence	1 0
Management Initiatives	- High (more than 20) - Medium (10-19) - Low (1-9) - No management	1 .75 .25 0

Among all the provinces, Occidental Mindoro has the highest score in the vulnerability factors while Romblon has the lowest relative to its extent of the area. Most of the management initiatives are highlight in Batangas Province and Mindoro Islands.

Table 10. Scores of Vulnerability Factors for each of the provinces in VIPMC

Vulnerability Factor	***Batangas***	***Marinduque***	***Occidental Mindoro***	***Oriental Mindoro***	***Romblon***
Fault and seismic	0	0	0	.5	1
Sea surface temperature (sst)	0	0	0	.5	.5
Tsunami	0	1	.5	.5	1
Coastal Habitat Cover					
• *Coral Reef Extent (%)*	.5	.75	.5	.5	.5
• *Mangrove (%)*	.25	.75	.25	1	0
Water Quality	.75	0	.75	0	0
Municipal Water	1	1	1	1	1
Terrestrial Protected Areas	1	1	1	1	0
Key Biodiversity Areas	1	1	1	1	0
Management Initiatives	1	0	1	1	0

Weighing of scores are derived from two preferences (1) stakeholders preferences on the vulnerability factors categories (see Annex 2. for the brief introduction of the Stakeholders) and (2) equal weights of the vulnerability factors.

Table 11. Calculation of vulnerability factors weight from stakeholders: Government; Private Sector; Expert; Non-Government Organization; Experts; and Student.

Vulnerability Factor	***Stakeholder***										***Average (Option 1)***	***Average (Option 2) = Equal weight***
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
Fault and seismic	.1	.05	.05	.05	.1	.05	.1	.05	.1	.05	0.07	.1
Sea surface temperature (sst)	.05	.1	.1	.05	.15	.05	.1	.05	.1	.025	0.078	.1
Tsunami	.05	.1	.1	.05	.15	.1	.1	.05	.2	.025	0.093	.1
Coral Reef Extent (%)	.1	.2	.14	.2	.05	.1	.1	.15	.1	.25	0.139	.1
Mangrove Extent (%)	.1	.05	.2	.1	.05	.1	.1	.15	.1	.25	0.120	.1
Water Quality	.1	.15	.05	.05	.1	.1	.05	.1	.05	.05	0.080	.1
Municipal Water	0	.05	.01	0	.05	.05	.05	.05	.05	.025	0.034	.1
Marine Protected Areas	.1	.1	.05	.2	.1	.1	.1	.15	.1	.1	0.0115	.1
Key Biodiversity Areas	.1	.1	.05	.2	.05	.05	.1	.15	.1	.1	0.1	.1
Management Initiatives	.3	.1	.2	.1	.2	.3	.2	.1	.1	.0125	0.1725	.1
Total	1	1	1	1	1	1	1	1	1	1	1	1

4.1.3.3 Combining Score

Two preferences were made to get the overall vulnerability index of each of the provinces; (1) combine score using the stakeholders weighted combined score; and (2) equal weighted combine score. Mindoro Islands obtained the highest vulnerability index while Romblon is the lowest. The presence of fault and seismic activities, SST, and percentage of extent cover of coral reefs and mangroves plays important role in the overall scores of the coastal vulnerability index.

Table 12. Overall Scores of the Two Options

Overall score	***Batangas***	***Marinduque***	***Occidental Mindoro***	***Oriental Mindoro***	***Romblon***
Stakeholders combine	.5805	.53525	.62675	.7305	.30425
Equal weighted combine	.55	.55	.6	.7	.4

4.1.3.4 Vulnerability Index Map of VIPMC

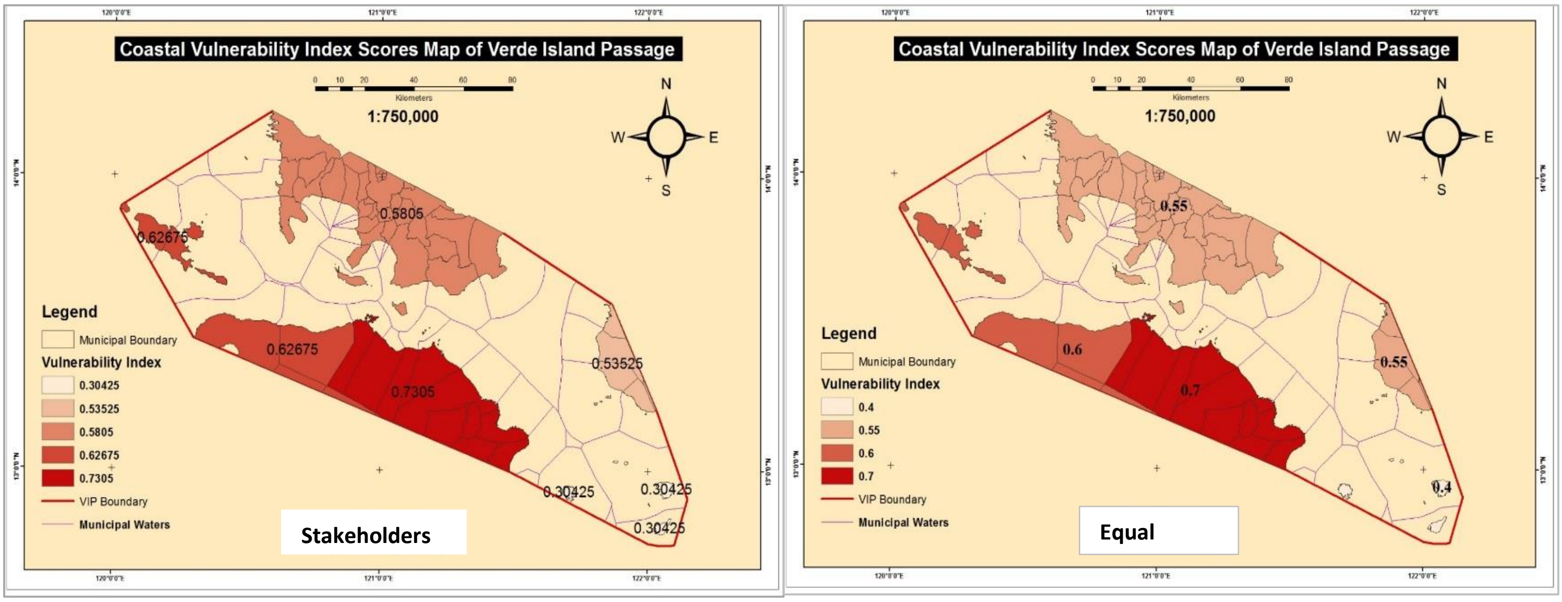


Figure 14. Coastal Vulnerability Index Scores Map of VIPMC (Stakeholder and equal weights)

4.1.4 Environmental State Indicator

Environmental state provides overall states of the environment wherein the ecosystem is functioning (World Bank, 2014). Water quality condition is a good indicator to measure the environmental state wherein it changes from year to year. There are three water quality parameters under the coastal and marine monitoring of DENR-EMB namely dissolved oxygen; faecal coliform; and total coliform. Dissolved Oxygen (DO) is defined as "the concentration of oxygen measured in its dissolved form; fish and other aquatic organisms require at least 5 milligrams per litre (mg/L) of dissolved oxygen to live". If the level of DO will be below this requirement, fish and other aquatic life will not be survived. Faecal Coliform, on the other hand, "is microscopic organisms that indicate significant content of pathogens from faeces of warm-blooded animals". Lastly, Total Coliform measures the overall count of coliform bacteria that includes faecal coliform. These three parameters are essential in evaluating the coastal water quality (DENR-EMB, 2014). Within the VIPMC, both faecal and total coliform failed to comply its water quality standards with poor rating. Dissolved oxygen parameter passed to the standards with fair rating.

Table 13. Percentage Compliance of Coastal and Marine Waters Monitored (Faecal Coliform, Total Coliform and DO), 2006 – 2013

Region	***Water Body***	***Dissolved Oxygen***				***Fecal Coliform***				***Total Coliform***			
		Total No	*Total Pass*	*%*	*Rating*	*Total No*	*Total Pass*	*%*	*Rating*	*Total No*	*Total Pass*	*%*	*Rating*
4A	Nasugbo Bay					*6*	*0*	*0*	*Poor*	*6*	*2*	*33.33*	*Poor*
4B	Muelle Bay	*15*	*9*	*60*	*Fair*					*3*	*0*	*0*	*Poor*
4B	Sabang Bay	*100*	*93*	*93*	*Fair*	*36*	*7*	*19.44*	*Poor*	*36*	*11*	*30.56*	*Poor*

Source: DENR-EMB, 2014

Rating	**%**
Good	98-100
Fair	50-97.99
Poor	0-49.99

4.1.5 Ecosystem Condition Indicator

Ecosystem condition indicator provides the state of an ecosystem that has the ability to generate services and its link to ecosystem service flows (UNEP et al, 2015). Coral reef ecosystems are considered to be a main source of various goods and services with economic value. Primary net productivity of coral reefs varies from its type such as hard and soft corals. Different categories of corals have different economic values (i.e. in carbon sequestration). As an ecosystem condition indicator, it is significant to know the percentage live cover of coral reefs to clearly quantify its economic value. Also, it can be a guideline for the decision makers to highlight the areas that need to be protected and maintained.

Based on the assessment conducted by Conservation International Philippines (2008), coral reefs were categorized into four type; (1) live corals; (2) Mixed (live corals + dead corals with algae +rock); (3) Overgrown (dead corals + rock) and (4) Abiotic (sand + rock) into 10 representative areas within VIPMC. Only live corals and mixed type corals were considered to compute the percentage cover of coral reefs in Verde Island Passage Marine Corridor as shown in Table 14.

Table 14. Area (ha) of coral reefs extent in VIPMC (2008)

Area	*Live Corals*	*Mixed (Live Corals, Dead Corals and Rock)*	*Total (ha)*
Lubang Island	572	1118	2638
Calatagan	560	802	2178
East Calumpan	16	7	46
Batangas Bay West	2	0	10
Batangas Bay East	172	168	493
Maricaban Island	20	10	67
West Mariduque	7	10	18
Wawa-Paluan	121	104	399
Puerto Galera-Naujan	248	174	1035
Naujan-Gloria	49	68	147
Total	1767	2461	**7031**

Percentage Cover of Coral Reefs in Verde Island Passage Marine Corridor (2008)

The mixed type corals are composing of live corals, dead corals and rock. With this, several selections were considered to compute the percentage cover of living corals within VIPMC as such; (1) measured the live corals type only; (2) considered the live corals and total mixed type; (3) obtained by getting the median of option 1 and 2, and lastly; (4) obtained by adding the live corals and assumption that 1/3 of the mixed type is live corals since mixed type is composed of three parts. Table 15 shows the percentage cover of living corals per area.

Table 15. Percentage cover of living corals in VIPMC

Area	***Percentage Cover (%)***			
	(1)Min (only live corals)	**(2) Max (including 100% mixed)**	**(3) Median**	**(4) Live corals + 1/3 of the mixed**
Lubang Island	22	64	43	36
Calatagan	26	63	44	38
East Calumpan	35	50	42	40
Batangas Bay West	20	20	20	20
Batangas Bay East	35	69	52	46
Maricaban Island	30	45	37	35
West Mariduque	39	94	67	57
Wawa-Paluan	30	56	43	39
Puerto Galera-Naujan	24	41	32	30
Naujan-Gloria	33	80	56	49

DENR-Biodiversity Management Bureau (formerly Protected Areas and Wildlife Bureau) under the implementation of Sustainable Coral Reef Ecosystems Management Program (SCREMP) developed qualification of the condition of coral reef. Table 16 shows the evaluation of coral cover in VIPMC. Overall, the percentage cover of coral reefs in VIPMC is under fair condition using option 1 (live corals only).

Table 16. Condition of live corals in VIPMC

Area	***Category** under DENR Administrative Order No. 12, series of Guidelines for the Implementation of the Sustainable Coral Reef Ecosystems Management Program (SCREMP)*			
	(1) Min	**(2) Max**	**(3) Median**	**(4) Live corals + 1/3 of the mixed**
Lubang Island	2	4	3	3
Calatagan	2	4	3	3
East Calumpan	3	3	3	3
Batangas Bay West	2	2	2	2
Batangas Bay East	3	4	4	3
Maricaban Island	2	3	3	3
West Mariduque	3	5	4	4
Wawa-Paluan	2	4	3	3
Puerto Galera-Naujan	2	3	3	2
Naujan-Gloria	3	5	4	3

Chapter 5. Ecosystem Services Supply Account

Ecosystem services is defined as the benefits of the human well-being from ecosystem which is classified into four categories namely provisioning (i.e. wood and food); regulation (climate and water regulation); cultural (i.e. recreation) and supporting (i.e. soil formation) (MA, 2003; Mongruel et al, 2015). It has different methods or ways in valuing ecosystems and their services specifically through economic, socio-cultural and ecological (MA, 2003; de Groot et al, 2010). Ecosystem accounting integrates and measures both in physical and monetary terms the ecosystems' capacity and ability to supply services. It is aligned with the methods and standards reflected on System of National Account (SNA) on measuring economic activities based on economic principles (Eden and Hein, 2013; UN et al, 2009).

This section presents the coral reefs' ecosystem services and values including fisheries related to reefs; coastal protection value, tourism and carbon value. It serves as guidelines for the decision makers to fully understand the importance of this ecosystem for the people's not just livelihood but also safety and security. White & Cruz-Trinidad, A. (1998) enumerated fisheries, tourism and shoreline protection as some of the many uses of reefs products and their values. Lately, it has been discovered that coral bacterial symbionts are important in primary production and that they are the main sources of organic nitrogen and fixed carbon on Earth (Rodriguez and Ho, 2016).). Hence, these indicators were selected for ecosystem accounting and described below are its units for ecosystem services' flow. Both physical and monetary values have been analysed in the identified ecosystem services.

