Social and policy science of blue carbon ecosystems assessment: Local perceptions towards global benefits and contributions in the Philippines

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Social and policy science of blue carbon ecosystems assessment: Local perceptions towards global benefits and contributions in the Philippines

（ブルーカーボン生態系評価の社会・政策科学的研究：フィリピンにおけるグローバルな便益と貢献に関する地域住民の認識）

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List of Acronyms and Abbreviations

BCEs	- Blue Carbon Ecosystems
BCEIs	- Blue Carbon Ecosystem Infrastructures
BCTWG	- Blue Carbon Technical Working Group
CBFM	- Community-Based Forest Management
CBD	- Convention on Biological Diversity
CRM	- Coastal Resource Management
CRMP	- Coastal Resource Management Project
CTR	- Coral Triangle Region
DA-BFAR	- Department of Agriculture – Bureau of Fisheries and Aquatic Resources
DENR	- Department of Environmental and Natural Resources
DILG	- Department of the Interior and Local Government
DPSIR	- Driver-Pressure-State-Impact-Response Framework
Eco-DRR	- Ecosystem-based Disaster Risk Reduction
EEA	- European Environment Agency
ES	- Ecosystem Services
FAO	- Food and Agriculture Organization
FARMCs	- Fisheries and Aquatic Resources Management Councils
GPS	- Global Positioning System
ICM	- Integrated Coastal Management
ICRM	- Integrated Coastal Resource Management
IPBES	- Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services
IUCN	- International Union for Conservation of Nature
KBA	- Key Biodiversity Area
LGC	- Local Government Code
LGUs	- Local Government Units
MAO	- Municipal Agriculture Office
MEA	- Millennium Ecosystem Assessment
MPA	- Marine Protected Area
NAMRIA	National Mapping and Resource Information Authority
NbS	- Nature-based Solutions
NGOs	- Non-government Organizations
NGP	- National Greening Program
OECD	- Organization of Economic Co-operation and Development
PAGASA	- Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCSD	- Palawan Council for Sustainable Development
PEMSEA	- Partnerships in Environmental Management for the Seas of East Asia
PES	- Payment for Ecosystem Services
PO	- People's Organization
REDD+	- Reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
SEP	- Strategic Environmental Plan
SRT	- Social Representations Theory
UNEP	- United Nations Environment Programme

Executive Summary

Mangrove forests, seagrass meadows, and salt marshes are among the most productive ecosystems delivering essential services (e.g., food provision, habitat, and coastal protection) that maintain the ecological balance of the environment while enhancing people's well-being at the local level. Meanwhile, on the global scale, they are vital in climate change mitigation and adaptation because of their capacity to sequester and store carbon dioxide; currently conceptualized as "Blue Carbon" Ecosystems (BCEs). Despite the benefits they provide, there has been a global decline induced by natural and anthropogenic threats. When degraded or destroyed, their essential services are reduced or lost in the process, which, in turn, will have consequences that are, for instance, global (e.g., the release of carbon dioxide back to the atmosphere) and local (e.g., scarcity of food source and vulnerability to coastal hazards) in scales. Thus, it has been an interest from different fields of the scientific community to further identify the drivers of such decline and to improve the existing understanding and management of BCEs.

This work highlights the social and policy-making and implementation aspects of BCE assessment which are still limited globally despite being an essential part of research and practice of BCE management relative to the natural science-related assessments (e.g., carbon stock assessment and remote sensing). Specifically, this study assessed the BCEs in the Philippines, utilizing quantitative (perception analyses) and qualitative (thematic and content analyses) methods at the local level, where local governments, residents, and other stakeholders are the ones directly interacting with these ecosystems. An overview and the list of associated publications of this dissertation are shown in Figure 1.1 and Table 1, respectively. The contents of each chapter are summarized as follows:

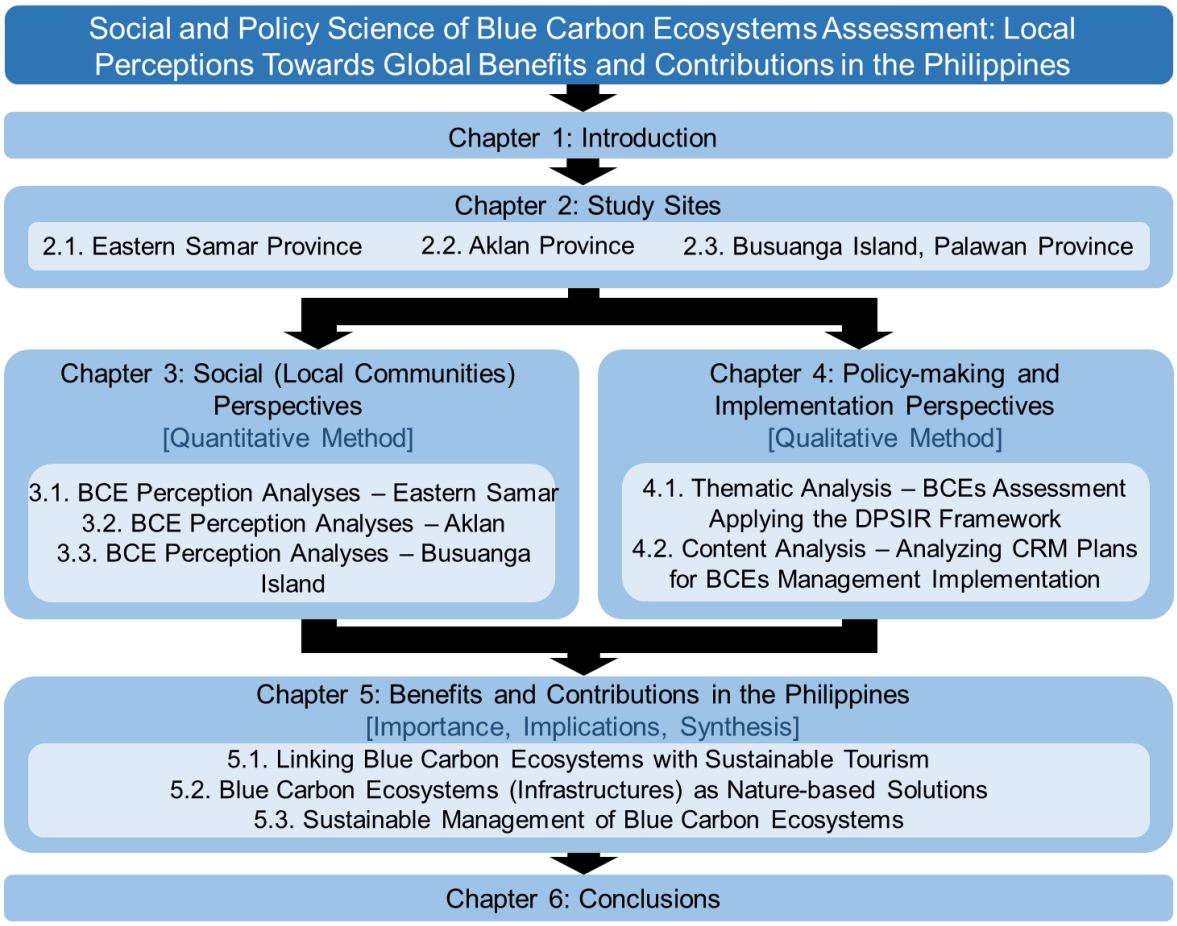


Figure 1.1. Overview of research dissertation.

Chapter 1 – Introduction. This chapter presents the research background and framework of the overall study. BCEs are gaining salience in the international arena due to their vital role in global climate change mitigation and adaptation. To date, the "blue carbon" concept has been a research interest to many scientists with investigations on, for instance, quantifying the carbon sequestered and stored in their biomass and sediments, identifying long-term changes and causal drivers, and assessing their ecological conditions. However, these studies are frequently concentrated under natural and applied science-themed investigations relative to social and policy science disciplines. There is, therefore, knowledge gaps on community dynamics to understand the drivers, resulting to a need to further increase the presence of social and policy science-related studies. These studies are essential in capturing insights and prospects of the management and governance of BCEs. This study contributes to such research

gap particularly in the Philippines where BCEs are a primary resource of several local communities. This study is conducted to answer three overarching research questions which include (i) how BCEs are perceived in the Philippines, (ii) if degraded, what are the causal relationships, and (iii) what are the existing BCE management strategies. By applying social and policy science assessments, this study offers valuable insights on the relationship between local communities and BCEs, key policy-makers and their role in the management, and current conservation and management schemes of BCEs in the country.

Table 1. List of peer-reviewed publications associated with each chapter.

Chapter	Corresponding Publication
3.1	Quevedo JMD, Uchiyama Y, Kohsaka R. 2020a. Perceptions of local communities on mangrove forests, their services and management: Implications for Eco-DRR and blue carbon management for Eastern Samar, Philippines. Journal of Forest Research, 25(1): 1–11. doi: 10.1080/13416979.2019.1696441
	Quevedo JMD, Uchiyama Y, Kohsaka R. 2020b. Perceptions of the seagrass ecosystems for the local communities of Eastern Samar, Philippines: Preliminary results and prospects of blue carbon services. Ocean and Coastal Management, 191: 105181. doi: 10.1016/j.ocecoaman.2020.105181.
3.2	Quevedo JMD, Uchiyama Y, Kohsaka R. 2021c. Local perceptions of blue carbon ecosystem infrastructures in Panay Island, Philippines. Coastal Engineering Journal. doi: 10.1080/21664250.2021.1888558.
3.3	Quevedo JMD, Uchiyama Y, Lukman KM, Kohsaka R. 2021d. How blue carbon ecosystems are perceived by local communities in the Coral Triangle: Comparative and empirical examinations in the Philippines and Indonesia. Sustainability, 13(1): 127. doi: 10.3390/su13010127.
	Quevedo JMD, Uchiyama Y, Kohsaka R. 2021b. Linking blue carbon ecosystems with sustainable tourism: Dichotomy of urban-rural local perspectives from the Philippines. Regional Studies in Marine Science, 45: 101820. doi: 10.1016/j.rsma.2021.101820.
4.1	Quevedo JMD, Uchiyama Y, Kohsaka R. 2021a. A blue carbon ecosystems qualitative assessment applying the DPSIR framework: Local perspective of global benefits and contributions. Marine Policy, 128: 104462. doi: 10.1016/j.marpol.2021.104462
4.2	Quevedo JMD, Uchiyama Y, Lukman KM, Kohsaka R. 2021e. Are municipalities ready in integrating blue carbon concepts? Content analysis of coastal management plans in the Philippines. Coastal Management, 49(4): 334–355. doi: 10.1080/08920753.2021.1928455.
5.1	Quevedo et al. 2021a, b, d
5.2	Quevedo et al. 2020a; 2021c, e
5.3	Quevedo et al. 2020a, b; 2021a, b, c, d, e

Chapter 2 – Study Sites. This chapter presents the study sites – Eastern Samar Province, Aklan Province, and Busuanga Island, Palawan Province. The Philippines, an archipelagic country, is home to many and diverse coastal and marine ecosystems. The BCEs, in particular, are among the main coastal resources that local communities depend on (e.g., as a food and livelihood source), yet, their distribution and abundance in the country has been, in general, declining over the years due to natural and anthropogenic threats. There is, therefore, a need to further identify the drivers of such decline and to improve the existing understanding and management of BCEs. Three sites were investigated in this study, namely: Eastern Samar, Aklan, and Busuanga Island, Palawan provinces which are geographically located at the eastern, central, and western side of the country, respectively. Each site offers unique characteristics that can provide a better understanding of what is happening on the ground. For instance, in terms of threats, BCEs are subjected to natural disturbances (e.g., tropical typhoons) in Eastern Samar, small-scale fishpond industries in Aklan, and tourism activities in Busuanga Island. These threats, in turn, provide insights on how local communities perceived the regulating (e.g., coastal protection), provision (e.g., food source), and cultural (e.g., recreation) services of BCEs, respectively. The studied sites also offer significant information on the role of different stakeholders (e.g., local government units, community and non-government organizations) and the importance of effective collaborations in BCEs management.

Chapter 3 – Social (Local Communities) Perspectives. This chapter pursues how BCE initiatives (from national and/or global scales) permeate through the local stakeholders using perception analysis. Local perceptions have a critical role in supporting collective responses for the sustainable management of BCEs and engaging the people to help define their role in the governance of ecosystems related to land-use change and decision-making. This section

presents the locals' awareness and utilization of ecosystem services, perceived threats, and perceived management strategies of BCEs in (3.1) Eastern Samar (Quevedo et al., 2020a, b), (3.2) Aklan (Quevedo et al. 2021c), and (3.2) Busuanga Island, Palawan (Quevedo et al. 2021b, d). Results of the analyses showed that awareness of BCE provisioning (e.g., food source), supporting (e.g., habitat of many organisms), and coastal protection services of BCEs is relatively high in all sites. Whereas, the public's awareness of cultural (e.g., recreational site) and carbon sequestration services are generally high in Aklan and Busuanga Island while low in Eastern Samar province. In terms of utilization, fishing in BCEs for own consumption is an everyday activity of locals in Eastern Samar and Busuanga Island while accessing BCEs for recreational activities is more frequent in Aklan. Factors influencing utilization frequency include awareness level and socio-demographic characteristics. The former shows significant correlations with utilization while the latter's influence varies in each site. Perceived threats can be categorized into natural and anthropogenic, with the former being perceived as the number one threat in all sites. Existing management strategies are present; however, locals perceived it to be weak. Thus, as the main stakeholders of BCEs, the locals highly recognized themselves to take lead in community-based management. Moreover, this section also discusses the essential role of non-government organizations (NGOs) in providing technical and financial assistance and the importance of efficient and effective collaborations among different stakeholders.

Chapter 4 – Policy-making and Implementation Perspectives. This chapter highlights two research activities: (4.1) assessment of BCEs management by interviewing key policy-makers and thematically analyzing the information gathered using the Drivers-Pressures-State-Impact-Response (DPSIR) framework in Busuanga Island (Quevedo et al. 2021a) and (4.2) evaluation of the present coastal management plans of Eastern Samar and Aklan highlighting the BCEs

by applying content analysis (Quevedo et al. 2021e). Application of the DPSIR model in the first study revealed that lack of institutional capacities (indirect driver) is the leading factor that hinders the progress or efficacy of the management while most pronounced pressures caused by direct drivers to BCEs include overexploitation and coastal developments. Meanwhile, existing management responses can be grouped into policies and implementation, capacity building development, welfare and livelihood development, and ecosystems management. In the second study, key results showed that there is a distinct gap in the inclusion of mangroves compared to seagrasses in the coastal management plans and the "carbon sequestration" functions of BCEs are not discussed or elaborated. Thus, there is an opportunity for policy-makers to update their present management plans particularly in advancing technical capacity and knowledge on the "blue carbon" concept that is not yet well established at the local level and branching their focus on integrated management of seagrass ecosystems.

Chapter 5 – Benefits and Contributions in the Philippines. This chapter presents the benefits and contributions of this study in the Philippines and, in theory, across regional and global scales. Despite the gaining momentum of the "blue carbon" discourse and collaborative action in the international and national arenas, there is still a lot of work to be done at the local level, particularly where local governments and implementers are the ones interacting with these ecosystems. The following sections explore the importance, implications, and synthesis of the different analyses (perception, content, and thematic) conducted in this work. In the first section (5.1), household surveys and key informant interviews offered insights on how BCEs and sustainable tourism can be linked together (Quevedo et al. 2021a, b, d). This work demonstrated that the public's awareness of BCE services can be correlated with perceived environmental changes caused by tourism. Environment-related plans received high recognition in promoting sustainable tourism. The linkage explored in this study could address

future planning of sustainable tourism master plan at the local level particularly those towns that feature BCEs as their main tourism attractions. In the second highlight (5.2), perception and content analyses of mangrove ecosystems provided empirical evidence of the role of BCEs (also referred to as BCEIs, in this study), for instance, in disaster risk reduction and climate change mitigation while enhancing people's well-being (Quevedo et al. 2020a; 2021c, e). This section explored the prospects of BCEIs in the context of Nature-based Solutions (NbS) in the country. Finally, in the last section (5.3), a synthesis is provided to reflect the importance of this study towards the sustainable management of BCEs. For instance, the role of NGOs is identified to be vital in bridging the gap of BCEs management between the national and local levels. They can serve as a link in delivering BCE-related policies and plans from the national level to implementation and adaptation at the grassroots level. Meanwhile, there is an opportunity for policy-makers and scientists to work together in establishing a more concrete and adaptable "blue carbon" strategy which is very much at an explorative phase in the Philippines and neighboring regions. Additionally, the findings of this research can be translated as useful metrics in contextualizing and/or enhancing BCE management plans specifically in strategizing advocacy campaigns and engagement of local stakeholders not only in the Philippines but also across regional and global scales.

Chapter 6 – Conclusions. This chapter serves as the final concluding remarks based on the social and policy science assessments on BCEs conducted in the Philippines. This study is a major contribution to the social science-related studies of BCEs in the country, which is relatively limited to date. Concomitantly, this study contributes to the pool of multi-disciplinary scientific knowledge in advancing BCE-related investigations across regional and global scales. In a way, this study provides a replicable guideline on baseline data gathering on how coastal communities interact with the BCEs especially at the local level where local

governments, implementers, and residents are the ones interacting with these resources and are directly impacted by their decline or loss. Overall, to enable more holistic and sustainable management of BCEs, this research concluded that (i) identifying community perceptions are essential to defining their role in the governance of BCEs, (ii) recognizing the role and functions of different policy-makers in providing valuable insights on the cause-effect relationships of environmental problems and threat-specific solutions as reflected in the applied DPSIR model, and (iii) determining how the current BCEs management strategies gives an opportunity for policy-makers, coastal managers, and implementers to update and/or amend their present management plans particularly in advancing technical capacity and knowledge on the "blue carbon" concept. Finally, the social and policy perspectives of BCEs assessment presented here can be used as a baseline to further advance the "blue carbon"-related studies not only in the Philippines but also across regional and global scales.

Chapter 1. Introduction

1.1. Research Background

Coastal ecosystems are among the most productive ecosystems; offering beneficial services that directly or indirectly enhance people's well-being and supporting local communities and national economies. Among these services are provisioning (e.g., food and timber), habitat for commercially important species, coastal protection, and cultural services (Primavera 2000; Uddin et al. 2013; Mukherjee et al. 2014; Hansen and Reidenbach 2017; Dasgupta et al. 2019). Another key service coastal wetlands provide that was overlooked in the past is the regulation of the global climate which is currently referred to as the "blue carbon" concept (Nellemann et al. 2009). This concept recognizes the vital role of the coastal wetlands as buffers to the adverse effects of and viable component to slow or even reverse the changing, in this case, increasing, world atmospheric carbon dioxide levels (Howard et al. 2017). This is possible through the thriving photosynthetic organisms in coastal ecosystems that extract carbon dioxide directly from the atmosphere and surface waters (Pidgeon 2009; McLeod et al. 2011). Mangrove forests, seagrass meadows, and salt marshes, collectively called "Blue Carbon Ecosystems" (BCEs), sequester and store carbon dioxide as organic carbon in their biomass (above and below ground) and soil material (Nellemann et al. 2009; Beaumont et al. 2014). BCEs may carry out this process continuously for thousands of years, locking away atmospheric carbon that could contribute to the heating of the earth's atmosphere into a large number of carbon stocks in biomass and organic-rich soils (Crooks et al. 2017). The BCEs have now reached international prominence because of their important role in reducing the risks and impacts of climate change through carbon sequestration while providing several other significant ecosystem services (Macreadie et al. 2019).

However, despite the benefits they provide, there has been a global decline in these coastal resources. The decreasing trends in area coverage are mostly due to conversion to other

land uses (Duarte et al. 2013) mostly for economic gain. It is estimated that half of the mangroves and salt marshes and 29% of seagrasses are lost since the turn of the 19th century (Crooks et al. 2017). The degradation of these environments could result in the loss of beneficial services such as food source and protection against storm surges (Munang et al. 2011; Costanza et al. 2014). Moreover, as BCEs are in decline, their intangible and long-term service of carbon sequestration and storage are likely to diminish as well. A large number of carbon stocks sequestered over the years are threatened to be released back into the air, contributing to the further rising of global temperature, if these ecosystems continue to be degraded and lost (Duarte et al. 2013).

Thus, in response, it has been a great interest from different perspectives of the scientific community, policymakers, and implementers to further identify the drivers of such decline and build a strong foundation of science, policy, and sustainable coastal management practices for the conservation and restoration of BCEs as a means of collective effort in addressing climate change (Crooks et al. 2017). BCE-related studies have progressed over the years. However, most of these investigations are closely related to natural science disciplines such as carbon stock assessment and carbon sequestration potential (e.g., Alongi et al. 2015, Wahyudi et al. 2020), ecological modeling systems (e.g., Jardine et al. 2014), and ecological and habitat assessments (e.g., Hantanirina and Benbow 2013, Friess et al. 2016). In the review studies conducted by Moraes et al. (2019) and Pricillia et al. (2021), they highlighted the importance of social and policy aspects (e.g., local knowledge, local capacity, and governance) in BC management. Through social and policy science assessments, key questions regarding the management of BCEs can be addressed. For instance, how payment schemes can encourage local stakeholders to conserve and protect BCEs for their services (Thompson et al. 2017), how to effectively integrated BCE to marine protected area (MPA) design and management (Howard et al. 2017), how local communities can effectively lead BCE management (Camacho

et al. 2020), and what are the legal and policy considerations (Bell-James 2016). There is, therefore, a need to further increase the presence of and advance research on the social and policy science perspectives of BCEs across the world since these studies capture valuable information to advance and sustain BCE management. Such views are echoed as opinion by groups of renowned scientists involved, for instance, in mangrove conservations that "public perceptions matter" (Dahdouh-Guebas et al. 2020).

This study contributes to such research gap by conducting social and policy science assessments of BCEs in the Philippines which is geographically located at the Coral Triangle Region (CTR) where BCEs are among the main resource of many communities, and yet, are continually being degraded. Despite the gaining momentum of the "blue carbon" discourse and collaborative actions in the international and national arenas, more work is still needed at the local level especially where local governments, implementers, and residents are the ones interacting with—benefiting from and taking advantage of resources from—these ecosystems. Thus, this study pursues how BCE initiatives permeate through the local communities in CTR, particularly in the Philippines using social (local communities) and policy-making and implementation inquiries.

1.2. Research Framework

The framework of ecosystem services is an integral part of natural resource management because it involves understanding the relationship between ecosystems and human behavior (MEA 2005). Since ecosystem services are benefits, it can be measured using different valuation approaches such as social and behavioral methods like peoples' perception of ecosystem services (e.g., Farber et al. 2002, Kumar and Kumar 2008). Local perceptions, based on comprehensive theoretical and empirical evidence, have a critical role in supporting collective responses for the sustainable management of natural resources (Quintas-Soriano et

al. 2018). In other words, perception studies reveal, among others, a) how knowledgeable the stakeholders are on BCEs, b) how, why and when are they using it and for what, and c) what kind of involvement regarding BCE utilization and management they are invested in or intend to do. Engaging local communities in ecosystem service assessments help define their role in the multi-governance of environments (MEA 2005; Ouko et al. 2018; Camacho et al. 2020).

Kohsaka (2010) noted that the inclusion of social values (e.g., participation, utilization) from local residents and the public is an integral step for the sustainability of project development. Human populations learn to distinguish how their activities and natural phenomena can affect them and their environments, allowing them to develop appropriate responses (Kohsaka and Rogel 2019). They have developed knowledge related to the places where they live which can help investigate, for instance, landscape changes, threats, and management strategies (Berkes et al. 2000; Bürgi et al. 2004; Aditya and Ganesh 2018). In the recent work conducted by Quevedo et al. (2021f), community perceptions were able to record mangrove cover changes and identify the causal factors, which are key information to obtain in formulating threat-specific management strategies of BCEs. Moreover, this knowledge allows the people to build a perception of reality that is driven by socio-ecological, cultural, and economic values (Almeida et al. 2016) and direct experience and observation that is accumulated over time (Kohsaka and Rogel 2019). Therefore, in this context, the use of community perceptions to evaluate environmental changes and identify their drivers and management is possible (Gebrehiwot et al. 2010; Solomon et al. 2018). Additionally, research on local perceptions enables the collection of valuable information that supports policy-makers in the development of conservation and sustainable management of the environment (e.g., Martínez-Espinosa et al. 2020, Lukman et al. 2020).

Thus, in this study, social (local communities) and policy-making and implementation inquiries were conducted using people's perceptions to address three overarching research

questions pertaining to the prospects of sustainable management of BCEs in the Philippines. Figure 1.2 illustrates the overall research framework with the three research methods used in this study. Perception analysis was used to answer the first question which is how people perceived the BCEs. Public's awareness level, utilization rates, perceived threats, and perceived management strategies were gathered and used as proxies in determining the familiarity of coastal communities to BCEs, which in turn could reflect the current management reach and effectivity at a local scale in the Philippines. The people's awareness and utilization of ecosystem services (ES) in this work are closely associated with assessing the instrumental value of the benefits (e.g., food provision and recreation) since these benefits allow people to achieve a good quality of life (Díaz et al. 2015). These perceptions can be translated to become useful metrics in contextualizing and/or enhancing coastal management plans specifically in strategizing BCE advocacy campaigns and engagement of local stakeholders to BCE management.

Thematic analysis was used to address the second question which is what are the are causal relationships of BCEs degradation (Figure 1.2). Perspectives of both local community (e.g., head of people's organizations) and government (e.g., municipal-level officers) were gathered through key interviews since these stakeholders play an important role in BCE management. Utilizing their perceptions can give a better holistic view of the current state of BCEs at the local scale. These insights can identify the potential cause-effect linkages of environmental problems (e.g., BCE degradation) which in turn can help them in enhancing or strengthening existing policies and programs.

The third question was addressed using content analysis (Figure 1.2). In order to effectively incorporate BCE management at the local level, it is important first to identify the present management implementations since this information can reflect the effectiveness of linkages between science, government, and private sectors, adequacy of policy or law

enforcement, and disconnect between socio-economic and cultural dimensions (Fortes et al. 2018). Analyzing the contents of present coastal management plans can show the current direction of management implementation, should the local leadership observed and honored the plan, and provide appropriate recommendations for integrated BCE management practices.

Through the application of the mix-methods (perception, thematic, and content analyses) approach, this study aims to provide valuable benefits and contributions to sustainable BCE management, particularly in the local contexts in the Philippines. Finally, the results and discussions presented here provide a solid foundation that can be used as a benchmark and/or baseline in improving and strengthening BCE management plans specifically in advancing the "blue carbon" concept (e.g., "Blue Carbon" awareness) and promoting community inclusivity of BCE management not only in the Philippines but also across regional (e.g., CTR) and global scales.

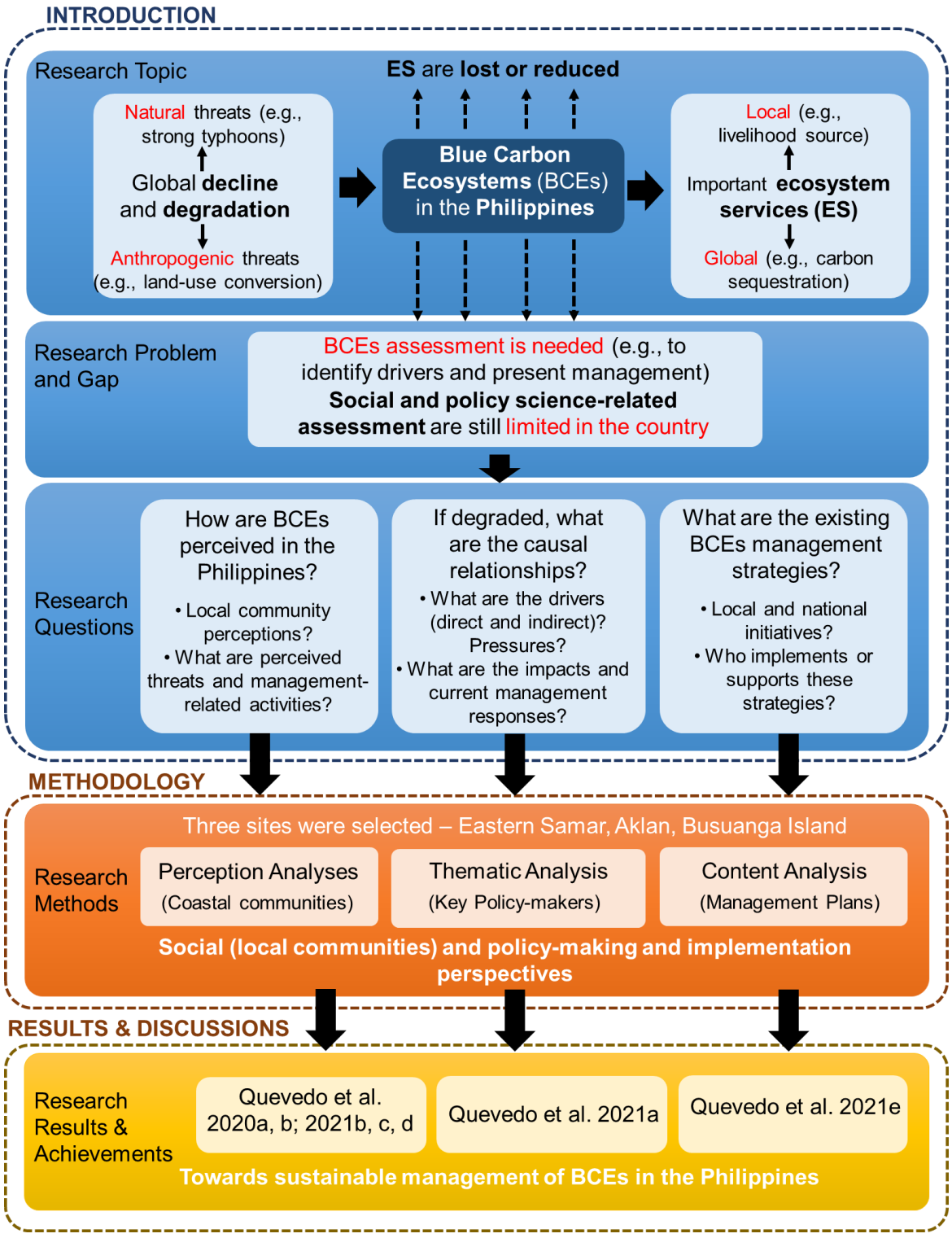


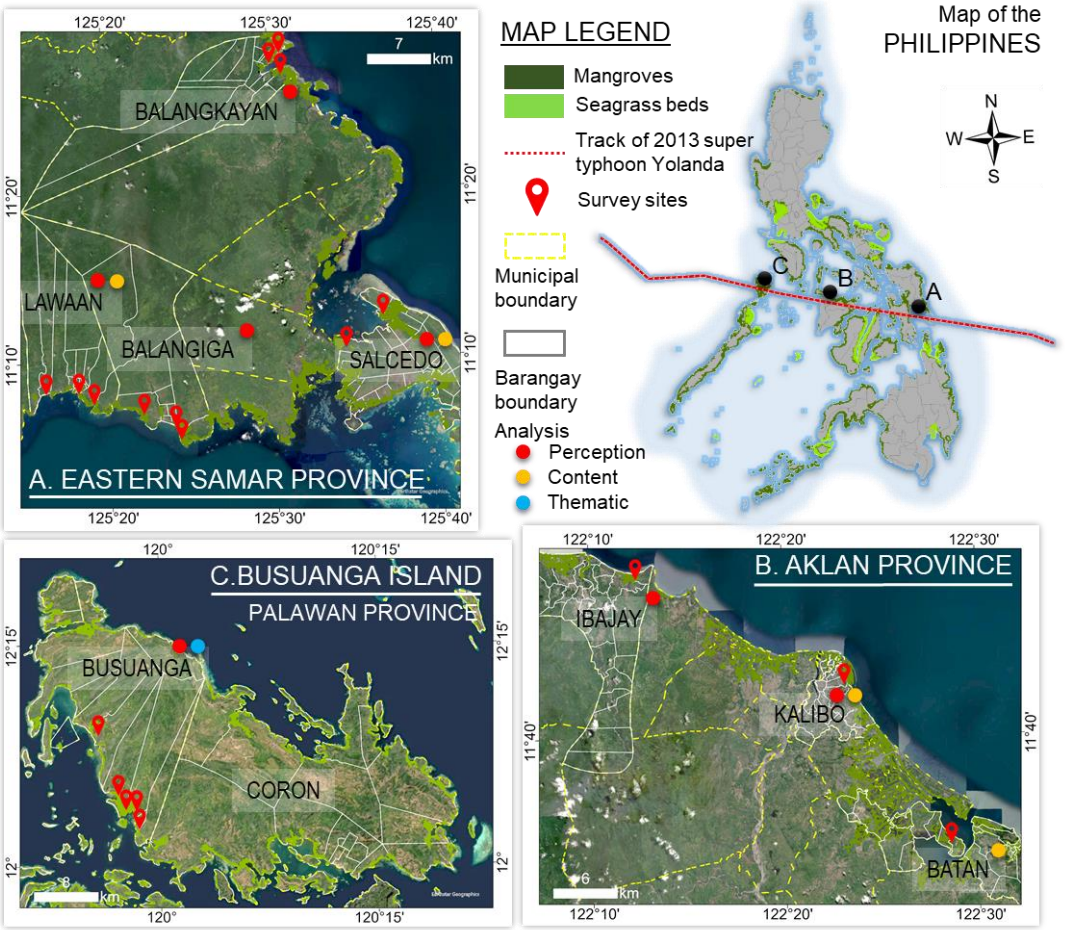
Figure 1.2. Overall research framework observed in this study.

Chapter 2. Study Sites

Mangrove forests and seagrass meadows comprise the BCEs in the Philippines (Figure 2.1). The country ranks 15th and 6th in terms of the most mangrove-rich countries in the world and Asia, respectively, based on the 2010 global mangrove forests distribution (Giri et al. 2011). The country holds at least half of the world's approximately 65 mangrove species (Garcia et al. 2014). The earliest mangrove cover estimates in the country had as much as half a million hectares in 1918 and drastically reduced to 120,000 ha in 1994 which was mainly caused by anthropogenic activities such as local exploitation for fuelwood, conversion to aquaculture ponds, and unregulated developments (Primavera 2000). Natural disturbances such as storm surges caused by strong typhoons were documented to also contribute to the decrease of mangrove forest cover in the country (Garcia et al. 2014). Recent estimates of mangrove cover applying remotely sensed satellite observations showed an increase in 2010 with 256,185 ha (Long and Giri 2011) then reduced to 220,984 ha in 2016 (Bunting et al. 2018) and increased to 227,808 ha in 2019 (Baloloy et al. 2020). The mangrove cover in the country can change over time, it can decrease due to natural and human-induced drivers (e.g. Garcia et al. 2014) or increase due to natural regeneration (Alura and Alura 2016) and reforestation programs (Primavera 2000).

In terms of seagrass ecosystem cover, the country has a total of approximately 97,800 ha (UNEP 2008). Of this, 34,300 ha have been estimated using combined remote sensing and ground-truth surveys while 63,500 ha have been measured using satellite images only (UNEP 2008). The country is one of the provinces in East Asia with diverse seagrass cover with 16 seagrass species out of 20 seagrass species found in the region (Fortes 2013). Historically, there is a difficulty in quantifying the loss and extent of seagrass beds in the Philippines, and, in general, in Southeast Asia due to the lack of data resulting from unsystematic studies and incidental collections (UNEP 2008). As pointed out by Crooks et al. (2017), seagrass meadows

are the most difficult BCE to determine the abundance and distribution mainly due to their subtidal location (e.g., they are underwater). Applying remote sensing techniques, in general, does not work, due to the constant presence of water which inhibits the use of most satellite or airborne sensors. Thus, assessments are conducted through scuba diving and manual delineation with global positioning system (GPS) units.



Map sources: National Mapping and Resource Information Authority (NAMRIA); Baloloy et al. 2020; UNEP-WCMC and Short 2021; OCHA Philippines 2018

Figure 2.1. Location map of the study sites.

These two BCEs, along with coral reefs, are the important coastal resources that local communities depend on (e.g., source of food, livelihood options, and coastal protection). However, despite this, mangroves' and seagrasses' cover has been observed to continuously decline mainly due to overexploitation (e.g., cutting of mangroves for charcoal making) by coastal residents (Primavera 2000) and land-use conversion (e.g., coastal development)

induced by rapid urbanization and tourism development (Fortes and Santos 2004). The degradation of these resources in the country could result in discernable loss of beneficial services such as food sources, protection against storm surges, and cultural services (Munang et al. 2011; Costanza et al. 2014; Spalding and Parrett 2019). As a response, different programs, policies, tools, and coastal management strategies designed for conserving coastal ecosystems have been crafted and implemented in the country (Courtney and White 2000).

Moreover, as BCEs are degraded, their intangible and long-term service of carbon sequestration and storage are likely to be reduced as well. A large number of carbon stocks sequestered over the years in the Philippines are threatened to be released back into the air, contributing to the further rising of global temperature, if these ecosystems continue to be degraded and lost (Crooks et al. 2011; Fourqurean et al. 2012; Duarte et al. 2013). Thus, over the past 10 years, scientists, policy-makers, and practitioners have built a strong foundation of science, policy, finance, and coastal management strategies for integrating the conservation and restoration of BCEs into the global effort to address climate change (Crooks et al. 2017). Protecting, restoring, and conserving BCEs are a key link to achieving sustainable development goals, growing blue economy, and meeting national commitments to the Paris Climate Agreement (Crooks et al. 2017).

In this study, three major sites were investigated, namely: Eastern Samar (Quevedo et al. 2020a, b; 2021e), Aklan (Quevedo et al. 2021c, e), and Busuanga Island, Palawan (Quevedo et al. 2021a, b, d) provinces which are geographically located at the eastern, central, and western side of the country, respectively (Figure 2.1). In 2013, super typhoon Yolanda has had passed along these provinces bringing catastrophic winds and storm surges (Figure 2.1). Each site offers unique characteristics that can provide a better understanding of what is happening on the ground (Table 2). For instance, in terms of threats, BCEs are subjected to natural disturbances (e.g., tropical typhoons) in Eastern Samar, small-scale fishpond industries in

Aklan, and tourism activities in Busuanga Island. These threats, in turn, provide insights on how local communities perceived the regulating (e.g., coastal protection), provisioning (e.g., food source), and cultural (e.g., recreation) services of BCEs, respectively. The studied sites also offer significant information on the role of different stakeholders (e.g., local government units, community and non-government organizations) and the importance of effective collaborations in BCEs management. The following sections present a closer look at each site.

Table 2. List of features and analysis conducted in each site.

Study Sites	Features	Analyses Conducted
Eastern Samar Lawaan Balangiga Balangkayan Salcedo	>BCEs are exposed to natural disturbances (e.g., typhoons and strong waves) >Strong presence of local government units >BCE management is geared towards disaster risk reduction and fisheries management >Existing management strategies in the presence of coastal plan	Perception analysis (mangroves & seagrasses) [Feb14 – 21, 2019] [Jun 8 – 10, 2019] Content Analysis
Aklan Kalibo Ibajay Batan	>BCEs are exposed to small-scale fishing industries (around Batan Bay) and urbanization >Strong presence of non-government organizations, local government units, community organizations >Presence of well-established mangrove eco-parks >BCE management is geared towards sustainable coastal and fisheries management within the Batan Bay >Existing management strategies in the presence of coastal plan, mangrove reforestation program, and assistance from non-government organizations	Perception analysis (mangroves only) [Mar 14 – 19, 2019] Content Analysis
Busuanga Island Busuanga	>BCEs are exposed to tourism activities, coastal development, and urbanization (rural-urban gradient) >Strong presence of community organizations, non-government organizations, and local government units >BCE management is geared towards sustainable tourism and fisheries management >Existing management strategies in the presence of provincial-level policies and programs, assistance from non-government organizations, and a partially protected key biodiversity area	Perception analysis (mangroves & seagrasses) [Jul 19 – 25, 2019] Thematic Analysis [Feb 11 – 14, 2020]

2.1. Eastern Samar Province

Eastern Samar province has a Type II climate based on the Modified Coronas Classification used by PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) which is characterized by the absence of dry season with a very pronounced maximum rain period from December to February, and minimum precipitation

during March to May. The province is geographically located on the central eastern coast of the country where tropical cyclones are known to make landfalls of an average of 5.9 times per year between 1945 and 2013 (Takagi and Esteban 2015). BCEs in this province are frequently battered by strong water currents and waves brought by typhoons, storm surges, and monsoon winds (Alura et al. 2015). Thus, it can provide insights on how BCEs thrive and their services function in a typhoon-prone area. Additionally, the coastal communities in this province can offer perceptions of the coastal protection benefits of BCEs and their management protocols.

There are four municipalities or towns investigated in this province, namely: Lawaan, Balangiga, Salcedo, and Balangkayan (Figure 2.1). These towns are among the municipalities that were severely damaged by super typhoon Yolanda in 2013 (Anticamara and Go 2017). For the perception analysis of mangrove and seagrass ecosystems, household surveys were conducted at the village level or barangay, the smallest administrative unit in the Philippines. What villages and how many villages to be surveyed were decided based on their accessibility and presence of BCEs and adjacent coastal communities. The municipality of Lawaan consists of 16 villages of which nine are located along the coast. Three from these coastal villages, the barangays of Guinob-an, Taguite, and Maslog, were surveyed. In Balangiga, which is comprised of 8 inland and 5 coastal villages, 3 of these coastal villages – barangays San Miguel, Poblacion VI, and Bacjao – were surveyed. The municipality of Salcedo has 41 villages, from which coastal villages of Matarinao and Caridad were surveyed. Lastly, the coastal villages of Poblacion I and III and Maramag were surveyed in Balangkayan, a municipality with 15 villages. The municipalities of Lawaan, Balangiga, and Salcedo were surveyed from February 14th to 21st, 2019 while Balangkayan town was surveyed from June 8th to 10th, 2019. For the content analysis, not all of the four study sites have existing coastal management plans, thus, the analysis was only limited to present coastal management plans of Lawaan and Salcedo.

2.2. Aklan Province

Aklan province is located in Panay Island, on the western side of the Philippines (Figure 2.1). The province has a Type III climate based on the Modified Coronas Classification used by PAGASA which is characterized by no pronounced maximum rain period and a short period of the dry season which only lasts from one to three months; either December to February or March to May. The province has had experienced an extensive loss of mangrove areas due to conversion to aquaculture ponds and unregulated developments (Primavera and Esteban 2008). Because of this, the province and Panay Island, in general, have had many mangrove rehabilitation programs that were implemented to ensure food security, enhance coastal protection, and diversify livelihood options (Primavera et al. 2012).

Aklan province is home to two well-known mangrove eco-parks, namely: Bakhawan and Katunggan It Ibajay eco-parks which are located in the municipalities of Kalibo and Ibajay, respectively (Figure 2.1). Bakhawan eco-park is approximately 220 ha of natural and rehabilitated mangrove forests (Figure 2.2). Over the years, several areas were effectively reforested and expanded (through natural recruitment) due to the cooperation of different stakeholders, making the eco-park a successful project (Walton et al. 2006). Katunggan It Ibajay eco-park has a total land area of ~44.20 ha of natural mangrove forest and abandoned ponds (Figure 2.3) (Primavera et al. 2012). The mangrove area which was declared as a mangrove eco-tourism park in 2009 through the Municipal Ordinance No. 092 is an important food resource of the adjacent communities (Lebata et al. 2007) and serves as a hub for educational and training activities to help raise awareness of the importance of mangroves to local communities (Primavera et al. 2012). These eco-parks are products of rehabilitation programs on the island which were assisted and funded by different organizations – both local and international agencies (e.g., DENR, NGOs, LGUs, POs). The eco-parks serve as a recreational site, food source to adjacent coastal communities, and livelihood source. The

province also has a network of small-scale fishponds within Batan Bay where BCEs are known to be located. Considering all the features of the province (Table 2), the site, in the context of this study, offers insights on the importance and role of different stakeholders in mangrove management, how people perceived mangroves, and the effect of small-scale fishpond industries. Unlike Easter Samar and Busuanga Island, perception analysis conducted in this site is only for mangrove ecosystems (Table 2) in the municipalities of Kalibo (Barangay New Buswang) and Ibajay (Barangay Bugtongbato) (Figures 2.1, 2.2, and 2.3). The survey was conducted from March 14th to 19th, 2019. Meanwhile, among the three sites that were visited in the province, only two existing coastal management plans were retrieved. Thus, content analysis was carried out on the coastal management plans of Kalibo and Batan.

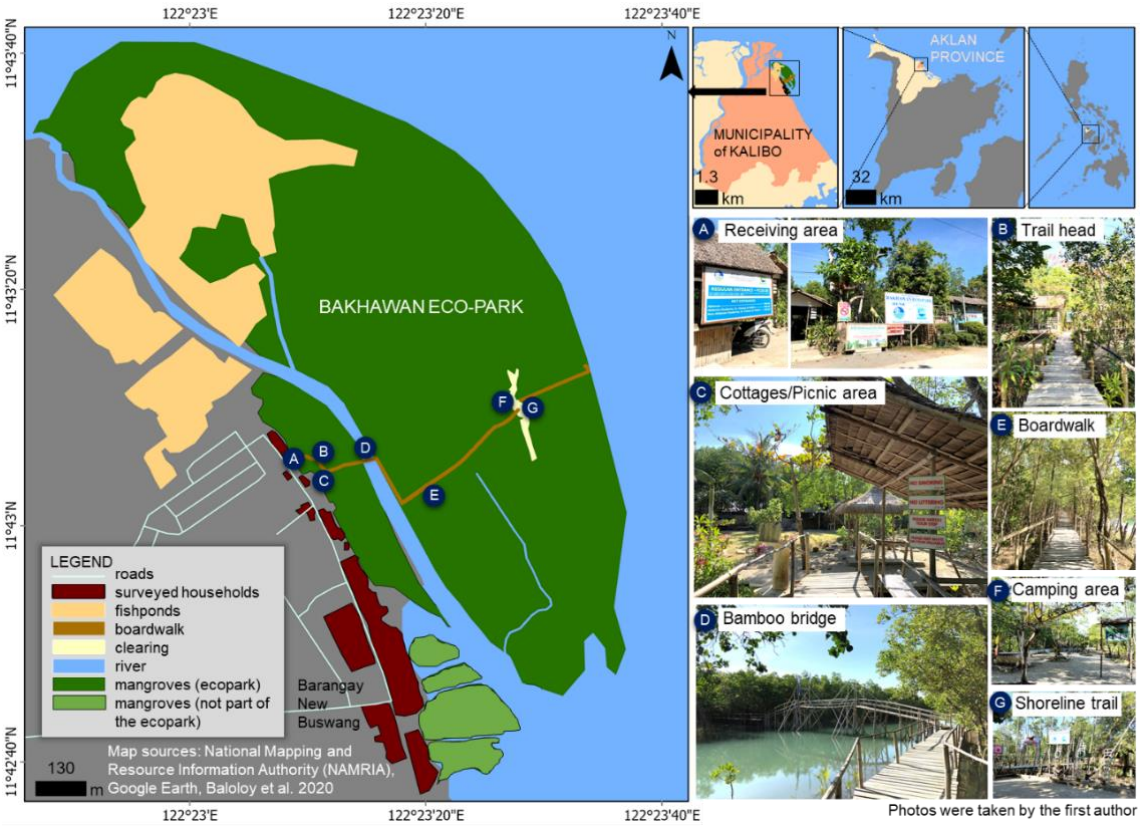


Figure 2.2. Bakhawan eco-park, Kalibo, Aklan (retrieved from Quevedo et al. 2021c).

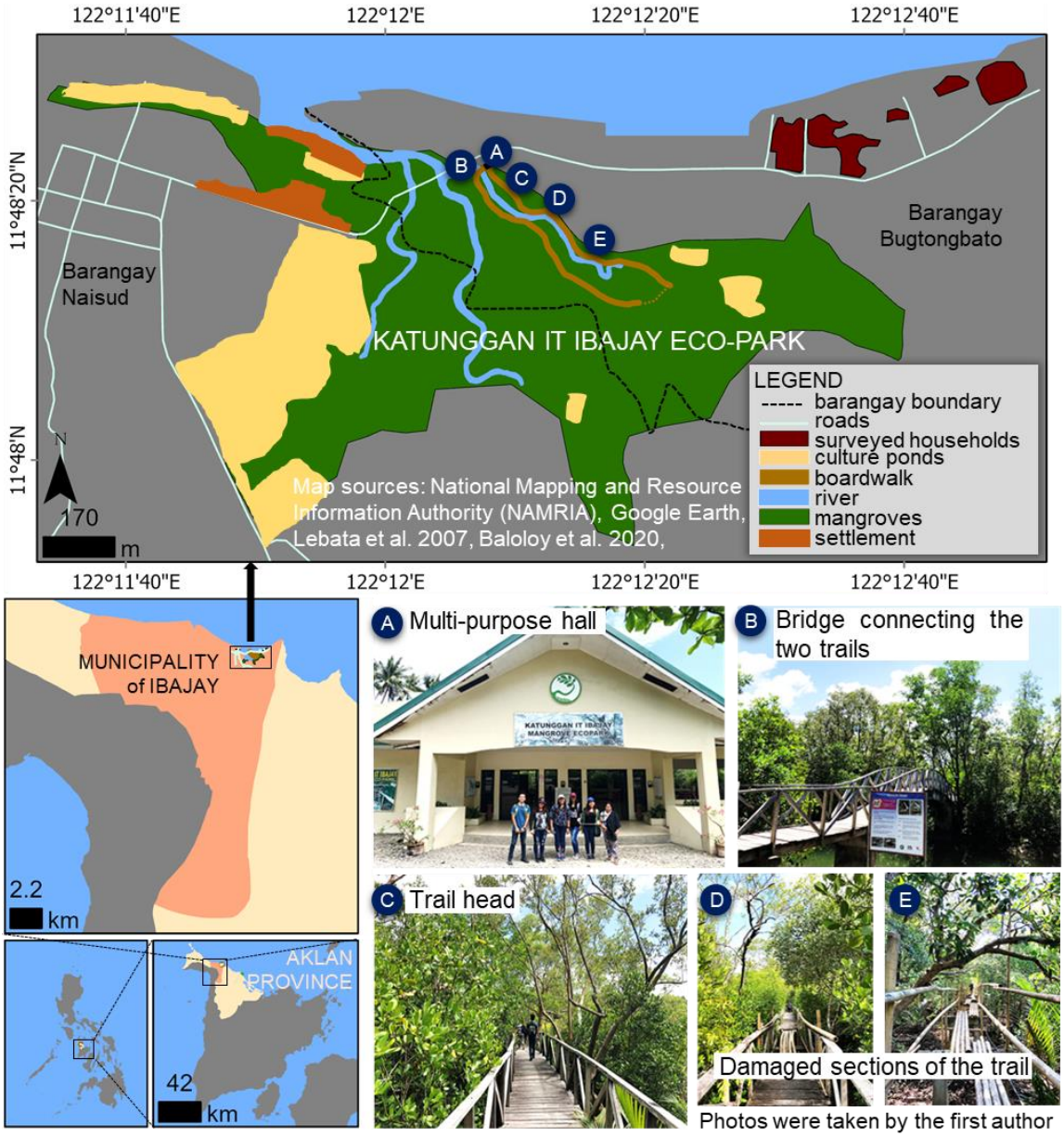


Figure 2.3. Katunggan It Ibajay eco-park, Ibajay, Aklan (retrieved from Quevedo et al. 2021c).

2.3. Busuanga Island, Palawan Province

Busuanga Island is located in the northern part of Palawan province, on the western side of the Philippines (Figure 2.1). The island is characterized by a Type I climate based on the Modified Coronas Classification used by PAGASA which is characterized by a dry season from November to April and a wet season during the rest of the year. The maximum rain period is observed from June to September. The island along with Calauit Island, Culion Island, and Coron Island has been identified as a partially protected key biodiversity area (KBA) (Ambal

et al. 2012) with an ecological zoning plan being followed under the strategic environmental plan (SEP) or Republic Act No. 7611. The total area of the KBA is approximately 66,509 ha, of which 16,326 ha constitutes the terrestrial KBA and 50,183 ha comprise the marine KBAs. The environmental conservation in the island is, among others, governed by a special institution called the Palawan Council for Sustainable Development (PCSD). Thus, the island offers interesting insights on BCEs management in a partially protected area with a provincial-level management body and protocol.

Busuanga Island which has only two municipalities (Busuanga and Coron) is a well-known tourist destination in the Philippines that offers pristine beaches, islands, marine sanctuaries, and snorkeling and diving sites. Moreover, the island has very interesting socio-economic characteristics (e.g., rural-urban gradient and tourism industry) which can give a unique perspective of BCE, their services, and threats. The island also reflects various active stakeholders present in the municipalities that are essential in achieving a better integrated coastal management system (Magbanua et al. 2007). For instance, the networks of social capitals such as the presence of people's organizations and non-government organizations encourages the active participation of community members in management-related activities (Quevedo et al. 2021b, d) while local government institutions (e.g., Municipal Agriculture Office or MAO) oversee formulation and implementation of coastal and marine management ordinances or policies (Quevedo et al., 2021a). Considering all the unique features (Table 2), the site is scientifically interesting especially in assessing the social and policy-making perspectives of BCEs. For the analyses, household surveys (perception) and key informant interviews (thematic) were conducted in 5 coastal barangays (Salvacion, Bogtong, Sagrada, Concepcion, and Sto. Niño) in the municipality of Busuanga (Figure 2.1) from July 19th to 25th, 2019 and February 11th to 14th, 2020, respectively.

Chapter 3 - Social (Local Communities) Perspectives

Locals' perceptions were collected and used in this study as proxies in determining the familiarity of communities with BCEs, which in turn could reflect the current conditions and management directives at a local scale in the Philippines. Specifically, this study addressed the first main research question raised in Chapter 1 which is how communities perceived the BCEs. Using perception analysis in the three sites (Eastern Samar, Aklan, and Busuanga Island), they provided specific insights on how communities (i) utilized and perceived the BCE services, (ii) perceived local threats, and (iii) are knowledgeable and involved in the existing conservation and management efforts at the local level. These perceptions can be translated to become useful metrics in contextualizing and/or enhancing BCE management policies, programs, and plans specifically in strategizing advocacy campaigns and engagement of local stakeholders. Up until recently, there has been a preference for a bottom-up approach in management and governance in the Philippines. How the study underscores local perceptions could also contribute to this grassroots/community-based and informed course of action for the national level to highly consider and prioritize.

Generally, it is acknowledged that perceptions of locals are subjective processes, which means that it can be based on their personal experiences and observation, level of comprehension, and manner of interpretation. Their perceptions can be influenced by, for instance, demographic attributes (e.g., Owuor and Newton 2019), knowledge and utilization (e.g., Puryono and Suryanti 2019), and accessibility and proximity to resources (e.g., Uchiyama and Kohsaka 2016). Thus, in this study, potential factors that could influence their perceptions as well as the relationships among the variables were also considered and explored cautiously. For instance, socio-demographic characteristics were factored in since previous studies have shown their effect on an individual's perceptions (Quintas-Soriano et al. 2018).

This chapter presents the perception analyses conducted in (3.1) Eastern Samar (Quevedo et al. 2020a, b), (3.2) Aklan (Quevedo et al. 2021c), and (3.3.) Busuanga Island (Quevedo et al. 2021b, d). An overview of the research flow of perception analysis conducted in the study sites is presented in Figure 3.1.

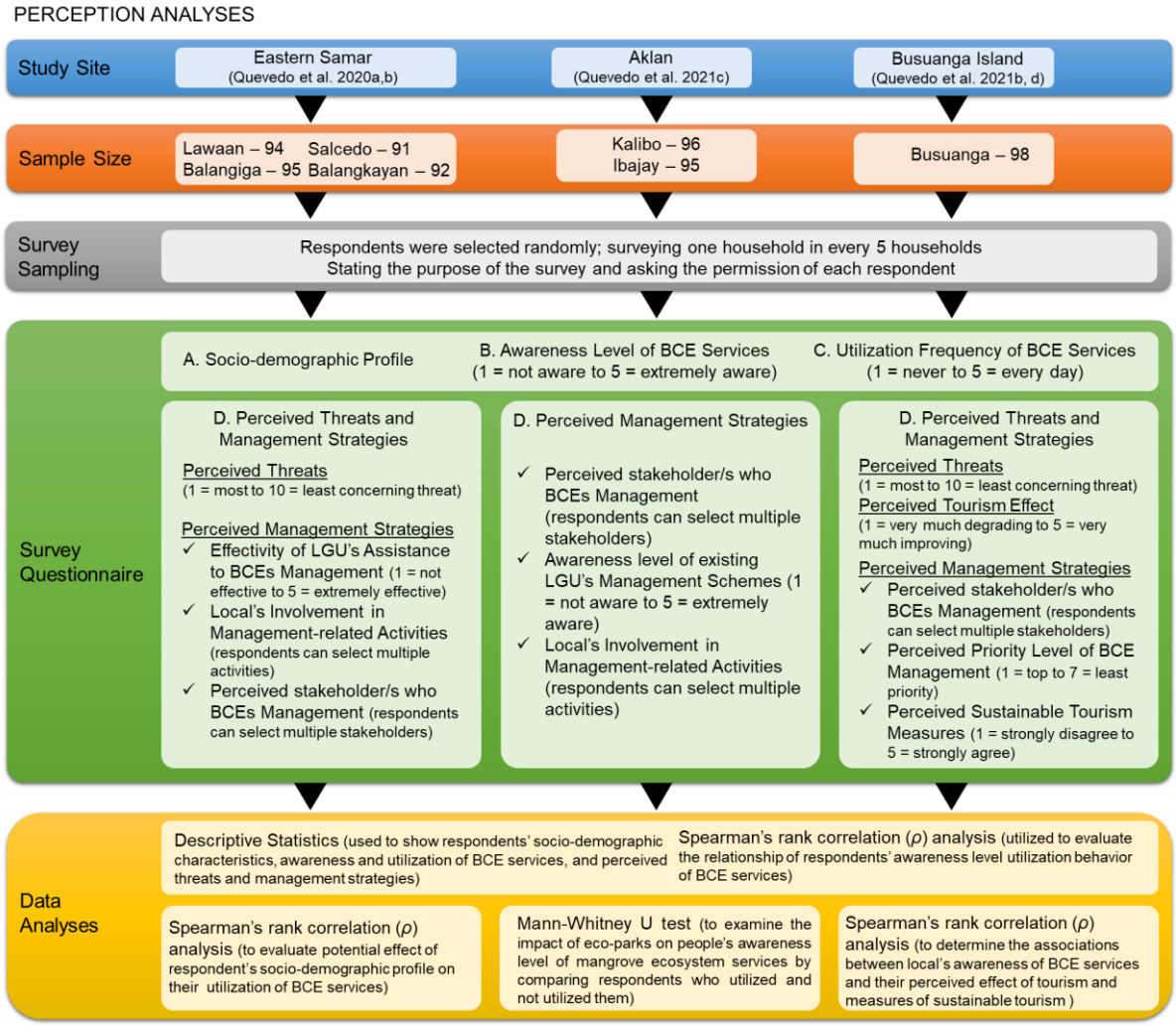


Figure 3.1. Overview of the research flow of perception analysis.

All sites followed the same sample size computation using Cochran's formula at a 95% confidence level with a 10% sampling error (Bartlett et al. 2001, see Appendix A for details). This was carefully done to get an appropriate representation of the populations and reliable interferences (Sarmah and Hazarika 2012). After calculating the target sample size in each site, all respondents were selected randomly; surveying one household in every 5-household

interval, where possible (e.g., Delfino et al. 2015). In case no one is around on the fifth household, the investigator (or enumerator) proceeds to the next available household, methodically noting the survey sampling count. Stating the purpose of the survey and asking the permission of each respondent were also carefully observed during the interviews. All respondents agreed to be interviewed after the pre-survey introductions. Field enumerators who were affiliated with the respective local government assisted in the conduct of surveys. A photo documentation of household surveys is appended in this study (Appendix B).

The household surveys were conducted using a structured questionnaire which was translated to *Waray* as the language of communication for Eastern Samar and *Filipino* or *Tagalog* for Aklan and Busuanga Island. The questionnaire has four sections, namely: (A) socio-demographic profile, (B) awareness level of ecosystem services, (C) utilization frequency of ecosystem services, and (D) perceived threats and management strategies (Figure 3.1). Section A gathered respondent's name, age, gender, educational attainment, occupation, and residency (years living in the area). Sections B and C used a five-point Likert scale, measuring awareness level from 1 (not aware) to 5 (extremely aware) and utilization frequency from 1 (never) to 5 (every day). The first three sections were applied in all the study sites while the last section (D) varied in each area (Figure 3.1). In Eastern Samar, perceived general threats on BCEs were measured using a ranking system: 1 = most concerning threat to 10 = least concerning threat. Meanwhile, in Busuanga Island, a well-established tourism site, perceived effects of tourism to BCEs were added which were measured using a 5-point Likert scale from 1 (very much degrading) to 5 (very much improving). Perceived threats in Aklan were not collected. For the perceived management strategies, each site had three sets of questions (Figure 3.1). In Eastern Samar, perceived management strategies involved: (i) effectiveness of LGU's assistance to BCEs management which was measured using a 5-point Likert scale from 1 (not effective) to 5 (extremely effective), (ii) local's involvement in management-related

activities (respondents can select multiple activities), and (iii) perceived stakeholder/s who they thought should be responsible in managing their BCEs (respondents can select multiple stakeholders). In Aklan, perceived management strategies included: (i) identifying from a list of stakeholders who they thought should be responsible for managing their mangrove eco-parks (respondents can select multiple stakeholders), (ii) measuring awareness level of existing LGU's management schemes (from 1 = not aware to 5 = extremely aware), and (iii) determining local's involvement in management-related activities (respondents can select multiple activities). Lastly, in Busuanga Island, perceived management strategies consisted of: (i) identifying from a list of stakeholders who they thought should be responsible for managing their BCEs (respondents can select multiple stakeholders), (ii) ranking perceived BCE management schemes according to the level of priority; from 1 (top) to 7 (least) priority, and (iii) measuring the perceived sustainable tourism strategies using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The questionnaires used in each site are appended in this work (please see Appendix C).

Finally, the data collected from the household surveys were tabulated and summarized using descriptive statistics (e.g., frequencies, percentages, and weighted means) and analyzed using non-parametric tests (Figure 3.1). The descriptive statistics were used to show respondents' socio-demographic characteristics, awareness and utilization of BCE services, and perceived threats and management strategies. Spearman's rank correlation (ρ) analysis (see Appendix A for details) was utilized to evaluate the relationship between respondents' awareness level and utilization behavior of BCE services. This analysis was also used to explore the potential effect of respondent's socio-demographic profile on their awareness and utilization of BCE services in Eastern Samar and to determine the associations between local's awareness of BCE services and their perceived effect of tourism and measures of sustainable tourism in Busuanga Island. In Aklan, a comparative analysis using a Mann-Whitney U test

(see Appendix A for details) was added in the data analysis to examine the impact of eco-parks on people's awareness level of mangrove ecosystem services by comparing respondents who utilized and not utilized them. The detailed results and discussions on each site are presented and elaborated in the succeeding sections.

3.1. BCE Perception Analysis – Eastern Samar Province

3.1.1. Introduction

This study assessed BCEs using locals' perceptions in Eastern Samar province where they are often threatened by natural disturbances (e.g., strong typhoon) as described in Chapter 2 (Table 2). Specifically, people's knowledge and utilization behavior of BCE services, natural and anthropogenic threats, and management-related strategies were determined. The results of this study provided insights on the role of local communities in the sustainable management of BCEs which are elaborated further in Chapter 5.

3.1.2. Socio-demographic Profile of the Respondents

The socio-demographic characteristics of the respondents are presented in Table 3.1. The respondents vary from ages 20 to 80 years old across the study sites with an average age of 48 years old. Male and female respondents in all four sites were nearly equal with an average of 52% and 48%, respectively. In terms of educational attainment, 31% – 48% of the respondents across the sites finished primary level and 33% – 36% graduated from secondary education. The respondents with no formal education account 15% – 27% of the total sample size. Fishing has been identified as a primary livelihood source by 44%, 32%, 60%, and 28% of the respondents in Lawaan, Balangiga, Salcedo, and Balangkayan, respectively. More than half (55% – 66%) of the respondents across sites have been living in the area "since birth".

Table 3.1. Socio-demographic characteristics of Eastern Samar's respondents (modified from Quevedo et al. 2020a, b).

Indicators	Lawaan (n = 94)		Balangiga (n = 95)		Salcedo (n = 91)		Balangkayan (n = 92)	
	Frequency (No)	Percentage (%)	Frequency (No)	Percentage (%)	Frequency (No)	Percentage (%)	Frequency (No)	Percentage (%)
Age								
20-30	12	13	6	6	6	7	19	21
31-40	17	18	9	9	22	24	8	9
41-50	18	19	23	24	26	29	25	27
51 and above	47	50	57	60	37	41	40	43
Gender								
Male	50	53	46	48	39	43	57	62
Female	44	47	49	52	52	57	35	38
Education								
No formal education	14	15	16	17	25	27	20	22
Primary	45	48	31	33	28	31	33	36
Secondary	32	34	34	36	30	33	30	33
Tertiary	3	3	14	15	8	9	9	10
Occupation								
Fisher	41	44	30	32	55	60	26	28
Farmer	16	17	18	19	7	8	21	23
Salaried Individual	22	23	40	42	21	23	41	45
Housewife	15	16	7	7	8	9	4	4
Years living in the area								
since birth	60	64	63	66	55	60	60	65
5-10 years	6	6	5	5	10	11	12	13
11-15 years	6	6	7	7	3	3	4	4
16-20 years	7	7	13	14	16	18	10	11
more than 20 years	15	16	7	7	7	8	6	7

3.1.3. Awareness and Utilization of BCE services

The BCEs are known to provide diverse benefits and services that directly or indirectly affect human well-being (Alongi 2008; Fortes 2013). This study determined the level of awareness of the coastal villagers to these ecosystem services (Figure 3.2). BCEs are nursery, feeding, and breeding grounds and home to many organisms. Since most of the respondents are fishermen, the awareness level is relatively high. For instance, awareness that mangroves can be a source of fish and other seafood ranges from "very aware" to "extremely aware"; 13%

– 55% in Lawaan, 27% – 33% of the respondents in Balangiga, 23% – 38% in Salcedo, and 9% – 63% in Balangkayan. Meanwhile, seagrass beds as a nursery, feeding and breeding ground and habitat for many organisms are recognized by 45% – 57% of the respondents across the sites.