5.1 Fisheries Account

Fisheries is one of the significant ecosystem services linked to coral reefs. It is one of the major sources of income of the people in the Philippines. However, coastal and marine habitat is being degraded because of different unsustainable practices such as using different destructive fishing methods and lack of proper awareness on fisheries laws and policies. With these, the Philippines government initiates several adaptation approaches to maintain the safety of fishing grounds. Mostly provincial and local ordinances on fishing in the Philippines are anchored to the implementation of Republic Act No. 8550 otherwise known as the "An act providing for the development, management and conservation of the fisheries and aquatic resources, integration all the laws pertinent thereto". It has the objective stated in Section 2 to "manage fishery and aquatic resources, in a manner consistent with the concept of an integrated coastal area management in specific natural fishery management areas, appropriately supported by research, technical services and guidance provided by the State". Under this law, commercial and municipal fishing were defined as:

> *"**Commercial Fishing** — the taking of fishery species by passive or active gear for trade, business & profit beyond subsistence or sports fishing, to be further classified as:*
>
> 1. Small scale commercial fishing — *fishing with passive or active gear utilizing fishing vessels of 3.1 gross tons (GT) up to twenty (20) GT;*
> 2. Medium scale commercial fishing — *fishing utilizing active gears and vessels of 20.1 GT up to one hundred fifty (150) GT; and*
> 3. Large commercial fishing — *fishing utilizing active gears and vessels of more than one hundred fifty (150) GT.*
>
> ***Municipal fishing** — refers to fishing within municipal waters using fishing vessels of three (3) gross tons or less, or fishing not requiring the use of fishing vessels."*

This section provides an indicative assessment of the use of reef fisheries including the capture fisheries of commercial and municipal marine fisheries (excluding aquaculture), in both physical and monetary terms.

5.1.1 Volume and Value of Production of Fisheries in Batangas, Province

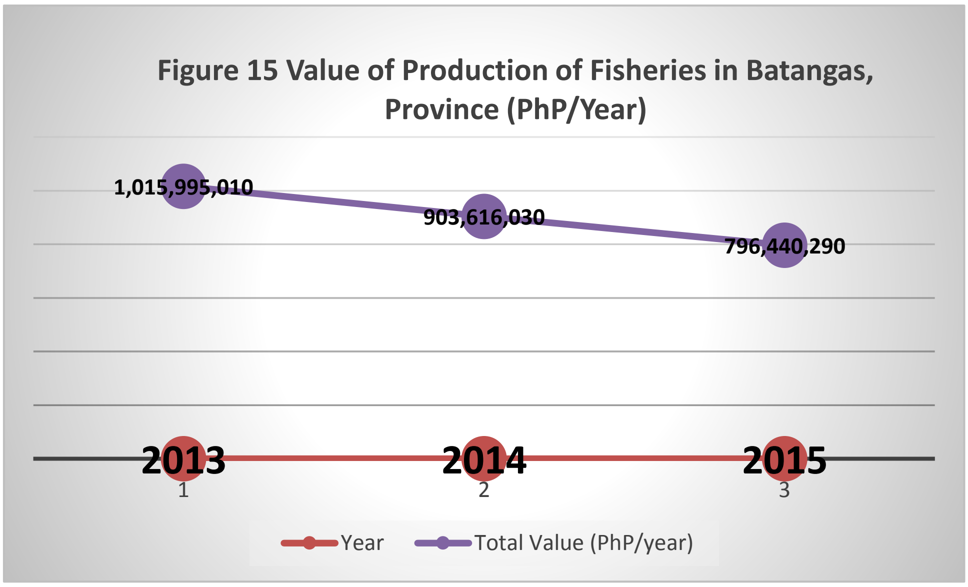
Data on volume and value of fish production from 2013-2015 were based on Philippine Statistics Authority (PSA). PSA defined commercial fishing as "the catching of fish with the use of fishing boats with a capacity of more than three (3) gross tons for trade, business or profit beyond subsistence or sports fishing while marine fishing as "covers fishing operation carried out with or without the use of a boat weighing three (3) gross tons or less". The top species to value of marine production in the Philippines are Roundscad, Indian Sardines, Yellowfin Tuna, Squid, Frigate Tuna, Threadfin bream. Skipjack, Big-eyed Scad and Indian Macakerel. On the other hand, commercial fisheries'top species area Acetes (Alamang), Anchovies (Dilis), Bi-eyed scad (Matang-baka), Bigeye tuna (Tambakol/Bariles), Blue Crab (Alimasag). Caesio (Dalagng Bukid), Cavalla (Talakitok), Crevalle (Salay-salay), Eastern little tuna (Katchorita) and fimbriated sardines (Tunsoy) (PSA,2016).

Figure 14 and Table 17 show the decline of production (volume and value) for both commercial and marine municipal fisheries in Batangas, Province (metric tons/year) from 2013 to 2015.

Table 17. Volume and Value of Production of Fisheries in Batangas Province

	2013	***2014***	***2015***
Commercial Fisheries			
Volume of Production (metric tons/year)	5,5012	4,512	4,519
Marine Municipal Fisheries			
Volume of Production (metric tons/year)	11,380	10,377	9,887
Total Volume (metric tons/year)	16,882	14,888	14,407
Total Value (Philippine Pesos/year)	1,548,147,520	1,350,707,890	1,197,081,790

Source: Philippine Statistics Authority (PSA), 2016



5.1.2 Resource Rent of Capture Fisheries in Batangas, Province

5.1.2.1 Respondents Profile and Perspectives

A total 31 fishermen were interviewed randomly for the resource rent survey within Batangas province (Fig 15). Each of the 14 municipalities and 1 city has two respondents (fishermen). Several questions were asked relating to the changes of fisheries in their municipal waters. Majority of the respondents answered that the fishing ground location is further since they have started fishing. Moreover, in terms of the size of the fish caught, most answered that the size of fishes are getting smaller compared to previous years (See Annex 1 for the respondents profile and perspectives).

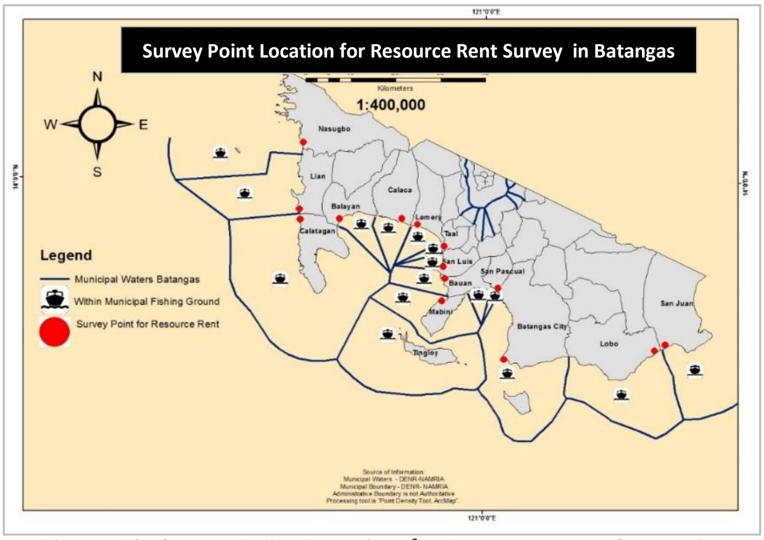


Figure 16. Survey Point Location for Resource Rent Survey in Batangas Province

5.1.2.2 Capture Fisheries in Batangas, Province

Based on the results of resource rent survey conducted in Batangas, Province, the most commonly used fishing gears are gill net and hook and line. These fishermen are using different types of fishing vessels namely (1) Non-Commercial-Non Motorized (40% of the respondents); (2) Non-Commercial- motorized (37% of the respondents); and (3) Commercial fishing vessel (23% of the respondents). The average fish catch from all species is 58,610 kilograms per fisherman per year. Batangas City yielded the highest fish catch with 447,792 kilograms/year while Municipality of Lian has the lowest with 3,213 kilograms/year. Average fish catch (kg/year/fisherman) was derived from the average fish catch (kg/day/fisherman) of each of the municipalities/city multiplied to its average total number of fishing days by the respondents (See Annex 5 for the detailed computation).

Table 18. Annual Average Fish Catch by Fisherman in Batangas Province

Area	*No. Fisherman (2008 data) Source: PGB and PEMSEA, 2008*	*Average Catch per day, kg*	*Total Fishing Days*	*Average Catch (all species) per fisherman (kg/year)*
Batangas City	862	1964	228	447,792
Nasugbu	3,003	176	240	42,240
Lian	3,146	11	306	3,213
Calatagan	4,100	92	300	27,600
Balayan	2,724	212	288	61,056
Calaca	440 (Boquiren,2010)	105	288	30,240
Lemery	1,318	240	186	44,640
Taal	49 (Boquiren,2010)	66	276	18,078
San Luis	140 (Boquiren,2010)	208	288	59,760
Mabini	495	64	240	15,240
Tingloy	106	26	246	6,273
Bauan	594	193	276	53,268
San Pascual	No data	45	300	13,500
Lobo	1,149	254	186	47,244
San Juan	2,700	38	240	9,000

For the fisheries account (2017), the resource rent obtained by the open water fishermen was computed. Table 19 presents the annual average resource rent per fisherman in 14 municipalities and 1 city of Batangas Province, which is estimated at four million PhP/year or 61 PhP/kg/day of 259 average total fishing days/year. The resource rent was computed by deducting all the cost input of the fishermen such as consumption of fixed capital, labour cost and intermediate cost from the gross revenue (PhP/year). Gross revenue was obtained from the sales of fish species such as sardines, round/mackerel scad, bigeye scad, lacustrine goby, squid, frigate tuna, anchovies, yellow fin tuna, skipjack tuna etc (See Annex 6 for the complete list of captured fish species). Taxes and other subsidies were excluded in the computation of gross revenue.

The costs were computed based the questions asked to the fishermen such as cost of construction of their owned fishing vessels and its maintenance per year ; cost of fishing gear; and fishing inputs per trip such as fuel, oil, crushed iced, meal expenses and rentals. Table 19 presents the details on average resource rent capture fishery (per fisherman per year) in Batangas Province for 2017.

Table 19. Calculation of Fisheries Resource Rent per kilogram among the fishermen in Batangas Province

Municipality	*Gross Revenue (Pesos/year)*	*Labor Cost (Pesos/year)*	*Intermediate Input/Cost (Pesso/year)*	*Consumption of Fized Capital (Pesos/year)*	*User Cost of Fixed Capital (assumed to be 10% of the total Fixed Capital (Pesos/year)*	*Total Resource rent (Pesos/year)*	*Resource Rent, pesos/kg*
Batangas City	44,055,120	1,380,000	1,192,135	752,500	75,250.00	40,655,235	91
Nasugbu	4,594,800	958,320	547,700	287,400	28,740	2,772,640	66
Lian	317,400	72,600	31,920	72,600	7,260	133,020	41
Calatagan	2,097,600	787,200	212,500	423,000	42,300	632,600	23
Balayan	3,027,600	1,299,060	132,000	508,866	50,887	1,036,787	17
Calaca	2,566,800	236,880	214,920	257,700	25,770	1,831,530	61
Lemery	3,844,800	330,000.	364,020	521,900	52,190	2,576,690	58
Taal	1,694,640	628,800	146,660	188,400	18,840	711,940	39
San Luis	6,156,000	1,485,000	301,320	357,000	35,700	3,976,980	67
Mabini	2,000,700	281,760	251,535	274,937	27,493	1,164,973	76
Tingloy	802,800	171,060	101,705	116,100	11,610	402,325	64
Bauan	5,254,800	882,000	440,275	568,250	56,825	3,307,450	62
San Pascual	2,125,200	218,640	273,075	129,200	12,920	1,491,365	110
Lobo	5,699,040	1,080,000	398,685	488,650	48,865	3,682,840	78
San Juan	924,000	130,800	76,350	119,550	11,955	585,345	65

Lastly, net value added (NVA) was computed through deduction of gross value added to consumption of fixed capital. Gross value added was derived from the gross sales of fisheries minus the intermediate expenses. From the resource rent generated rate, below shows the NVA from the province of Batangas. The NVA of fisheries in Batangas is approximately 5 million PhP. It is indicated that the increase in value added reflected an increase of demand of fish production (UNEP, 2015). (See annex 13 for detailed computation of NVA)

Table 20. Net Value Added (NVA) for fisheries

	Gross Revenue (PhP)	*Intermediate Input/Cost (PhP)*	*Consumption of Fized Capital (PhP)*	*Net value added (PhP)*
Batangas Province	5,677,420	312,320	337,737	5,027,363

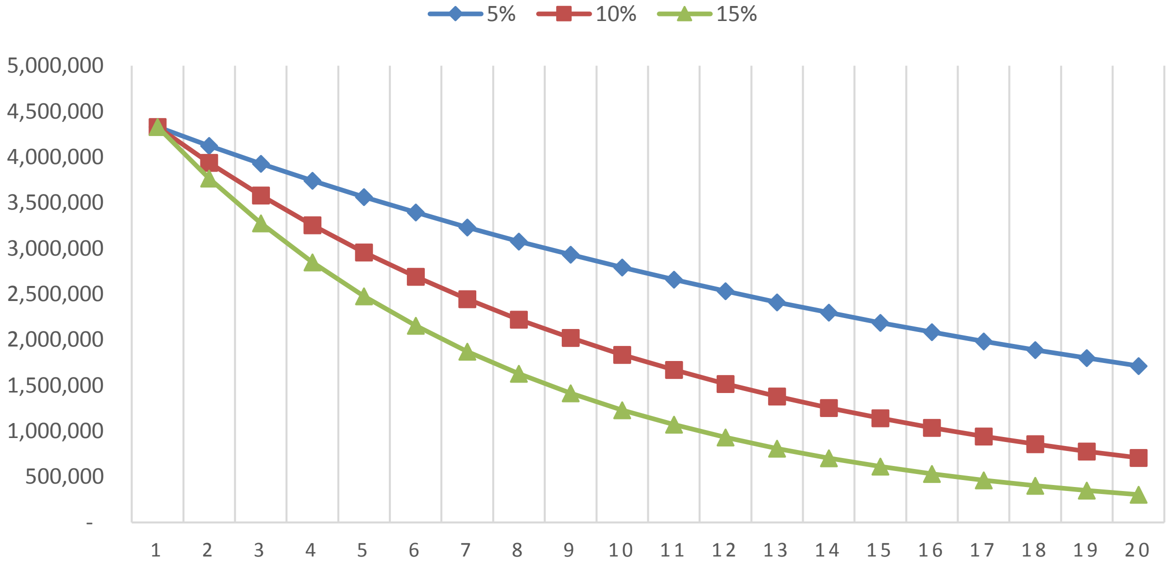
5.1.2.3 Asset Account for Fisheries Resource Rent

There are two concepts in measuring ecosystem assets, first is based on the terms of ecosystem condition and extent; and second is the "an estimated stock of expected ecosystem service flows". However, as the function of the ecosystems' condition and extent change, the expected ecosystem service flows and its capacity of ecosystem assets to generate services to future sustainable flow can also be affected (UN, 2014b). Thus, capacity can change over time due to changes in the condition and extent of an ecosystem. It can also decrease or increase depending on the ecosystem uses and management options (Schröter et al, 2014).