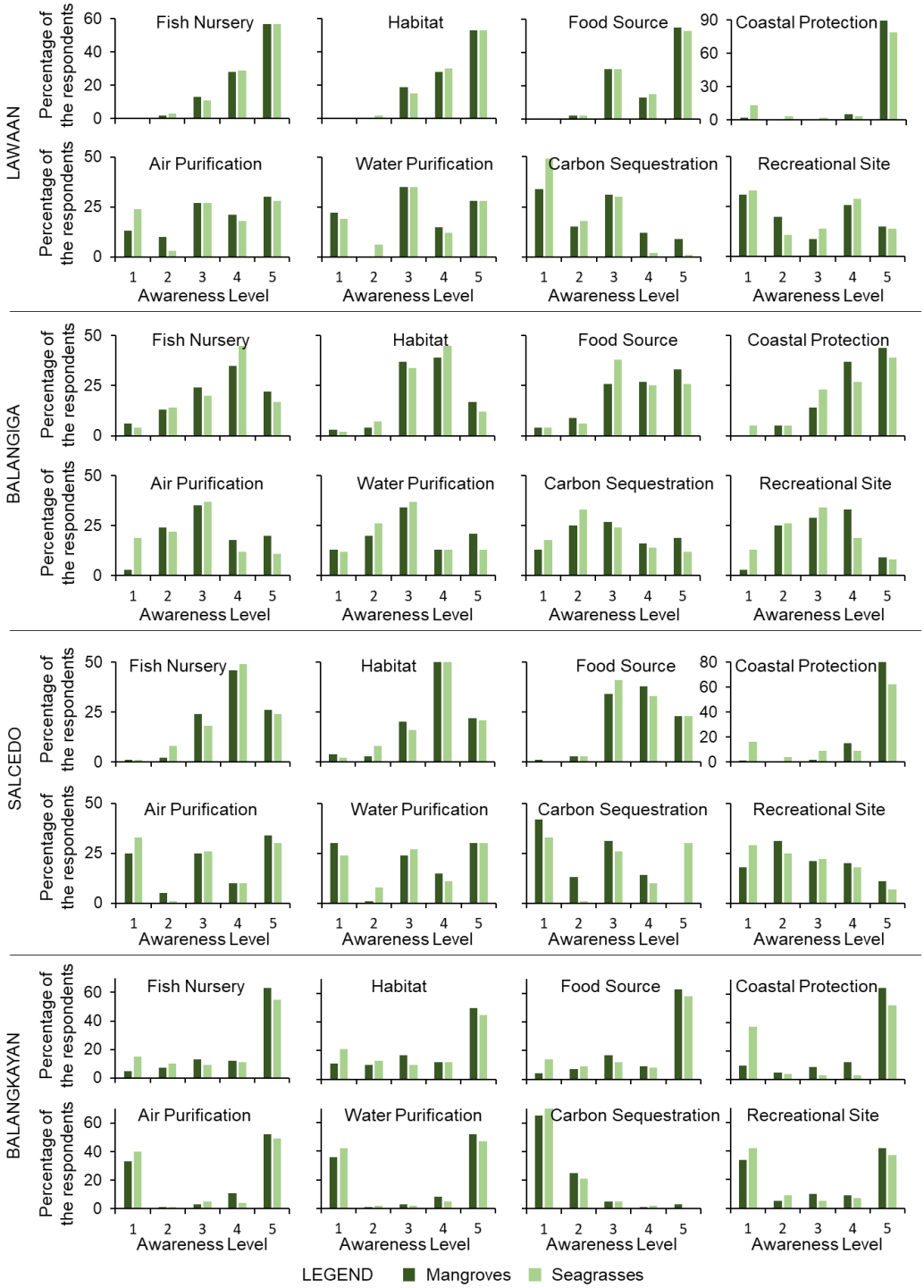


Figure 3.2. Awareness level (from 1 = not aware to 5 = extremely aware) of mangrove ecosystem services (modified from Quevedo et al. 2020a, b).

Awareness on regulating services of BCEs was also asked (Figure 3.2). For coastal protection functions, 44% to 93% of the respondents from the coastal villages said they are "extremely aware" that mangroves can protect them from strong waves and storm surges. The awareness is relatively high since the respondents have had first-hand experience of these benefits when super typhoon Yolanda hit the country in 2013. Similar results were found in the perception study conducted in Leyte and Eastern Samar for the coastal protection functions of mangrove forests (Delfino et al. 2015). Generally, most of the respondents are extremely aware that seagrass meadows can offer coastal protection. Although most of the locals are "extremely aware", there's a difference in perception among the municipalities, which can be due to the difference in density of seagrass meadows and hydrodynamic conditions of the area. As pointed out by Hansen and Reidenbach (2017) and Nordlund et al. (2018), the wave attenuation and reduction of current velocity functions of seagrasses vary among meadows with different species compositions and under site-specific geographical conditions. The respondents also acknowledged that mangrove forests have the ability to purify the air and water in the environment (Figure 3.2); 20%, 30%, 34%, and 52% of the respondents in Balangiga, Lawaan, Salcedo, and Balangkayan, respectively are "extremely aware". For seagrasses' role in water quality improvement, 28% –37% of the respondents in Balangiga, Salcedo, and Lawaan are "moderately aware" while 47% of Balangkayan respondents are "extremely aware".

Another significant regulating function of BCEs is their capacity to sequester carbon, which contributes to climate change mitigation (Kennedy et al., 2010; Crooks et al., 2017). However, the results of the perception surveys showed that respondents have relatively low awareness (Figure 3.2). For mangrove forests, 13% – 25% of the respondents across sites are "slightly aware" while 13% – 65% are "not aware" at all. For seagrass meadows, 49%, 38%, and 72% of the respondents in Lawaan, Salcedo, and Balangkayan, respectively are "not aware" of this benefit while 33% of the participants in Balagiga are "slightly aware". Overall

low awareness of the carbon sequestration function of BCEs indicates that local communities are not yet familiar with the ongoing BCE campaigns and studies in the Philippines.

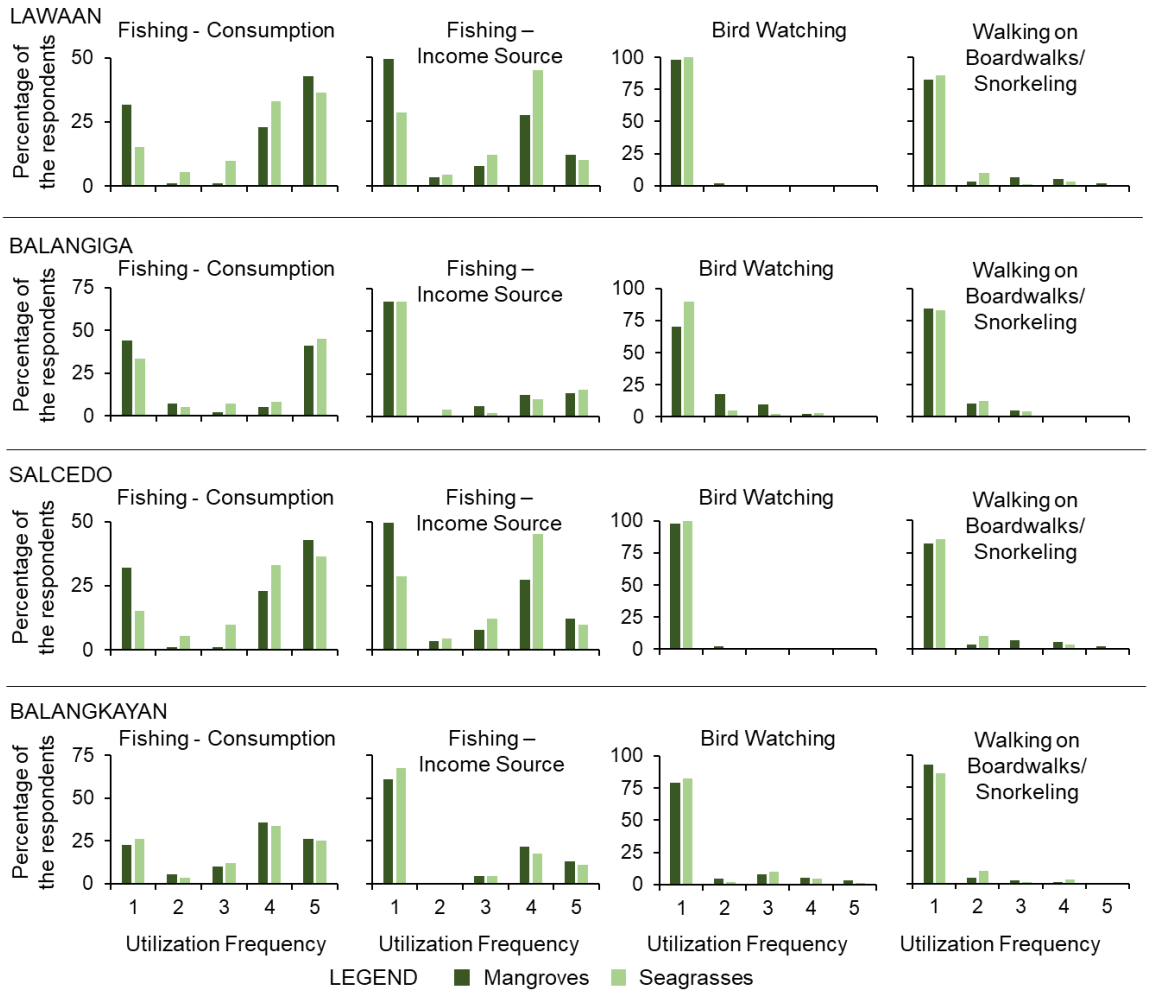


Figure 3.3. Respondents' utilization frequency (from 1 = never to 5 = every day) of provisioning and cultural services of BCEs (modified from Quevedo et al. 2020a, b).

Cultural services offered by mangrove ecosystems in the Philippines have been welcomed by several local government units. To date, some provinces in the country have well-established tourism activities in mangrove areas such as mangrove eco-parks in Panay Island (Primavera et al. 2012). However, in this study, the respondents in Lawaan (9% – 26%), Balangiga (25% – 33%), and Salcedo (20% – 31%) are "slightly" to "very aware" that mangrove areas can be used as a recreational site. In contrast, 42% of the sample size in Balangkayan are "extremely aware". Tourism development in the Lawaan, Balangiga, and

Salcedo is still in the process while Balangkayan town has few developments such as the Minasangay Island where mangrove forests can be seen. Similar results were obtained for seagrass beds, 29% – 42% of the respondents in Salcedo, Lawaan, and Balangkayan are "not aware" while 34% in Balangiga are "moderately aware". This low awareness supports the fact that cultural services of seagrasses are poorly understood and seldom being communicated (Nordlund et al., 2018).

Looking at their utilization pattern (Figure 3.3), 26% – 60% of the respondents across the study sites sourced their food (fish) in mangrove areas "every day". Some respondents have never utilized mangroves (16% – 43%) to collect seafood while other residents have sourced their food in mangrove areas at least once a year (1% – 7%) to once a week (1% – 10%). If the fish yield is abundant during a day's fishing, 12% – 30% of the respondents sell some of it to the local market or neighbors. About 49% – 67% of the participants have "never" fished in mangrove areas for selling purposes. Similar trends were observed in seagrass beds utilization (Figure 3.3). Fishing in seagrass meadows for their consumption is the most frequent activity; varying from "once a week", about 34% of the locals in Balangkayan, to "every day" (36% – 59%) in Balangiga, Salcedo, and Lawaan. Meanwhile, in terms of fishing or gleaning in seagrass beds as an income source, 49% – 67% of the respondents in Balangiga, Lawaan, and Balangkayan "never" collect fishes in seagrasses for selling purposes while 45% of Salcedo catch fishes for sale at least "once to week". Based on field surveys and personal accounts of the respondents, the reason why the utilization rate is generally low is due to the scarcity of fishes, shells, and others to collect. In the Philippines, a study by Muallil et al. (2014) has attributed the decrease in the fish catch to the increasing fishing population. In terms of accessing BCEs for recreational activities, majority of the locals, 71% – 97%, have "never" accessed the mangroves for bird or bat watching and 72% – 92% have "never" experienced walking on boardwalks (Figure 3.3). The same results were also observed for seagrass bed

utilization; 83% – 100% and 34% – 91% of the respondents across the sites have "never" used seagrass meadow for bird watching and snorkeling (Figure 3.3).

The utilization trends of the respondents observed in the study sites were correlated with their awareness and socio-demographic characteristics since previous studies have documented these associations (e.g., Asah et al. 2014). Results of the correlation analysis showed, to some extent, that the awareness level of BCEs and socio-demographic profile can influence respondents' utilization frequency (Table 3.2 and Table 3.3, respectively). For instance, positive associations were observed in Lawaan (ρ = 0.336), Balangiga (ρ = 355), and Salcedo (ρ = 544) suggesting that with high awareness of the provisioning services of the mangroves, the utilization rate will likely be high, whereas those with low awareness tends to utilize less. Moreover, across the study sites, the occupation of the respondents statistically correlates with their utilization; fishermen have high utilization whereas farmers, salaried individuals, and housewives have low utilization. There are also negative correlations observed in the analysis. For instance, in Balangkayan, the level of education negatively correlates with fishing activities (ρ = -0.189, ρ = -0.196) indicating the higher the educational attainment is, the less frequent respondents access BCEs. In general, the trends in respondents' utilization rates of BCE services can be influenced by the social demography and level of awareness. In existing studies, utilization and the level of awareness correlate with each other to certain degrees (Zhang et al. 2016). The relationship among these three parameters (socio-demography, frequency of use, and awareness) vary across the study sites. These variations on the results clearly show that multiple factors could influence the utilization activities of the respondents. Furthermore, it is important to look at multiple factors to better understand the perceptions of the local communities to BCEs and their services.

Table 3.2. Correlation analysis between respondents' awareness level and utilization frequency of BCE services (modified from Quevedo et al. 2020a).

Variable			Ecosystem Services			
			Food provision	Coastal protection	Carbon sequestration	Recreational site
Mangrove Ecosystems	Lawaan	Fishing - consumption	0.366**	0.231*	0.317**	
		Fishing - income source				
		Bird/bat watching	0.334**		0.276**	0.481***
		Mangrove boardwalk	0.308*			0.514***
	Balangiga	Fishing - consumption		0.336***	0.325***	
		Fishing - income source	0.355**			
		Bird/bat watching				
		Mangrove boardwalk		-0.387***	-0.222*	
	Salcedo	Fishing - consumption	0.544***		0.507***	
		Fishing - income source	0.414***		0.442***	
		Bird/bat watching				
		Mangrove boardwalk	0.351**		-0.370***	
	Balangkayan	Fishing - consumption			-0.213*	
		Fishing - income source				
		Bird/bat watching	0.419***	0.263**		0.333***
		Mangrove boardwalk				
Seagrass Ecosystems	Lawaan	Fishing - consumption	-0.176*			
		Fishing - income source				
		Bird/bat watching				
		Snorkeling		-0.267**		
	Balangiga	Fishing - consumption		0.432***	0.240**	-0.219**
		Fishing - income source		0.232**		
		Bird/bat watching				
		Snorkeling				
	Salcedo	Fishing - consumption		0.550***	0.452***	
		Fishing - income source		0.370***		
		Bird/bat watching	-0.210**		-0.180*	
		Snorkeling		-0.481***	-0.453***	
	Balangkayan	Fishing - consumption				
		Fishing - income source		-0.184*		
		Bird/bat watching	0.285***			0.226*
		Snorkeling	0.425***	0.383***		0.317***

Note: *, **, ***correlation coefficients are statistically significant at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively; only statistically significant correlations are shown.

Table 3.3. Correlation analysis between respondents' socio-demographic characteristics and utilization frequency of BCE services (modified from Quevedo et al. 2020a).

Variable			Education	Occupation			
				Fisherman	Farmer	Salaried Individuals	Housewife
Mangrove Ecosystems	Lawaan	Fishing - consumption		0.354***			-0.264**
		Fishing - income source		0.689***	-0.324***		-0.305**
		Bird/bat watching					
		Mangrove boardwalk					
	Balangiga	Fishing - consumption			0.315**		
		Fishing - income source		0.366***			
		Bird/bat watching					
		Mangrove boardwalk	-0.229*	0.264**	-0.209*		
	Salcedo	Fishing - consumption					-0.216*
		Fishing - income source		0.368***			
		Bird/bat watching		-0.032		0.333***	
		Mangrove boardwalk		-0.210*		0.292**	0.201*
	Balangkayan	Fishing - consumption		0.428***		-0.211*	-0.255**
		Fishing - income source		0.441***		-0.242*	
		Bird/bat watching					
		Mangrove boardwalk					
Seagrass Ecosystems	Lawaan	Fishing - consumption		0.267***			
		Fishing - income source		0.680***	-0.290***	-0.321***	-0.273***
		Bird/bat watching					0.248**
		Snorkeling	0.258***				0.180*
	Balangiga	Fishing - consumption		0.193*	0.270***	-0.317***	
		Fishing - income source			0.252***	-0.240**	-0.188*
		Bird/bat watching					
		Snorkeling					
	Salcedo	Fishing - consumption		0.288***			-0.249**
		Fishing - income source		0.462***	-0.204*	-0.228**	-0.266***
		Bird/bat watching		0.185*	-0.238*		-0.218**
		Snorkeling		-0.180*			0.331***
	Balangkayan	Fishing - consumption	-0.189*	0.458***		-0.287***	
		Fishing - income source	-0.196*	0.441***		-0.240**	
		Bird/bat watching	0.179*				
		Snorkeling	0.183*	-0.247**	0.187*		

Note: *, **, ***correlation coefficients are statistically significant at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively; only statistically significant correlations are shown.

3.1.4. Perceived Threats of BCEs

BCEs in the Philippines are facing threats from natural and anthropogenic disturbances (Primavera 2000; Garcia et al. 2014; Fortes and Santos 2004). Thus, in this study, perceived

natural and anthropogenic threats of BCEs were also collected from the respondents (Table 3.4). Natural disasters such as intense typhoons, storm surges, and strong waves are perceived to be the most concerning threat to BCEs. It ranked first by 65%, 29%, 60%, and 95% of the respondents of Lawaan, Balangiga, Salcedo, and Balangkayan, respectively for mangrove ecosystems, while 73%, 28%, 58%, and 97% of the participants in Lawaan, Balangiga, Salcedo, and Balangkayan, respectively, for seagrass ecosystems. This perception is consistent with the fact that Eastern Visayas is among the provinces frequented by typhoons (as discussed in Chapter 2) particularly with the devastation brought about by the super typhoon Haiyan on mangrove forests of Balangkayan (Alura et al. 2015), Balangiga (Long et al. 2016) and Salcedo and Lawaan (Primavera et al. 2016). The effects of the super typhoon Haiyan in Eastern Samar have changed the perspective of the local communities in the study sites. The destruction of the BCEs, particularly the mangrove forests, has halted the lives of the coastal villagers in the province.

Table 3.4. Perceived threats of BCEs (modified from Quevedo et al. 2020a, b).

	Perceived Threats	Lawaan		Balangiga		Salcedo		Balangkayan	
		Mode[ab]	%	Mode[ab]	%	Mode[ab]	%	Mode[ab]	%
Mangrove Ecosystems	Natural disasters	1	65	1	29	1	60	1	95
	Pollution (domestic wastes)	10	35	4	24	3	30	2	54
	Informal settlers	5	30	6	29	6	30	6	21
	Increasing population	5	26	5	29	4	29	5	26
	Charcoal making	3	34	2	43	2	21	4	22
	Conversion to nipa and coconut	7	28	8	22	7	27	7	24
	Mangrove cutting	2	45	1	46	1	33	3	24
	Building infrastructures in coastal areas	9	29	9	22	8	24	8	36
	Conversion to residential areas	8	38	7	26	7	32	9	47
	Conversion to fishponds	9	29	10	43	10	35	10	75
Seagrass Ecosystems	Natural disasters	1	73	1	28	1	58	1	97
	Pollution (domestic wastes)	9	29	4	20	3	26	2	77
	Increasing population	5	22	5	23	8	23	6	21
	Building infrastructures in coastal areas	9	20	5	15	4	19	5	26
	Mangrove planting on seagrass beds	4	29	3	22	4	31	3	24
	Sand mining	2	17	7	21	7	23	8	37
	Unregulated gleaning	3	27	1	27	1	21	3	28
	Siltation	6	27	7	21	6	28	6	20
	Beach reclamation	7	42	9	36	9	37	9	60
	Increasing sea surface temperature	9	30	10	43	10	57	10	80

Note: [a]most frequently occurring response, [b]measured from most (1) to least (10) damaging threats.

Human-induced activities such as illegal cutting of mangroves and charcoal making are also among the top ranks that threaten mangrove forests. These activities were ranked second (45%) and third (34%), respectively in Lawaan, first (33% – 46%) and second (21% – 43%), respectively in Balangiga and Salcedo, and third (24%) and fourth (22%), respectively, in Balangkayan. Meanwhile, unregulated gleaning activities and mangrove planting on seagrass beds have been perceived to be among the top concerning threats of seagrass ecosystems. The former was ranked first in Balangiga (27%) and Salcedo (21%) and third in Lawaan (27%) and Balangkayan (28%), while the latter is ranked third in Balangiga (22%) and Balangkayan (24%) and fourth in Lawaan (29%) and Salcedo (31%). Unregulated gleaning activities could result in biodiversity loss (Nordlund and Gullström, 2013), while mangrove planting on seagrass meadows has been attributed to fish abundance decline (Mendoza et al. 2019).

The least perceived threat (ranked 10^{th}) to mangrove forests is conversion to fishponds in the municipalities of Balangiga (43%), Salcedo (35%), and Balangkayan (75%) and domestic pollution in Lawaan (35%). Meanwhile, for seagrass beds, the least threat is increasing sea surface temperatures as perceived by 30%, 43%, 57%, and 80% of the respondents in Lawaan, Balangiga, Salcedo, and Balangkayan, respectively.

3.3.5. Perceived Management Strategies of BCEs

Local government units (LGUs) aid their communities in managing BCEs through their coastal plans. This study also gathered villagers' perceptions on the performance of LGUs in the sites as a benchmark for official local government activities. Figure 3.4 shows the perceptions of the residents on the effectiveness of the assistance provided. About 41% to 57% of the respondents across the sites said that the assistance is "moderately effective". A few percentages (7% – 13%) said that the assistance is "extremely effective" while others answered

"slightly effective" (5%-9%). About 7%, 14%, and 8% of the respondents in Lawaan, Salcedo, and Balangkayan said that the assistance provided was not effective.

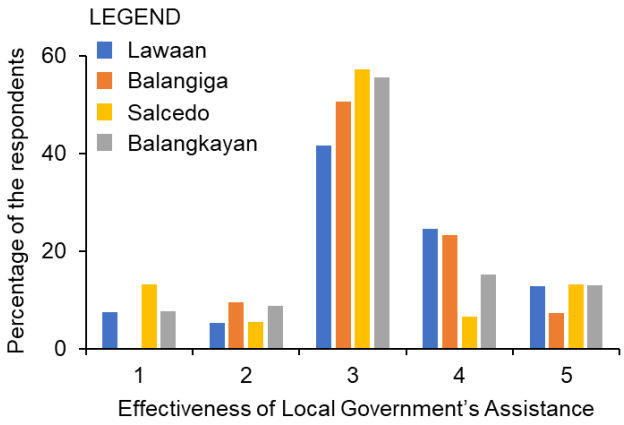


Figure 3.4. Respondents' perceived level of effectiveness (from 1 = not effective to 5 = extremely effective) of local government's assistance (modified from Quevedo et al. 2020a).

The role of local government units is essential in BCEs management. For instance, they usually join activities such as monitoring and evaluation, information and education campaigns, and ordinance formulation. However, local stakeholders are equally important as well in the management since they are the ones who manage, use and change these ecosystems (Muhamad et al. 2014). In this study, participation of local communities in BCEs-related management activities such as coastal clean-up and mangrove planting is relatively high. As reflected in Figure 3.5, 72%, 87%, 87%, and 52% of the respondents in Lawaan, Balangiga, Salcedo, and Balangkayan, respectively, have participated in coastal clean-up activities. Mangrove planting has also engaged 47% – 73% of the respondents across the sites. The same results were observed from the study conducted by Delfino et al. (2015) where a majority of the respondents from municipalities of Eastern Samar and Leyte agreed to the benefits of planting mangroves along the coastlines. Participation rates of these activities are usually high in the Philippines since these are often encouraged by the national government (e.g., the presence of the National Greening Program (NGP) under Executive Order no. 26 of 2014). Only a small fraction of the respondents did not participate in any coastal activities; 19% in

Lawaan, 8% in Balangiga, 4% in Salcedo, and 39% in Balangakayan. The voluntary participation of the locals is consistent with their perceptions on who should manage and protect the BCEs (Figure 3.6). The majority (72% – 100%) of the respondents across the sites have perceived that they should take the lead in safeguarding and managing of BCEs along with other stakeholders. The results of this study suggest that the partnership between local communities and government units is important in managing BCEs from multiple perspectives. LGUs can educate the communities on the ecosystem services offered by BCEs while communities can support their government by active participation and cooperation in coastal management activities.

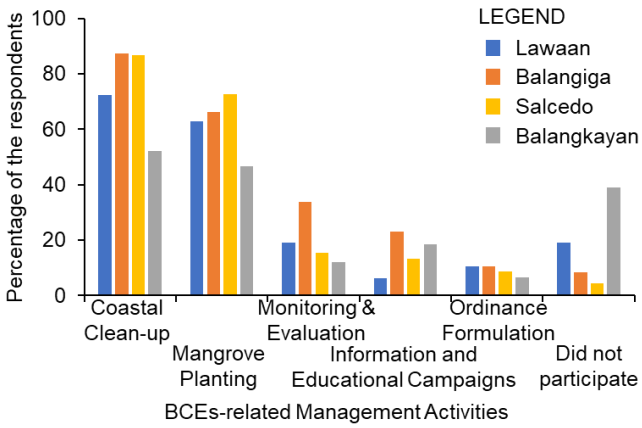


Figure 3.5. Respondents' participation on various BCEs-related management activities (modified from Quevedo et al. 2020a).

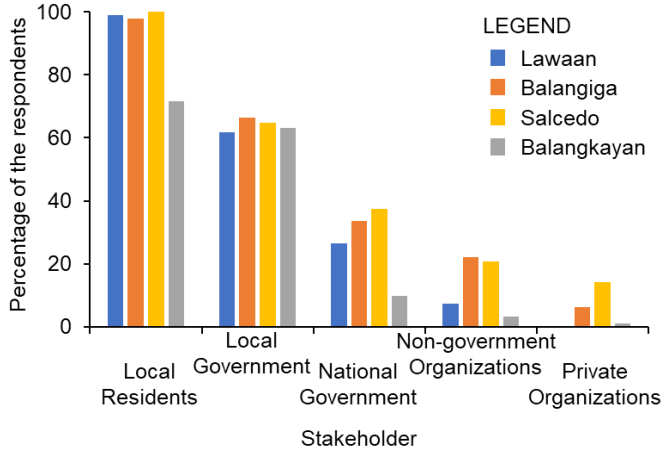


Figure 3.6. Respondents' perceptions on who should lead the management of BCEs (modified from Quevedo et al. 2020a).

3.2. BCE Perception Analysis – Aklan Province

3.2.1. Introduction

This study focused on the perceptions of coastal communities on the management of BCEs, specifically in the context of mangrove eco-parks which were also referred to as blue carbon ecosystem infrastructures (BCEI). As mentioned in Chapter 2, two well-known mangrove eco-parks were investigated in Aklan province. These are Bakhawan and Katunggan It Ibajay eco-parks which are located in the municipalities of Kalibo and Ibajay, respectively. The BCEIs investigated in this work are among the successful mangrove rehabilitation projects in the Philippines (Primavera and Esteban 2008; Primavera et al. 2012). The success of the eco-parks is linked with excellent coordination, active protection, and participation of different stakeholders including LGUs, non-government organizations (NGOs), and people's organizations (POs) (Primavera and Estaban 2008; Barrientos and Apolonio 2017). Thus, this study provided insights on the relationship between BCEIs and communities and multi-stakeholder management of BCEIs, which are important points to consider in the context of the overall study. By determining the locals' awareness, utilization, and management perceptions of BCEIs, in this case, mangrove eco-parks, the study offered empirical evidence of how well-implemented eco-parks can increase mangrove awareness as well as deliver ecological and economic services. Through the analysis of people's perceptions, the study also looked into obtaining conceptual implications of BCEIs as Nature-based Solutions (NbS) and providing practical prospects for BCEI applications in the Philippines which are presented and discussed in Chapter 5.

3.2.2. Socio-demographic Profile of the Respondents

The socio-demographic characteristics of the respondents are reflected in Table 3.5. Kalibo respondents in Barangay New Buswang, with a total sample size (n) of 96, are only slightly male-dominated (51%) while Ibajay respondents in Barangay Bugtongbato (n = 95) is

only slightly female-dominated (53%). The former has an average age of 39 years old while the latter has a mean age of 45 years old. Most (58–68%) of the respondents in both sites have been residing in the village since birth. In terms of educational attainment, 44% and 49% of the respondents have attained primary school in Kalibo and Ibajay, respectively. For the occupation profile, 49% of the sample size in Kalibo came from the "salaried individuals" group which covers skilled workers, government employees, and part-time workers while 40% are housewives and 11% are fishers. In contrast, 37% of the respondents in Ibajay are fishers, 29% are housewives while 34% are salaried individuals.

Table 3.5. Socio-demographic characteristics of Aklan's respondents (modified from Quevedo et al. 2021c).

Indicators		Kalibo (n = 96)		Ibajay (n = 95)	
		Frequency (No)	Percentage (%)	Frequency (No)	Percentage (%)
Age					
	20-30	25	26	18	19
	31-40	34	35	21	22
	41-50	20	21	21	22
	51 and above	17	18	35	37
Gender					
	Male	49	51	45	47
	Female	47	49	50	53
Education					
	Primary	42	44	46	49
	Secondary	35	37	38	40
	Tertiary	18	19	10	11
Occupation					
	Fisher	11	11	35	37
	Salaried Individual	47	49	32	34
	Housewife	38	40	28	29
Years living in the area					
	since birth	56	58	65	68
	5-10 years	18	19	7	7
	11-15 years	5	5	5	5
	16-20 years	6	6	8	8
	more than 20 years	11	11	10	11

3.2.3. Awareness and Utilization of Mangrove Ecosystem Services

Overall, Aklan's respondents displayed a relatively high awareness of mangrove ecosystem services (Figure 3.7). More than half of the respondents, 54% – 67% in Kalibo and 51% – 65% in Ibajay, are "extremely aware" of the regulating services such as coastal protection, natural buffer, air purification, and carbon sequestration while only 4% – 11% (former) and 3% – 6% (latter) of the group is "not aware" of these benefits. Provisioning services are also well perceived by the respondents, 23% – 30% and 20% – 28% are "moderately" to "extremely aware" that mangroves can be a food source in Kalibo and Ibajay, respectively. Moreover, supporting services such as habitat and nursery, feeding, and breeding ground of many organisms are highly recognized by the respondents. At 34% – 41% of the sample size of Kalibo are "very aware" while almost half (43% – 47%) of Ibajay's respondents are "extremely aware". Lastly, the cultural benefits of mangroves are well-acknowledged ("extremely aware") by 65% – 67% of the respondents in the study sites.

For fishing activities, the most frequently occurring response falls under the "never" utilized category accounting for 63% – 69% and 68% – 86% of the respondents in Kalibo and Ibajay, respectively (Figure 3.8). However, it should be noted that a few fractions, 9% – 10% and 3% – 7% of the respondents access the mangrove areas to fish for their consumption and selling purposes, respectively, from "once a week" to "every day". The same pattern was also observed in Ibajay; at least 14% – 16% of the respondents have sourced out their fishes in mangroves from "once a week" to "every day" while 9% of them have collected fishes in the area to earn money at least "once a week". In terms of recreational (cultural) activities, 16% of the respondents visit the eco-park in Kalibo "every day" to observe birds while others (14% – 20%) from "once a week" to "once a year." Walking along the bamboo trails (Figure 2.2.) has been a daily activity to some (28%) of the respondents whereas a few percentages (7% – 14%) have visited it at least "once a year" to "once a week". Educational (research) activities are also

observed in the eco-park at least "once a year" by 28% of the sample size. Meanwhile, in Ibajay, 26% of the respondents visit their eco-park daily for birdwatching activities while a few have done it "once a week" (16%), "once a month" (14%), and "once a year" (4%). Moreover, 35% of the respondents enjoyed a daily walk along the eco-trails, whereas others, 5%, 9%, and 2% have used it at least "once a week," "once a month," and once a year," respectively (Figure 2.3). Some (14% – 25%) of the respondents utilize it "every day" or "once a week" for educational activities.

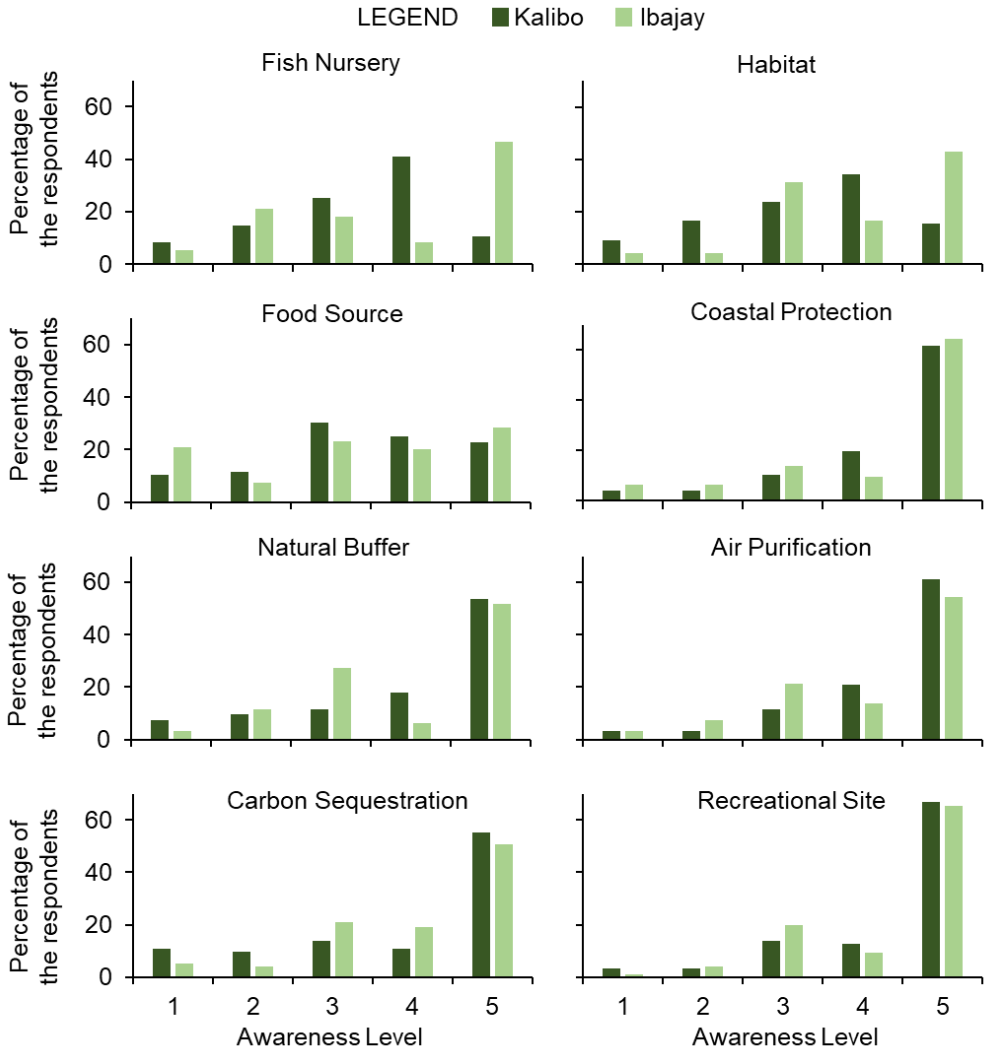


Figure 3.7. Awareness level (from 1 = not aware to 5 = extremely aware) of mangrove ecosystem services (modified from Quevedo et al. 2021c).

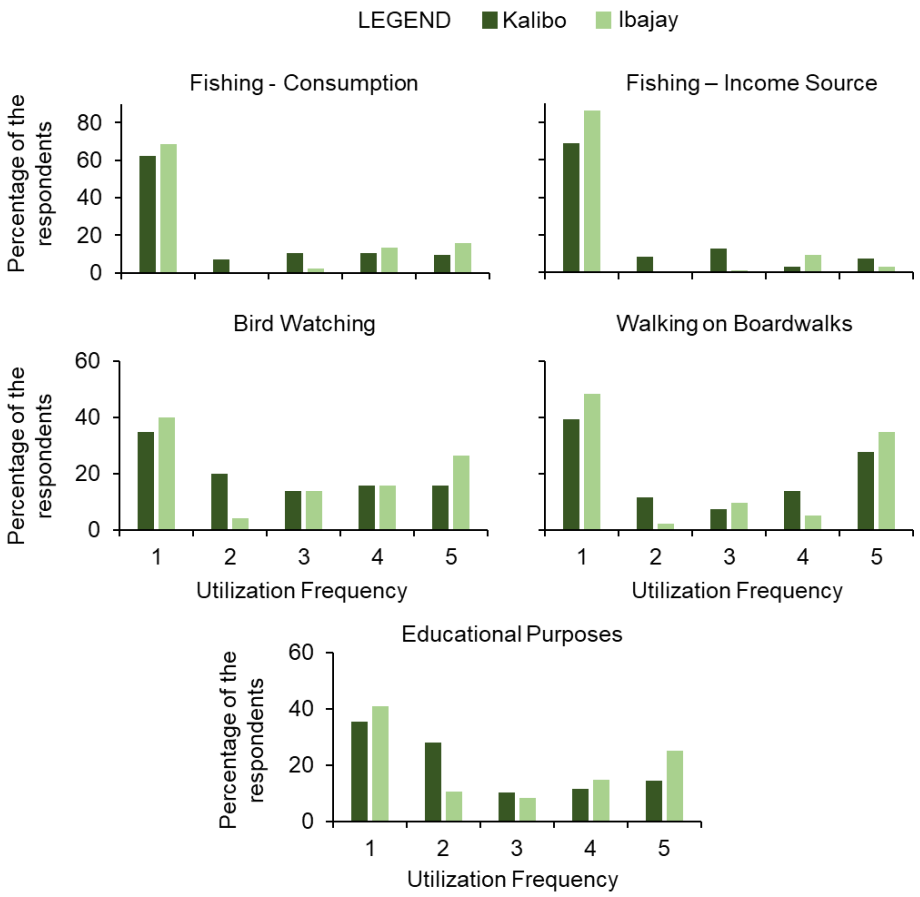


Figure 3.8. Respondents' utilization frequency (from 1 = never to 5 = every day) of provisioning and cultural services of mangroves (modified from Quevedo et al. 2021c).

Respondent's awareness level and utilization frequency are often correlated with each other as documented by previous studies (e.g., Zhang et al. 2016; Quevedo et al. 2021d). Correlation analysis was also conducted in this study. Table 3.6 shows the Spearman's rank (ρ) correlation coefficients with significant values being noted. For instance, in Kalibo, awareness of mangroves as a food source and fishing activities is positively correlated ($\rho = 0.21$, $p < 0.05$), suggesting locals who recognize mangroves as a food source will yield higher utilization rates. Meanwhile, in Ibajay, positive correlations are reflected between cultural service awareness and conduct of recreational activities like bird watching ($\rho = 0.35$, $p < 0.001$) and walking on boardwalks ($\rho = 0.40$, $p < 0.001$), implying higher frequencies of activities in the eco-parks if locals are more knowledgeable. However, there are also negative correlations observed in the results (Table 3.6). For example, in both sites (Kalibo: $\rho = -0.23$, $p < 0.05$, Ibajay: $\rho = -0.32$,

p < 0.001), respondents who have a higher awareness of mangroves as a recreational site will fish less while those who have low awareness will fish more in the mangrove areas. This negative relationship between cultural awareness and provisioning utilization is also observed in the perception study of Quevedo et al. (2020a) in Eastern Samar. Respondents enjoy mangrove areas as recreational sites rather than fishing grounds. Although awareness and utilization can influence each other to certain degrees, it is important to consider other factors (e.g., socio-demographics) to understand these relationships (Asah et al. 2014).

Table 3.6. Correlation analysis between respondents' awareness level and utilization frequency of mangrove ecosystem services (modified from Quevedo et al. 2021c).

Site	Ecosystem services	Provisioning and Cultural Services				
		Fishing - consumption	Fishing - income source	Bird watching	Walking on boardwalks	Educational purposes
Kalibo	Fish nursery			0.29**	0.33***	0.20*
	Habitat	0.30**	0.30**	0.40***	0.45***	0.40***
	Food source	0.21*	0.27**	0.31**	0.44***	0.37***
	Coastal protection		0.28**		0.44***	0.23*
	Natural buffer				0.48***	0.37***
	Air purification				0.35***	0.35***
	Carbon sequestration	-0.27**		-0.26**	0.34***	
	Recreational site	-0.23*		-0.25**	0.32***	
Ibajay	Fish nursery					-0.21*
	Habitat					
	Food source			-0.27**	-0.24*	
	Coastal protection	-0.45***		0.31**	0.32***	0.26**
	Natural buffer	-0.22*				
	Air purification				0.20**	
	Carbon sequestration				0.20**	
	Recreational site	-0.32***		0.35***	0.40***	0.42***

Note: *, **, ***correlation coefficients are statistically significant at p < 0.05, p < 0.01, and p < 0.001, respectively; only statistically significant correlations are shown.

3.2.4. Awareness and Participation in Mangrove-related Management Strategies

The respondents were asked about their awareness of different management strategies implemented by their respective local government offices. In Kalibo, 48% of the respondents

are “slightly aware” of the presence of coastal management plans while 14% are “not aware” at all (Figure 3.9). About 38% of the respondents comprise the “moderately” to “extremely aware” group of which only 12% are “extremely aware”. This pattern was observed throughout the perception survey on mangrove management schemes. For instance, 33%, 31%, and 39% are “slightly aware” of the occurrence of seminars/training, presence of national and local policies, and monitoring and evaluation activities, respectively, while 27% are “not aware” of the penalties for violating relevant laws/ordinances. Only a few percentages (2% – 4%) of the sample size are “extremely aware” of these management-related strategies. In contrast, 40% of the respondents in Ibajay are “extremely aware” of the coastal management plans while only a few (4% – 6%) of them are “slightly aware” (Figure 3.9). The big difference in the awareness of mangrove management-related strategies can be attributed to how information is being disseminated in the community. Anecdotal accounts from Kalibo revealed that information is sometimes limited within the member of POs and are not shared to the rest of community members unlike in Ibajay.

Despite the low awareness of the respondents observed in Kalibo, 76% of them perceived themselves to be the lead in management followed by LGUs, NGOs, and national government with 59%, 18%, and 11% of the sample size, respectively (Figure 3.10). This is also observed in Ibajay where the majority (73%) of the respondents identified themselves to be the lead of management efforts. This high recognition that they should lead the management activities is reflected in their participation. Overall, respondents’ participation in coastal management-related activities is fairly high, with 88% and 93% of the sample size participated in various coastal activities in Kalibo and Ibajay, respectively (Figure 3.11). Among the activities, mangrove planting and coastal clean-up received the most number of participants involving 50–74% and 68–90% of the respondents, respectively. Other activities like monitoring and evaluation, information and educational campaigns, and ordinance formulation

which are mostly executed by LGUs and POs have participation rates of 25–45%, 17–44%, and 5–18%, respectively.

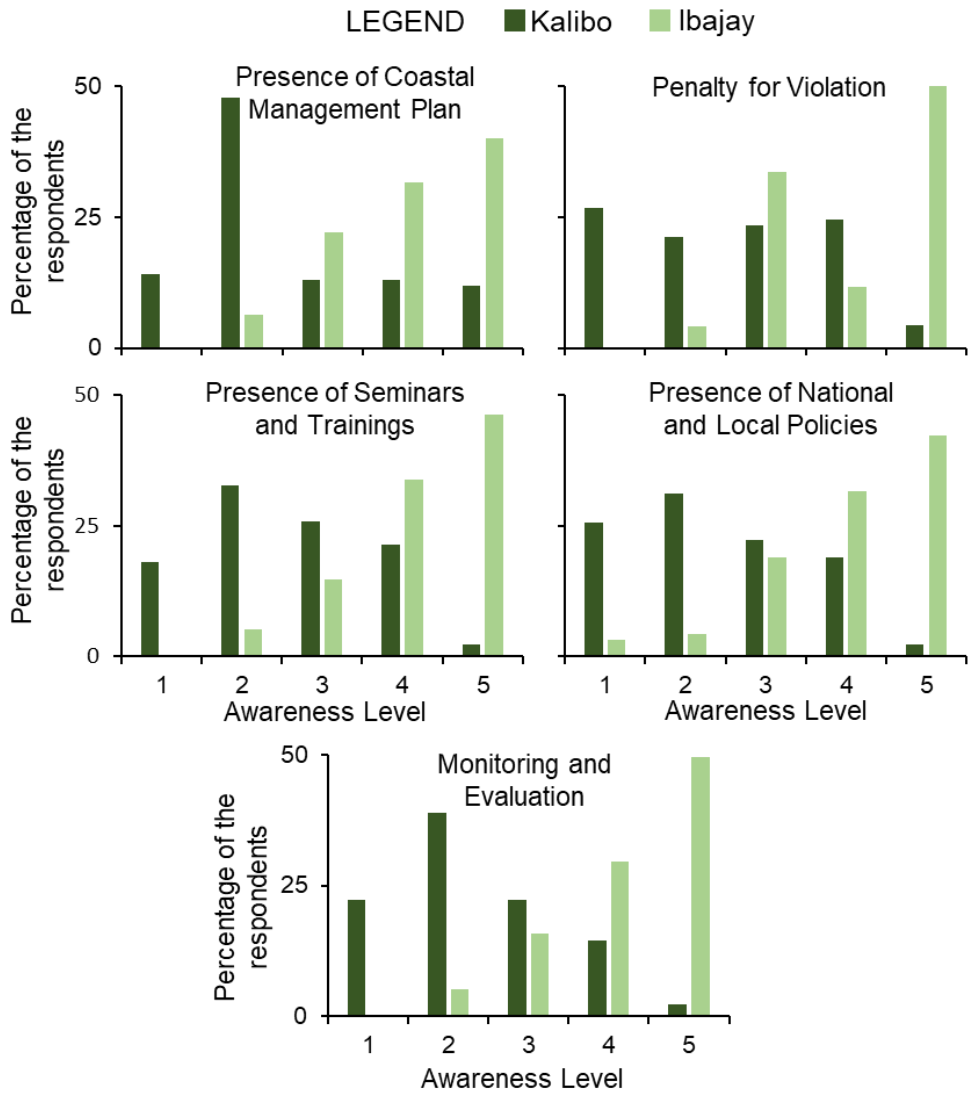


Figure 3.9. Respondents' awareness level (from 1 = not aware to 5 = extremely aware) of the LGU's mangrove-related management strategies (modified from Quevedo et al. 2021c).

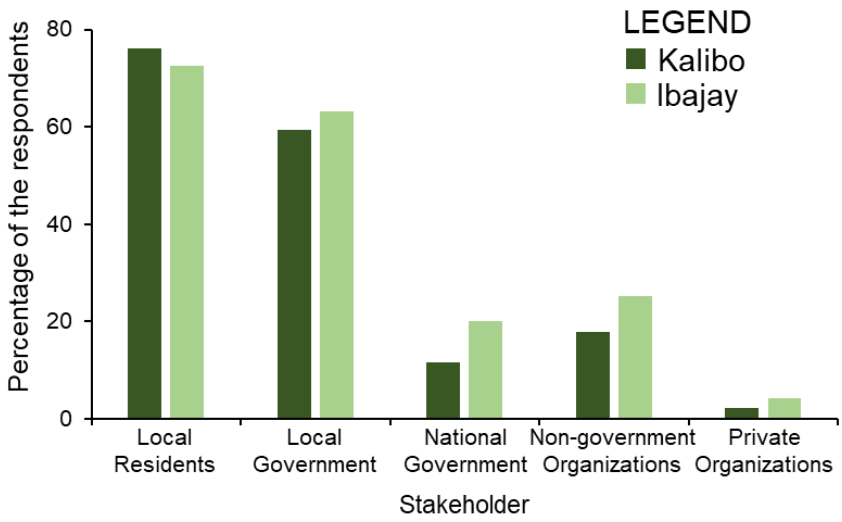


Figure 3.10. Respondents' perceptions on who should lead the management of mangrove ecosystems (modified from Quevedo et al. 2021c).

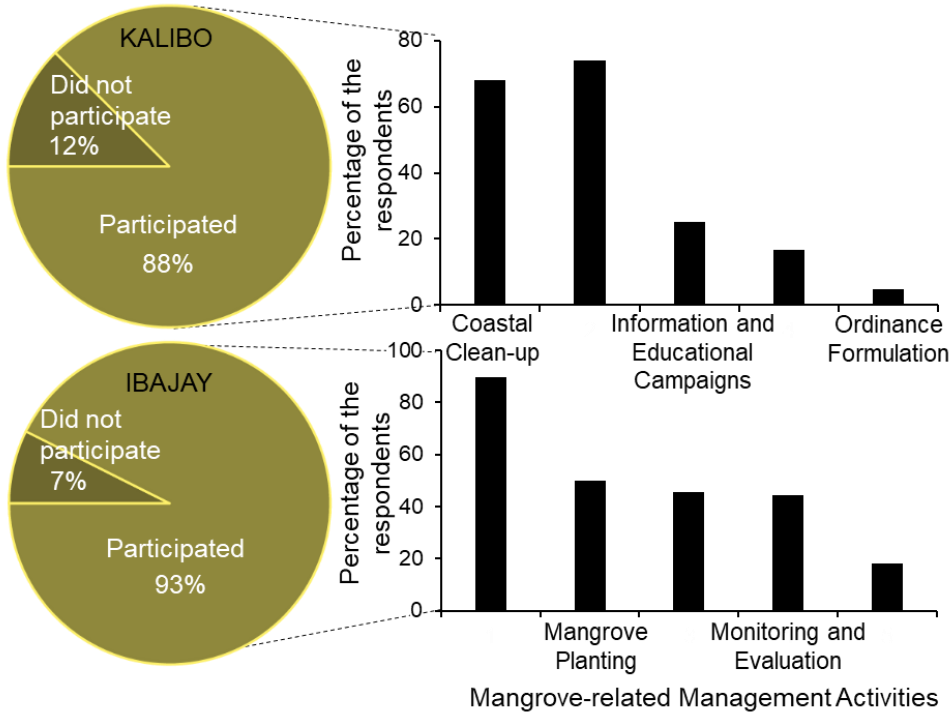


Figure 3.11. Respondents' participation on various mangrove-related management activities (modified from Quevedo et al. 2021c).

3.2.5. Perceived Impact of Mangrove Eco-parks

The mangrove eco-parks were established as means to protect mangroves, provide an alternative income and pride to local communities, and serve as an educational and

awareness tool (Primavera et al. 2012). This role is reflected in the perception surveys collected in this study. Overall awareness of mangrove ecosystem services is fairly high (Figure 3.7) which can be linked to the presence of eco-parks. To further examine the relationships between awareness and utilization, this study compared the awareness level between respondents who utilized and not utilized the eco-parks using a Mann-Whitney U test. Results of the comparative analysis linking awareness level to the utilization of cultural benefits (e.g., as a recreational site) showed that respondents who frequently access the eco-parks have higher awareness levels than respondents who have not used them (Table 3.7). For instance, 52% – 61% of the respondents who visited (Figure 3.8) the eco-parks for its boardwalks/eco-trails (refer to Figures 2.2 and 2.3 for photos), have higher awareness (3.49 – 4.64 in Kalibo and 4.16 – 4.65 in Ibajay) than those who have not visited (39% – 48% of the respondents) the eco-parks (2.84 – 3.95 in Kalibo and 3.65 – 4.00 in Ibajay). Similarly, 59% – 65% of the respondents who accessed the eco-parks for educational activities have higher awareness ranging from 3.56 to 4.58 in Kalibo and 4.30 to 4.68 in Ibajay than respondents who did not use them, with means ranging from 2.82 to 3.97 (former) and 3.67 to 3.85 (latter).

These findings agree with the investigation by Acanto (2016) wherein he associated respondents' high recognition of mangrove ecosystem services to the presence of Katunggan It Ibajay eco-park in Ibajay, particularly its ecological and economic importance. Meanwhile, in Kalibo, anecdotal accounts revealed that information and educational campaigns are held in the Bakhawan eco-park which this study interpreted to be a contributing factor for overall high awareness of the respondents (Table 3.7). These interpretations, however, are limited to the data presented in this study. Nevertheless, the results of this study concord with other observations from other studies. For example, Sawairnathan and Halimoon (2017) have documented that local's awareness of mangrove functions is influenced by their distance to

Kuala Selangor Nature Park in Malaysia. Another case study, also in Malaysia, by Ahmad (2009), has indirectly associated the knowledge capacity of coastal communities with the presence of the Larut Matang mangrove forest reserve. Similar patterns are also observed on a larger scale. For instance, Repka et al. (2017) highlighted how the National Parks of countries in the Visegrád Group have influenced the environmental awareness of the students in the area.

Table 3.7. Comparison of awareness level (mean) between respondents who utilized (U) and not utilized (NU) the mangrove eco-parks (modified from Quevedo et al. 2021c).

Site	Ecosystem services	Cultural or recreational activities					
		Bird watching		Board walking		Educational activities	
		U	NU	U	NU	U	NU
		Awareness Level (from 1 = not aware to 5 = extremely aware)					
Kalibo	Fish nursery			3.49	2.92		
	Habitat			3.59	2.84	3.56	2.82
	Food source			3.66	2.95	3.63	2.94
	Coastal protection			4.63	3.78	4.48	3.97
	Natural buffer			4.41	3.27	4.35	3.26
	Air purification			4.51	3.95	4.58	3.76
	Carbon sequestration			4.17	3.27		
	Recreational site			4.64	3.70	4.47	3.94
Ibajay	Fish nursery						
	Habitat						
	Food source						
	Coastal protection	4.47	3.76	4.55	3.80	4.50	3.74
	Natural buffer			4.16	3.65		
	Air purification			4.33	3.74	4.30	3.67
	Carbon sequestration	4.28	3.71	4.31	3.78	4.32	3.67
	Recreational site	4.58	3.97	4.65	4.00	4.68	3.85

Note: Only statistically significant results ($p < 0.05$) are shown.

Aside from promoting mangrove awareness, mangrove eco-parks can boost local economies (e.g., Dehghani et al. 2010; Uddin et al. 2013). Particularly, mangrove eco-parks that are locally managed by communities can serve as a valuable income source to residents. The more locals used the eco-parks, the higher the income will be generated from the entrance and other fees. Acanto (2016) has documented that the locals are willing to pay for the entrance and conservation fees to enjoy the sceneries and services offered by the eco-park. In this study, the economic importance of eco-parks was evaluated through the utilization trends (Figure 3.8).

The observed patterns related to recreational activities (e.g., bird watching) suggest incomes (e.g., from entrance fees) are being generated. Based on the context that higher utilization yields more income, it is important to understand the utilization behavior of the respondents to maximize the potential of eco-parks in generating income. So, in this study, respondent's utilization frequency was correlated with their awareness. Results (Table 3.6) showed significant correlations suggesting that as the awareness level increases, utilization rate increases too, and vice versa. In Busuanga Island, Quevedo et al. (2021d) have documented that the frequency of using mangrove areas for recreational activities positively correlates with local's knowledge of mangroves' cultural values. Although there's a correlation between awareness and utilization, it is important to look at other factors to understand better these relationships (e.g., Martín-López et al. 2012; Moutouma et al. 2019) since people's perceptions of ecosystem services and their social-environmental context is a complex relationship (Quintas-Soriano et al. 2018). The interpretations presented in this work are based on the data collected and applicable analyses only. This study recommends that a more in-depth analysis of these relationships can be considered in future studies.

Public's perceptions of coastal ecosystems are oftentimes influenced by the presence of coastal management strategies like coastal plans, policies, and educational campaigns (e.g. Wortman et al. 2006). In the Philippines, mangrove eco-parks serve as a great venue for educating the public about coastal management strategies (Primavera et al. 2012). Although this study did not specifically account for the presence of eco-parks to questions on coastal management strategies (see Appendix C), the results suggest the potential impact of its presence. In Ibajay, for example, overall perceptions of the respondents are relatively high with 40% – 51% of them are "extremely aware" of the mangrove-related programs (Figure 3.7) and the majority (93%) of them participated in coastal management activities (Figure 3.11). This can be due to the strong involvement of local groups (POs) in managing the eco-park (Acanto

2016), which, in turn, could circulate the information to other members of the community. Moreover, the active participation of the respondents corresponds well with their perceptions that they should take the lead in managing the mangrove forests (Figure 3.10). As pointed out by Camacho et al. (2020), a community-based mangrove management approach encourages participation and commitment of local communities while Kongkeaw et al. (2019) highlighted strong leadership and capacity to organize activities lead to the success of management schemes. Conversely, in Kalibo, despite similar trends with Ibajay in terms of participation (Figure 3.11) and recognition of who should manage (Figure 3.10), the awareness level of coastal management plans/programs are relatively low, with 48% of the respondents are "slightly aware" and 14% are "not aware" (Figure 3.7). During the conduct of the surveys, some respondents shared how the information on coastal management schemes sometimes does not reach them. This scenario on weak information dissemination is a common problem that hinders the success of coastal management in the Philippines (CRMP 2003). Although not directly implied, the results point out the vital role of mangrove eco-parks in circulating management-related programs, which is an important factor in engaging local stakeholders in coastal management practices (White et al. 2006).

As a public infrastructure, the status of awareness and participation of locals in the management of BCEIs is instrumental. In this study, a potential ideal cycle of raising awareness and facilitating the participation of locals is detected, with mangrove eco-parks as a contributing factor to generating the cycle. Although the area of mangrove eco-parks, the scope of this study, is rather limited in the overall mangrove area of the country, the potential roles of eco-parks to generating such promising cycle and related mainstreaming effects are identified. These findings can serve as bases for future plans.

3.3. BCE Perception Analysis – Busuanga Island

3.3.1. Introduction

This study presented a good opportunity to show how people perceive BCEs, their services, and management status because of local communities depending on them. This study also highlighted how tourism industry in island affects the BCEs and how they can be linked together. The former is presented in this chapter while the latter is presented in Chapter 5. For consistency and clarity in data presentation and discussion, 'Busuanga Island' will be used instead of 'Busuanga'.

3.3.2. Socio-demographic Profile of the Respondents

Table 3.8 shows the socio-demographic characteristics of the respondents from Busuanga Island (n = 98). The respondents are almost equally distributed in terms of gender (male is 51% and female is 49%) with a mean age of 44 years old. The majority (76%) of the respondents is living in the neighborhood since birth, while others, about 11%, are relatively new in the area (5–10 years). In terms of formal education, 51% of the locals have finished primary school while 33% have completed secondary school. A few percentages (5%) of the respondents have finished tertiary education. About 11% of the respondents did not finish formal education. Moreover, in terms of occupation, salaried individuals (daily, weekly, or monthly earners) covering part-time workers, skilled workers, and government employees comprised 41% of the total interviewees while 23% are fishermen and 5% are farmers. The unemployed group accounts for 31% of the total respondents.

Table 3.8. Socio-demographic characteristics of Busuanga Island's respondents (modified from Quevedo et al. 2021d).

Indicators		Busuanga Island (n = 98)	
		Frequency (No)	Percentage (%)
Age			
	20-30	20	20
	31-40	22	22
	41-50	23	23
	51 and above	33	34
Gender			
	Male	50	51
	Female	48	49
Education			
	No formal education	11	11
	Primary	50	51
	Secondary	32	33
	Tertiary	5	5
Occupation			
	Fisher	23	23
	Farmer	5	5
	Salaried Individual	40	41
	Unemployed	30	31
Years living in the area			
	since birth	74	76
	5-10 years	11	11
	11-15 years	8	8
	16-20 years	5	5
	more than 20 years	0	0

3.3.3. Awareness and Utilization of BCE Services

The awareness level of mangrove ecosystem services in Busuanga Island is fairly consistent, where 28% to 36% of the respondents are "very aware" of all the benefits (e.g., source of food, coastal protection, carbon sequestration, a habitat of many organisms, and cultural services) listed in the questionnaire while only 10% to 22% are "not aware" of these benefits (Figure 3.12). They have high recognition of mangroves because of their tangible benefits. Field observations and oral accounts documented that locals collect fish and shells in mangrove areas when their financial capacity to buy food is limited. This scenario is highly

common among coastal communities in the Philippines. Some locals are getting paid for assisting recreational activities such as firefly watching and paddling in mangrove areas. Moreover, coastal residents have first-hand experience with the protection services of mangroves when the super typhoon Haiyan hit the country in 2013. Quevedo et al. (2020a) have documented that mangrove services are highly recognized by the people when they are directly benefited by them; the more services they can get or observe, the higher they value the ecosystem.

Meanwhile, the recognition of seagrass benefits depends on the type of service (Figure 3.12). For instance, 50% to 60% of the respondents are “moderate” to “extremely aware” that seagrass beds serve as a source of food, habitat, nursery, feeding and breeding ground of many organisms, and site for cultural activities, whereas, regulating services such as coastal protection and natural buffer are poorly known (“not aware”) with 43% to 46% of the respondents. Another regulating service that the locals are not so familiar with is the capacity of seagrasses to sequester and store carbon; a little over half (54%) of them are aware while 46% are “slightly aware” to “not aware”. Unlike mangroves, seagrass ecosystem services are not well streamlined in coastal programs or often grouped with other ecosystems because the priorities for research and development activities are usually directed towards coastal resources with immediate economic impacts (Quevedo et al. 2021e). However, C3 Philippines, an NGO, is changing this trend. This group has already conducted several seagrass awareness campaigns (including blue carbon functions) on the island as part of their thrusts on the Dugong conservation program (program coordinator of C3 Philippines, personal communication, 19 July 2019).

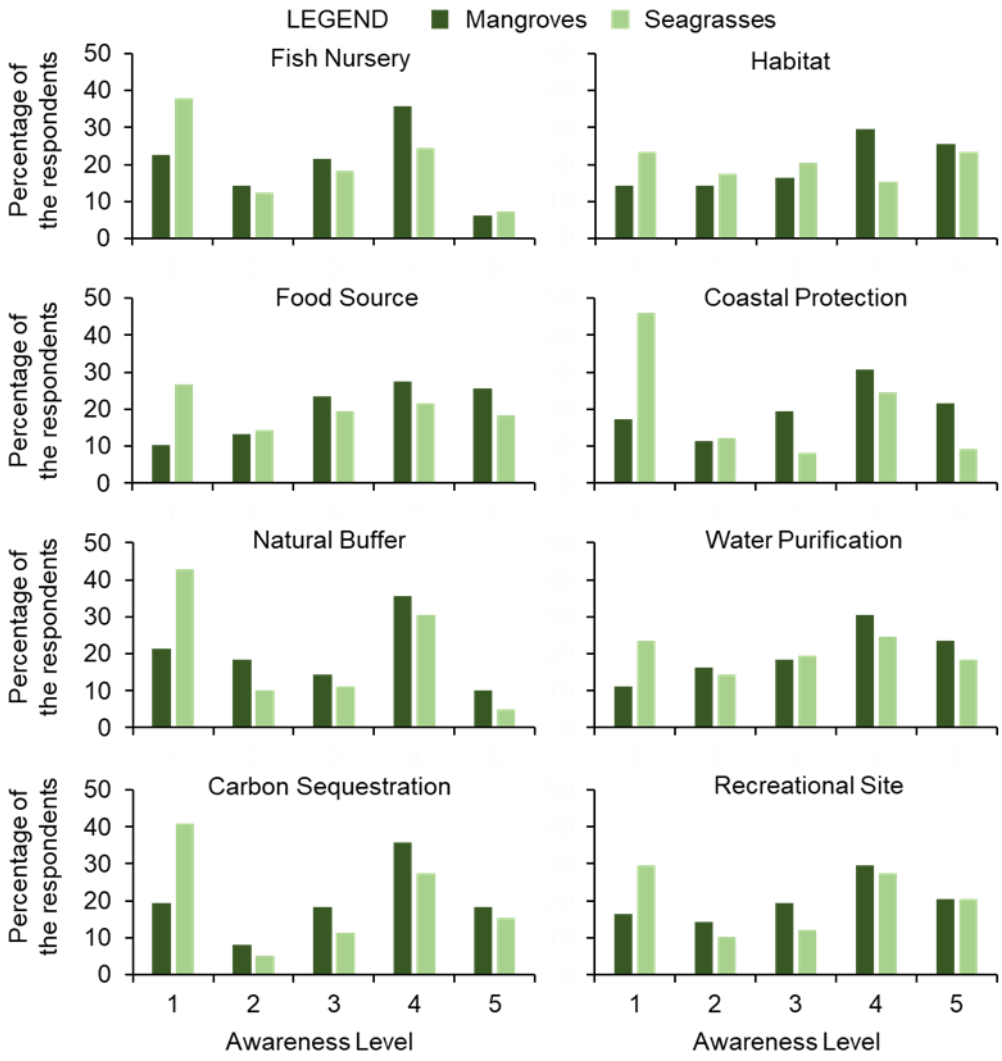


Figure. 3.12. Awareness level (from 1 = not aware to 5 = extremely aware) of BCE services (modified from Quevedo et al. 2021d).