In this section, the Net Present Value (NPV) of the resource rent generated by fisheries production was calculated. NPV is one of the approaches used to analysed ecosystem assets account in monetary terms following the UN Guidelines. Moreover, estimating the NPV will be quantified as per ecosystem services, and not for ecosystems as a whole. UN (2014a) discusses estimates discount rates for the derivation of NPV can be private, marginal, and market based discount rates. It is stated that for the purposes of SEEA, "it is recommended that a discount rate be determined that is consistent with the general approach to valuation in the SEEA and the SNA". Several fisheries studies use between 0%-24% discount rate for its sensitivity analysis (Harte et al, 2000; Larkin, 2000). Another consideration is based on the Philippine government's National Economic and Development Authority's (NEDA) shadow discount rate which is estimated to be 15% (Southern Palawan Technical Group, 2015). Therefore, three different discount rates (5%, 10% and 15%) have been analysed using a discounting period of 20 years .

Assume that the condition of fisheries in Batangas Province has no change, hence, an average amount of 4.3 million PhP will be same for the period of 20 years. With this, under the given discount rates of 5%, 10% and 15% for the period of 20 years, the sum of resource rent of fisheries (PhP/Year) from the baseline current year 2017 are 57 million PhP (5%), 41 million PhP (10%) and 31 million PhP (15%). Figure 16 shows the NPV of fisheries resource rent (See Annex 7 for the detailed computation)

FIG. 17 NET PRESENT VALUE OF FISHERIES RESOURCE RENT, (PHP/YEAR)



5.2 Carbon Account

Lately, it has been discovered that coral bacterial symbionts are important in primary production and that they are the main sources of organic nitrogen and fixed carbon on Earth (Rodriguez and Ho, 2016). Among all the ecosystem type including mangroves, algal, estuaries, upwelling zone, shelf water and open ocean, coral reefs has the highest primary productivity with 1800-4200 grams carbon/m2/year (White & Cruz-Trinidad, 1998). Another study cited by Emerton (1998) showed that coral reefs absorbed an estimated half of 1.2 X 1013 molecules of calcium/ year, which is equivalent to a net primary productivity in excess of 2,500 g carbon/m2/year

(Spurgeon and Aylward 1992). Thus, coral reefs' produce high primary productivity as compared to other habitat such as mangrove and seagrass (Polovina, 1984).

This section, accounting was based on the Social Cost of Carbon (SCC) which refers "to as the monetary value of the damage done by emitting one more tonne of carbon at some point of time"(Pearce,2003). Sumarga and colleagues (2015) used the value of SCC at "USD 32/t CO2 which is equal to € 24/t CO2 (€ 88/t C) with an exchange rate of $ 1.33 for € 1 (2010). In this study, the value used for SCC is at US$ 20, US$ 40 and US$ 80 per ton of Carbon. Under the coral reef condition account, choice number (4) was preferred for the carbon account which is computed as the summary of live corals and 1/3 of the mixed type corals (in hectares) of the assessed areas within VIPMC. Hence, below is the formula to compute the monetary value of carbon sequestration using SCC within VIPMC:

Coral Reef Carbon Sequestration Value (US$/yr)= Minimum/Maximum/Median Productivity Range (tons of C /ha/yr) (Area of Live Corals + 1/3 of the mixed type) (ha)* Social Cost of Carbon (SCC) value (US$/tons of C)*

Table 21-23. Monetary Value of Carbon Sequestration using SCC in VIPMC

Area	*Live corals + 1/3 of the mixed (hectare)*	*Minimum (LC) t of C/yr*	*SCC US$/year (20US$/t of C)*	*SCC US$/year (40 US$/t of C)*
Lubang Island	945	17,010	340,200	680,400
Calatagan	828	14,904	298,080	596,160
East Calumpan	18	324	6,480	12,960
Batangas Bay West	2	36	720	1,440
Batangas Bay East	228	4,104	82,080	164,160
Maricaban Island	23	414	8,280	16,560
West Mariduque	10	180	3,600	7,200
Wawa-Paluan	156	2,808	56,160	112,320
Puerto Galera-Naujan	306	5,508	110,160	220,320
Naujan-Gloria	72	1,296	25,920	51,840
Total	**2,588**	**46,584**	**931,680**	**1,863,360**

Median t of C /yr	***SCC US$/year (20US$/t of C)***	***SCC US$/year (40 US$/t of C)***	***SCC US$/year (80 US$/t of C)***
28,350	567,000	1,134,000	2,268,000
24,840	496,800	993,600	1,987,200
540	10,800	21,600	43,200
60	1,200	2,400	4,800
6,840	136,800	273,600	547,200
690	13,800	27,600	55,200
300	6,000	12,000	24,000
4,680	93,600	187,200	374,400

9,180	183,600	367,200	734,400
2,160	43,200	86,400	172,800
77,640	**1,552,800**	**3,105,600**	**6,211,200**

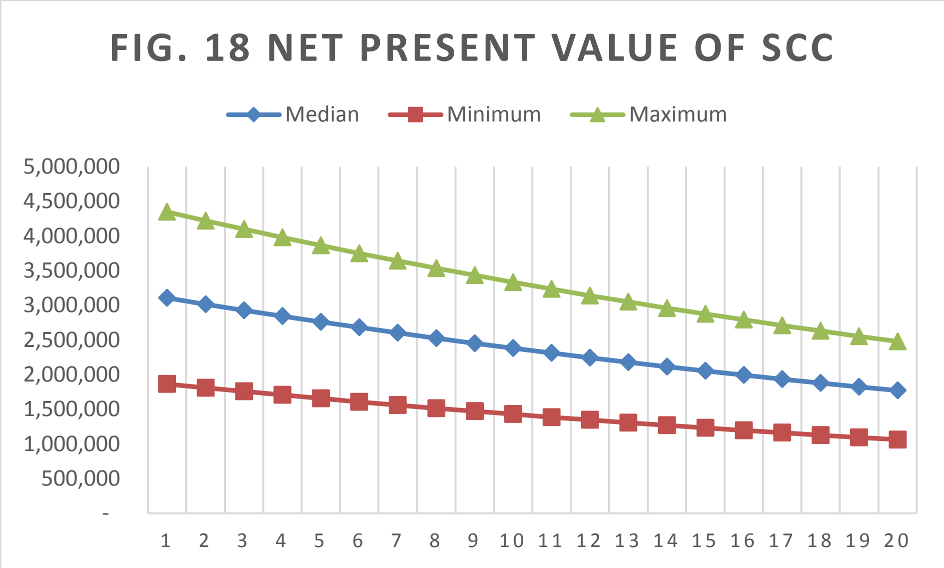
Maximum(LC) t of C/yr	*SCC US$/year (20US$/t of C)*	*SCC US$/year (40 US$/t of C)*	*SCC US$/year (80 US$/t of C)*
39,690	793,800	1,587,600	3,175,200
34,776	695,520	1,391,040	2,782,080
756	15,120	30,240	60,480
84	1,680	3,360	6,720
9,576	191,520	383,040	766,080
966	19,320	38,640	77,280
420	8,400	16,800	33,600
6,552	131,040	262,080	524,160
12,852	257,040	514,080	1,028,160
3,024	60,480	120,960	241,920
108,696	**2,173,920**	**4,347,840**	**8,695,680**

An estimated amount of three million US$ (median primary productivity 40 US$/t of C) is contributed to carbon sequestration monetary value. Also, NPV was computed to get the monetary assets account (See Annex 8 for the detailed computation). A social discount rate of 3% will be applied subsequent to the Interagency Working Group on Social Cost of Carbon and United States (2013) (Sumarga et al,2013). “Discount rate is used to calculate the present value of the stream of damages in the year when the additional unit of emissions was released” (Greenstone et al, 2013). Therefore, 3% discount rate is analysed using a discounting period of 20 years .

Assume that the condition and extent of coral reefs within VIPMC will have no change, hence, an average amount of approximately 3 million US$ (median net primary productivity), 1.9 million US$ (minimum net primary productivity) and 4 million US$ (maximum net primary productivity) will be the same for the period of 20 years, the sum of SCC (US$/year) from the baseline year 2008 are 47 million US$ (median net primary productivity); 29 US$ (minimum net primary productivity) and 67 US$ (maximum net primary productivity). Hence, table 22 shows the summary value of SCC for the year 2018 and 2027 (end year for the period of 20 years) from its baseline year (2008). Figure 17 shows the declining value of SCC for the period of 20 years.

Table 24. Net Present Value of SCC

	SCC value (US$ /yr) 2008	SCC value (US$ /yr) 2018	SCC value (US$ /yr) 2027
1 Minimum	1,863,360	1,386,515	1,062,648
2 Maximum	4,346,714	3,234,363	2,478,870
3 Median	3,105,600	2,310,858	1,771,080



5.3 Tourism

In this section of the paper, tourism associated to coral reefs such as scuba diving and snorkelling were analysed. The monetary value of the nature recreation service was estimated based on the number of tourists (foreign and domestic) visiting the area and their average daily expenditures and length of stay based on the online database from Philippine Statistics Authority (PSA) and Department of Tourism (DoT). For the simplicity of the study, it is assumed that diving and snorkelling are the reasons that the tourists are visiting the area. To value the contribution of coral reefs ecosystem to tourism in Batangas, a resource rent (RR) approach is used. The RR approach deducts from the gross revenue to the total cost from the tourism national data. Also, the RR generated from the diving were estimated wherein a survey on December 2017 was conducted to collect data on the benefits and costs from diving operators and resorts owners. A total of 12 diving operators and resort owners were interviewed for the survey to ask the revenues and costs including their intermediate consumptions, consumption of fixed capital and labour costs.

5.3.1 Study Area (Mabini, Batangas)

Mabini, Batangas is the southern tip of Batangas Province ,bounded on the north by the Municipality of Bauan, on the east by Batangas Bay, Balayan Bay on the west and south by Verde Island. Several dive spots are known in Mabini such as Twin Rocks, Secret Bay, Kirby's, Cathedral and Devil's Point. There are 54 registered resorts located in eight coastal barangays in Mabini namely Brgy. Majuben, Brgy.San Jose, Brgy. Ligaya, Brgy. Bagalangit, Brgy. San Teodor, Brgy. Mainit and Brgy. Anilao (Banluta et al, 2013). Figure 18 shows the location map of some of the resorts and dive sites in Mabini.

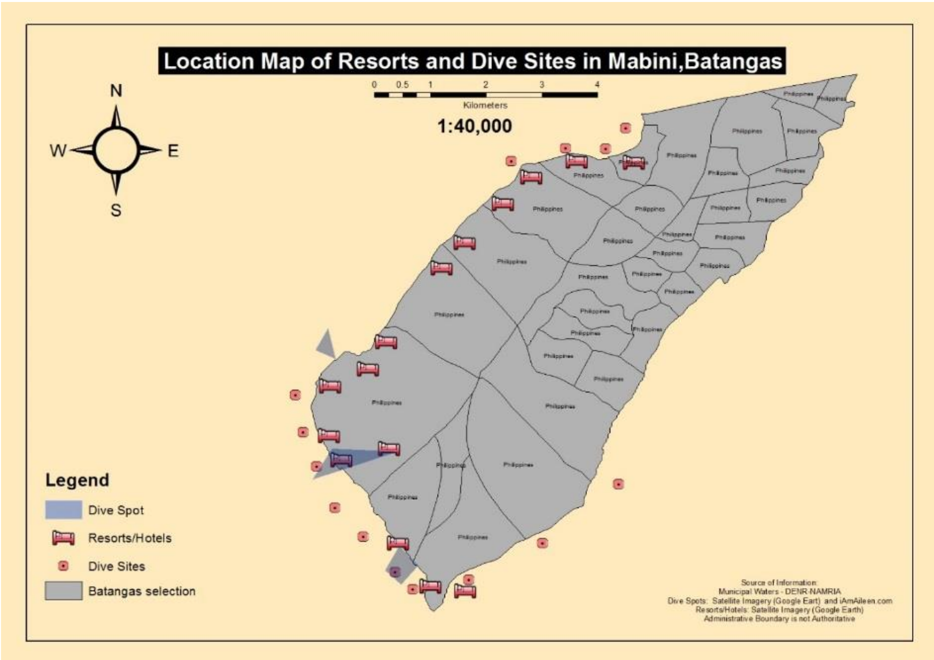


Figure 19. Location Map of Resorts and Dive Sites in Mabini Batangas

A study on Climate Change Vulnerability Assessment initiated by Conservation International Philippines estimated 22,000 divers per year visiting Mabini with a total of nearly 94 million PhP or $1.7 million US dollars. The annual revenues are generated from boat rentals (4.2 million PhP); resorts and hotels (88 million PhP) and unified fees (1.2 million PhP). From the five coastal barangays (San Jose, Ligaya Solo, San Teodoro and Bagalangit), a total of 336 room capacity and maximum of 1061 visitor capacity can be generated (Boquiren,2010).

5.3.2 Gross Revenue of Tourism in selected Municipalities in Batangas Province

In Batangas province, Mabini, Nasugbo and Tingloy are the diving destinations while Lian and Calatagan are mostly into snorkelling and swimming. Hence, these municipalities were selected to value the tourism industry linked to coral reefs. To get the estimated gross revenue of tourism, data on the number of tourists (foreign and domestics) and the tourists' average daily expenditure and average length of stay were obtained. Data was based on the published online data from PSA and DoT from the year 2013-2015.