Generally, the utilization frequency of provisioning and cultural services of BCE services in Busuanga Island is generally low despite residents' proximity to these resources (Figure 3.13). Twenty-eight percent (28%) of the respondents have collected fishes and other seafood in mangrove areas at least "once a week" and 23% have done it once a month while the majority, about 34%, have "never" done it. About 26% of the respondents have collected seafood as an income source "once a week", although a bigger portion (48%) have "never" utilized mangroves as their livelihood source. In terms of cultural services, majority of the respondents about 43% and 76% have "never" visited this habitat for bird or bat watching and paddling activities, respectively. Roughly 91% of the participants have "never" accessed the

mangrove areas for research or educational purposes. Meanwhile, utilization frequency of provisioning and cultural services of seagrass ecosystem is relatively low; about 53%, 66%, 84%, 82%, and 93% of the respondents have "never" used them for food source, livelihood source, snorkeling, and educational purposes, respectively (Figure 3.13).

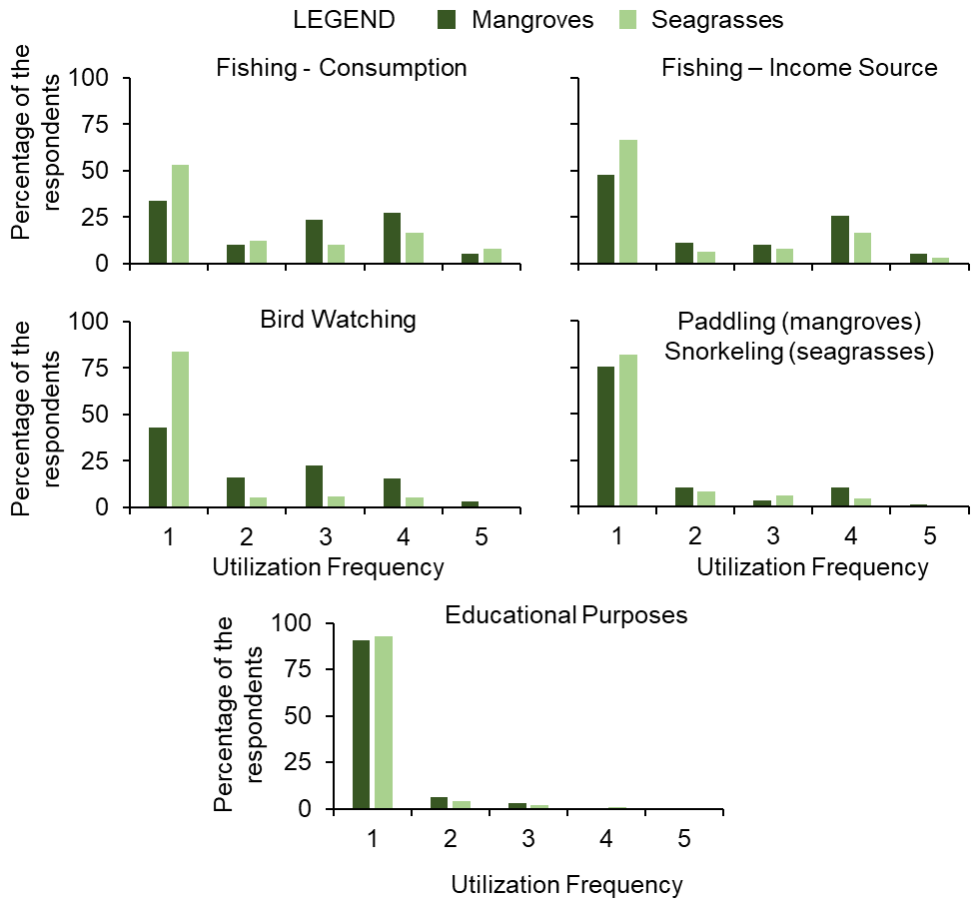


Figure 3.13. Respondents' utilization frequency (from 1 = never to 5 = every day) of provisioning and cultural services of BCEs (modified from Quevedo et al. 2021d).

Using correlation analysis, awareness level and utilization behavior of the respondents were explored to determine whether the former influences the latter. Results showed significant and positive associations between the two variables in the island indicating that the awareness level of the respondents can affect the way they use or access the BCE services (Table 3.9). For instance, high (low) perception of provisioning and cultural services of BCEs will result in more (less) frequent utilization of services like fishing for consumption (ρ = 0.255, $p < 0.01$)

and recreational activities in mangroves (ρ = 0.287, p < 0.01) and fishing for income source (ρ = 0.659, p < 0.01) and bird watching (ρ = 0.311, p < 0.05) in seagrass beds.

Table 3.9. Correlation analysis between respondents' awareness level and utilization frequency of BCE services (modified from Quevedo et al. 2021d).

Ecosystem services		Provisioning and Cultural Services				
		Fishing - consumption	Fishing - income source	Bird watching	Paddling/ Snorkeling	Educational purposes
Mangrove ecosystems	Fish nursery				0.225**	
	Habitat	0.278***		0.194*	0.443***	
	Food provision	0.255***			0.381***	
	Coastal protection	0.200**		0.254***	0.198**	
	Natural buffer	0.337***	0.297***		0.300***	
	Water purification	0.353***	0.377***	0.282***	0.228**	
	Carbon sequestration	0.192*	0.299***	0.274***	0.305***	
	Recreational Site	0.261***	0.283**		0.287***	0.171*
Seagrass ecosystems	Fish nursery	0.198**		0.266***	0.376***	
	Habitat	0.257***	0.217**	0.239**	0.252***	
	Food provision	0.320***	0.255***	0.181*	0.305***	
	Coastal protection		0.234**	0.297***	0.265***	
	Natural buffer	0.280***	0.411***	0.184*	0.279***	0.209**
	Water purification	0.355***	0.318***	0.174*		
	Carbon sequestration	0.218**	0.343***	0.179*	0.200**	
	Recreational Site	0.240**	0.251***		0.227**	

Note: *, **, ***correlation coefficients are statistically significant at p < 0.10, p < 0.05, and p < 0.01, respectively; only statistically significant correlations are shown.

3.3.4. Perceived Threats of BCEs

The residents were asked to rank the threats based on their perceptions from most (1) to least (10) damaging threats (Table 3.10). Natural disturbances like typhoons resulting in strong waves and storm surges are perceived to be the most damaging threat to BCEs in Busuanga Island. About 49% and 40% of the respondents of Busuanga Island have identified natural disasters (e.g., typhoons, storm surges) to be the most (1st) concerning threat to mangrove and seagrass ecosystems, respectively. The residents highly recognized natural calamities to destroy BCEs since they have personal experiences and observations. For example, when the super typhoon Haiyan devastated the Philippines in 2013, it caused significant damage to BCEs in the country (Villamayor et al. 2016). During the conduct of

household surveys, many residents recalled and shared their observations on how the super typhoon destroyed the BCEs. Similar findings were also documented from the residents in Eastern Samar where the super typhoon first hit the country (Quevedo et al. 2020a).

Table 3.10. Perceived threats of BCEs (modified from Quevedo et al. 2021d).

	Perceived Threats	Mode[ab]	Percentage	Weighted Mean[b]
Mangrove Ecosystems	Natural disasters	1	49	3.2
	Pollution (domestic wastes)	2	35	2.8
	Informal settlers	6	21	5.1
	Increasing population	5	31	5.7
	Charcoal making	4	35	3.6
	Conversion to nipa and coconut	8	36	7.2
	Mangrove cutting	2	19	3.9
	Building infrastructures in coastal areas	7	27	6.5
	Conversion to residential areas	9	51	7.7
	Conversion to fishponds	10	65	8.9
Seagrass Ecosystems	Natural disasters	1	40	3.3
	Pollution (domestic wastes)	1	44	2.1
	Increasing population	3	22	5.5
	Building infrastructures in coastal areas	4	17	5.7
	Mangrove planting on seagrass beds	4	18	5.4
	Sand mining	6	16	5.4
	Unregulated gleaning	6	21	6.6
	Siltation	6	17	5.5
	Beach reclamation	9	34	7.4
	Increasing sea surface temperature	10	52	8.4

Note: [a]most frequently occurring response, [b]measured from most (1) to least (10) damaging threats.

Pollution from domestic wastes was also recognized to be one of the top concerning threats of BCEs (Table 3.10). It was ranked second in mangroves by 35% of the respondents while it occupied the top spot in seagrasses by 44% of the respondents. The lack of discipline and effective solid waste management systems are common factors that propagate increasing pollution pressure to BCEs (Quevedo et al. 2021a). Other concerning threats to mangroves include illegal harvesting for firewood and charcoal-making. This problem has been a consistent challenge to address since local communities have direct access to mangrove forests

(Primavera 2000); however, a recent survey in the locality has shown a decline in illegal activities due to the presence of local ordinances and national policies (e.g., Quevedo et al. 2020a).

Conversion to fishponds was identified as the least concerning threat (65% of the respondents) of mangrove forests since there are no converted aquaculture ponds on the island (Table 3.10). This is noteworthy since conversion to fishponds was one of the main causes of rapid mangrove degradation in the country in the early years (Primavera 2000). Current programs and policies (e.g., Coastal Resource Management (CRM) and Integrated Coastal Management (ICM) and Revised Forestry Code of the Philippines [Presidential Decree No. 705]) at the local and national level have reduced these activities. Meanwhile, perceived threats specific to seagrasses include mangrove planting on seagrass beds (18%), unregulated gleaning (21%), and siltation (17%). These pressures from human activities could result in a cascading effect on the whole coastal ecosystem. For instance, unregulated gleaning could result in biodiversity loss (Nordlund et al 2013). In the Philippines, cases of seagrass and associated organisms' decline were perceived and attributed to these human-induced stressors (Fortes 2013). Beach reclamation and increasing sea surface temperature are perceived to be the least threats, occupying the 9th (34%) and 10th (52%) places, respectively.

Since Busuanga Island is a well-established tourism site in the country, the perceived effect of tourism activities on BCEs was also gathered in this study. Based on the household surveys, respondents observed that the BCEs are relatively improving (Figure 3.14). BCEs cover was perceived to be "improving" by 52% – 59% of the respondents while only a few of them (4% – 5%) have observed it to be "degrading". Conservation efforts and accessibility of BCEs were also perceived to be "improving" by the majority (46% – 62%) of the respondents. The availability of fishes and other seafood that are sourced out in BCEs was also perceived by the respondents to be not affected, suggesting that there is no shortage of stocks.

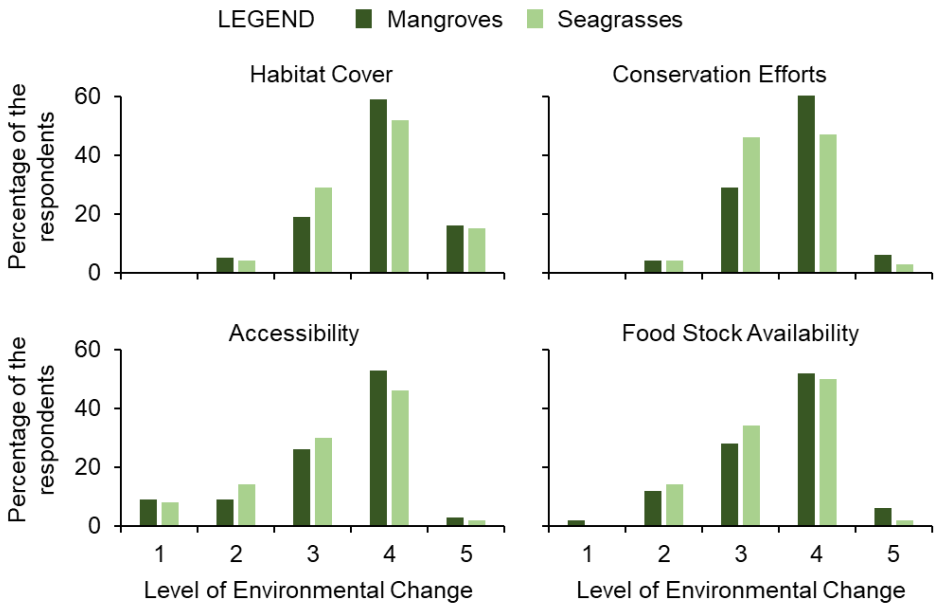


Figure 3.14. Respondents' perceived environmental change (from 1 = very much degrading to 5 = very much improving) caused by tourism activities to BCEs (modified from Quevedo et al. 2021b).

3.3.5. Perceived Management Strategies of BCEs

In recent years, marine ecosystems in Busuanga Island have improved due to the presence of regulatory bodies (e.g., PCSD and the Fisheries and Aquatic Resources Management Councils or FARMCs), local authorities (e.g., municipal agriculture office), and civil society organizations (CSOs) (e.g., the NGO, C3 Philippines, and different POs). These agencies/bodies empower communities to join management-related activities. With this, the residents prefer that organizational strengthening and capacity development and law enforcement should be prioritized first in the list of management strategies. As shown in Table 3.11, 31% and 23% of the respondents in Busuanga Island have recognized "Organization strengthening and capacity development" and "Coastal and fisheries law enforcement" as the top strategies that need to be prioritized. These perceptions relate to the findings of Austin and Eder (2007) that community-based management has not been successful because communities lack self-sufficiency and their participation is merely rhetorical. There is a need to strengthen

and capacitate communities in coastal management. Previous studies have documented that the ecosystems' (e.g., mangroves) conditions in the island have improved through collaborative protective management with the POs (D'Agnes et al. 2010) and a stronger presence of NGOs in the communities (Austin and Eder 2007). To further strengthen management strategies, FARMCs and POs have encouraged local constituents and members to actively participate in management-related activities such as coastal clean-up and mangrove planting. The positive reception of the locals in these initiatives could explain why a majority (73% – 74%) of the respondents said "local residents" should manage their BCEs (Figure 3.15). Other areas in the Philippines have had practices where locals are active stakeholders in the management of BCEs (Gevaña et al. 2019).

The continued degradation of coastal resources on the island has also been linked to the weak presence and enforcement of habitat protection and management interventions (Magbanua et al 2007). Field observations and stories from the locals revealed that some illegal activities like mangrove cutting are still ongoing partly because of weak law enforcement. There is also a concern for the ambiguity and overlapping roles of government organizations and NGOs, which can cause frustration and even conflict in the community (Austin and Eder 2007). Thus, it is important to establish different policies and plans for organizations in the community. For the lowest priority strategies, residents ranked "Information and educational campaigns" (29%) and "Coastal zoning" (28%) at the bottom (Table 3.11) since these programs are already implemented on the island. Awareness campaigns are done by C3 Philippines as their primary environmental protection and biodiversity conservation efforts, an NGO, for coastal communities around the island (Quevedo et al. 2021a) while PCSD regulates the use of the coastal zone.

Table 3.11. Perceived BCEs-related management strategies (modified from Quevedo et al. 2021b, d).

Perceived Management Strategies	Mode[ab]	Percentage	Weighted Mean[b]
Organization strengthening and capacity development	1	31	2.8
Coastal and Fisheries Law Enforcement	1	23	3.3
Fisheries Management	4	19	3.5
Habitat management and marine sanctuaries	3	22	4.1
Enterprise, livelihood, and tourism development	5	23	4.3
Information and educational campaigns	6	29	4.8
Coastal zoning	6	28	4.1
Perceived Sustainable Tourism measures	**Mode[ac]**	**Percentage**	**Weighted Mean[c]**
Strengthening the environmental regulations	4	65	4.2
Strict implementation of local plans and policies	4	61	4.2
Cooperation with non-government organizations and private sectors	4	58	4.0
Prioritize conservation of natural resources	4	58	4.3
Promote ecosystem-based tourism plan	4	59	4.1
Promote protection of the environment	4	54	4.1
Promote safety and carrying capacity strategies	4	53	4.0
Cater the needs of tourists as well as the locals	4	59	4.0
Inclusion of the welfare of local stakeholders and Indigenous people	4	52	4.0
Hiring of local people	4	56	4.1
Sustainable and environment-friendly infrastructures	4	58	4.2
Development in appropriate land areas	4	60	4.1

Note: [a]most frequently occurring response, [b]measured from top (1) to least (7) priority management strategies, [c]measured using 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

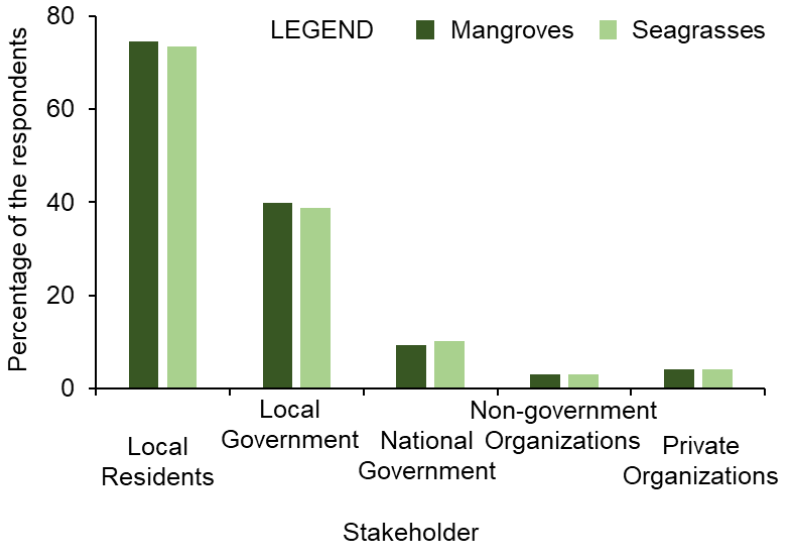


Figure 3.15. Respondents' perceptions on who should lead the management of BCEs (modified from Quevedo et al. 2021d).

In terms of perceived sustainable tourism measures, residents in the island agree, with varying degrees, of the suggested strategies (Table 3.11). Among the proposed actions, environment-related plans received high recognitions; “Prioritize conservation of natural resources” has the highest mean (4.3) followed by “Strengthening the environmental regulations” (4.2). Also, “Sustainable and environment-friendly infrastructures” has been acknowledged fairly by 60% of the respondents with a mean of 4.2. Overall, the respondents are highly perceptive of what sustainable tourism should be on the island and in agreement that protecting their resources is a necessary step moving forward. Sustainable tourism should aim for the balance between environmental protection and economic development while improving the local economies and people’s well-being (Dedeke, 2017).

Chapter 4. Policy-making and Implementation Perspectives

Although much has been done in the past in terms of overall coastal management strategies in the Philippines through, for example, CRM and ICM, the complex marine environment, which includes the BCEs, remains to be highly vulnerable to anthropogenic processes (Elliott et al. 2017). The BCEs in the country have been continuously declining mainly due to overexploitation (e.g., cutting of mangroves for charcoal making) by coastal residents and land-use conversion (e.g., coastal development induced by rapid urbanization and tourism development) (Primavera 2000; Fortes and Santos 2004). There is, therefore, a need to better understand the linkages between the environment and human particularly at the local level where people benefit from as well as impact the BCEs, how decision-makers perceive the challenges and measures, and how to design suitable management and communication strategies for all stakeholders (Lewison et al. 2016).

This chapter highlights two studies that aim to answer two main research questions presented in Chapter 1: (i) if BCEs are degraded, what are the causal relationships and corresponding solutions and (ii) what are the existing BCEs management strategies at the local level. By doing so, this chapter aims to capture the policy-making and implementation aspects of BCE management in the country. The first study (4.1) addressed the former question by determining cause-effect linkages of BCEs degradations through interviewing key policy-makers and thematically analyzing the information gathered using the Drivers-Pressures-State-Impact-Response (DPSIR) framework in Busuanga Island (Quevedo et al. 2021a) while the second research (4.2) answered the latter question by evaluating the present coastal management plans for BCEs management implementation in Eastern Samar and Aklan utilizing content analysis (Quevedo et al. 2021e).

4.1. Thematic Analysis – BCEs Assessment Applying the DPSIR Framework

4.1.1. Introduction

The Drivers-Pressures-State-Impact-Response (DPSIR) framework is a holistic problem-structuring tool that can be used to identify the causes, effects, and responses to change by unifying social and natural sciences, with the motivation to inform and support policy-makers (Lewison et al. 2016; Patrício et al. 2016; Ramos-Quintana et al. 2018). As a systems model, DPSIR has long been utilized in integrating and providing structure to the management of a complex marine environment (Atkins et al. 2011; Gari et al. 2015; Lewison et al. 2016; Patrício et al. 2016). The key strength of this framework is that it can identify the relationships in environmental management by establishing a chain of causal links from 'driving forces' which put 'pressures' in the society's 'state', thereby resulting in certain 'impacts' that will lead to various 'responses' (Figure 4.1) (Kristensen 2004; Jago-on et al. 2009). Because the model can be used to integrate knowledge across multiple disciplines, it can be applied both qualitatively and quantitatively and with which can potentially bridge the gap between scientific disciplines and link science to policy and management (Tscherning et al. 2012; Lewison et al. 2016).

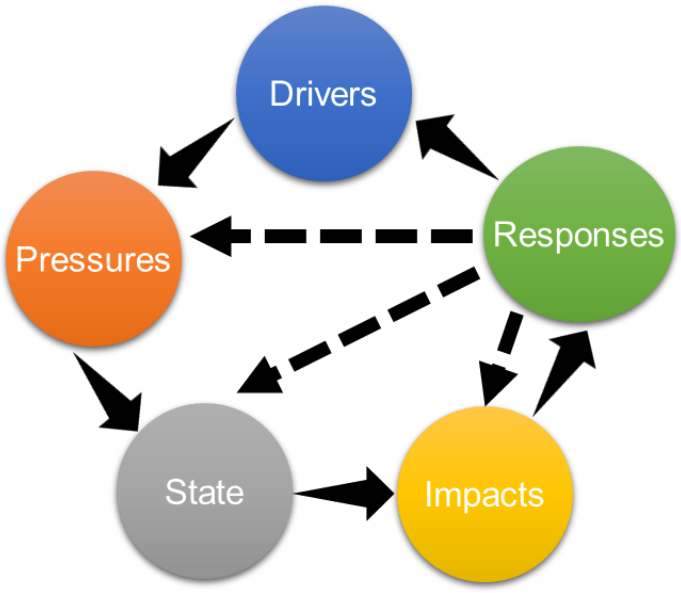


Figure 4.1. The DPSIR Framework (modified from Gabrielsen and Bosch 2003).

This framework has been utilized in various studies on marine and coastal habitats assessments. Patrício et al. (2016) conducted a comprehensive review of the application of the DPSIR framework in coastal ecosystems. Their study revealed that after two decades, the use of the model has evolved; with 25 derivative approaches in structuring and analyzing information in management and decision-making across ecosystems. Before this study, Lewison et al. (2016) reviewed literatures covering 24 papers on the application of the framework as a tool to organize and support scientific research and transdisciplinary knowledge in understanding the functions, processes, and components of coastal ecosystems and how this approach can help the ocean and coastal policy and management outcomes. Gari et al. (2015) have also studied 79 published and gray literature sources involving eight DPSIR derivatives for coastal social-ecological systems. These studies have shown the wide applicability of the framework for a holistic assessment of marine and coastal ecosystems.

Where most applications of the DPSIR model are focused on integrated marine and coastal habitats, a few studies highlight usage to specific habitats such as the BCEs. For instance, Sarmin et al. (2016) have identified, analyzed, and evaluated the anthropogenic factors (e.g., agriculture, aquaculture, and urbanization) of mangrove changes and the impacts of deforestation in Johor, Malaysia using the DPSIR model. In the city of La Paz, Mexico, Ávila-Flores et al. (2017) have documented tourism, urban growth, and waste as the pressing factors that affect the mangrove communities using the framework as an assessment tool. Applications of DPSIR to seagrasses include: examining the loss and degradation of Mediterranean seagrass beds with implications to future changes in socio-economic drivers and policy (Jackson et al. 2010) and identifying the main drivers, pressures, state, and impacts causing the decline of seagrasses and provide potential management schemes for its protection in the Ria de Aveiro lagoon, Portugal (Azevedo et al. 2013).

Patrício et al. (2016) reviewed comprehensively the use of DPSIR after two decades which showed that the framework is needed and had evolved in approach for coastal ecosystems management. Moreover, their study illustrated that there are now 25 derivatives of the framework, for instance, DAPSI(W)R(M) which added 'A', 'W', and 'M' components that stands for 'Activities', impacts on 'Welfare', and responses using 'Measures'. Although there are now variations in the original model, its applications still remain to be criticized. Nevertheless, DPSIR functions well by identifying and simplifying issues for decision-makers because it can integrate knowledge from different disciplines and stakeholders, which, in turn, can be utilized to develop management indicators of small-scale environmental problems (Tscherning et al. 2012). Recent literatures recommend the application of the DPSIR model along with other methods such as quantitative and synthetic approaches to show more synergistic cause-effect relationships among the various elements of marine ecosystems and include all relevant stakeholders to ensure responses are suitable for a specific environmental problem (Lewison et al. 2016). Moreover, DPSIR, to be effectively used, requires the merging and cooperation of natural and social scientists and thus involves multi- and cross-disciplinary approaches (Patrício et al. 2016).

Reflecting on these existing lessons, this work used the DPSIR model to assess the coastal environment with an emphasis on the BCEs and their management from local (e.g. head of community organizations) and central government (e.g. municipal officers) perspectives. These two perspectives were integrated since they are both important stakeholders of coastal management and utilizing their perceptions can give a better holistic view of the current state of BCEs at the local scale. By identifying the DPSIR indicators, this study aims to (1) provide a general assessment of coastal ecosystems with an emphasis on BCEs and their management, and (2) reflect potential cause-effect linkages especially at the community level to help the local government units in policy-making.

4.1.2. Challenges of Using the DPSIR Model

Although the DPSIR framework has been used widely, it received many critiques and limitations that are very important to address when using the framework (Gari et al. 2015). Carr et al. (2007) mentioned four (4) criticisms to this framework: (1) it sets a group of indicators to serve as a foundation for analysis that may not capture the changing dynamics of the systems in questions, (2) it cannot reflect trends except by repeating the study of the same indicators at regular intervals, (3) it does not clearly illustrate the cause-effect linkages for environmental problems, and (4) it suggests linear, unidirectional causal chains in the context of complex environmental problems.

One of the challenges in using the framework is the definition and interpretation of the different components. For instance, the use of 'D' and 'P' indicators are inconsistent and commonly utilized interchangeably (Gari et al. 2015; Oesterwind et al. 2016) such as 'climate change' where some studies define it as a driver (MEA 2005) while others refer to it as a pressure (Omann et al. 2009). Similarly, 'I' indicators are oftentimes used to refer to 'state changes' as impacts of society on the environment (Atkins et al. 2011). The interpretation of P-S links can vary whether from natural or social science perspectives, for example, natural scientists can provide a high degree of detail of the pressures and corresponding state changes of the environment while social scientists can give fewer details on the P-S links but more on solving problems (responses) through management (Patrício et al. 2016). Also, there is another concern about its ability to depict the real picture. The strength of the DPSIR was that it was originally aimed to cross-cut the different sectors and ecosystems by relatively simple causal relationships of the indicators, however, many have argued that it cannot capture the complexity of environmental problems and dynamics of the systems (e.g., Carr et al. 2007; Svarstad et al. 2008). For example, DPSIR focuses on one-to-one relationships thereby simplifying and disregarding the nuanced interactions like the effects of multiple pressures

(termed cumulative effects) arising from a single activity and the multidirectional impact of indictors to one another (Atkins et al. 2011; Patrício et al. 2016). Carr et al. (2007) documented that the framework's structure does not deal with different level of drivers and responses such that analyses often target global or at least national level, and if applied at the local level, would require careful consideration of how the model organizes and incorporates aggregated impacts of local and informal responses on drivers, pressures, and states changes. Moreover, there's a challenge of linking the 'S' and 'R' or status (monitoring science) and response (policy), which if successfully illustrated in the framework could be a powerful and attractive discourse for both scientists for their output and policy-makers for legitimacy and justification of their policy.

This study acknowledges the challenges of using the DPSIR framework. Despite the availability of DPSIR derivatives, this study utilizes the original framework (Gabrielsen and Bosch 2003; Kristensen 2004) tailored for BCEs at the local scale (municipal level). Moreover, the proposed model is aimed not to be too large in the number of indicators and dimensions, but at integrating the concepts of 'leverage points,' where key specific points of governance interventions are targeted (e.g., environmental law and implementation), and 'boundary objects,' where different disciplines and stakeholders are involved to synthesize diverse knowledge systems from the conceptual framework and discussions of the global assessments of the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) (Dunkley et al. 2018; IBPES 2019; Stevance et al. 2020). The study hypothesized that the administrative management area of the blue carbon is a 'boundary object' such that different stakeholders are competing for their jurisdictions as their domain.

4.1.3. Data Gathering and Analysis

Interviews were conducted to compile the DPSIR framework for BCEs and their management and examine the appropriateness of the model by having inputs and feedbacks from practitioners at the local level. The interview process consisted of 2 parts, a preliminary introduction and the interview proper (Figure 4.2). In the introduction part, the author explained the study, its objectives, and the purpose of the discussion. Respondents were also asked if the conversation could be recorded for data analysis purposes. The main part included 3 sections: respondent's basic information (e.g., affiliation and work mandate), BCEs (e.g., conditions, services, pressures and impacts), and management strategies (e.g., plans, policies and partner organizations). The guide questions used in this study are appended (Appendix D). The interview time varied from 10 to 37 min with an average time duration of 21.5 min. Three respondents requested an off-the-record interview and 3 respondents opted to be interviewed together (Table 4.1).

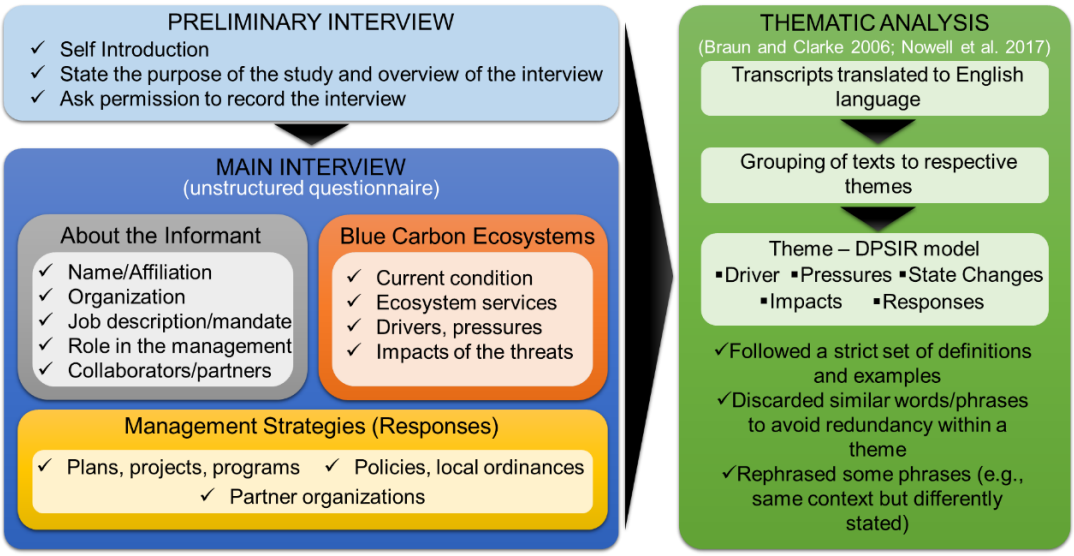


Figure 4.2. Flow of data gathering and analysis of this study (modified from Quevedo et al. 2021a).

The key informant interviews were conducted from 11th to 14th of February 2020 in the municipality of Busuanga, Busuanga Island. The selection of the key informants followed a

purposeful sampling approach which is a widely used method in qualitative research in identifying and selecting information-rich cases related to the specific interests (Palinkas et al. 2015). In this study, all respondents were chosen because of their role and knowledge in coastal resource management. Table 4.1 shows the list of key informants and the duration of each interview. A total of 17 stakeholders were interviewed in the municipality. Busuanga's respondents included 5 municipal-level officials, 5 barangay-level staff, 6 personnel from various community organizations (e.g., fisherfolk associations), and 1 from a non-government organization (NGO).

Table 4.1. List of the key informants interviewed in this study (modified from Quevedo et al. 2021a).

Key Informant	Designation	Interview duration (mins)*
Municipality of Busuanga - Local government units and policy-making bodies		
	Municipal Agriculturist	35
	Chairman - MFARMC	24
	Municipal Councilor (Environment Committee)	27
	Municipal Toursim Officer	**
	Former Vice Mayor	23
	Barangay Councilor	14
	Barangay Councilor	20
	Barangay Councilor	10
	BFARMC	19***
	Barangay Councilor	23
Municipality of Busuanga - People's organization		
	BFARMC/ President - Sto Nino Fisherfolk Association	17
	President - Sagrada Fisherfolk Association	15
	President - Concepcion Fisherfolk Association	28
	Vice President - Bogtong Fisherfolk Association	19***
	President - Bogtong Fisherfolk Association	19***
	MPA Guard	14
Non-government organization		
	C3 Philippines	32

Notes: MFARMC – Municipal Fisheries and Aquatic Resources Management Council, BFARMC – Barangay Fisheries and Aquatic Resources Management Council
* Preliminary interview not included in recorded time, ** Off the record interview (as requested), *** Interviewed together (as requested)

This study used a theoretical or deductive thematic analysis that uses a predetermined framework to analyze the data (Braun and Clarke 2006). This analysis is particularly useful when the researchers have specific questions and already identified the main themes used to group data and examine similarities and differences (Nowell et al. 2017). The flow of the data analysis is presented in Figure 4.2. Initially, the interview transcripts were translated into the English language before applying the pre-set themes. The themes utilized in this work are the components of the DPSIR framework which includes the driving forces, pressures, state changes, impacts, and responses. To reduce the error of grouping the texts into respective themes, this study followed a set of definitions and some examples of each component from previous studies (e.g., Gabrielsen and Bosch 2003; Kristensen 2004; Mateus and Campuzano, 2008; Butler et al., 2014; Lewison et al., 2016; Oesterwind et al., 2016) as listed in Appendix E. After grouping the texts, similar words or phrases were discarded to avoid redundancy (for instance, the same responses from two different stakeholders) within a theme. Also, where appropriate, some answers were rephrased (for instance, the same context, differently stated) to maintain cohesiveness and clarity of data interpretations. An example of detailed coding of texts to themes is appended in this study (Appendix F).

4.1.4. Results

The key informants of Busuanga Island clearly stated population growth, poverty, perceptions, behavior or discipline, and institutional capacities as indirect drivers that put pressure on the health of coastal ecosystems (Figure 4.3). Examples of observed pressures triggered by these indirect drivers include overexploitation of resources, land conversion, illegal activities, and domestic waste production. They also mentioned that their institutional capacities are limited which results in limited personnel and technical staff, lack of technical trainings, weak implementations, and limited conservation projects. Direct anthropogenic

drivers that were mentioned by stakeholders include tourism with the addition of upland activities and pearl farms. The presence of pearl farms has obstructed the fishing ground of small-scale fisheries. Lastly, natural drivers were also observed by the policy-makers that directly affect their coastal ecosystems. Typhoons, precipitations, strong waves, tides, and climate change are among the natural drivers identified. Based on their observations, these drivers destroy their coastal resources. For instance, during intense precipitation, they observed that debris from upland areas is being washed away to coastal areas. They also noticed that during typhoons, strong waves damage their mangrove areas.

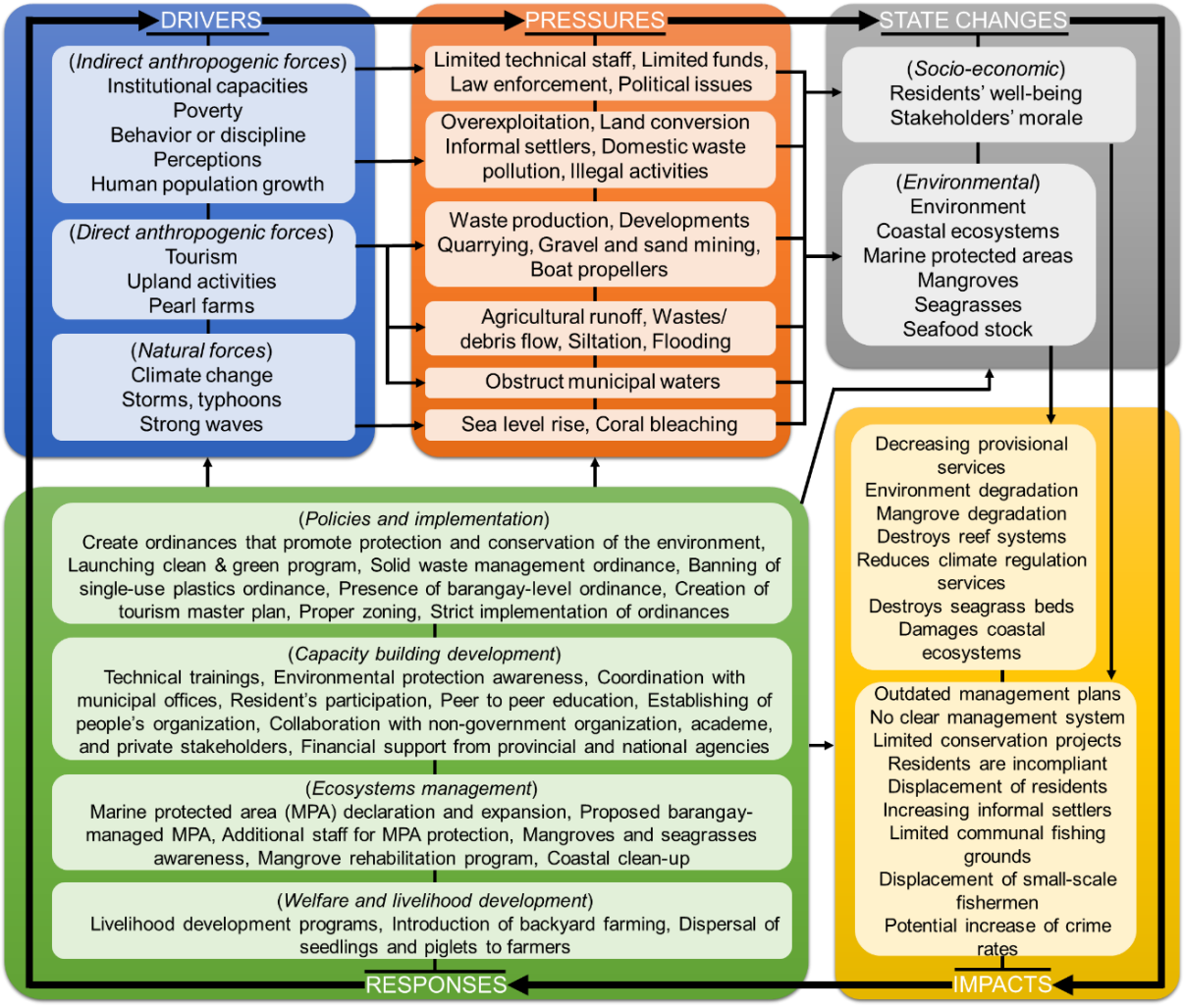


Figure 4.3. The DPSIR system model of Busuanga Island (n=17) (modified from Quevedo et al. 2021a).

Although most studies using the DPSIR model refer 'S' to be environment-related (e.g., Gabrielsen and Bosch 2003; Zhang and Xue 2013; Butler et al. 2014), this study categorized the answers of the focal persons into two states changes - socio-economic and environmental dimensions (Figure 4.3). The socio-economic state identified in the island comprises residents' well-being and stakeholders' morale. This selection is based on the definition of the Organization of Economic Co-operation and Development (OECD) (2003) and Kristensen (2004) where 'S' could also refer to the effects of pressures on living conditions of humans. Meanwhile, the environmental states mentioned are the coastal ecosystem, marine protected areas (MPA), mangroves, seagrasses, and seafood stock. Also, some respondents did not indicate a particular ecosystem so, the 'environment' was added into the 'S' component to account for other ecosystems (e.g., corals) and as the whole ecosystem.

The impacts to resident's well-being (state) recorded in this study include increasing informal settlers, displacement of residents, an increase of crime rates, increasing noise and waste pollution, loss of livelihood, and displacement of small-scale fishermen as caused by the pressures from anthropogenic drivers (e.g., population growth, poverty). For the stakeholders, particularly local government offices, the lack of institutional capacities (driver) impacts their morale (state). Examples of impacts on stakeholders' morale involved limited conservation projects, unclear management systems, outdated coastal resource management plans, and conflicting political and personal interests. Moreover, impacts on the environmental state include decreasing provisional services, reducing climate regulation services, environmental degradation, mangroves, seagrass beds, and coral reefs' destructions and eutrophication in coastal waters. In addition, continued use of illegal fishing methods alters the seafood stock because juvenile fishes are caught resulting in reduced fish reproduction rates.

Responses can refer to decision making undertaken by different stakeholders (Maxim et al. 2009), changes in the existing policies, and implementing alternative actions (Lewison et

al. 2016) or environmentally sustainable and administratively achievable measures (Mateus and Campuzano 2008). Acknowledging the multiple drivers, pressures, and impacts to coastal ecosystems' condition and people's well-being, the different policy-makers in this study were able to mention various strategies from environmental measures to socio-economic responses. The responses compiled from the interviews are grouped into policies and implementation, capacity building development, ecosystems management, and welfare and livelihood development (Figure 4.3).

Some examples of policies and implementation measures in the island include the creation of ordinances that promote protection and conservation of the environment (terrestrial and marine), solid waste management, presence of barangay-level ordinances, strict implementation of national and provincial directives, strict compliance of the residents to local ordinances, banning of single-use plastics, and proper zoning schemes and creation of tourism plan. Capacity-building development strategies mentioned involve technical training, environmental awareness campaigns, establishing people's organizations, collaboration with NGOs and other stakeholders, and financial support from provincial and national agencies. During the conduct of the study, existing projects and financial support from NGOs were already present in the local government. Moreover, a few programs were mentioned for welfare and livelihood development such as backyard farming and dispersal of seedlings and piglets to farmers. Lastly, ecosystem management responses gathered from the interviews that aim to protect, conserve, and sustainably manage the marine environment include MPA establishment, declaration, and expansion, assessment and monitoring, and coastal clean-up. Actions tailored to BCEs involve mangrove and seagrass awareness, and mangrove rehabilitation programs.

4.1.5. Discussions

The BCEs in Busuanga Island are subjected to anthropogenic and natural drivers (Quevedo et. 2021b, d). Among these drivers, population growth has resulted in different pressures that degrade the condition of the ecosystems. As pointed out by Bremner et al. (2010), increasing population growth has always been a factor that affects resource utilization, where if not regulated and sustainable will result in the degradation of coastal resources. This cause-effect relationship has been observed in Busuanga Island where coastal villagers depend on the marine environment for their food source and occupation (Quevedo et al. 2021d). The key informant interviews also revealed that fish yield has been decreasing as the human population increases due to overexploitation (e.g., unregulated fishing and collecting of other seafood). Moreover, as the population increases, the need for extra spaces also increases which results in the conversion of mangrove forests to residential areas which would eventually increase domestic waste production. Moreover, poverty which is often related to population growth (MEA 2005), is also an underlying factor of ecosystem change in the Island. The same vein of increasing population led some the villagers who are socio-economically deprived to move to coastal areas where there are more open and free spaces, food source can be plentiful, and fishing livelihoods can be a practical source of income. Mangrove forests are often affected by poverty since people can easily harvest and sell them as raw material for house or charcoal production in return for money.

Perceptions and behavior of the residents also indirectly affect the BCEs. For instance, the few illegal activities (charcoal production) that continue to exist on the island were attributed to a lack of discipline and low awareness (President - Concepcion Fisherfolk Association, personal communication, February 18, 2020). This relationship between perception and discipline with resource utilization has also been documented in other islands of the Philippines. For instance, in Eastern Samar province, residents' perceptions of mangrove

and seagrass ecosystems influence their utilization and management patterns, which in turn reflect ecosystems' condition (Quevedo et al. 2020a, b) while in Aklan province, locals' awareness of mangrove ecosystem services correlates well with their utilization behavior (Quevedo et al. 2021c).

Among the indirect drivers identified in this work, 'institutional capacities' are found to be a leading factor that affects coastal management in Busuanga Island (Figure 4.3). Based on the interviews with the municipal agriculturist of the town who are in charge of marine and terrestrial resource and other related activities (Table 4.1), their work, including monitoring and evaluation and awareness campaigns, is always limited or driven by their institutional capacities such as availability of funds, lack of personnel and technical staff, and lack of technical trainings. These limitations can be the main cause of inadequate management plans and strategies for BCEs. The limited institutional capacities of local government units (e.g., MAO) have always been a challenge not only in Busuanga Island but also in other areas of the country (e.g. Primavera 2000). Moreover, continued use of kaingin (slash-and-burn) method in the upland areas in Busuanga town resulted in degradation of the seagrass beds as they are the direct receiver of wastes/debris during episodes of heavy siltation brought about by intense precipitation. As noted by Fortes and Santos (2004), nutrient loading which results in coastal eutrophication has been a major threat to seagrass ecosystems in the country. Furthermore, although tourism in Busuanga is still developing, early signs of tourism pressures to BCEs have been observed. Tourism-related developments have resulted in the cutting of mangrove forests. Siltation, as an effect of these projects, destroys seagrasses.

Natural drivers also played a major cause of destruction to BCEs. For example, mangrove forests in Busuanga Island were heavily damaged by the super typhoon Haiyan that ravaged the country in 2013 (Kobayashi 2017). Typhoons, which could trigger flooding and siltation events, will degrade the coastal environment especially the seagrass meadows. Also,

in the study conducted by Quevedo et al. (2020a), natural drivers are perceived to be the number one threat to mangrove ecosystems. This study along with other investigations (e.g. Harwell et al., 2010; Butler et al., 2014) showed that natural forces can significantly affect the state of the marine environment.

4.2. Content Analysis – Analyzing CRM Plans for BCEs Management Implementation

4.2.1. Introduction

Studies analyzing management plans and policies in the context of "blue carbon" services investigations are progressing in recent years. For instance, Lukman et al. (2019) reviewed 27 provincial spatial plans in Indonesia to determine the present focus in mangrove management utilizing content analysis. The results of their analysis show that there are nine (9) clusters (e.g., prohibited activity, tourism, and aquaculture) of management activities pertaining to mangroves and, of which the relatively new concept, "blue carbon" is only discussed in the spatial plans of Central Kalimantan, Jakarta, and Papua provinces. Another study by Ganguly et al. (2018) evaluated the potential of seagrass ecosystem carbon finance based on current national and international climate policy frameworks and recommended the inclusion of this ecosystem in informal climate change policies such as REDD+ (Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks). Although much has been done in the past years, there is still no clear pathway on how existing coastal plans can effectively capture and include the "blue carbon" concept into coastal ecosystem management, particularly at the local scale, where it is a critical place for translating the strategies into contextualized implementations.

Most of the existing studies on coastal management plans in the Philippines are limited to the evaluation of coastal plans, their effectiveness, application, and perception. An example

is a study by Mudge (2018) that investigated coastal management practices using community perceptions in the coastal areas of Baybay City, Leyte. Another study evaluated the comprehension of the coastal communities in San Joaquin, Iloilo on coastal resource management using the Social Representations Theory (SRT) (Baquiano 2016). Aldon et al. (2011) explored the socio-cultural aspects of fishermen in Anini-y, Antique particularly on their participation in coastal resources management and how they become an effective partner in management activities. To date, there are no published studies that utilized content analysis to evaluate local coastal management plans on its present directives towards management in the context of BCEs. Thus, this study is the first in the Philippines. It aims to show how the contents of existing coastal management plans at the local level inform the current directions of management implementation and their implications towards future management schemes. As highlighted by Fortes et al. (2018), it is important to determine the management implementations since this information can reflect the effectiveness of linkages between science, government, and private sectors, adequacy of policy or law enforcement, and disconnect between social-economic and cultural dimensions. By applying the content analysis to current local coastal management plans, this study can depict the existing implementation of management protocols and provide appropriate recommendations for integrated coastal management practices. Moreover, the results of this study can serve as a potential benchmark for future related investigations on other coastal management-related plans in other areas in the Philippines and other countries as well as a basis for formulating coastal plans to effectively encapsulate BCEs and integrating them into existing management strategies.

4.2.2. Overview of Coastal Resource Management in the Philippines

The Department of Environment and Natural Resources (DENR), Department of Agriculture- Bureau of Fisheries and Aquatic Resources (DA-BFAR), and Department of the

Interior and Local Government (DILG) in 2001 have identified the mangrove forests, seagrass beds, along with coral reefs, beach systems, and lagoons and estuaries as the critical habitats to be addressed in coastal resource management (CRM) in the country (CRMP 2004). The continued overexploitation and degradation of these natural resources have resulted in developments of national policies and legal frameworks that support CRM in the country. Figure 4.4 shows the evolution and timeline of CRM in the country from the top-down legal mandates of the 1970s and 1980s to shifting to local government jurisdiction (CRMP 2004). CRM has progressed over the years to more integrated, multi-sectoral, and ecosystem-based management approaches.

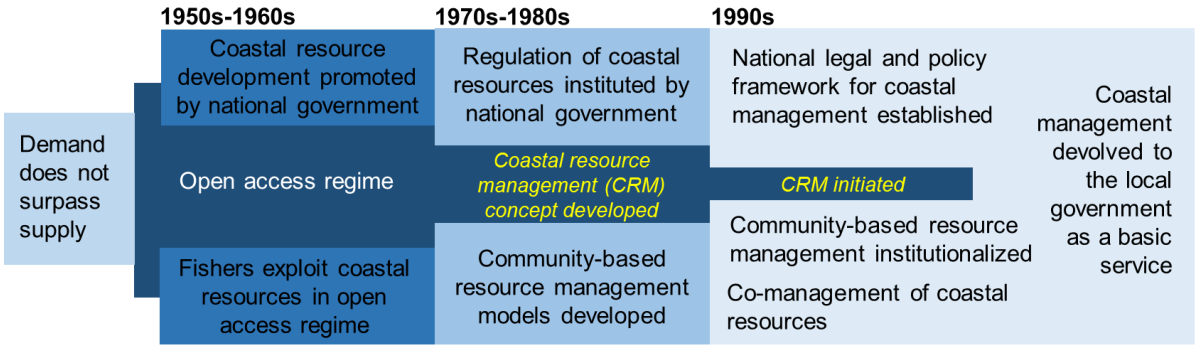


Figure 4.4. Evolution of coastal resource management in the Philippines (modified from CRMP 2004).

The progress of CRM in the Philippines over the years has been influenced by two major forces. The first is a series of donor-assisted government and non-government programs that have provided several large outputs in CRM, also referred to as integrated coastal resource management (ICRM) (Courtney and White 2000). These programs have ranged from narrow to wide geographical boundaries and from low levels of financial support to multimillion-dollar assistance over five or more years (White et al. 2005). These programs have pushed for the inclusion of local communities and government units to actively participate in coastal management to build constituencies for CRMs from the bottom up (Courtney and White 2000).

The second major force that influenced the legal and policy framework of CRM in the country is the decentralization of authority from the central (national) to the local governments (municipal and provincial) with the passage of the Local Government Code (LGC) of 1991 and the Fisheries Code of 1998 (White et al. 2006). This current legal and policy framework for CRM creates new institutional roles and responsibilities for various stakeholders (e.g., national and local governments, NGOs, and academe) and coincides well with the policy of including local communities in planning and management and with the Philippine constitution that recognizes democratic decision-making processes at all levels (Courtney and White 2000; DENR et al. 2001).

Mangrove ecosystems have been a focus of the national government since the 1970s and are all protected by law with many kinds of research done on the plight and value of mangrove forests in the Philippines. A few of the earlier legal bases for the protection and conservation of mangrove areas in the country include the revised forestry code (Presidential Decree No. 705, 1975) which states the retention of a 20-m wide mangrove strip along shorelines that serves as a protection against high winds and typhoons, Presidential Proclamation 2146 (1981) that prohibits mangrove cutting, and DENR Administrative Order (AO) No. 15 (1990) which established regulations governing the utilization, development, and management of mangrove resources. The works of Primavera (2000; 2004) for instance, have documented how important mangrove ecosystems are, and that if not protected would result in loss of valuable assets. In response to continued degradation over time, mangrove-related policies are progressing. Examples are the National Mangrove Conservation and Rehabilitation Act (House Bill No. 460, 2013), National Mangrove Forest Protection and Preservation Act (Senate Bill No. 326, 2016), and National Coastal Greenbelt Act (Senate Bill No. 1917, 2020). The strong presence of and advances on legal frameworks for mangrove protection and conservation in the country have pushed to the strengthening of mangrove management

strategies in ICRM plans. Fortes and Salmo (2017) have summarized the status and trends of mangrove research and management in the Philippines and highlighted that a science-based approach in mangrove conservation and management is necessary for it to be successful and effective.

Seagrass ecosystem management in the Philippines is much weaker in terms of the presence of legal mandates and policies in comparison to mangrove ecosystems. Oftentimes, seagrass meadows are generally lumped together with coral reefs and other ecosystems in marine conservation planning in the country and thus, are not usually addressed separately. For instance, in the Philippine Fisheries Code of 1998 (Republic Act No. 8550), protection and conservation of seagrass beds are mandated along with the coral reefs, mangrove forests, and seaweed beds. Another example is the DA-BFAR Fisheries Administrative Order 250 series of 2014 which states that collecting, harvesting, gathering, selling, and/or exporting seagrasses is strictly prohibited along with the brown algae (e.g., *Sargassum* spp.). Unlike mangrove ecosystems, seagrass ecosystem investigations are few and priorities for research development activities are usually directed towards other coastal resources (e.g., coral reefs) with immediate economic impacts (fishery industry) (Fortes 2012). Another important study of Fortes (2018) that reflects the weak seagrass ecosystem management strategies and focus in the country is the big gap or disconnect between seagrass science, policy, and practice. In his study, most of the works on seagrass habitat management are focused largely on identifying but rarely quantifying the impacts and outcomes, and do not specify and recommend input variables that produce effective management and proposing solutions to issues.

4.2.3. Data Gathering and Analysis

The materials used in this study are the existing municipal coastal management plans of the municipalities of Lawaan and Salcedo in Eastern Samar province and municipalities of Batan and Kalibo in Aklan province. These sites were specifically selected to complement the

previous works (Quevedo et al 2020a, 2020b, 2021c). Although these studies covered other municipalities, unfortunately, not all have coastal management plans. Thus, the studied documents are very limited to four (4) municipalities only. The retrieved coastal management plans in Salcedo and Lawaan are both in word document files (soft copy) while the plans in Batan and Kalibo are hard copies (photographed). Table 4.2 shows a brief summary of the details in each coastal plan. The municipalities of Salcedo and Lawaan have a 5-year (2018-2022) coastal management plan while Batan has a 10-year (2013 – 2022) plan. All three (3) plans are up for updating. Kalibo, on the other hand, has a 6-year coastal management plan that has lapsed in 2019.

Table 4.2. List of the coastal management plans used in this study (modified from Quevedo et al. 2021e.

Coastal Management Plan	Municipality, Province	Implementation Year	Number of Pages
Integrated Coastal and Fisheries Management cum Sustainability Plan of Salcedo, Eastern Samar	Salcedo, Eastern Samar	2018 -2022	118
Integrated Coastal and Fisheries Resource Management cum Sustainability Plan of Lawaan, Eastern Samar	Lawaan, Eastern Samar	2018-2022	93
10 Year Coastal Resource Management Plan	Batan, Aklan	2013-2022	50
Integrated Coastal Management (ICM) Plan	Kalibo, Aklan	2014-2019	127

Coastal ecosystems in the provinces of Aklan and Eastern Samar are often disturbed by natural and anthropogenic forces as most of the coastal communities in the country. It is critical to examine how these resources are being managed at the municipal level and investigate perceptions towards different services and activities as reflected in the existing management plans. In evaluating the documents, a content analysis method was used to determine the current directions of the coastal management plans. Content analysis incorporating thematic/

topical coding (Bowen 2009) to analyze the substance of a document (e.g., policy plans) is an increasingly employed approach in recent years (Neuendorf 2017). This method involves a sequence of steps including the building of a coding frame to cover several pre-identified categories (Schreier 2012) starting from a lower level to a higher level of abstraction, where categories (called clusters) can reflect the latent meaning of the texts (Bengtsson 2016; Erlingsson and Brysiewicz 2017).

This study utilized the same methodological approach by Lukman et al. (2019) that analyzed Indonesia's provincial spatial plans with which the mangrove ecosystem is the main theme. However, in this study, coding was carefully performed with caution under an overarching theme "fishery" with two of its important resources, "mangrove" and "seagrass" ecosystems, as the main themes (Figure 4.5). Moreover, coding keywords were adjusted and modified to better capture the BCEs and their corresponding management schemes at the local level. For consistency and clarity, the terms "fishery" or "fisheries" were not used as keywords and strictly used as the overarching theme. However, there were several fishery-related keywords applied in the coding process such as "breeding", spawning", and "regulation" which were related to some of the clusters like *ecosystem services* and *laws, policies, & ordinances*. The complete list of keywords applied to derive the 8 clusters is appended (Appendix G). Cluster frequency and total cluster frequency per ecosystem were also calculated and presented in this study. The former is used to reflect how frequently the clusters are being discussed in the management plans while the latter is about capturing the present composition of the coastal plans with regards to the BCEs.

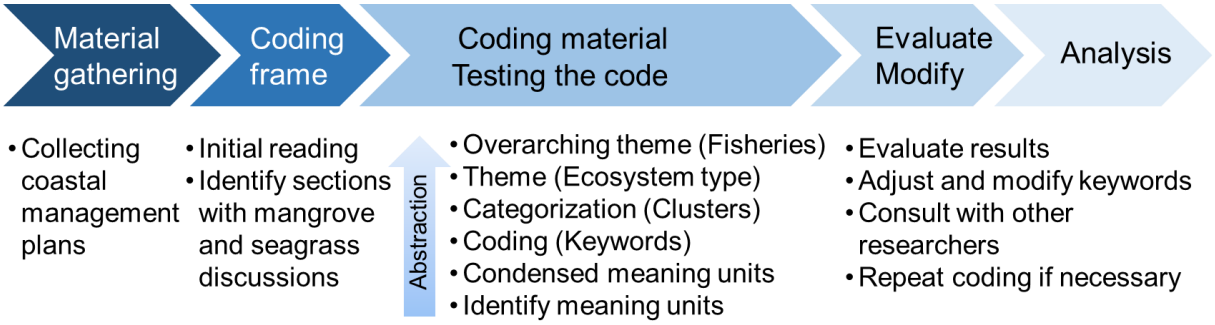


Figure 4.5. Flow of the methodology (modified from Lukman et al. 2019).

4.2.4. Results

The content analysis of the management plans relating to mangrove and seagrass ecosystems generated 8 clusters namely: *ecological profile, ecosystem services, carbon sequestration, tourism, natural threats, anthropogenic threats, laws, policies, & ordinances,* and *management activities*. Figure 4.6 shows the cluster ranks, cluster frequencies per ecosystem, and overall total cluster frequencies. Among the clusters, *management activities* are the most (first) frequented topic with a total cluster frequency of 42. In contrast, the least (eighth) mentioned cluster is *carbon sequestration* with a total frequency of 1. All 8 clusters are covered in the mangrove ecosystem section of the plans while only 5 clusters are discussed under the seagrass ecosystem section (Figure 4.6). *Management activities* cluster is common for both ecosystems. Activities on mangrove area management such as planting and coastal clean-up, among others, are stated more frequently with 38 iterations compared to conservation actions for seagrass habitats, with only 4 mentions. The basic information of the ecosystems such as distribution and abundance as well as the various services they offered is categorized separately into *ecological profile* and *ecosystem services* clusters with 24 and 19 iterations, respectively.

Threats caused by *anthropogenic* and *natural* disturbances to BCEs are also discussed in the documents. Human-induced disturbances such as illegal cutting of mangrove trees and mangrove planting in seagrass beds, among others, are repeatedly indicated across the plans;

making the cluster the second most stated topic for both ecosystems (Figure 4.6). Natural calamities such as strong typhoons and their effects on BCEs, on the other hand, are relatively less mentioned. This cluster ranked fourth in mangrove ecosystems with a cluster frequency of 10 and third in seagrass ecosystems with a cluster frequency of 6. Other clusters discussed in the management plans include *laws, policies & ordinances*, *tourism*, and *carbon sequestration*, with cluster frequency of 9, 3, and 1, respectively (Figure 4.6). However, these clusters are only mentioned under mangrove ecosystems.

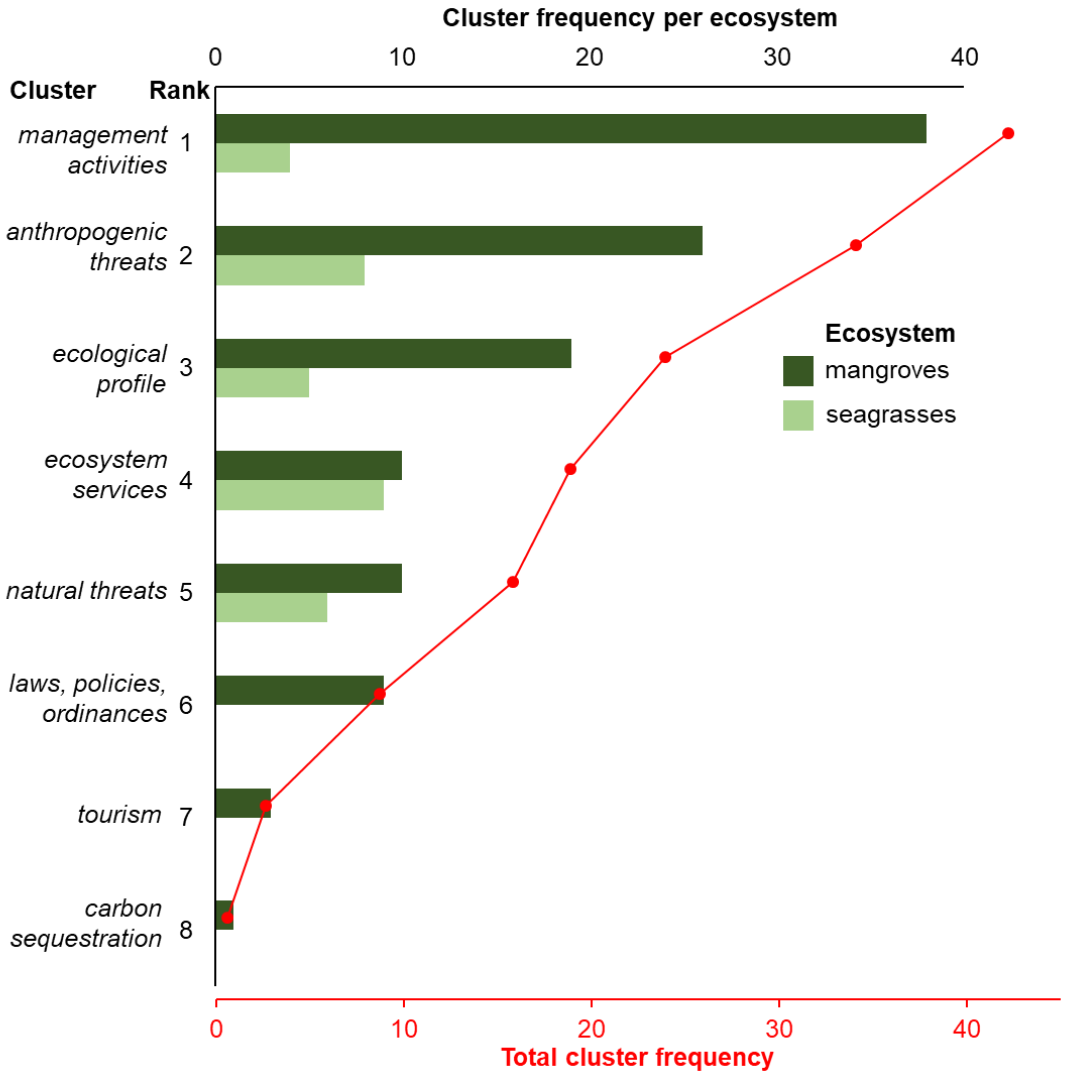


Figure 4.6. Cluster rank, frequency per ecosystem, and total cluster frequency. The cluster rank is based on the total cluster frequency (modified from Quevedo et al. 2021e).

The results of the analysis also show how clusters are distributed per ecosystem per municipality. Figure 4.7 presents the current content of these plans in terms of the frequency of clusters per ecosystem per municipality. All municipalities have relatively the same trends in the content of their plans; that is, clusters of mangrove ecosystems are frequently mentioned than seagrass ecosystems. Discussions on mangrove forests comprise 68.49% to 97.06% of the plans while a small fraction, about 2.94% to 31.51%, is accounted for seagrass meadows. *Ecological profile*, *ecosystem services*, *anthropogenic threats*, and *management activities* clusters for mangrove ecosystems are common in all four coastal plans. *Management activities* cluster dominates Lawaan, Batan, and Kalibo, whereas Salcedo town is more focused on the ecological profile of mangrove forests (Figure 4.7). Among the municipalities, Lawaan has the most number of discussed clusters, with 8 and 5 clusters for the mangrove and seagrass ecosystems, respectively. Clusters highlighting mangrove areas are fairly stated in Salcedo (6), Batan (4), and Kalibo (7) while clusters stressing seagrass habitats are very few, with one to three clusters only. Clusters of seagrass ecosystems are limited to their profile and benefits, threats, and a few management-related activities (Figure 4.6).

4.2.5. Discussions

Mangrove ecosystems, their services, threats, and management plans are well represented by the eight (8) clusters generated from the content analysis (Figure 4.6). Profile of mangrove areas are well established in the municipal plans since several mangrove ecosystem assessments have already been done in Eastern Samar – Salcedo and Lawaan (e.g., Mendoza and Alura 2001; Salmo et al. 2019), and Aklan – Batan, and Kalibo (e.g., Primavera et al. 2004; Walton et al. 2006; Altamirano et al. 2010) that could provide data for the mangroves' location, abundance, distribution, and species present. Mangrove habitat assessments have increased in these provinces in response to the destruction brought by super

typhoon Haiyan (e.g., Alura and Alura 2016; Long et al. 2016; Primavera et al. 2016). All four municipalities have been greatly affected by the super typhoon in 2013. Data from these assessments are accessible to local government units, hence, the *ecological profiles* of mangrove ecosystems are well reflected and robust in their respective coastal plans (Table 4.3).