Table 25. Number of Foreign and Domestic Travellers in selected Batangas municipalities

Batangas (with diving as tourism)	*Foreign Travellers*	*Domestic Travellers*	*Total 2013*	*Foreign Travellers*	*Domestic Travellers*	*Total 2014*	*Foreign Travellers*	*Domestic Travellers*	*Total 2015*
Nasugbo	10,564	121,748	132,351	11,129	200,200	211,782	10,282	182,278	192,560
Lian	5,115	23,665	28,780	5,875	45,840	51,715	2,798	37,647	40,445
Calatagan	366	14,948	15,314	345	8,853	9,198	302	142,224	142,526
Mabini	31,672	98,947	134,256	11,674	31,098	46,205	16,318	66,296	84,339
TOTAL	47,717	259,308	310,701	29,023	285,991	318,900	29,700	428,445	459,870

Source: Philippine Statistics Authority and Department of Tourism

Table 26. Average Expenditure and Length of Stay of the Tourists in the Philippines

	2013		*2014*		*2015*	
Average daily Expenditure (PhP)	4,292	2,212	4,637	2,212	5,514	2,212
Average Length of Stay (Days)	10	4	10	4	9	4
Total (PhP/tourist)	41.201	8,848	44,514	8,848	47,748	8,848

Source: PSA, DoT, www.oxfordbusinessgroup.com/country/Philippines

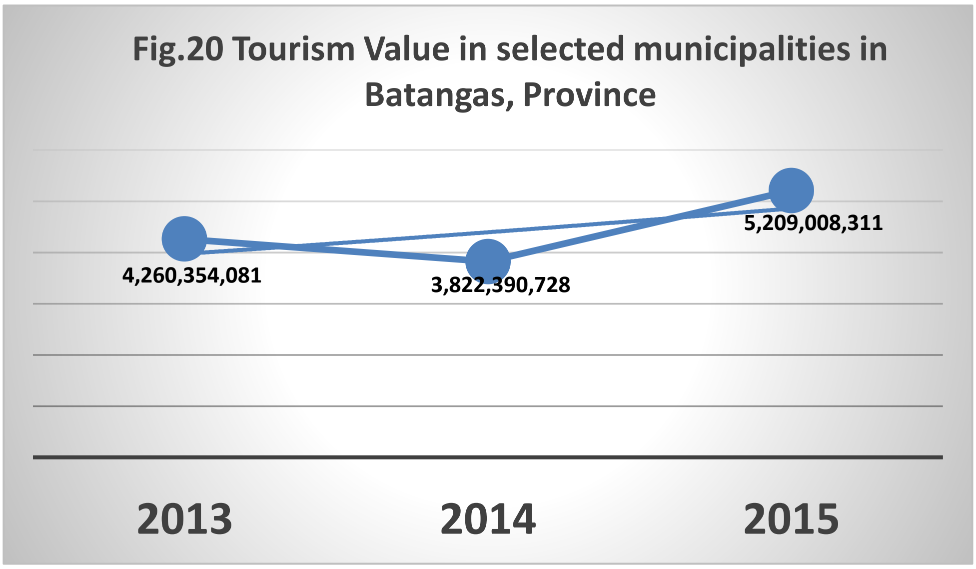


Fig.20 Tourism Value in selected municipalities in Batangas, Province

5.3.3 Monetary Valuation of the contribution to Tourism using Resource Rent Approach

The calculation of resource rent was based on the data from PSA and DoT. Gross revenue computation was showed in section 3.3.4.1. For the total costs of tourism, it is assumed to be 76% of the gross revenue which was acquired based on the proportion of costs to revenue from the tourism national data. From the years 2013-2015, resource rent is calculated around 24% of the total gross revenue. RR per overnight stay is estimated as 780 PhP/stay (2013); 822 PhP/stay (2014) and 927 PhP/stay (2015). Table 25-27 presents the data used to calculate the RR.

Table 27. Data for the monetary valuation of the contribution to tourism (2013)

Indicator	*Number of Visitors*	*Average night stay*	*Expenditure per night (pesos/night)*	*Gross Revenue (million pesos)*	*Total Cost (million pesos)*	*RR (million pesos)*	*RR/Overnight Stay (pesos/stay)*
Foreign Visitors	31,672	9	4,292	1,223	930	294	1030
Domestic Visitors	98,947	4	2,212	875	665	210	531
Total	130,619			2,099	1,595	504	
Average	65,310	7	3,252				**780**

Data on the number of visitors are from Philippine Statistics Office (PSA), Average night stay from PSA and Department of Tourism (DoT), Expenditure per night from PSA, DoT and Oxford Business Group. On the other hand, data on the proportion of costs to revenue are from the Tourism National Data extrapolated to Mabini, Batangas based on the PSA Statistics. Thus, RR is calculated around 24% of the total gross revenue.

Table 28. Data for monetary valuation of the contribution of ecosystems to tourism (2014)

Data on the number of visitors are from Philippine Statistics Office (PSA), Average night stay from PSA and Department of

Indicator (2014)	*Number of Visitors*	*Average night stay*	*Expenditure per night (pesos/night)*	*Gross Revenue (million pesos)*	*Total Cost (million pesos)*	*RR (million pesos)*	*RR/Overnight Stay (pesos/stay)*
Foreign Visitors	11,674	9	4,637	487	370	117	1113
Domestic Visitors	31,098	4	2,212	275	209	66	531
Total	42,772			762	579	183	
Average	21,386	7	3,424				**822**

Tourism (DoT), Expenditure per night from PSA, DoT and Oxford Business Group. On the other hand, data on the proportion of costs to revenue are from the Tourism National Data extrapolated to Mabini, Batangas based on the PSA Statistics. Thus, RR is calculated around 24% of the total gross revenue.

Table 29. Data for monetary valuation of the contribution of ecosystems to tourism (2015)

Indicator (2015)	*Number of Visitors*	*Average night stay*	*Expenditure per night (pesos/night)*	*Gross Revenue (million pesos)*	*Total Cost (million pesos)*	*RR (million pesos)*	*RR/Overnight Stay (pesos/stay)*
Foreign Visitors	16,318	8	5,514	720	547.03	173	1323
Domestic Visitors	66,296	4	2,212	587	445.81	141	531
Total	82,614			1,306	992.84	314	
Average	41,307	6	3,863				**927**

Data on the number of visitors are from Philippine Statistics Office (PSA), Average night stay from PSA and Department of Tourism (DoT), Expenditure per night from PSA, DoT and Oxford Business Group. On the other hand, data on the proportion of costs to revenue are from the Tourism National Data extrapolated to Mabini, Batangas based on the PSA Statistics. Thus, RR is calculated around 24% of the total gross revenue.

5.3.4 Resource Rent Generated by Diving

Based on the respondents, the tourists visit Mabini,Batangas for diving and snorkelling purposes. Several questions were asked during the survey on the coral reefs condition (See Annex 9 for the respondents profile and perspective). Most of the respondents answered that the coral reefs condition are slowly deteriorating because of the unsustainable practices to fishing and tourism, and lack of awareness of the people in coral reef habitat despite that the Mabini Tourism Information Office issued 200 PhP conservation fees to the divers (Banluta et al, 2013).

As part of the tourism account, RR generated from diving was computed through a survey from diving operators and resort owners. The respondents was randomly selected. Table 28 presents the detailed computation for the RR of diving operators. An average of 6 million PhP (PhP/year) was obtained. The RR was computed by deducting all the cost input such as consumption of fixed capital (from the invested equipment, boat and gears; and maintenance cost); user cost of fixed capital which is assumed to be 10% of the total fixed capital; intermediate input (fuel, gas, oil etc) and labour cost (dive instructors fees and other employees). Gross revenue was obtained from estimated number of divers/month and package fees from diving (See Annex 3 for the sample survey questionnaires asked). Taxes and other subsidies were excluded in the computation of gross revenue. An average resource rent of 6 million PhP/year is computed.

Table 30. Cost and Revenue of diving operators in Mabini, Batangas

Respondent (Diving Operator)	*Annual Total Revenue (PhP/Year)*	*Consumption of Fixed Capital (PhP/Year)*	*User Cost of Fixed Capital (assumed to be 10% of the total Fixed Capital (PhP/Year)*	*Labour Cost (PhP/Year)*	*Intermediate Input (PhP/Year)*	*Resource Rent (PhP/Year)*	*Resource Rent, pesos/diver /day*
1	11,856,000	1,123,000	112,300	2,389,200	374,400	7,857,100	909
2	22,102,344	4,480,000	448,000	9,164,938	523,800	7,485,606	1,664
3	11,271,888	1,778,690	177,869	4,868,755	726,000	3,720,574	2,067
4	19,750,164	2,090,758	209,075	6,249,049	522,000	10,679,281	989
5	7,963,008	1,930,000	193,000	1,970,602	522,000	3,347,406	490
6	9,030,000.00	635,000	63,500	3,087,000.00	2,175,000.00	3,069,500	2,842
Average	13,662,234.00	2,006,241	200,624	4,621,590.60	807,200.00	6,026,578	1,068

On the other hand, RR generated by the resort owners was computed through deduction gross revenues from all the costs such as labour (all the resorts employees); intermediate input such as the estimated annual electricity, water, meal expenses for the employees, meal expenses (if breakfast is include in the accommodation), internet and telephone bill, cleaning materials and toiletries. Consumption of fixed capital was calculated using the national data on the average construction cost for non-residential which is 9,589 PhP per square meters. Non-residential building construction is dominated by commercial-type buildings (PSA, 2013). Also, due to lack of readily available data and simplicity of the study, the average size of a resort will be based on personal observation. It is assumed that the average size of diving resort is 1,000 square meters and each of these resorts lent this amount to bank for approximately 20 years with 4.90 interest rate. With this, consumption of fixed capital in this study is as follows:

Monthly interest rate *= 4.9% (Yearly interest rate)/12=0.00408*
Construction cost (PhP)*=9,589 (PhP/m2)*1000m2=9,589,000 (PhP)*
Monthly payment (PhP/Month)= *9,589,000 *0.00408*(1+0.00408)^240/((1+0.00408)^240-1)=62,755 (PhP/month)*
Yearly payment (PhP/yr)*=Monthly payment * 12= 62,755*12=****753,056*** *(PhP/yr)*

User Cost of fixed capital is assumed to be 10% of the total fixed capital. Table 29 shows the detailed computation of the cost and revenue of resorts in Mabini, Batangas. Hence a total of 19 million (PhP/year) RR is generated from resorts.

Table 31. Cost and Revenue of Resorts Owners in Mabini, Batangas

Respondent (Hotel/Resorts)	***Annual Total Revenue (PhP/Year)***	***Consumption of Fixed Capital (PhP/Year)***	***User Cost of Fixed Capital (assumed to be 10% of the total Fixed Capital (PhP/Year)***	***Labor Cost (PhP/Year)***	***Intermediate Input (PhP/Year)***	***Resource Rent (PhP/Year/Resort)***
1	21,168,000	753,056	75,306	1,725,360	2,100,000	16,514,279
2	7,140,888	753,056	75,306	2,364,000	3,242,400	706,127
3	40,200,000	753,056	75,306	1,680,000	2,160,000	35,531,639
4	16,500,000	753,056	75,306	1,236,000	1,740,000	12,695,639
5	55,527,000	753,056	75,306	4,080,000	3,684,000	46,934,639
6	7,875,000	753,056	75,306	2,844,000	1,152,000	3,050,639
Average	24,735,148	753,056	75,306	2,321,560	2,346,400	19,238,827

5.3.5 Asset Account for Resource Rent Generated by Diving

In this section, the NPV of the RR generated by diving was calculated. Discount rates used are same with the fisheries account (See Section 3.3.1.2.2) with 5%, 10% and 15%. 15% was based on the Philippine government's National Economic and Development Authority's (NEDA) shadow discount rate which is estimated to be 15% (Southern Palawan Technical Group, 2015). NPV was analysed using a discounting period of 20 years. Assume that the condition of the diving operators and resorts will not change over the period of 20 years, hence RR will be the same with an average of 6 million PhP/year for diving operators and 19 million PhP/year for resort owners. With this, under the given discount rates, the sum off RR from the baseline current year 2017 are 43 million PhP (15% discount rate) for diving operators and 138 million (15% discount rate) for resort owners for the given period of 20 years . (See Annex 10 and 11 for the detailed computation)

FIG. 21 NET PRESENT VALUE OF DIVING OPERATOR RESOURCE RENT (PHP/YEAR)

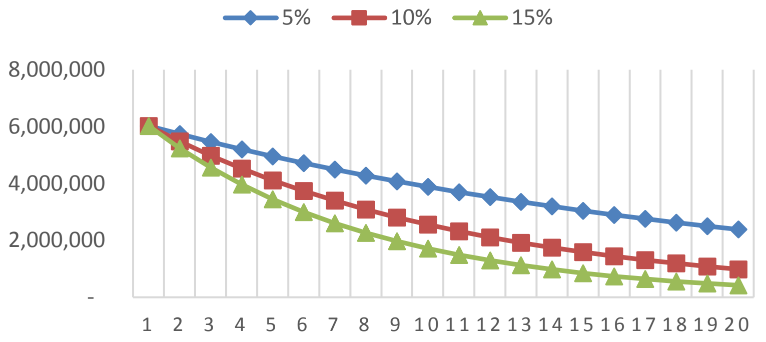
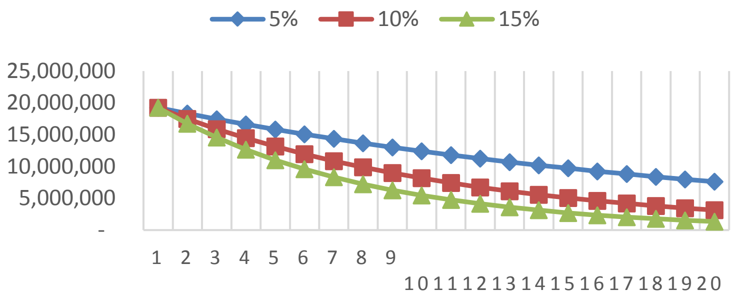


FIG.22 NET PRESENT VALUE OF RESORT OWNER RESOURCE RENT (PHP/YEAR)



5.4 Coastal Protection

The geographical location of Philippines is known as prone to many disasters and hazards in the world such as flooding, earthquakes and volcanic eruptions (Gaillard, 2007). It is considered as one of the most hazard-prone countries in the world (Cola, 1993; Delica, 1993; Benson, 1997, Zoleta-Nantes, 2000). In the Philippines, disasters such as typhoons and storms which can result to flooding can be account around 80% of total losses with an estimates of three million US Dollars losses (Losada et al, 2017). Coral Reefs, mangroves, seagrass beds and salt marshes provide coastal protection (Koch et al,2009). Coral reefs help protect the shoreline from currents and waves. It has the ability to disperse the energy from the waves and helps for the growth of other coastal and marine habitats such as mangrove and seagrass (Moberg, 1999).

The method used to account the monetary values of coastal protection is damage cost avoided (DCA) approach. UNEP et al, 2015 defined this approach as "prices are estimated in terms of the value of production losses or damage that would occur if the ecosystem services were reduced or lost due to ecosystem changes". Initially, the household population of the coastal barangays within VIPMC were obtained using the Philippine Statistic Authority's (PSA) updated data. The household population was laid-out, analysed and processes through ArcGIS as shown in Figure 22.