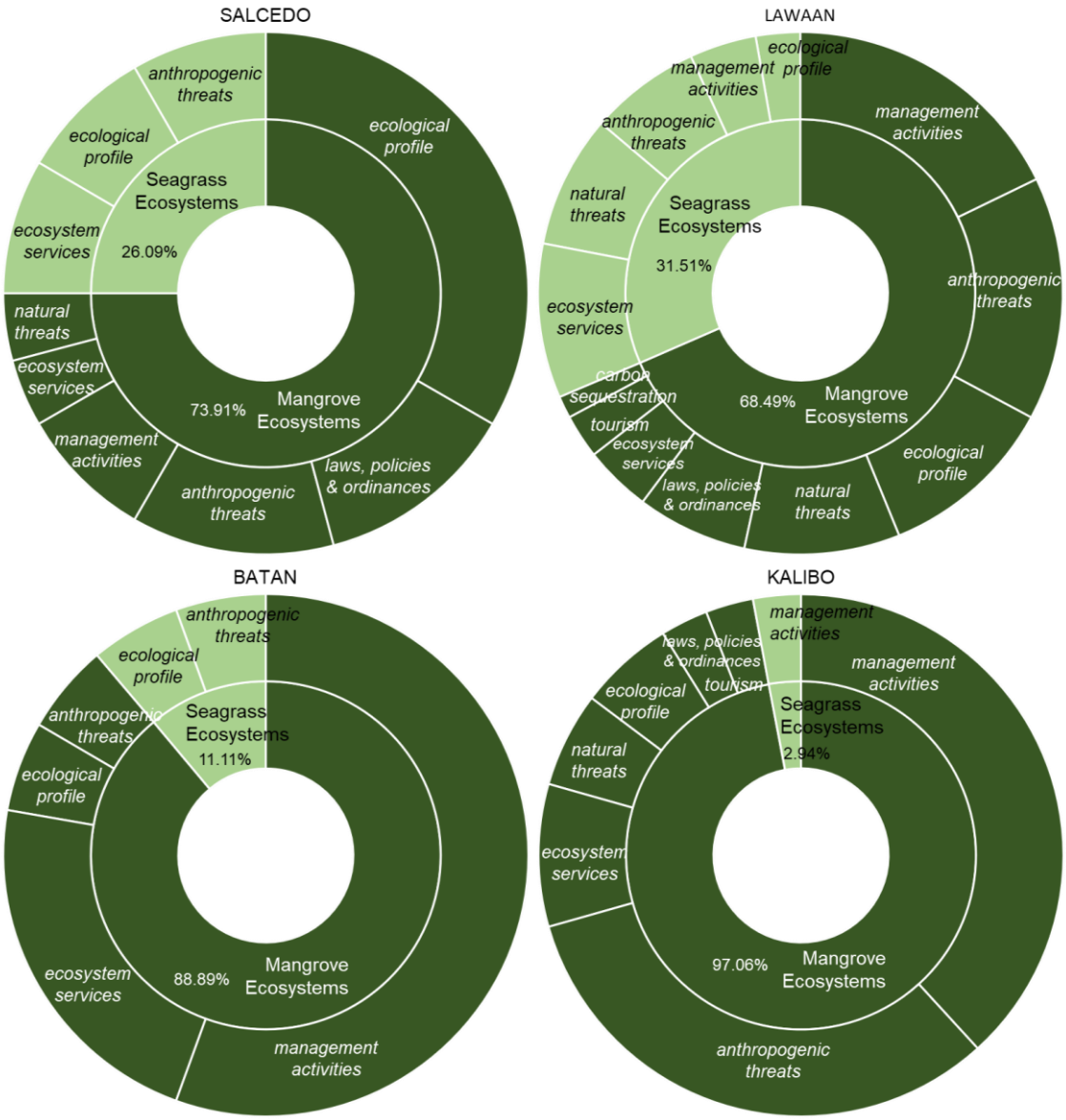


Figure 4.7. Cluster distribution per ecosystem in each municipality. The inner portions represent total frequencies of mangroves and seagrasses in percent while the outer portions show the clusters. The size of each portion depends on its cluster frequency (modified from Quevedo et al. 2021e.

Ecosystem services offered by mangroves are recognized in the coastal plans as well. However, only provisioning services (e.g., food source and firewood) are common in the four

towns. Provisioning services are expected to be present in their plans since coastal communities depend on mangrove forest areas to source out food and sometimes livelihoods (Walton et al. 2006; Quevedo et al. 2020a). Other services that are stated at least once include coastal protection (Lawaan and Batan), home to various organisms (Batan and Kalibo), and nutrient cycling (Kalibo). It is interesting to note that coastal protection as an ecosystem service of mangroves has had not been elaborately discussed and explored as an opportunity for the municipalities of Lawaan and Salcedo given that their plan effectivity period is five (5) years after the super typhoon Haiyan devastation in 2013.

Moreover, the clusters on *tourism* and *carbon sequestration*, which are cultural and regulating ecosystem services, respectively, lack visibility in the plans. Because tourism activities, in general, in the municipalities of Salcedo, Lawaan, and Batan, are still limited, recreational activities in mangrove areas remain unexplored. In contrast, Kalibo town has a well-established mangrove eco-park known as the Bakhawan Eco-Park (Quevedo et al. 2021c), thus, a *tourism* cluster was mentioned in their coastal plan. Although recreational activities in mangrove areas are already known locally and globally, little attention is still given towards pursuing them compared to other ecosystems (e.g., coral reefs and beaches) (Spalding and Parrett 2019; Quevedo et al. 2021b).

Results of this study show that the *carbon sequestration* cluster is the least mentioned topic despite the gaining momentum of discourse and researches on the carbon capture and storage capacities of mangrove ecosystems. These findings suggest how inchoate the existing coastal management plans are in this field. These results may also indicate having a relatively low or lack of knowledge towards carbon sequestration and the economic potential it could offer to coastal communities. This observation is also documented in the perception survey made by Quevedo et al. (2020a) where public's awareness of the "blue carbon" concept in Salcedo and Lawaan is relatively low. Moreover, even at a higher scale, in the case of Indonesia

for instance, the presence of the “blue carbon” topic is barely discussed in the provincial spatial plans (Lukman et al. 2019).

Table 4.3. Mangrove and seagrass profiles retrieved in the present coastal management plans (modified from Quevedo et al. 2021e).

Municipality, Province	Available Ecological Profiles from the Coastal Management Plans (*This study*)	
	Mangrove Profile	Seagrass beds Profile
Salcedo, Eastern Samar	1,791.05 ha - p.65 15 locally-known true mangroves and 9 associated species - p.65 Species commonly found are: *Rhizophora* sp., *Bruguiera* sp., *Lumnitzer* sp., *Scyphiphora* sp., *Xylocarpus* sp., *Nypa fruticans* - p.66 Total stem density of mangroves - p.68 Total stem density of seedlings - p.69	1,419.69 ha - p.8 mostly found in coastal villages facing the Pacific Ocean with an estimated area of 787.57 hectares - p.8
Lawaan, Eastern Samar	Total area of mangroves is 275.6 ha; mostly found in the villages of Maslog and Taguite - p.25 Mangrove cover per barangay - p. 25 Diversity and distribution of mangrove species across the coastal barangays in Lawaan - p.25	Six marine protected areas (MPAs) in Lawaan have patches of seagrass beds. Only three of the 6 MPAs have more than 50% seagrass cover - p.26
Batan, Aklan	Four major mangrove species found in Batan namely bakhaw (*Rhizophora* sp.), nipa (*Nypa fruticans*), pagatpat (*Sonneratia* sp.) and piapi (*Avicennia* sp.) - p.24 Around 112 ha of mangroves remain in barangays Bay-ang, Camaligan, Lalab, Poblacion and Magpag-ong. - p.24 Rehabilitated areas are 3 ha in Napti, 5 ha in Mambuquiao, and 50 ha in Cabugao. - p.24	Seagrass species that are present includes spoon grasses (Hydrocharitiсae) in Napti and Mambuquiao, turtle grass (*Thalassia* sp.) and *Enhalus* sp. in Songcolan, Ipil, Tabon and Mambuquiao. - p.25
Kalibo, Aklan	Man-made plantation of Bakauan sp. Around 220 ha. In barangays Buswang Old and Buswang New. - p.21 Other species that naturally grows are Perada (*Sonneratia* sp.), Pagatpat (*Sonneratia* sp.), and *Rhizophora* sp. - p.21	No available description

Natural threats to mangrove forests like typhoons, sea-level rise, siltation, and predation among others are listed in the coastal plans of Salcedo, Lawaan, and Kalibo while none of these

threats are mentioned in Batan. The effects of typhoons in mangrove areas are easily identified by the locals based on their previous experiences. For example, in Lawaan, they identified in their plan that "typhoon damaged large portions of the mangroves…" referring to the aftermath of super typhoon Haiyan in 2013. Typhoons, storm surges, and strong waves are perceived to be the most concerning threats by coastal communities in the study sites (Quevedo et al. 2020a). The municipalities have also identified the anthropogenic activities that threaten their mangrove ecosystems. Among these activities, conversions of mangrove forests to other land-uses and illegal cutting of mangrove trees for charcoal and firewood production are common in the four municipalities. According to Long et al. (2014), 10.5% of total mangrove area loss from 1990 to 2010 was attributed to anthropogenic activities, with conversion to aquaculture ponds as the leading cause of mangrove degradation in the Philippines (Garcia et al. 2014). However, a recent study in Salcedo and Lawaan involving local communities has shown that mangrove cutting and charcoal making, as well as conversion to the fishpond, is not a major threat anymore due to strict implementation of local ordinances like "no illegal cutting of mangroves" policy (Quevedo et al. 2020a). Field observations and anecdotal records from Kalibo and Batan have also shown a decrease in these anthropogenic threats. However, scientific investigations should be conducted to corroborate these individual comments and observations from the locals.

Management-related strategies in the four municipalities cover a wide range of activities. This is to be expected in a local management plan since LGUs are concerned with outlining the roadmap of activities for implementation and budgeting. These are also mandated under and supported by several laws, policies, and local ordinances. Mangrove planting/rehabilitation/reforestation, which is a common mangrove conservation activity, is stated in all the coastal plans. This initiative has increased following the creation and filing of the National Mangrove Forest Protection and Preservation Act (Senate Bill No. 326, 2016) and

National Coastal Greenbelt Act (Senate Bill No. 1917, 2020) in the country which mandates at least a 100-meter-wide band from the sea towards the land of protected zones which primarily consists of mangrove and beach forests and seagrass beds. Other activities, for instance in Lawaan, include monitoring and evaluation, and coastal clean-up. In Batan, strategies consist, for example, of solid waste management and increasing awareness on mangrove ecosystems while Kalibo town aims to manage their mangrove forests through community-based forest management programs, coastal zoning, shoreline, and frontline development, and information and educational campaigns. These activities are oftentimes instructed by local authorities through their ordinances. For instance, an excerpt in Lawaan coastal plan says "an ordinance regulating the cutting and poaching of mangroves, specifically "bakhaw" within the jurisdiction of the Municipality of Lawaan." These variations in the management activities in the coastal plans suggest how comprehensive the plans can be. For instance, some municipalities may have a robust list of activities while others may only identify restorative activities (e.g., mangrove planting). In addition, the lack of or limitation of management activities may correspond to a lack of technical expertise in the fields of strategic planning and formulation.

Meanwhile, seagrass ecosystems are unsubstantially tackled in the coastal management plans compared to mangrove ecosystems (Figure 4.7), with clusters including only profile, threats, and a few management actions (Figure 4.6). As pointed by Duarte et al. (2008), the presence of seagrass ecosystems in coastal management is often disregarded and limited. The municipalities of Salcedo, Lawaan, and Batan have limited information on the location of their seagrass beds, their extent, as well as what species they have in their coastal areas (Table 4.3). Kalibo town has no available profile of their seagrass meadows based on the analysis done (Table 4.3). This could be due to the fact that there are no reported seagrass habitats on their coasts, as revealed by local authorities during field consultations. However, anecdotal accounts

from coastal communities have said that patches of seagrass beds are seen in some barangays (villages) of Kalibo. The lack of or no data suggests a more comprehensive assessment should be done to establish detailed ecological profiles. However, these constraints are sometimes caused by insufficient funding and resources (McKenzie et al. 2000) and the capacity of local government units (Deguit et al. 2002). Moreover, the lack of available data on seagrass ecosystems in the municipalities can foster collaborations between the local government units and state universities or colleges in or near the area for seagrass-themed research.

Seagrass ecosystems offer several services to local communities (Cullen-Unsworth et al. 2014; Nordlund et al. 2018). However, only Salcedo and Lawaan have discussed some of these benefits in their current plans. Provisioning services (e.g., food source) are mostly mentioned while a few regulating services like filtering wastes from upland activities are stated. The limited discussion of their benefits in the plans suggests that awareness of seagrass ecosystem services is generally low. The study of Quevedo et al. (2020b) showed that perceptions of local communities in Salcedo and Lawaan vary on the type of ecosystem service; regulating and cultural services are not well perceived or known. Such trends are reflective of the global scenes as well. In broader contexts, global public awareness of seagrass benefits is understood to less extent (Duarte et al. 2008). Having said this, the visibility of scientific investigations of seagrass ecosystems is gaining salience in recent years, particularly in the field of their ecosystem services, contribution to the natural environment and people, and effective conservation and management strategies (UNEP 2020).

Seagrass beds are highly vulnerable to human-induced and natural disturbances. The municipalities have recognized the threats that damage their seagrasses. In Lawaan for example, they identified threats like unregulated gleaning, nutrient loading, and siltation while Salcedo has documented overexploitation and destructive fishing. Over the past 50 years, about half of the seagrass beds in the Philippines have been severely degraded. Some of the major causes

include destructive and overfishing, sedimentation from coastal development, and eutrophication (Fortes 2018). Another concerning threat that was pointed out in Lawaan's management plan is mangrove planting in seagrass meadows. Planting on the seagrass beds has decreased the catch of edible invertebrates according to field survey results and personal accounts of the locals. Similar observations were found by the fishermen in Santa Fe, Bantayan Island in Central Visayas (Mendoza et al. 2019); where there is a decline in shellfish and rabbitfish catch in seagrass areas where mangroves were planted.

The most important content in the plans is the *management activities* cluster reflecting how LGUs are approaching management measures for seagrass ecosystems. However, only four activities have been recorded for seagrass bed management. These are coastal clean-up, seagrass habitat assessment, and protection in Lawaan and seagrass ecosystem protection by regulating fishing activities in Kalibo. Coastal clean-up is a common management activity that is usually conducted at least once a month according to local government units. Although seagrass ecosystem assessments and protection are mentioned, it is too general to determine what kind of assessment and protection strategies are being planned for in Lawaan and Kalibo. According to Fortes (2018), the majority of current management of seagrass ecosystems is focused largely on identifying the impacts or outcomes and not specifying and signifying input variables that produce effective management and proposing solutions to issues. Unfortunately, there are no management activities reported in Salcedo and Batan coastal plans. Although seagrass ecosystems are targeted for resource management in the last 8 years (Fortes 2012), management schemes are still lacking.

Chapter 5. Benefits and Contributions in the Philippines

Despite the gaining momentum of the "blue carbon" discourse and collaborative action in the international and national arenas, there are still a lot of future challenges to be addressed at the local level, particularly where local governments and implementers are the ones interacting with and are directly impacted by these ecosystems. This study presented an opportunity to address these gaps by conducting social and policy science assessments of BCEs in the Philippines. The results of this study provide valuable benefits and contributions for the country, and, in theory, across regional and global scales. The following sections explore the importance, implications, and synthesis of the different analyses (perception, content, and thematic) conducted in this work. In the first section (5.1), household surveys and key informant interviews offers insights on how BCEs and sustainable tourism can be linked together (Quevedo et al. 2021a, b, d). The linkage explored in this study could address future planning of sustainable tourism master plan at the local level particularly those towns that feature BCEs as their main tourism attractions. In the second highlight (5.2), perception and content analyses of mangrove ecosystems provides empirical evidence of the role of BCEs (also referred to as BCEIs, in this study), for instance, in disaster risk reduction and climate change mitigation while enhancing people's well-being (Quevedo et al. 2020a; 2021c, e). This section explored the prospects of BCEIs as Nature-based Solutions (NbS) in the country. Finally, the last section (5.3), presents a synthesis that reflects the importance of this study towards the sustainable management of BCEs. The findings of this research can be translated as useful metrics in contextualizing and/or enhancing BCE management plans specifically in strategizing advocacy campaigns and engagement of local stakeholders not only in the Philippines but also across regional and global scales.

5.1. Linking Blue Carbon Ecosystems with Sustainable Tourism

5.1.1. Tourism and BCE Linkages

Tourism is widely perceived to be an integral economic factor that could enhance the quality of life through employment opportunities, economic diversity, access to natural and cultural attractions, outdoor recreation and hang-out places, and the enhancement of food and hospitality industries (Andereck et al. 2005). Although tourism is an important economic booster to a community, it can also negatively impact the environment particularly the vulnerable ecosystems including BCEs (Andereck et al. 2005). As listed by Sunlu (2003), environmental impacts of tourism include scarcity of water (particularly for small islands and islets) and local resources, land degradation, air, noise, and aesthetic pollution, solid waste, littering and sewage issues, and negative physical impacts (e.g., developments and land-use conversions). For example, constructed ports could lead to eutrophication of coastal waters, which is a major threat to seagrass ecosystems (e.g., Fortes and Santos 2004) and coastal developments of tourism facilities could result to mangrove loss (e.g., Brenner et al. 2018). In addition to these impacts, there is the possibility that local policies and plans will shift their focus in catering to the short-term needs of tourists, frequently disregarding the indirect long term effects on the environment (Andereck et al., 2005).

In Busuanga Island, Philippines, the coastal and marine tourism industry has been a major contributor to its economic growth, thus, tourism-related infrastructures are well developed over the past decade in the island (Okazaki, 2008, Tomeldan, 2009). Oftentimes, tourism developments such as reclamation and road widening projects threaten BCEs on the island, frequently unnoticed by the residents as certain portions are changed underwater or due to indifference. Results of the perception analysis (Chapter 3, Quevedo et al. 2021b, d) showed that anthropogenic activities like building infrastructures and pollution from domestic wastes threaten the BCEs. Similarly, thematic analysis (Chapter 4, Quevedo et al. 2021a) conducted

on the island also revealed how tourism-related activities pressure BCEs and other coastal ecosystems. Although these activities can be linked as impacts of tourism industry, explicit investigations of the impacts, whether positive or negative, to BCEs are very limited, hence, more comprehensive analyses are needed. To address these gaps, this study utilized the information gathered from local communities (household surveys) and policy-makers and other relevant stakeholders (key informant interviews) to show the impacts of tourism on BCEs on the island (Figure 5.1). By identifying the various stakeholders' social and policy science perceptions, the insights of this study can support policy decision-makers in crafting a holistic approach to sustainable tourism development and BCE resource management attuned to the local contexts in the Philippines.

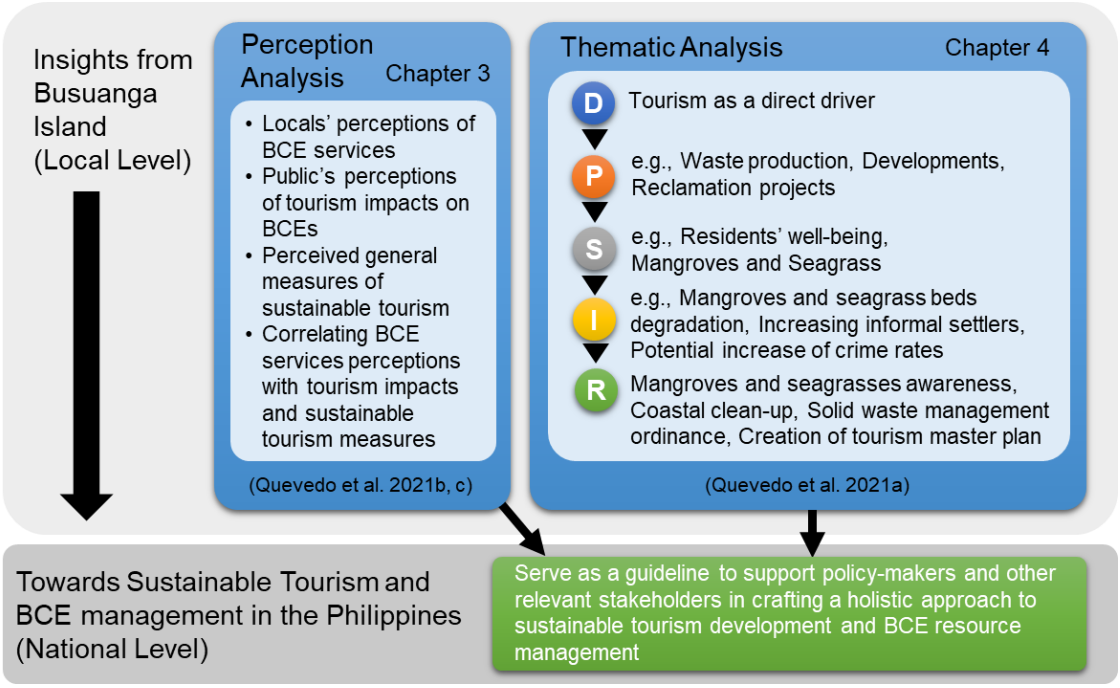


Figure 5.1. Implications of this study towards sustainable tourism and BCE management.

Using correlation analysis, this study linked social perceptions (awareness) of BCEs services with perceived tourism impacts to BCEs and general measures for sustainable tourism (Quevedo et al. 2021b, d). The results showed significant associations when respondents' perceived effects of tourism were correlated with their awareness of BCE services, indicating

a mediating effect of the level of cognizance on respondents' observed effects (Table 5.1). Negative relationships were obtained between mangroves awareness and the effect of tourism on its cover, conservation efforts, accessibility, and food stock availability. For instance, perceptions on mangroves' general cover are associated with their awareness of "habitat of many organisms" (ρ = -0.221), as a "food source" (ρ = -0.268), and "coastal protection" (ρ = -0.252). In contrast, the associations acquired when correlating seagrass ES awareness with perceived environmental changes were all positive. The perceived general condition of seagrasses, for instance, is influenced by their knowledge that these ecosystems are home to various fauna (ρ = 0.760), a great source of food (ρ = 1.000), and sequester carbon (ρ = 0.416). These relationships may reflect that through their awareness (high or low) of BCE benefits, they can effectively recognize the changes (improving or degrading) brought by tourism to BCEs.

Table 5.1. Correlation analysis of respondents' awareness of BCE services and perceived tourism impacts to BCEs (modified from Quevedo et al 2021b).

Ecosystem services	Cover (general observation)	Conservation efforts	Accessibility	Food stock availability
		Mangrove Ecosystems		
Habitat of many organisms	-0.221		-0.420	-0.368
Food source	-0.268		-0.480	-0.353
Coastal protection	-0.252	-0.269	-0.449	-0.399
Air purification		-0.212	-0.229	
Water purification		-0.304	-0.309	
Recreational site	-0.216	-0.153	-0.311	-0.285
Carbon sequestration		-0.227	-0.165	
		Seagrass Ecosystems		
Habitat of many organisms	0.760	0.612	0.545	0.638
Food source	1.000	0.641	0.445	0.519
Coastal protection	0.641	1.000	0.608	0.671
Air purification	0.445	0.608	1.000	0.712
Water purification	0.519	0.671	0.712	1.000
Recreational site	0.525	0.489	0.556	0.649
Carbon sequestration	0.416	0.565	0.689	0.786

Note: only significant correlations at $p < 0.05$ are shown.

When respondents' overall awareness of BCE services was correlated with their perceptions on general measures of sustainable tourism, positive linkages were also observed (Table 5.2). For instance, high (low) recognition of mangroves' benefits will result in a high (low) agreement to the following actions: e.g., "Strict implementation of local plans and policies" (ρ = 0.238), "Cooperation with NGO and private sectors" (ρ = 0.299), and "Prioritize conservation of natural resources" (ρ = 0.336) while overall seagrass awareness (high or low) influences for example "Promote safety and carrying capacity strategies" (ρ = 0.357), "Cater the needs of tourists as well as the locals" (ρ = 0.228), and "Hiring of local people" (ρ = 0.385) perceptions.

Table 5.2. Correlation analysis of respondents' overall awareness of BCE services with perceived potential measures of sustainable tourism (modified from Quevedo et al. 2021b).

Perceived sustainable tourism measures	Mangrove Ecosystems	Seagrass Ecosystems
Strengthening the environmental regulations		
Strict implementation of local plans and policies	0.238	0.324
Cooperation with non-government organizations and private sectors	0.299	0.390
Prioritize conservation of natural resources	0.336	0.365
Promote ecosystem-based tourism plan	0.374	0.369
Promote protection of the environment	0.292	0.368
Promote safety and carrying capacity strategies	0.243	0.357
Cater the needs of tourists as well as the locals	0.241	0.228
Inclusion of the welfare of local stakeholders and Indigenous people	0.289	0.283
Hiring of local people	0.371	0.385
Sustainable and environment-friendly infrastructures	0.280	0.302
Development in appropriate land areas	0.366	0.367

Note: significant correlations at $p < 0.05$ are shown.

Key informant interviews of the policy-makers (Quevedo et al. 2021a) were also able to document tourism as a direct driver. Despite tourism is still developing in Busuanga town, early sights of tourism pressures have been observed. For instance, tourism-related developments have resulted in the cutting of mangrove forests and siltation as an effect of these

projects damages seagrass beds (Figure 5.1). Thus, the policy-makers in the municipality are in preparation to produce a tourism master plan that incorporates sustainable management of BCEs.

5.1.2. Prospects of Sustainable Tourism in the Philippines

Sustainable tourism aims for the balance between environmental protection and economic development (Dedeke 2017) – improving local economies and people's well-being. Since local communities are considered to be the most important players as they are most likely affected either positively or negatively by the tourism industry, it is considered imperative to determine their views on possible measures of sustainable tourism (Eshliki and Kaboudi 2012; Xu et al. 2016).

Overall, the different stakeholders in Busuanga Island are highly perceptive of what sustainable tourism should be because of their knowledge of BCE services as documented in this study. In a similar vein to existing studies (e.g., Puryono and Suryanti 2019; Treephan et al. 2019), the public's perceptions of tourism impacts correlate with their knowledge of BCE services; the more (less) they are aware of the benefits the better (least) they can recognize the impacts. After super typhoon Yolanda hit the country in 2013, there has been a shift towards the improvement of environmental protection and conservation in line with the tourism industry. As reflected in the results, environment-related measures are well perceived by the respondents since they are highly cognizant of the benefits and services they can get from these ecosystems. These findings are in concordance with Kobayashi's (2017) assessment in 2014, where stakeholders have high regard for environmental protection strategies.

Tourism if not sustainable can result in ecosystem loss. Thus, the local communities agree that protecting their resources is a necessary step moving forward. They are optimistic that their local government will follow the principles of sustainable tourism. Although the role

of NGOs is not investigated in this study, results implicitly show how important they are in promoting sustainable tourism. These groups, as civil society organization counterparts, are instrumental in educating the local communities about the possible environmental impacts of tourism on their coastal and marine resources. The more people are aware of the importance of BCE, the more they recognize environmental protection and conservation measures.

This study suggests that it is important to understand the attitudes of the residents in the community to ensure the effective implementation of sustainable tourism measures. As tourism grows rapidly on the island, a holistic approach should be done including different stakeholders' perceptions, collaborations with NGOs, private and international sectors as well as multidisciplinary and realistic researches. Such networks of social capital are instrumental in pursuing sustainable tourism. With that, the results of this research can provide a basis for a roadmap for local governments to pursue especially in enabling policies to promote sustainable development that improves environmental conditions and residents' well-being.

Lastly, the global benefits of conservations and tourism at local levels are frequently in a trade-off relationship. Although this work did not explore the solutions to the full extent, the results suggest that identifying the indirect drivers (e.g., awareness of BCE services, personal experiences) are significant and good indicators to determine community perceptions of environmental changes in coastal areas where the tourism industry exacerbates the vulnerable coastal and marine ecosystems.

5.2. Blue Carbon Ecosystem Infrastructures as Nature-based Solutions

5.2.1. Global Standards of Nature-based Solutions

Nature-based Solutions (NbS) are defined by the International Union for Conservation of Nature (IUCN 2016) as "actions to protect, manage and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." There have been ongoing discussions at the conceptual level to streamline NbS with existing approaches, particularly with biodiversity-related international processes. The NbS framework, which emerged from the Ecosystem Approach (e.g., forest landscape restoration, integrated water resource management) underpinning the Convention on Biological Diversity (CBD 2004), is gaining traction in the scientific literatures (e.g., Kabisch et al. 2016; Cohen-Shachem et al. 2019) and within national policies, programs, and platforms (e.g., IUCN 2020; Thiele et al. 2020). Significant efforts are now being invested in developing principles, guidelines, or standards for global system-management strategies that fall within NbS (Cohen-Shacham et al. 2019; IUCN 2020). To date, NbS are categorized into five main approaches, namely: 1) Ecosystem restoration approaches, 2) Issue-specific ecosystem-related approaches, 3) Ecosystem-based management approaches, 4) Ecosystem protection approaches, and 5) Infrastructure-related approaches (Cohen-Shacham et al. 2016). Amongst various types of NbS, this study focuses on infrastructure-related solutions such as blue infrastructures. Edwards et al. (2013) refer to the term "blue infrastructure" to the coastal and near-shore habitats that provide the physical matrix for ecological functions, which in turn deliver important services and ecological benefits to communities. Blue infrastructure restoration such as mangrove reforestation provides valuable economic benefits by rehabilitating habitats that contribute to the economic growth and overall well-being of the society (Primavera et al. 2012). Currently, blue infrastructures are incorporated in different financing schemes such as the Blue Natural Capital (BNC)

projects and investments that aim to protect, restore, and conserve the coastal and marine habitats and to guard their ecosystem services (Thiele et al. 2020).

This study focuses on mangrove habitats which are also referred to as "blue carbon ecosystems" (e.g., Nelleman et al. 2009) and "blue infrastructures" (Edwards, Sutton-Grier, and Coyle 2013). For consistency and clarity in the following discussions, this study combines the two terminologies and refers to mangroves as "blue carbon ecosystem infrastructures" (BCEIs). BCEIs provide important ecosystem services like regulating (e.g., coastal protection and climate regulation), provisioning (e.g., subsistence and commercial fisheries), cultural (e.g., tourism and recreation), and supporting (e.g., nutrient cycling and nursery habitats) services (MEA 2005). At the conceptual level, BCEI restorations can be an NbS approach (Cohen-Shacham et al. 2016). Following the IUCN (2020) global standard for NbS, this study presents how BCEI restorations fit the framework by carefully interpreting each criterion and referring to published scientific literatures for appropriate examples (Table 5.3). Criterion 1, with three indicators, ensures that NbS effectively (1) addresses societal challenges, (2) understands clearly these challenges, and (3) delivers substantive benefits to human wellbeing. BCEI restorations fit the first criterion since it addresses multiple socio-environmental challenges while providing benefits to human well-being. Mangrove restoration programs are revisited in the context of "blue carbon" strategies and received international attention as an NbS for climate change mitigation and adaptation (Crooks et al. 2017; Morris et al. 2018; Taillardat et al. 2018; Taillardat et al. 2020). Second is the disaster risk reduction capability of BCEIs. There are many published works (e.g., Spalding et al. 2014; Narayan et al. 2016; Menéndez et al. 2018) that documented the benefits of mangroves as a natural defense to coastal hazards (e.g. wind and swell waves are rapidly reduced as they pass through mangroves, which can be effective in reducing the flooding impacts of storm surges). In the Philippines, mangrove reforestation projects have been implemented mainly in the Visayas (central) region,

with islands that are more vulnerable to typhoons than the bigger islands of Luzon (north) and Mindanao (south), for wood supply and protection against monsoon winds and typhoons (Primavera 2000). In the aftermath of super typhoon Yolanda in 2013, mangroves' protection services were highly perceived by the coastal communities in the Visayas region (Quevedo et al. 2020a; 2021c). The subsequent increase of this at the national level resulted in national coastal greenbelt initiatives evidenced by the filing of Senate Bill No. 651 or the National Coastal Greenbelt Act and replanting projects (Primavera et al. 2013). Lastly, BCEIs can also promote economic and social development, human health, and food security. For instance, payment for ecosystem services (PES) schemes for rehabilitated mangroves in the context of blue carbon are emerging (e.g. Thompson et al. 2014). Cultural services of mangroves also have a huge potential for economic gains through mangrove tourism activities (Spalding and Parrett 2019). In the Philippines, for example, mangrove rehabilitation projects were aimed to contribute to economic growth and community resiliency through livelihood options and food sources (Primavera 2000; Primavera et al. 2012).