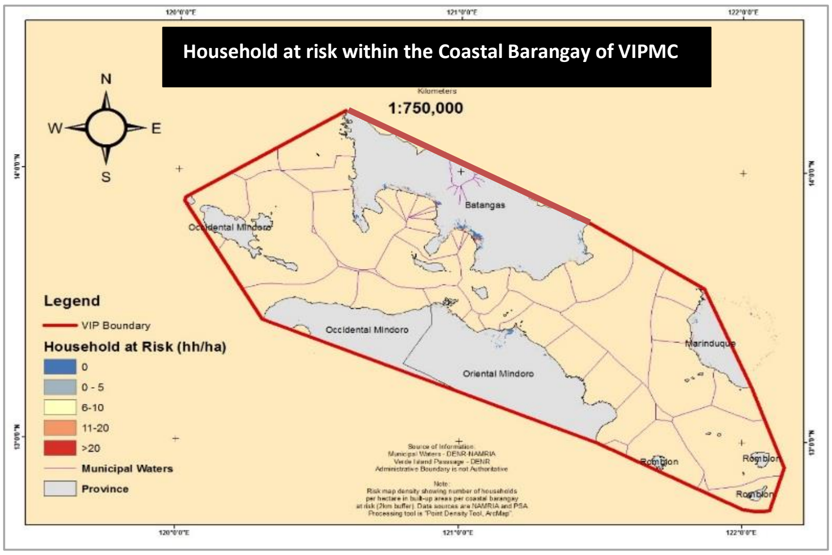


Figure 23. Household at Risk in VIPMC

Approximately 374 coastal barangays will be affected with 170,950 household population. Figure 22 presents the household at risk to flood, storm surge, tsunami and coastal erosion. In analysing the ecosystem service supporting coastal protection in monetary terms, it is assume that there's 1:1 ratio of household and house, with an amount of 244,000 PhP for each unit of the house for the construction/repair (Arroyo, 2013). The construction costs was based on one of the studies during the Typhoon Haiyan on 2013 which is considered as "one of the most powerful typhoons ever to make landfall in recorded history" (Lagmay et al, 2015). Hence, it is assumed in this accounting that same level of typhoon will be repeated and will cross within the provinces of VIPMC. The computation of coastal risk damage cost is the household at risk multiplied to the construction/repair cost. Relatively to its size, Batangas Province has the highest coastal risk damage costs amounting to approximately 13 billion pesos or 260 million US Dollars while Romblon has the lowest with 63 million PhP or 1.2 million US Dollars. Table 21 shows the coastal risk damage costs of all the provinces within VIPMC with a total of approximately 20 billion PhP or 400 million US Dollars.

Table 32. Coastal Risk Damage Costs within VIPMC

Province	Coastal Risk Damage Cost (PhP)
Batangas	12,669,700,000
Marinduque	2,259,928,000
Occidental Mindoro	1,203,408,000
Oriental Mindoro	3,671,956,000
Romblon	63,440,000
Grand Total	**19,868,432,000**

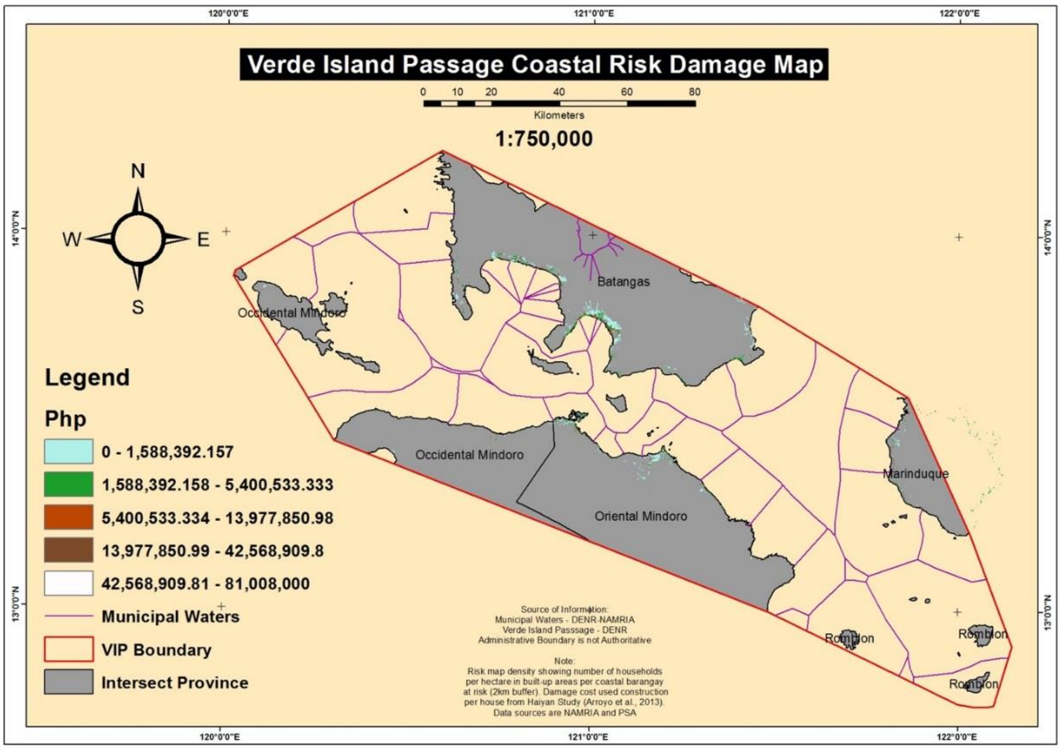


Figure 24. VIPMC Coastal Risk Map

Chapter 6. Discussion

6.1 Discussion

6.1.1 Mangrove and Coral Reefs Extent Account. Mangrove extent within the VIPMC declined massively through the years. The importance of tropical mangroves such as for nursery support, coastal protection, land builders and carbon sequestration have already been proved from several studies (Lee et al, 2014). However, due to several threats including land conversion and destruction for livelihood purpose, there must be an urgent need to strengthen and improve mangrove management. Primavera (2000) mentioned that the decline of Philippine mangroves are from "local exploitation for fuelwood and conversion to agriculture, salt beds, industry and settlements". With this, mangrove rehabilitation and conservation projects have been prevalent such as local and community involvement in management, mangrove replanting and fishery sector program (White and De Leon, 2004; Primavera and Esteban, 2008).

There is a challenge in obtaining the extent of coral reefs in VIPMC. This is a challenge not just in VIPMC area but the whole Philippines, first, there is no official coral reef maps in the Philippine. DENR-BMB which has the mandate for coral reef management is currently implementing the baseline mapping of coral reefs in the country. Second, it is difficult to assess and produce large scale coral reefs mapping in general. Even reflectance properties of high resolution optical images are insufficient to classify coral reefs at large scales (Caras et al., 2017). The result in this study used the CI Philippines coral reef survey using video and phot transect methods. It is categorized into four namely (1) live corals; (2) Mixed (live corals + dead corals with algae +rock); (3) Overgrown (dead corals + rock) and (4) Abiotic (sand + corals) (Boquiren et al, 2010). Other coral reef assessment tool introduced in the Philippines is Reef Check initiated by NOAA which is considered as the first global survey of coral reefs with the help of volunteer divers led by marine scientists and includes four types of data in survey protocol namely (1) a fish survey; (2) an invertebrate survey; (3) site description ; and (4) a substrate survey (Hodgson, 1999). Reef check is focused on quantification of the "extent of the impacts of human activities on coral reefs" (Raymundo, 2003). Still, with all these initiatives to coral reefs study in the Philippines, a comprehensive assessment is needed in Verde Island Passage Marine Corridor to show the extent at higher level of accuracy in valuation of this ecosystem.

In this study, the result of quantification of the extent of mangroves and coral reefs within VIPMC indicates that there is a need to expand these ecosystems. Locally established marine protected areas (MPAs) is one of the conservation strategies in VIP, Central Philippines, wherein, local governments and their communities are collaborating for the conservation of marine resources (Horigue et al, 2015).

6.1.2 Coral Reef Condition Account. White and colleague (2000) stated that the condition of coral reef in the Philippines is not in good condition because of reef destruction. This threat affects fisheries, tourism, coastal protection and biodiversity values (White et al, 2000). Coral reef condition account in this paper clearly shows the biological and physical characteristic of VIPMC. Monetary valuation "does not apply to ecosystem condition accounts which only required physical analysis" (Hein, 2014).

VIPMC has active faults and seismic activities, therefore earthquakes are frequent in the area. This can be a source of "liquefaction, subsidence and tsunami" that can cause coastal inundation (Boquiren et al, 2010). In the case of Caribbean of Costa Rica, earthquake was associated to stressed and mortality to reef communities, since the continental basement was uplift, the reefs are more expose and increase in sediments causing the stress and mortality (Cortes et al, 1992). The faults and seismic activities in VIPMC will always be present in the area, however there are several restoration actions that we can do such as removing and/or stabilizing loose debris, structural reconstruction, transplanting sponges and corals; and technological advances (Jaap, 2000). Furthermore, in this study, several factors were considered to get the vulnerability index of the provinces categorized into exposure (fault and seismic; sea surface temperature (SST), tsunami); sensitivity (coral reefs and mangrove extent cover, water quality); and adaptive capacity such as protected areas, key biodiversity areas and local management initiatives. One study conducted by Alino et al (2010) on the vulnerability assessment of marine ecosystems and fisheries to climate change in Verde Island Passage included exposure as to sea level rise, storm frequency and intensity; SST; ocean acidification and changes in variability of rainfall as climate-related impacts; sensitivity to coastal and marine habitats focused on corals, mangroves and seagrass; and its potential impact and adaptive capacity. These climate-related impacts as resulted in the study have great effects on the coastal and marine communities, fisheries, livelihood and economic development within VIPMC (Alino et al, 2010). Increase in sea surface temperature is significantly associated with coral bleaching leads to diminishing areas covered by living coral reefs. Relative to this, "changes in the topographic complexity and loss of coral cover affect reef fishes by reducing viable coral growths that provide shelter and protection and food source which ultimately affect settlement, recruitment and overall biological diversity" (Alino et al, 2010).

Analyzing the condition of coral reefs within VIPMC provides the complete picture to the ecosystem. It can be associated to what ecosystem services it can be generated. With the presence of several climate-related impacts within VIPMC, adaptive capacity and mechanism should take into place to eradicate or at least lessen the effects not just on coastal and marine communities but also to human well-being.

6.1.3 Ecosystem Services Supply Account. This paper managed to account (physical and monetary terms) four ecosystem services such as fisheries, tourism, carbon sequestration and coastal protection. VIPMC is considered as "home to many endangered and threated species such as green turtle (*Chelonia mydas*), the olive ridley (*Lepidochelys olivacea*), and the critically endangered hawksbill turtle (*Eretmochelys imbricata*)". It has a total of 162 species of fish which belongs to 30 families (DENR & CI, 2009). Alino et al (2010) mentioned that the changes in the climate-related impacts such as to increase in SST, storm surges and tsunamis;

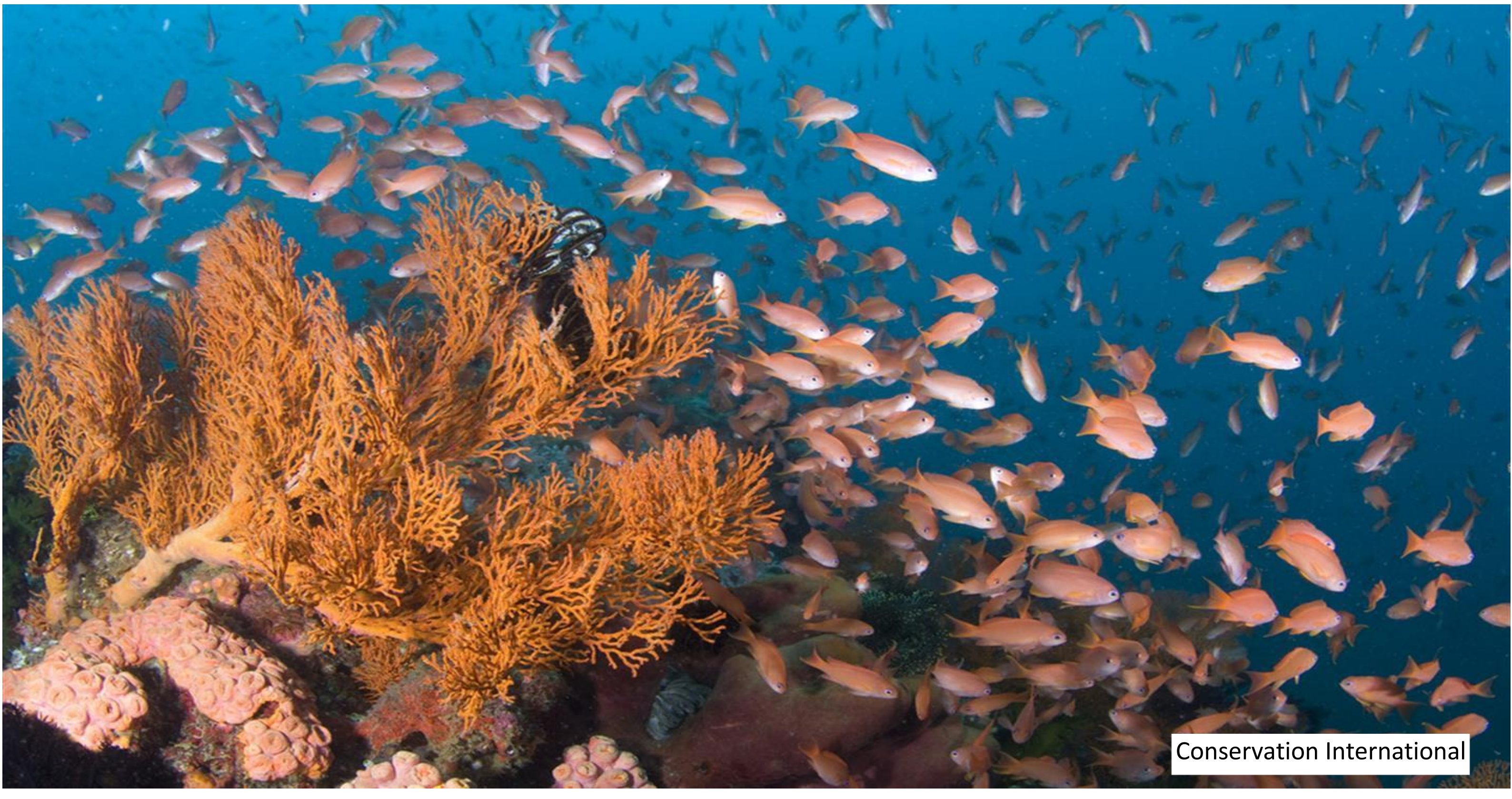
and increase in storm frequency can possibly affect the distributional patterns of some fish species. Fisheries sector is very important in VIPMC, as it serves as livelihood for most of the residents in the area. Average RR of fisherman in this study resulted to approximately 4 million pesos per year which is a good pointer that fisheries play a significant part to livelihood of the people within VIPMC. On the other hand, Coral reefs habitat has the highest primary net productivity of carbon among the other coastal habitats with the range of 1800 -4200 grams carbon/m2/year (White and Trinidad, 1998). The estimated economic value of coral reefs in terms of carbon sequestration is US$240/ha/year using avoided future cost in Southeast Asian reefs (Chou,2000). To get more precise value on the economic benefits of coral reefs to carbon storage and sequestration, an updated assessment of coral reef extent within VIPMC is highly recommended, since the date used in this study in not yet being updated by the government.

In this study, coastal protection was analysed using damage cost avoided (DCM). Cited in Lapidez et al (2015), there are an average of 20 typhoons per year entering the Philippine area of responsibility (PAR). One of the strongest typhoon ever recorded in the world that landfall in the Philippines was Typhoon Haiyan equivalent to Category 5 on the Saffir-Simpon hurricane scale, it recorded approximately 6300 death, 1000 missing and 29,000 injured in the aftermath (Lagmay et al, 2015). The estimated number of destroyed houses in Typhoon Haiyan was 490,000 and 520,000 damaged (Arroyo,2015). Verde Island Passage Marine Corridor specifically has an average of 3 storms annually as it "lies within the track of most of the typhoons in the western Pacific" and with this the condition of the ocean become rough (Alino et al, 2010). Considering that Category 4-5 will be happening in VIPMC, approximately 370 coastal barangays will be affected with 171,000 households will be at risk. Coral reefs help protect the shoreline from currents and waves. It has the ability to disperse the energy from the waves and helps for the growth of other coastal and marine habitats such as mangrove and seagrass (Moberg, 1999). Indeed, protection of coastal and marine habitats could lessen the risks in the coastal communities.

Lastly, tourism industry within VIPMC is increasing most specially in Batangas and Occidental Mindoro where diving and snorkelling are predominant. It gives livelihood and employment for the coastal communities. Tourism sector depends largely on the quality of the coastal and marine resources, hence strict policy regulation should be implemented. VIP Framework Plan by DENR and CI (2009) enumerated the key conservation strategies for tourism such as policy enforcement (e.g. tourism code), review of ordinances creating Marine Protected Areas (MPAs) and MPAs management plan, waste management, Information, Education and Communication Campaign targeting resorts and tourist, rationalization of collection and use of user's fees and determination of carrying capacity of tourism areas. These actions could strengthen and protect sustainably the tourism sector with VIPMC.

6.1.4 Policy Implications and Recommendations. Developing ecosystem accounting in VIPMC can support the decision makers in policy making in various ways. *First*, to answer the main objective of this study, way forward, this this accounting serves as reference for monitoring purposes, perceive the changes of its assets and support in the policy making and analysis. The output of VIPMC coral reef accounting can be can be incorporated to the national governments' – Coastal and Marine Ecosystem Management Program (CMEMP) with the program goal to "comprehensively manage, address and effectively reduce the drivers and threats of degradation of the coastal and marine ecosystems in order to achieve and promote sustainability of ecosystem services, food security and climate change resiliency for the benefit of the present and future generations". Second, the condition account can specify the sensitive areas where management initiatives should take in. Policy interventions shall be based on the priority areas or the most affected areas (i.e. coastal communities at risk showed in 5.4). *Second,* in this study, fisheries production from marine and commercial fisheries are declining. The loss in fisheries can be linked to loss of coral reefs. A study on the impacts related to this link are recommended to develop. *Third*, tourism industry not just in Batangas but the whole country is drastically increasing. Tourism associated with coral reefs such as diving and tourism needs some policy guidelines for a more sustainable use of the ecosystem. One of the approaches related to diving and snorkelling is the guidelines in the implementation of Green fins Code of Conduct pursuant to the implementation of the DENR Administrative Order No. 2013-12, Guidelines for the Implementation of the Sustainable Coral Reef Ecosystems Management Program (SCREMP). Green Fins (GF) is initiated by United Nations Environment Programme (UNEP) conservation initiative developed "to address the gap in knowledge and awareness about the growing threats to the marine environment and to protect and conserve coral reefs by establishing and implementing environmentally-friendly guidelines to promote a sustainable diving and snorkelling industry". GF promotes a set of standards for environmentally sustainable dive tourism with the dive centres. Batangas Province is one of the pilot sites in implementing GF, however, this needs to strengthen by inclusion of GF in the regular activities to regional, provincial and local offices of DENR (Reef-World Foundation, 2018). *Lastly and more importantly,* developing ecosystem accounting focused in coral reefs is recommended to implement in a national level.

Chapter 7. Conclusion


Conservation International

7.1 Conclusion

This paper mapped the extent and condition of coastal and marine habitats particularly coral reefs and mangrove; and valued the its ecosystem services supply aligned with SEEA-EEA context. Mangrove extent in VIPMC showed a decline in its condition from 4,416 hectares in 1950s to 1404 hectares in 2010. This signifies a loss of nearly 70% in over 6 decades. Coral reefs, on the other hand, has a total of approximately 2,600 hectares based on the coral reef survey conducted by Conservation International Philippines (Boquiren et al, 2010). There is no official coral reef maps in the Philippines, and therefore recommended to do comprehensive coral reef survey within the VIPMC. The characteristics of an ecosystem is important to consider to fully understand the condition in assessing an ecosystem. The biophysical indicators in this study such as fault line, SST, and tsunami inundation areas affect the coral reef condition and coastal stability. Increase in sea surface temperature is significantly associated with coral bleaching leads to diminishing areas covered by living coral reefs. Presence of fault line and seismic activities are associated with coastal stability that can also impact the community. With this, the coastal vulnerability index maps shown that Oriental Mindoro is the most vulnerable province within VIPMC to climate-related stimuli. The results can serve as guideline to decision makers to highlight which area should focus on adaptive management and capacity. Further, under the environmental state, additional coastal and marine water quality monitoring stations within VIPMC is recommended to established for regularly monitoring. Declining water quality can be associated with increase in global temperature which resulted to ocean acidification (Hoegh-Guldberg et al, 2007). Through its extent and condition, coral reefs generated ecosystem services particularly fisheries, tourism, carbon sequestration and coastal protection. The fisheries production in Batangas Province is declining from 2013 to 2015. Annual average RR per fisherman is estimated at four million PhP/year with an average total fishing days/year of 259. The RR survey for fishermen was randomly selected hence, the result might be overestimated due to the type (commercial or municipal fishing) of fishermen interviewed. Coral reefs habitat has the highest primary net productivity of carbon among the other coastal habitats (White and Trinidad, 1998). In VIPMC, it is estimated to contribute of 3 million US$ using SCC value of 40US$/t of C. Tourism value on the other hand is increasing using the number of tourists (foreign and domestic) from year 2013 to 2015. Lastly, coastal protection was analysed using damage cost avoided (DCM) approach. Based on the physical valuation, it showed that the provinces within VIPMC is coastal hazard prone. Many coastal communities are at risks because many are located in coastal areas. A total of approximately 400 million US$ will be the damage costs for construction of houses of about 171,000 household population. Also, engineered interventions are costly to achieve. There are still other ecosystem services of coral reefs that did not include in this study. The benefit value may be higher if other ecosystem services of coral reefs will be incorporated. Policy interventions and management initiatives should have carried out in these priority areas, and thus, strengthening of the laws and policies are strongly recommended. This ecosystem accounting focus on coral reefs within the Verde Island Passage Marine Corridor can be a reference for monitoring purposes and alarm the decision makers the need to develop and establish accounting. As mentioned in the problem statement, the importance of coral reefs had long been undervalued and unrealized hence, it is worthwhile to pursue an ecosystem accounting for the coastal and marine resources in the Philippines.

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APPENDICES

ANNEX 1- STAKEHOLDERS BACKGROUND

1. **Maria Isabel Senal**
   Water Quality Expert – PhP Candidate
   University of the Philippines – Diliman under Marine Science Institute
   Aarhus University

2. **Sandra Manulat**
   Hydrology Expert / Instructor
   Mindanao State University, Philippines

3. **Arnan Araza**
   GIS Expert/ Consultant
   University of the Philippines

4. **Desiree Eve Maano**
   Chief, Coastal and Marine Division
   Department of Environment and Natural Resources
   Biodiversity Management Bureau

5. **Yingying Xie**
   Urban Planner/ MSc Student
   Environmental Systems Analysis
   Wageningen University and Research

6. **Rej Winlove Bungabong**
   Ecosystem Management Specialist/ GIS Expert
   Department of Environment and Natural Resources
   Biodiversity Management Bureau

7. **James Santiago**
   Ecosystem Management Specialist
   Department of Environment and Natural Resources
   Biodiversity Management Bureau

8. **Nicasio Espina**
   Environmental Architect/ Diver
   University of the Philippines- Diliman

9. **Maria Katrina L. Apaya**
   Author

10. **Dazzle Labapis**
    CSO Forum Facilitator
    Non-Timber Forest Products – Exchange Programme

ANNEX 2 - FISHERIES RESOURCE RENT SURVEY

MSc Urban Environmental Management
Environmental Systems Analysis (ESA) Group
Wageningen University and Research
Wageningen, the Netherlands

Developing Ecosystem Account for Verde Island Passage Marine Corridor, Philippines focusing on Coral Reefs

Questionnaire No.: __________

1. Name of Respondents: ____
2. Municipality: _______________________________ Barangay:___________________________________
3. Age: ______ 4. Gender: ____Male ___Female 5. Civil Status: (1) Single; (2) Married; (3) Widower/Widow; (4) Separated/Annulled/ Divorces; (5) Common law/ Live-in
4. Highest Educational Attainment: (1) Primary; (2) High school; (3) College; (4) Vocational Course ; (5) None
5. Family Size: __________
6. Household Sources of Income:

Source	No. of Times per month	Amount per month
1.		
2.		
3.		
4.		
5.		

7. Location of Fishing Ground: (1) Within the Municipal Waters; (2) Outside the Municipal Waters
8. How many years have you been fishing?
   (1) < 5 years ; (2) 6-10 years; (3) 10- 20 years; (4) more than 20 years
9. Is there a change in the location of fishing ground? (1) Yes, fishing ground is farther; (2) Yes, fishing ground is nearer; (3) No Change at all; (4) I don't know
10. Is there any changes in the quantify of fish caught since you have started fishing?
    a. Yes, Decreasing
    b. Yes, Increasing
    c. No change
11. Is there any changes in the size of the fish caught?
    a. Yes, size is getting smaller
    b. Yes, size is getting bigger
    c. No change
    d. I can't see the difference
12. What do you think are the reasons for these changes (referring to questions 9-11)? ____
    ____
13. Months, time spent in fishing and production of fish by species

Major Species	**Average Fish Catch (kg/day)**	**Average Price of Fish (PhP/kg)**	**Number of fishing trips per month**	**Total Fishing Days (days/year)**	**Gross Sale From Fish Catch (PhP/yr)**
1					
2					

3					
4					
5					
Other Species					
1					
2					
3					
4					
5					

14. Do you own fishing vessel? (1) yes; (2)no
15. What type of fishing vessel you own?

Type of Fishing Vessel	Quantity	Size (Capacity in Tons)	Cost of Construction/ Acquisition (PhP)	Estimated Economic Life (yrs.)	No. of repairs in a year	Estimated amount per repair	Total Amount
1. Non-Commercial – Non Motorized fishing Vessel							
2. Non-Commercial – Motorized Fishing Vessel							
3. Commercial Fishing Vessel							

16. What are the types of fishing gear do you use and own for fishing activities?

Type of Gear	Quantity	Cost of Acquisition per gear (PhP)	Estimated Economic Life (yrs.)	No. of repairs in a year	Estimated amount per repair	Total Amount
1.						
2.						
3.						
4.						

17. Labour Cost

- Do you have employee or do you hire someone to help you ? (1) Yes; (2) No; (3) Sometimes
- If yes or sometimes, how much do you pay per day? ; how many times per month on an average?
  ______________________________ ; ______________________________

Number of employees hired?	Compensation for Employment per fishing trip (wage) (PhP/day)	How many times in a month?

18. Fishing Inputs per trip (Intermediate Cost)

Items	Quantity (unit/trip)	Cost Per Unit
1. Fuel (litres/trip)		
2. Oil		
3. Crushed Ice (kg/trip)		
4. Hooks		
5. Tingga		
6. Bait (kg/trip)		
7. Rentals (gear, boat etc)		
8. Meal Expenses (if separate from labour pay) php/trip		
9. Others		

Thank you ....

ANNEX 3 – RESOURCE RENT SURVEY FOR DIVING (TOURISM)

WAGENINGEN UNIVERSITY & RESEARCH

MSc Urban Environmental Management
Environmental Systems Analysis (ESA) Group
Wageningen University and Research
Wageningen, the Netherlands

Developing Ecosystem Account for Verde Island Passage Marine Corridor, Philippines focusing on Coral Reefs

Questionnaire No.: __________

1. Name of Respondents: ____
2. Municipality: ____________________________ Barangay:_________________________________
3. Age: ______ 4. Gender: ____Male ___Female 5. Civil Status: (1) Single; (2) Married; (3) Widower/Widow; (4) Separated/Annulled/ Divorces; (5) Common law/ Live-in
4. Highest Educational Attainment: (1) Primary; (2) High school; (3) College; (4) Vocational Course ; (5) None
5. Occupation: ____________________________
6. Nationality: ____________________________
7. How long have you been to this industry?
   <1 year ; 1-5 years; 5-10 years; 10-20 years; more than 20 years
8. What do you think is primary reason of the tourists travelling in this area?
   a. Diving and Snorkelling
   b. Night Life
   c. Cultural activities
   d. Relax and Unwind

e. Others

9. Is there any physical changes in the coral reef condition in this area?
   a. Yes, Coral Reef are slowly deteriorating ;
   b. Yes, Coral Reef are more healthy;
   c. No, there's no changes, still the same
   d. I don't know
10. Are you part of any activities to maintain a healthy coral reef condition? Yes or No
    a. If Yes, what activities? ___________________________________
11. What do you think shall we do to maintain a healthy coral reef condition?

    ____

12. Revenue

Room type	Room price	Booked rate per month/per day (average)		
		Busy season	Slack season	Others
Single				
Double				
Four People				
Dorm				
Others				

13. Which month are the busy season? Which month are slack season? others?

Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec

14. Intermediate Input

	Average monthly bill
1. Average electricity Bill/Month	
2. Average water bill/month	
3. Meal Expenses (if breakfast is included in hotel/resort)	
4. Meal Expenses (if separate from the labour pay) php/month	
5. average internet bill/month	
6. average telephone bill/month	
7. monthly cost of the room toiletries and cleaning materials	
8. Others	

15. How many employees do you have?

Number of employees	Number of working days/ month	Wage per day or per month

Thank you ....

MSc Urban Environmental Management
Environmental Systems Analysis (ESA) Group
Wageningen University and Research
Wageningen, the Netherlands

Developing Ecosystem Account for Verde Island Passage Marine Corridor, Philippines focusing on Coral Reefs

Questionnaire No.: __________

7. Name of Respondents: ____
8. Municipality: ____________________________ Barangay:__________________________________
9. Age: ______ 4. Gender: ____Male ___Female 5. Civil Status: (1) Single; (2) Married; (3) Widower/Widow; (4) Separated/Annulled/ Divorces; (5) Common law/ Live-in
10. Highest Educational Attainment: (1) Primary; (2) High school; (3) College; (4) Vocational Course ; (5) None
11. Occupation: ____________________________
12. Nationality: ____________________________
13. How long have you been to diving industry?
    <1 year ; 1-5 years; 5-10 years; 10-20 years; more than 20 years
14. Is there any physical changes in the coral reef condition in this area?
    a. Yes, Coral Reef are slowly deteriorating ;
    b. Yes, Coral Reef are more healthy;
    c. No, there's no changes, still the same
    d. I don't know
15. Are you part of any activities to maintain a healthy coral reef condition? Yes or No
    a. If Yes, what activities? ________________________________
16. What do you think shall we do to maintain a healthy coral reef condition?
    ____
17. Average Number of divers and dives/divers

Average number of divers/month?	Average Number of dives per diver	Average Dive Price/Diver (PhP)	Total Annual Dive (PhP)

18. Proportion of Dive Price (Equipment)

	Average Number of Divers/Month	Average Number of dives per diver	Average Price/Diver (PhP)
1. Complete Package with All Equipment (Tanks, Suit, mask, Regulator			
2. Package with Tank and Regulator only			
3. Without any equipment rental			

19. Dive Certification

Average number of divers per month who gets certification	Average Price for a dive certification

20. Do you own boat for diving? Yes or No, If Yes,

Type of Diving Boat	Quantity	Cost of Construction/Acquisition (PhP)	Estimated Economic Life (yrs)	No. of Repairs in a year	Estimated amount per repair	Total Amount

21. Do you own diving equipment's? Yes or No, If Yes,

Diving Equipment	Quantity	Cost of Construction/Acquisition (PhP)	Estimated Economic Life (yrs)	No. of Repairs in a year	Estimated amount per repair	Total Amount
1. Tanks						
2. Regulators						
3. Wetsuits						
4. Mask						
5. Fins						
6. Dive Computers						
7. Other Accessories						

22. Labour Cost

- Do you have employees? If so,

Number of Employees hired?	Compensation for employment per diving trip (PhP/Day)	How many times in a month?

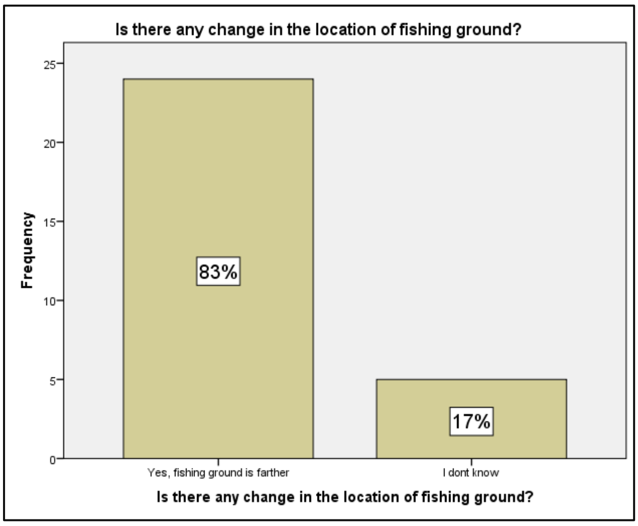
23. Intermediate Input

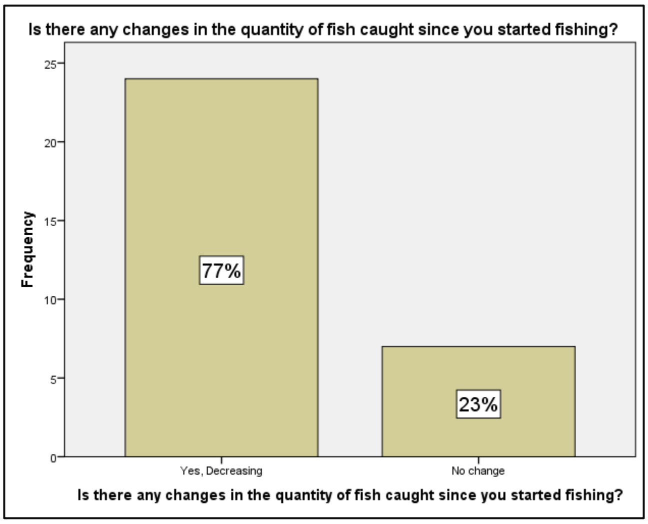
Items	Unit/Trip	Cost Per Unit
1. Fuels (liters/dive)		
2. Oil		
3. Rentals (Boat, gear)		

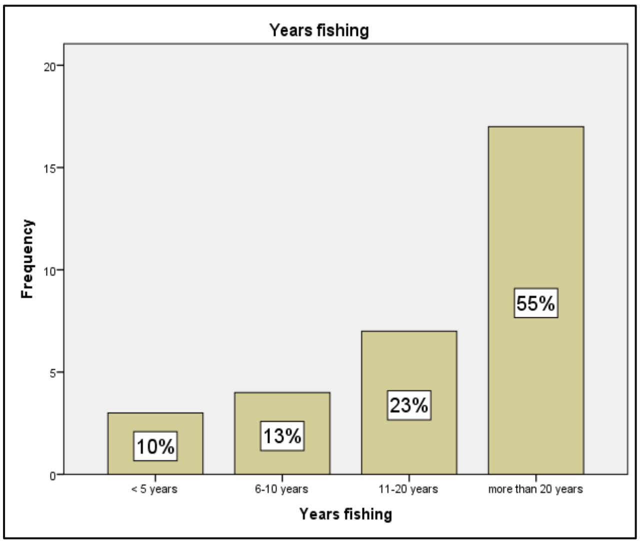
4. Diving Fees		
5. Meal Expenses (if separate from the labour pay) php/trip		
6. Others		

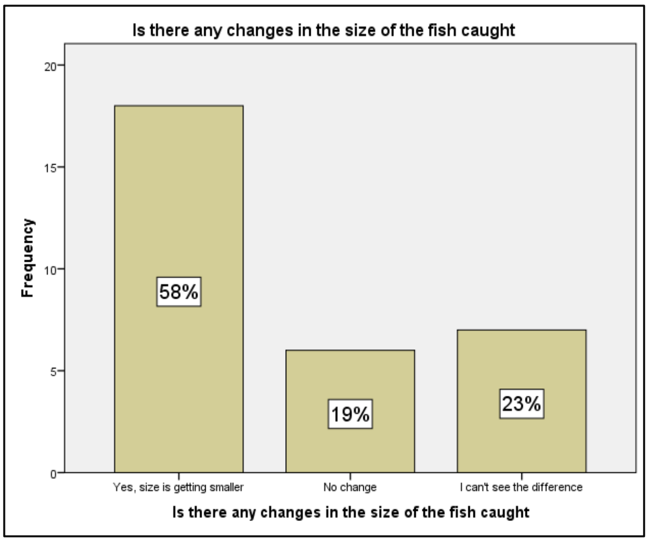
Thank you ….

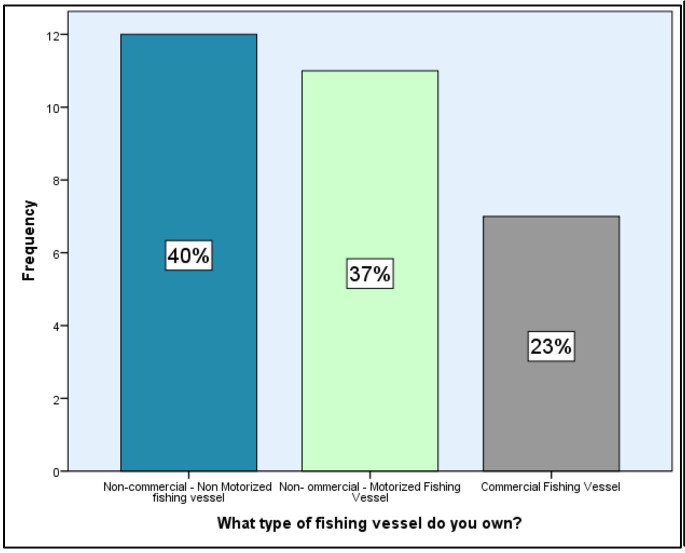
ANNEX 4 – FISHERIES RESPONDENTS PROFILE AND PERSPECTIVE (SPSS SOFTWARE)

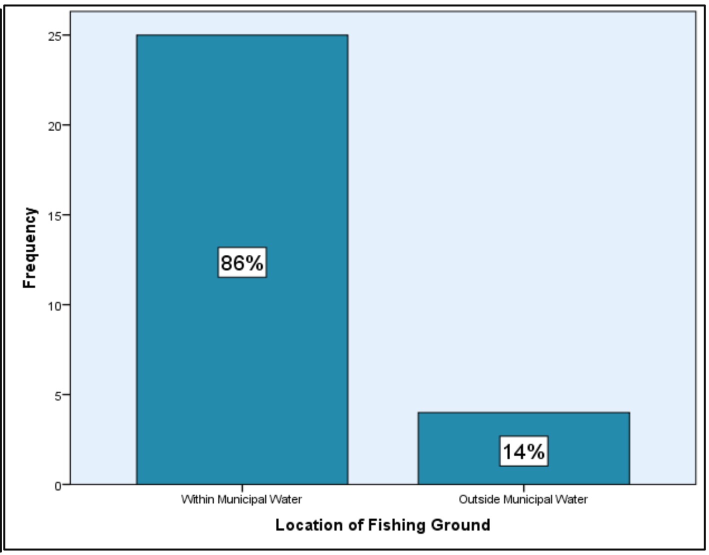












ANNEX 5 – CAPTURE FISHERIES

Municipality	Respondents	Average Catch per day, kg	Total Fishing Days	Total Catch per year, kg
Batangas City	1	3610	264	953,040
	2	318	192	61,056
Average		1964	228	447,792
Nasugbu	3	340	240	81,600
	4	12	240	2,880
Average		176	240	42,240
Lian	5	12	312	3,744
	6	9	300	2,700
Average		11	306	3,213
Calatagan	7	175	240	42,000
	8	9	360	3,240
Average		92	300	27,600
Balayan	9	8	360	2,880
	10	8	360	2,880
	11	620	144	89,280
Average		212	288	61,056
Calaca	12	200	216	43,200

	13	10	360	3,600
Average		105	288	30,240
Lemery	14	220	180	39,600
	15	260	192	49,920
Average		240	186	44,640
Taal	16	11	312	3,432
	17	120	240	28,800
Average		66	276	18,078
San Luis	18	400	216	86,400
	19	15	360	5,400
Average		208	288	59,760
Mabini	20	34	240	8,160
	21	93	240	22,320
Average		64	240	15,240
Tingloy	22	8	180	1,440
	23	43	312	13,416
Average		26	246	6,273
Bauan	24	349	312	108,888
	25	37	240	8,880
Average		193	276	53,268
San Pascual	26	80	240	19,200
	27	10	360	3,600
Average		45	300	13,500
Lobo	28	500	180	90,000
	29	8	192	1,536
Average		254	186	47,244
San Juan	30	40	240	9,600
	31.	35	240	8,400
Average		37.5	240	9,000

ANNEX 6 - CAPTURED FISH SPECIES

Sardines

Round/Mackerel scad (galunggong)

Big eye scad (matambaka)

Lacustrine Goby (Dulong)

Squid (Pusit)

Frigate Tuna (Tulingan)

Grouper (lapu-lapu)

Anchovies (dilis)

Yellow Fin Tuna

Skipjack Tuna (Gulyasan)

Fusilier (Dalagang Bukid)

Round/Mackerel scad (galunggong)

Yellow stripe Scad (Salay-Salay)

Threadfin Bream (Bisugo)

Crab

Moonfish (hiwas)

Squid (Pusit)

Long-jawed mackerel (Alumahan)

Surgeonfish (Labahita)

Snapper (Maya-Maya)

Mulmol (Common Name)

Munites (Common Name)

ANNEX 7 – NET PRESENT VALUE (FISHERIES)

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Discount Rate	1	2	3	4	5	6	7	8	9	10
5%	4,330,781	4,124,554	3,928,146	3,741,092	3,562,945	3,393,281	3,231,696	3,077,805	2,931,243	2,791,660

10%	4,330,781	3,937,074	3,579,158	3,253,780	2,957,982	2,689,074	2,444,613	2,222,376	2,020,341	1,836,674
15%	4,330,781	3,765,897	3,274,693	2,847,559	2,476,138	2,153,164	1,872,316	1,628,101	1,415,740	1,231,078

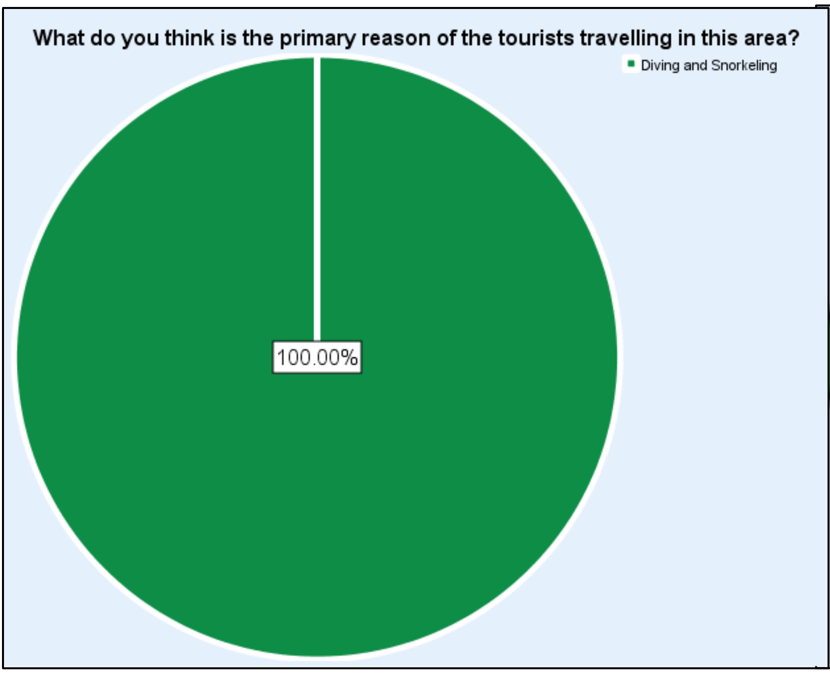
2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	SUM
11	12	13	14	15	16	17	18	19	20	
2,658,724	2,532,118	2,411,541	2,296,706	2,187,339	2,083,180	1,983,981	1,889,506	1,799,529	1,713,837	56,669,664
1,669,704	1,517,912	1,379,920	1,254,473	1,140,430	1,036,755	942,504	856,822	778,929	708,117	40,557,421
1,070,503	930,872	809,454	703,873	612,064	532,229	462,808	402,442	349,949	304,304	31,173,965

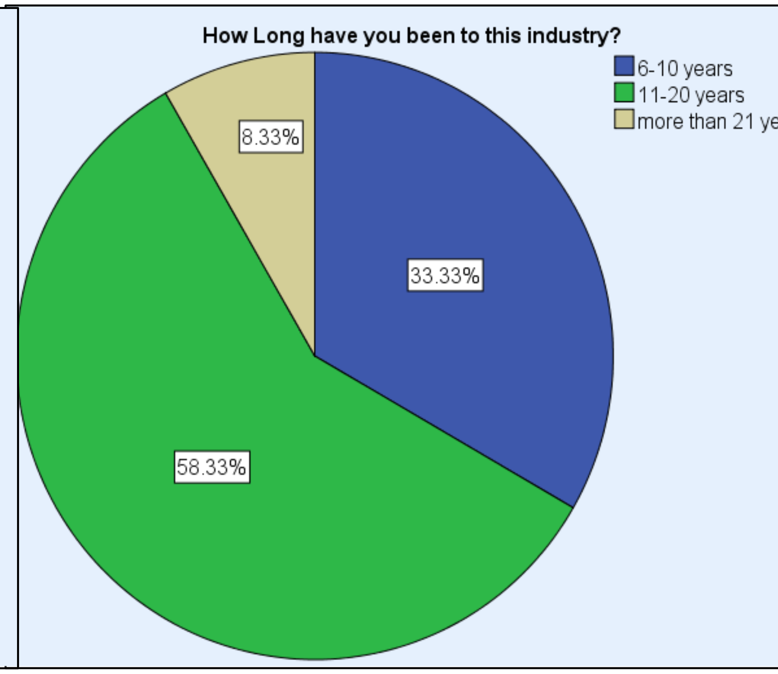
ANNEX 8 – NET PRESENT VALUE (CARBON ACCOUNT)

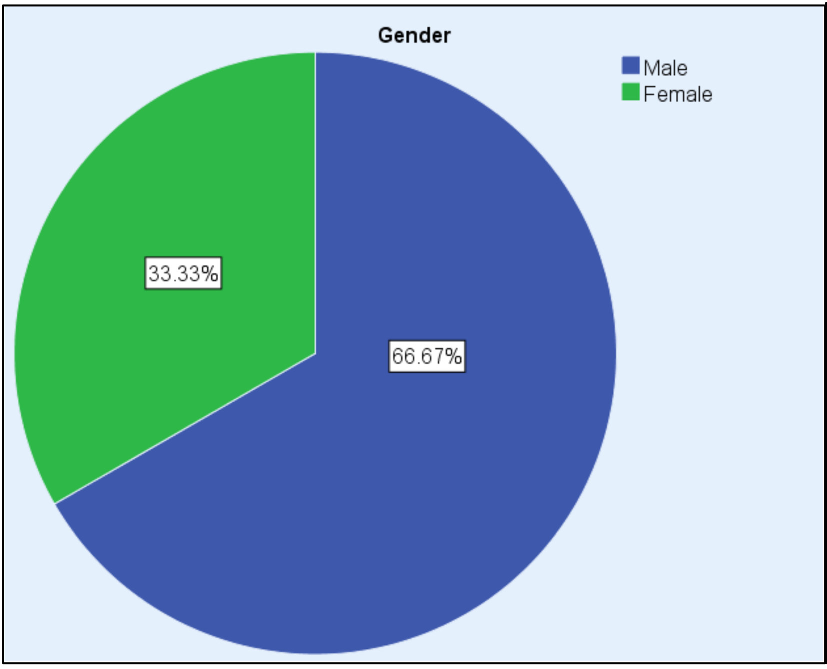
Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
3% Discount Rate	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Median	6,830,551	6,631,603	6,438,449	6,250,922	6,068,856	5,892,093	5,720,479	5,553,863	5,392,100	5,235,049
Minimum	4,098,331	3,978,962	3,863,070	3,750,553	3,641,314	3,535,256	3,432,288	3,332,318	3,235,260	3,141,029
Maximum	9,562,772	9,284,245	9,013,830	8,751,291	8,496,399	8,248,931	8,008,671	7,775,409	7,548,941	7,329,068

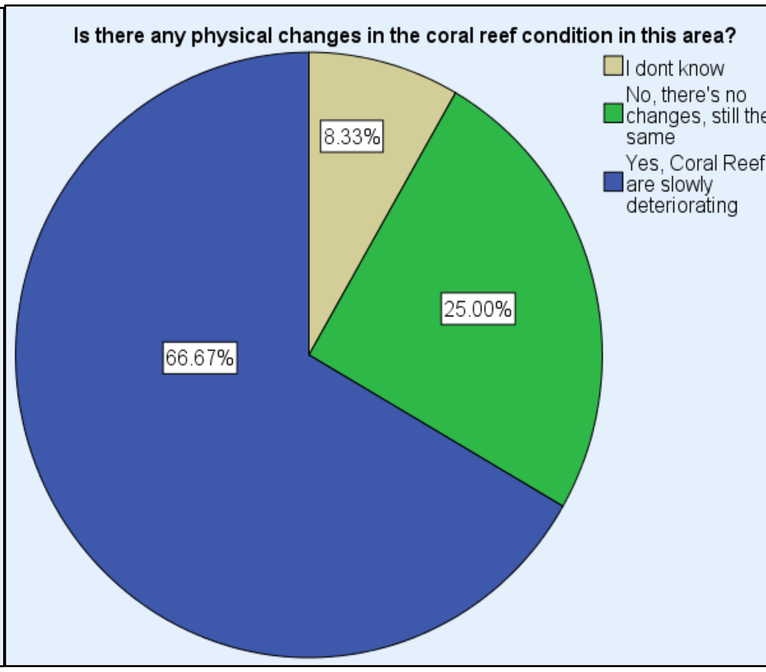
2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**SUM**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
5,082,571	4,934,535	4,790,811	4,651,273	4,515,799	4,384,271	4,256,574	4,132,596	4,012,229	3,895,368	104,669,991
3,049,543	2,960,722	2,874,487	2,790,764	2,709,480	2,630,563	2,553,944	2,479,558	2,407,338	2,337,221	62,802,001
7,115,600	6,908,350	6,707,136	6,511,782	6,322,119	6,137,979	5,959,203	5,785,634	5,617,121	5,453,515	146,537,997

ANNEX 9 – TOURISM RESPONDENTS PROFILE AND PERSPECTIVE (SPSS SOFTWARE)


What do you think is the primary reason of the tourists travelling in this area?
Diving and Snorkeling
100.00%


How Long have you been to this industry?
6-10 years
11-20 years
8.33%
33.33%
58.33%





ANNEX 10 – NET PRESENT VALUE (DIVING OPERATORS)

Discount Rate	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
5%	6,026,578	5,739,598	5,466,284	5,205,985	4,958,081	4,721,982	4,497,125	4,282,976	4,079,025	3,884,786
10%	6,026,578	5,478,707	4,980,643	4,527,857	4,116,234	3,742,031	3,401,846	3,092,587	2,811,443	2,555,857
15%	6,026,578	5,240,503	4,556,959	3,962,573	3,445,716	2,996,274	2,605,456	2,265,614	1,970,099	1,713,130

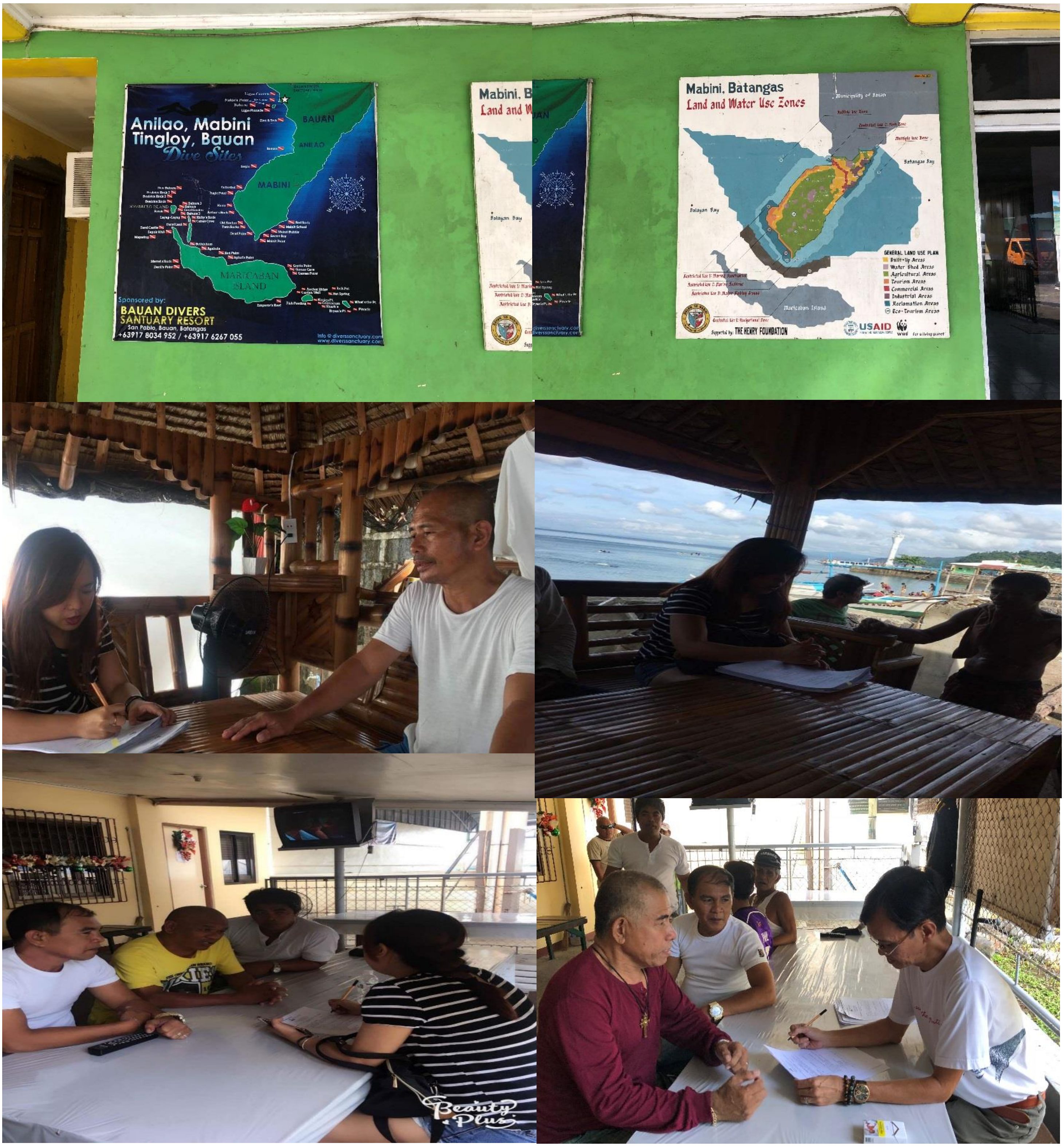
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Sum**
2027	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	
3,699,796	3,523,615	3,355,824	3,196,023	3,043,831	2,898,887	2,760,845	2,629,376	2,504,168	2,384,922	78,859,707
2,323,507	2,112,279	1,920,253	1,745,685	1,586,986	1,442,715	1,311,559	1,192,326	1,083,933	985,394	56,438,421
1,489,678	1,295,372	1,126,411	979,487	851,728	740,633	644,029	560,025	486,978	423,459	43,380,702

ANNEX 11 – NET PRESENT VALUE (RESORTS)

Discount Rate (Resorts)	1	2	3	4	5	6	7	8	9	10
Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
5%	19,238,827	18,322,692	17,450,183	16,619,222	15,827,831	15,074,124	14,356,309	13,672,675	13,021,595	12,401,51
10%	19,238,827	17,489,843	15,899,857	14,454,415	13,140,378	11,945,798	10,859,816	9,872,560	8,975,055	8,159,141
15%	19,238,827	16,729,415	14,547,317	12,649,841	10,999,862	9,565,097	8,317,476	7,232,588	6,289,207	5,468,875

11	12	13	14	15	16	17	18	19	20	Sum
2027	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	
11,810,971	11,248,544	10,712,899	10,202,761	9,716,915	9,254,205	8,813,528	8,393,836	7,994,130	7,613,457	251,746,224
7,417,401	6,743,091	6,130,083	5,572,803	5,066,184	4,605,622	4,186,929	3,806,299	3,460,272	3,145,702	180,170,078
4,755,544	4,135,255	3,595,874	3,126,847	2,718,998	2,364,346	2,055,953	1,787,785	1,554,596	1,351,822	138,485,525

ANNEX 12- SURVEY SAMPLE PICTURES



ANNEX 13. NET VALUE ADDED

MUNICIPALITY	GROSS REVENUE (PHP)	INTERMEDIATE INPUT/COST (PHP)	CONSUMPTION OF FIZED CAPITAL (PHP)	NET VALUE ADDED (PHP)
BATANGAS CITY	44,055,120	1,192,135	752,500	42,110,485
NASUGBU	4,594,800	547,700	287,400	3,759,700
LIAN	317,400	31,920	72,600	212,880
CALATAGAN	2,097,600	212,500	423,000	1,462,100
BALAYAN	3,027,600	132,000	508,867	2,386,733
CALACA	2,566,800	214,920	257,700	2,094,180
LEMERY	3,844,800	364,020	521,900	2,958,880
TAAL	1,694,640	146,660	188,400	1,359,580
SAN LUIS	6,156,000	301,320	357,000	5,497,680
MABINI	2,000,700	251,535	274,938	1,474,228
TINGLOY	802,800	101,705	116,100	584,995
BAUAN	5,254,800	440,275	568,250	4,246,275
SAN PASCUAL	2,125,200	273,075	129,200	1,722,925
LOBO	5,699,040	398,685	488,650	4,811,705
SAN JUAN	924,000	76,350	119,550	728,100
TOTAL	5,677,420	312,320	337,737	5,027,363