Despite the known valuable benefits these mangroves (and, generally, the entire BCEs) offer to the environment and the community (e.g., Acharya 2016, Alongi 2008), they are among the most threatened ecosystems (Crooks et al. 2017). Globally, it is estimated that mangrove areas have declined to 35% with continued losses of 0.16% – 0.39% per annum (Valiela et al. 2009; Hamilton and Casey 2016). In the Philippines, mangrove losses were attributed to overexploitation and conversion to other land uses such as aquaculture ponds, coastal developments, and residential area expansions (Primavera 2000). Depletion and degradation of these ecosystems would result in the decrease or loss of their valuable services (Spalding et al. 2014; Crooks et al. 2017). Thus, to prevent further mangrove decline, rehabilitation and restoration projects are implemented (Primavera et al. 2012). BCEI restorations are covered and informed by a wide-scale which is a standard requirement under Criterion 2 of the IUCN

(2020) NbS framework (Table 5.3). Interpreting the three indicators (please see Table 5.3), mangrove reforestation recognizes and complements well with other sectors like economy, society, and other ecosystems (e.g., Primavera and Esteban 2008). For instance, rehabilitation of wetlands, including mangroves, help manage floods and tidal surges, thus nearby physical assets (e.g., ports, roads) and communities are protected (Thiele et al. 2020).

Table 5.3. How BCEI (mangroves) restorations fit the criterions of global standard of NbS framework (adapted from IUCN 2020) (modified from Quevedo et al 2021c).

Criterion	Example of Indicators	BCEI restorations as an NbS
1. NbS effectively address social challenges	(a)most pressing societal challenges are prioritized, understood and documented, (b) human well-being outcomes are identified	Climate change mitigation and adaptation (e.g., Taillardat et al. 2020), Disaster risk reduction (e.g., Menéndez et al. 2018), and Promote economic and social development, human health, and food security (e.g., Spalding and Parrett 2019)
2. Design of NbS is informed by scale	(a) recognizes and responds to interactions between the economy, society and ecosystems, (b) integration with other complementary interventions, (c) incorporates risk identification and management beyond the intervention site	Mangrove reforestation recognizes and complements well other sectors like economy, society, and other ecosystems (e.g., Primavera and Esteban 2008), Help manage floods and tidal surges, thus nearby physical assets (e.g., ports, roads) are protected (Thiele et al. 2020), Consider the impact to other adjacent ecosystems (Primavera et al. 2012)
3. NbS result in a net gain to biodiversity and ecosystem integrity	(a) evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss, (b) clear and measurable biodiversity conservation outcomes are identified	Mangrove planting programs at previously abandoned ponds resulted to increase coastal protection (and other services) and biodiversity (increase in wildlife) (Primavera and Esteban 2008; Primavera et al. 2012)
4. NbS are economically viable	(a) direct and indirect benefits and costs associated are identified, (b) design is justified against available alternative solutions, (c) considers resourcing options such as public sectors	Can cost-effectively avoid more than a third of expected losses (Barbados, Mueller, and Bresch 2014), Improved financial capacities of coastal communities (Primavera and Esteban 2008)
5. NbS are based on inclusive, transparent and empowering governance processes	(a) stakeholders who are directly and indirectly affected have are identified and involved, (b) decision-making processes document and respond to the rights and interests of all participating and affected stakeholders	Promotes collaboration of different stakeholders (Primavera et al. 2012), Encourages participation of local communities in planning, implementation and management (Gevaña et al. 2018; Camacho et al. 2020)

Note: Only 5 out of 8 criterions are presented, refer to IUCN 2020 for the complete guidelines.

Moreover, BCEI restorations consider the impact to other adjacent ecosystems such as seagrasses, for example, by applying correct mangrove zonation in the process (Primavera et al. 2012). Thus, rehabilitating these habitats could allow the ecosystem to recover and eventually provide valuable ecosystem services (Criterion 3, Table 5.3, IUCN 2020). In the Philippines, mangrove planting programs at previously abandoned ponds resulted to increased coastal protection (and other services) and biodiversity (increase in wildlife) (Primavera and Esteban 2008; Primavera et al. 2012). Under Criterion 4, NbS should be economically viable (Table 5.3, IUCN 2020). In the Barbados case study, Mueller and Bresch (2014) investigated that the country could cost-effectively avoid more than a third of expected losses by implementing risk mitigation initiatives such as mangrove revivals. In the Philippines, successful mangrove restorations have improved the financial capacities of coastal communities by providing alternative sources of livelihood (Primavera and Esteban 2008).

Although, even with the added incentives and legal mandates, some mangrove rehabilitations in the country are unsuccessful due to noncompliance to scientific guidelines and weak collaboration of stakeholders (Primavera and Esteban 2008; Primavera et al. 2012). As set in NbS global standard under 'Criterion 5′ (Table 5.3, IUCN 2020), NbS "acknowledge, involve, and respond to the concerns of a variety of stakeholders especially right holders." It is essential to share the results of, for example, risk assessments regarding biodiversity degradation among relevant stakeholders to maintain the stability of, for instance, conservation budgets (Uchiyama and Kohsaka 2019). In the Philippines, through the government implementation of community-based forest management (CBFM) agreement, forest management rights and responsibilities are transferred to local communities paving the way for organizing and strengthening of POs such as in Banacon Island, Bohol in central Visayas (Gevaña et al. 2018). The strong commitment of the PO to protect and manage their mangroves has been successful, receiving several recognitions like the Food and Agriculture

Organization's (FAO) Outstanding Tree Farmer Award in 1991. Similarly, in the recent review of CBFM practices in the Philippines and Myanmar, Camacho et al. (2020) have highlighted that the CBFM approach encourages participation and commitment of local communities and collaboration with other stakeholders such as government and non-government institutions. Through an in-depth review and summarizing of the success and challenges of rehabilitation programs, they documented that one of the key factors for a successful mangrove restoration is the empowerment of local communities by legitimizing their resource rights as well as management responsibilities. This work acknowledges that the scope of case studies presented here is limited and only interpreted as examples of NbS engaging local stakeholders (Criterion 5, IUCN 2020). Furthermore, it is noteworthy that this study focused on criterions 1 to 5 of the IUCN framework since these are related to the context and governance of BCEI. The other three criteria (6 to 8) are related to detailed implementation methods such as consideration of cost and benefit, evidence-based approach, and mainstreaming actions. Since the purpose of this study is to identify the basic context and governance of BCEI and its impact on local communities in terms of their perception and behavior, this work presents fundamental information of characteristics of BCEI. The results of this study can contribute to exploring the detailed implementation methods of BCEIs, which are discussed in the criterions 6 to 8 in the IUCN framework (IUCN 2020).

5.2.2. Prospects of BCE Infrastructures as Nature-based Solutions in the Philippines

The social and policy science assessment of mangrove ecosystems presented and discussed in Chapters 3 and 4 provide insights and prospects of BCEIs as NbS in the Philippines (Figure 5.2). Specifically, the results of perception and content analyses were interpreted in the context of the global standards of NbS (IUCN 2020). For instance, in Eastern Samar, the public's perceptions of mangrove ecosystems offer implications of BCEIs as NbS for disaster risk reduction or more commonly referred to as ecosystem-based disaster risk reduction (Eco-

DRR) (Quevedo et al. 2020a). Eco-DRR, as defined by Estrella and Saalismaa (2013), involves sustainable management, conservation, and restoration of ecosystems that provide services that reduce disaster risk and improve community livelihood resilience. Results of perception analysis in the province showed that the majority of the local communities sourced their food (Figure 3.2) in mangrove areas. Their high awareness of the coastal protection capabilities of mangrove forests and involvement in various mangrove management activities complement well with the IUCN NbS framework (Table 5.3). In the Philippines, the National Greening Program (NGP) which involves the restoration of mangrove ecosystems along the coasts aims to lessen the impact of natural hazards and enhance community resilience. Currently, it is interesting to note that based on the content analysis, coastal protection as an ecosystem service of mangroves has had not been elaborately discussed and explored as an opportunity for the municipalities of Lawaan and Salcedo given that their plan effectivity period is five (5) years after the super typhoon Haiyan devastation in 2013 (Quevedo et al. 2021e). Thus, there is an opportunity to integrate the role of mangrove ecosystems, and, in general, the BCEIs in Eco-DRR and finally as NbS in future coastal management policies and plans.

Meanwhile, social perceptions gathered in Aklan province show initial insights that offer valuable prospects of mangrove eco-parks as an example of BCEIs as an NbS in the Philippines (Quevedo et al. 2021c). The positive and high correlation of community involvement and mangrove utilization (visits) suggests that there is a huge potential for NbS to be successful at the grassroots level. For instance, respondents' high awareness of regulating services (e.g., coastal protection, carbon sequestration) of mangrove forests reflects the role of BCEIs in addressing societal challenges such as coastal hazards and climate change mitigation which complements the IUCN NbS framework (Table 5.3).

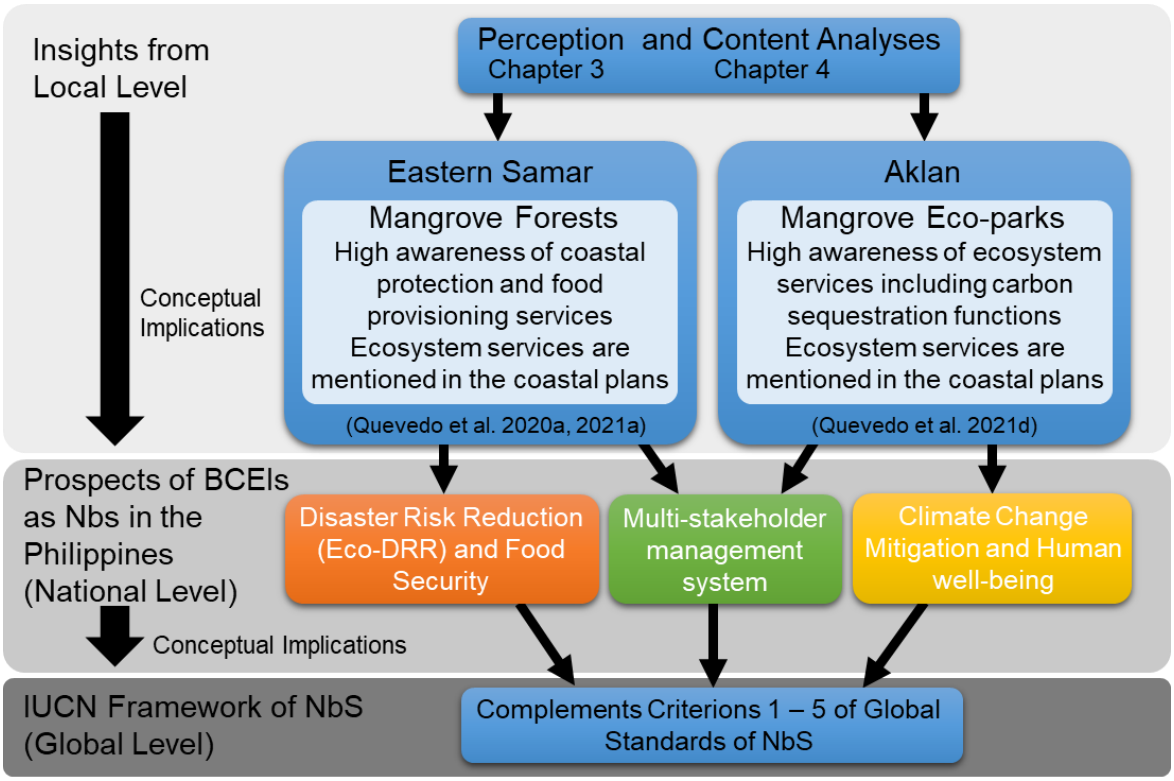


Figure 5.2. Conceptual implications of this study towards BCEIs as NbS in the Philippines.

In terms of reliance on NbS against climate-induced coastal hazards, BCEIs can replace traditional built coastal infrastructures. Several studies have already presented the benefits of mangroves as a natural defense to coastal hazards globally (e.g., Spalding et al. 2014; Narayan et al. 2016) and in the Philippines, in particular (e.g., Menéndez et al. 2018). Moreover, with regards to climate change mitigation, BCEIs, if managed and maintained well, will have a significant contribution as important carbon sinks and storage. Previous carbon stock analyses in the study areas (Castillo and Breva 2012; Duncan et al. 2016; Barrientos and Apolonio 2017) showed how much carbon can be sequestered and stored. Through locals' active participation in coastal management activities, as reflected in this study, mangrove eco-parks, again, when managed and protected well, can be a vital tool in climate change mitigation as a carbon sink and storage. Engaging local communities in planning, implementing, and managing BCEI is essential for its success. Community organizations such as POs encourage the active participation of residents in coastal management activities like mangrove planting, as reflected

in this study. As previously documented and examined, involving and authorizing local stakeholders give them a sense of commitment to protect, conserve, and sustainably manage coastal resources including BCEIs (e.g., CRMP 2003; White et al. 2006; Primavera and Esteban 2008; Camacho et al. 2020). BCEIs such as mangrove eco-parks also improve public's awareness and financial capacity as shown in the awareness and utilization patterns of its ecosystem services. Thus, with existing mangrove eco-parks and ongoing rehabilitation programs (Primavera et al. 2012; 2013), the country's present and future BCEIs and, generally, the future NbS programs have a huge potential to improve people's perceptions and well-being.

5.3. Sustainable Management of Blue Carbon Ecosystems

The social and policy science assessments conducted in this study provided valuable insights for the sustainable management of BCEs in the Philippines which can be shared and/or adopted by other countries with similar geopolitical and geomorphological settings such as those component nations of CTR. Figure 5.3 illustrates a summary of implications from the three analyses conducted in this paper.

5.3.1. Importance of Local Perceptions in Sustainable Management of BCEs

Local perceptions, based on comprehensive theoretical and empirical evidence, have a critical role in supporting collective responses for the sustainable management of natural resources (Quintas-Soriano et al. 2018). This study was able to demonstrate how local perceptions can be used to identify the different BCE services, local threats, and present management directives. Results of the analyses showed that awareness of BCE provisioning (e.g., food source), supporting (e.g., habitat of many organisms), and coastal protection services is relatively high across all sites. Whereas, the public's awareness of cultural (e.g., recreational site) and carbon sequestration services are generally high in Aklan and Busuanga Island while

low in Eastern Samar province. In terms of utilization, fishing in BCEs for own consumption is an everyday activity of locals in Eastern Samar while accessing BCEs for recreational activities is more frequent in Aklan. Factors influencing utilization frequency include awareness level and socio-demographic characteristics. The former shows significant correlations with utilization while the latter's influence varies in each site. These findings are important insights to consider in increasing people's overall awareness and utilization of BCE services. For instance, there is an opportunity for government agencies at the local and national levels to increase the awareness of climate change mitigation functions (carbon sequestration) of BCEs by mainstreaming this function at coastal management plans and programs. Government agencies can explore the option of PES that are complementary to carbon stock management to incentivize proper conservation and protection practices of BCEs (Thompson et al. 2017). Several studies have shown that the Philippines' BCEs have a huge potential and capacity to sequester carbon (Gevaña et al. 2013; 2019). Thus, the country needs to have an effective and comprehensive conservation management plan for BCEs.

Perceived threats are categorized into natural and anthropogenic, with the former being perceived as the number one threat in all sites. The policy-makers, coastal managers, and other relevant local stakeholders are strongly encouraged to consider the perceived threats of BCEs identified in this study when planning management schemes as preparatory and adaptation measures should these threats arise in their respective sites. The difference in the ranks between the threats among the sites indicates that natural and anthropogenic pressures are site-specific; hence, solutions should also be tailored to be site-specific. For instance, in Busuanga Island, policy-makers can prepare an efficient tourism master plan based on lessons learned in this study such as prioritizing community awareness and engagement (e.g., BCE and other ecosystem information and education campaigns and tourism-related trainings and jobs placement) as well as ensuring effective implementation of environmental laws or softer

customary regulations or strategies (e.g., solid waste management and BCE conservation and protection) to further enhance their tourism industry.

Existing management strategies though present are perceived by locals to be weak. Thus, there is a need to investigate further to better understand and tailor the current management practices in each site. Moreover, there are key important points gathered from locals' perceptions that are strongly endorsed for consideration. The locals highly recognized themselves to take lead in the management of BCEs. This is a very essential input to have since it reflects how people at the local level value their resources. For instance, coastal communities are now more aware of the importance of mangrove forests and mangrove eco-parks because they experienced first-hand the protection provided by mangrove ecosystems when super typhoon Yolanda hit the study sites in 2013. Locals are now more conscious and obedient to the mangrove management ordinances, activities, and directives.

Based on respondents' perceptions, LGUs, NGOs, and POs play a very important role in leading management activities in their municipalities. For instance, in Aklan, POs take lead in coastal clean-up activities and mangrove planting activities, while in Busuanga Island, the role of NGOs has been vital in delivering sustainable management awareness campaigns and practices. In Eastern Samar, LGUs have been observed to initiate the protection of BCEs as part of a collective effort of disaster risk reduction and mitigation strategies. This information on the essential role of different stakeholders is very important to have especially at the local scale where many organizations interact and that have sometimes led to the overlapping of tasks. Moreover, this observation is also reflective at the national level where various government agencies (e.g., DENR and DA-BFAR) have an overlapping of tasks and mandates which oftentimes lead to ineffective and confusing management directives (Primavera 2000). Thus, the results presented here can serve to support policy-makers, practitioners, and other relevant stakeholders to organize themselves efficiently and collaborate effectively.

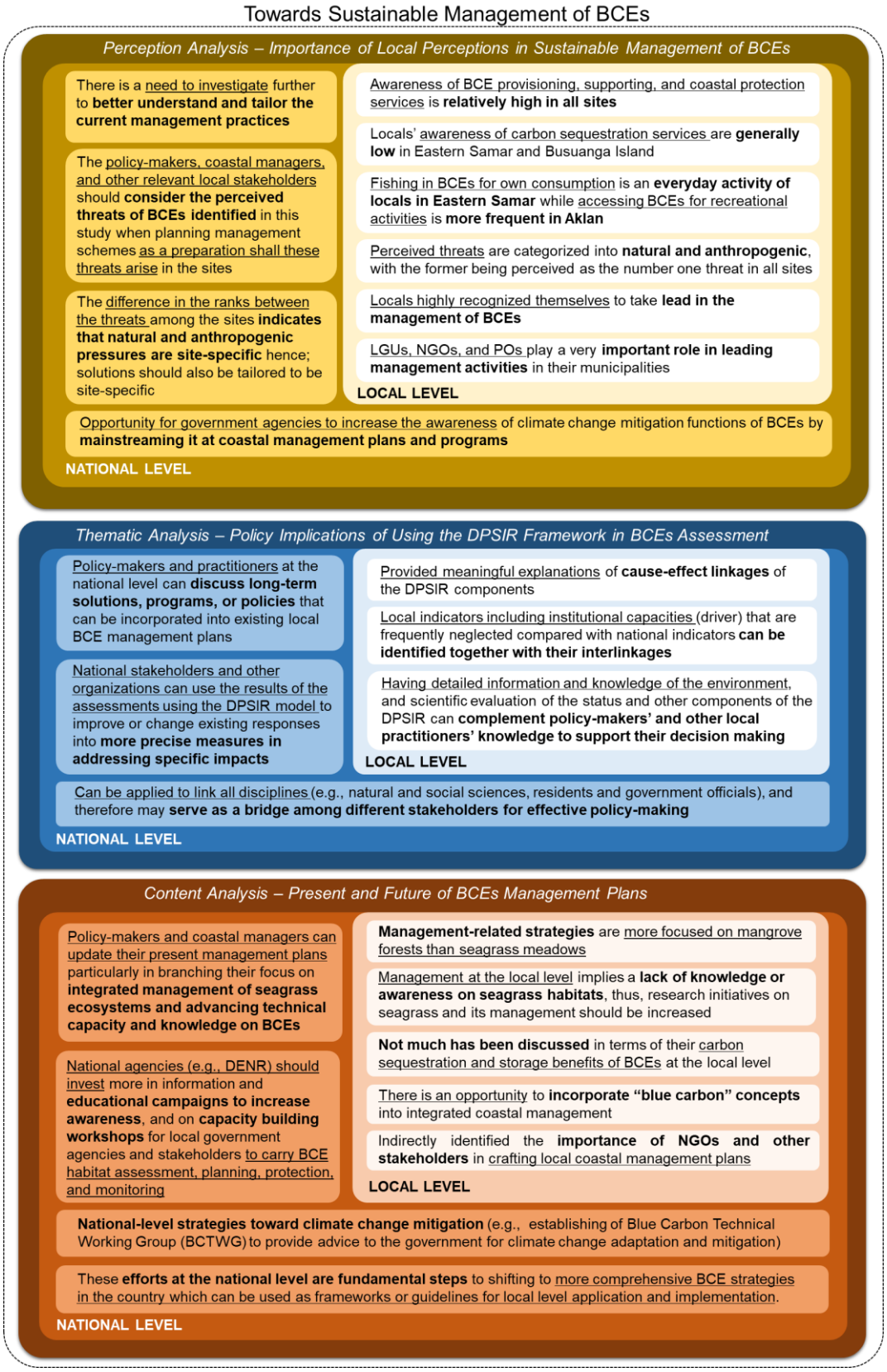


Figure 5.3. Implications towards sustainable management of BCEs in the Philippines.

Overall, the locals' perceptions gathered here provided multiple insights towards the sustainable management of BCEs. The availability of this information across the Philippines could be a sound foundation to compare and contrast how coastal communities from different provinces perceive and value their resources. This crucial learning could then be furthered into identifying common grounds that can be transferrable across or translated into a contextualized national program not only in the Philippines but also in other countries with similar geopolitical and geomorphological settings. For instance, the works of Quevedo et al. (2021d) and Lukman et al. (2020) illustrated the application of the methods used in this study for the case of Indonesia. Both of the studies analyzed the public's perceptions of BCE through their awareness, utilization, and perceived threats and management systems. The perception analysis conducted in Karimunjawa Island, Indonesia, particularly on the section where locals were asked to prioritize management efforts, to some extent, served as a feedback mechanism and an assessment tool. The former illustrated that the least prioritized management actions are the ones that are already being strongly and widely, if not effectively, implemented such as coastal zoning, while the latter revealed that certain management activities, like the ones perceived to be prioritized, are the activities or programs that are less felt and experienced.

5.3.2. Policy Implications of Using the DPSIR Framework in BCEs Assessment

The usefulness of the DPSIR framework to assess BCEs has been demonstrated in this study. DPSIR provided meaningful explanations of cause-effect linkages of the drivers, pressures, state changes, impacts, and responses at the local level which are very important information for policy-makers to have. Examples of identified linkages in Busuanga Island include population growth – overexploitation – degraded marine ecosystems, tourism – developments – destruction of the coastal environment, and institutional capacities – limited technical personnel and skills – inadequate or limited conservation programs (see Figure 4.3).

Although this work did not use secondary data (e.g., population data and habitat profiles) to support the results of the model, this study acknowledged that further research involving the use of other criteria as well as other analysis (from natural sciences) could increase the efficacy of the framework.

By applying the DPSIR model with the key policy-makers, localized responses were collected (see, for example, Figure 4.3). These local responses such as establishing community-managed MPA, village ordinances, and updating of municipal coastal management plans are oftentimes ignored since responses from national (or sometimes global) are the ones being followed or prioritized (Carr et al. 2007). Identifying local responses is important to properly address the impacts of, for instance, pressures (e.g., land-use conversion) to BCEs at a local scale. Also, local indicators including institutional capacities (driver) resulting in limited technical skills and personnel (pressure) which in turn result in inadequate activities (impact) that are frequently neglected compared with national indicators can be identified together with their interlinkages using the model. By applying the framework at the grassroots level, the number of indicators and dimensions can be more precise in terms of scope and scale and initially capture and reflect the current state of the coastal ecosystems at a local scale. For future policy-making using the DPSIR framework, the indicators can be expanded by considering or categorizing the spatio-temporal scales particularly the 'D' indicators. For example, the broad spectrum of climate change and its effects (e.g., sea level rise and increased frequency of typhoons) can be specified in the model based on the observed or assessed impacts at the community level. By doing so, policy-makers and practitioners can discuss long-term solutions, programs, or policies that can be incorporated into their existing local BCE management plans. For instance, local stakeholders can adopt long-term interventions for climate change from national (e.g., National Climate Change Action Plan 2011–2018) or international (e.g., Paris Agreement) programs. Notably, this study shows that the application

of the DPSIR framework with stakeholders can initially gather and reflect local responses under the response or 'R' indicators, which can be useful to address impacts more precisely. The local stakeholders and other relevant organizations can use the results of the assessments of the DPSIR model to improve or change existing responses into more precise measures in addressing specific impacts.

Finally, the framework can also be applied to link all disciplines and/or views (e.g., natural and social sciences and barangay and municipal level) and, therefore, may serve as a bridge among different stakeholders (e.g., residents and government officials) for effective policy-making. In decision making, it is important to include all relevant stakeholders to efficiently determine whether existing plans or policies are effective or not and whether necessary alternative policy options can be placed.

5.3.3. Present and Future of BCE Management Plans

The results of this study provided the present direction of coastal management plans towards BCEs at the local level in the Philippines. Despite the limited number of documents (only four municipalities) investigated, the following points observed could provide insights and prospects of BCEs management:

Although mangroves and seagrasses are equally important components of BCEs, there is a gap in the current management between these resources at the local level. Management-related strategies, as seen in the analysis, are more focused on mangrove forests than seagrass meadows (Figures 4.6 and 4.7). This may be due to their coastal protection services which were observed and experienced by coastal communities when super typhoon Haiyan hit the study sites in 2013. Anecdotes and scientific investigations in the affected sites contributed to increasing attention for mangroves' conservation and protection measures as part of disaster

risk reduction strategies. Meanwhile, the presence of seagrass ecosystems in the municipal coastal plans is very limited. As pointed out by Fortes (2018), the link among scientific bodies, policy-makers, and stakeholders on seagrass habitat management is rather weak and oftentimes disconnected from each other. This discrepancy in the management at the local level implies a lack of knowledge or awareness on seagrass habitats, thus, research initiatives on seagrass and its management should be increased, collaborating with those of mangrove forests. Generally, municipal governments have limited human resources and budget in biodiversity and environmental management programs (Kohsaka and Uchiyama 2017). Intersectional policy collaborations, such as coastal and terrestrial management policies, are also a challenging issue (Uchiyama and Kohsaka 2019). Considering the issues of municipal governments, national agencies in the Philippines (e.g., DENR) should invest more in information and education campaigns to increase awareness of the local authorities, management bodies, and the rest of the coastal communities and on capacity building workshops for local government agencies and stakeholders to carry seagrass habitat assessment, planning, protection, and monitoring.

In the existing coastal plans, legal frameworks are, again, limited to mangrove ecosystems. There are no reported laws, policies, or local ordinances to date that specifically addressed the conservation and management of seagrass ecosystems. Their protection and management are oftentimes minimally subsumed under coral reefs and other ecosystems programs and plans as a coastal ecosystem network approach. Inconsistency of the content of the plans across the municipalities can be influenced by several factors, however, this study did not explore these factors. Thus, there is an opportunity to consider future studies on factors affecting plan formulation and subsequent implementation. For instance, a future investigation could examine the role of stakeholders in the development of coastal management plans. Although this study did not include a detailed analysis of stakeholders' roles, their contributions have been identified in the studied documents. For instance, in the CRM plan of

Batan, NGOs have been acknowledged as important players in the implementation of CRM plans while the academic institutions are valued for their technical assistance. In the coastal plan of Salcedo, NGOs are recognized to be vital in the planning of CRM and organizing the local stakeholders while national government agencies like the DENR and DA-BFAR are important players in the conduct of biological and socio-economic assessment. Community organizations have also been identified to be important communicators in disseminating coastal management strategies (Quevedo et al. 2021c, d). These contributions are very important in contextualizing and implementing CRM plans, thus, a more comprehensive examination of their role can be conducted to support these anecdotes.

Lastly, the role and recognition of BCE services and their scale-dependence need to be addressed. The "blue carbon" concept is increasingly better understood in global climate change mitigation, while it is barely established nor communicated at the local level. A 2017 report published by the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and NGOs is showing strategic "blue carbon" opportunities in the seas of East Asia and it has recommended incorporating BCEs into integrated coastal management (Crooks et al. 2017). Clearly, this is not yet realized. Although the results of this study show that mangrove ecosystems are well incorporated in the CRM plans, not much has been discussed in terms of their carbon sequestration and storage benefits. Moreover, seagrass ecosystems received less attention in the CRM plans with no information of their role in climate change mitigation. However, there are now efforts at the national level toward climate change mitigation focusing on BCEs. For instance, Blue Carbon Technical Working Group (BCTWG) has been established to provide advice to the government for climate change adaptation and mitigation. There is also the filing of the National Coastal Greenbelt Act (Senate Bill No. 1917, 2020) which includes seagrass meadows as a major component along with mangrove forests. These efforts at the national level are fundamental steps to shifting to more comprehensive

BCE strategies in the country; which can be used as frameworks or guidelines for local level application and implementation.

Although the results presented in this study are rather limited and at the local scale only, this research can serve as a benchmark for policy-makers and coastal managers in updating their present management plans particularly in branching their focus towards integrated management of seagrass ecosystems and advancing technical capacity and knowledge on BCEs. Based on the understanding of the present directives of the coastal management plans, it is necessary to investigate the factors that facilitate the management practices and policies in different local contexts to strategically promote BCE management beyond the scale of one nation (the Philippines in this case) to targeted regional and global areas. Identifying the status of coastal management plans is instrumental in understanding the status and trends of the issues as demonstrated in this work. Moreover, in future research, factors such as incentives (e.g., PES) that can be shared among local stakeholders and accelerate the management of BCEs can be explored further following the early works of, for example, Thompson et al. (2017), Gevaña et al. (2018), and Satizábal et al. (2020).

Chapter 6. Conclusions

This study, the social and policy science assessments of BCEs in the Philippines, is a major contribution both in science and practice given that the availability of social science-related studies of BCEs in the country is still limited. In a similar vein, this study updates the pool of scientific knowledge that advances BCE-related investigations across regional and global scales. Collectively, this study provides baseline data on how coastal communities interact with the BCEs especially at the local level where local governments, implementers, and residents are the ones interacting with these resources.

The results of this work show that local communities are aware of the services they can get from BCEs. However, their awareness depends entirely on the type of benefit they directly receive. For instance, provisioning services (e.g., as a food source) is highly recognized by the residents. Personal experiences of the communities also greatly influence their perception of the BCEs (e.g., coastal protection services). Factors affecting their perceptions were explored in this study as well. Awareness and utilization of BCE services correlate with one another. Moreover, the willingness of the locals to actively participate in management-related activities has been collected in this study as well. This observation is a useful indicator in strategizing advocacy campaigns and the levels of engagement of local stakeholders in the Philippines. It is noteworthy that engaging local communities in ecosystem service assessments facilitates in defining their role in multi-governance of the environments. This perception study, particularly on the section where locals were asked to prioritize management efforts, to some extent, served as (a) a feedback mechanism on the impact of prior and/or existing BCE management activities; and (b) an assessment tool that helps identify the gaps of the management plans and programs for the study sites. This study is a crucial learning in how collective perceptions are instrumental in moving forward in BCE management strategies in the Philippines as well as a

tool for identifying common grounds that can be shared and are transferrable across regional scales.

Through a deductive thematic analysis employed among key policy-makers in Busuanga Island, this study was able to classify the interview results into the drivers, pressures, state changes, impacts, and responses that constitute the DPSIR framework, which is frequently used for systematic assessment of ecosystems (for instance, by the European Environment Agency (EEA 2002) and national governments). By applying the framework, the drivers can be categorized into natural and anthropogenic, where the latter can be further sub-categorized into direct and indirect forces. Although the drivers in this study were not ranked, key respondents identified 'institutional capacities' to be a leading factor that hinders BCE management. Examples include limited management skills and staffing and no habitat-specific (e.g., for mangroves and seagrasses) management plans or strategies. The model in this study also determined potential cause-effect linkages that can help the local government units in policy-making. Moreover, the local responses ('R') collected in the interviews can be a sound foundation in terms of future management programs and updating of management plans. Local stakeholders can use the results of the assessments using the DPSIR model to improve or change existing responses into more precise measures in addressing specific impacts. Moreover, this study further concluded that the framework can link all disciplines and/or purviews (e.g., natural and social sciences and barangay and municipal level) and therefore may serve as a bridge among different stakeholders (e.g., residents and government officials) for effective policy-making.

Despite the limited number of management plans analyzed in this study, the results of the content analysis were able to capture the present management implementations for BCEs in the Philippines. This information can show the effectiveness of linkages among different sectors such as the government, academe, and local stakeholders, adequacy of policy and plan

enforcement, and disconnect between socio-economic and cultural dimensions (Fortes et al. 2018). The findings collected in this study showed the current directives of coastal management implementation and provided appropriate recommendations in integrating BCE management practices. For instance, there is a gap between the management of mangrove and seagrass habitats where policies and programs are more specified towards the former than the latter. Additionally, there is an inconsistency observed (not because of contextualized programming) in the contents of coastal management which can be explored in future studies. Based on the understanding of the present directives of the coastal management plans, it is necessary to investigate the factors that facilitate the implementation of management practices and policies in different local contexts to strategically promote BCE management in the country. Moreover, it is further concluded that the "blue carbon" concept, in general, are yet to be incorporated in the existing coastal plans. The results presented here can serve as a benchmark for policy-makers and coastal managers in updating their present management plans particularly in branching their focus into integrating seagrass ecosystems management.

The perception, thematic, and content analyses of this study also provided valuable insights for linking BCEs with sustainable tourism and as an NbS. The data collected in Busuanga Island can serve as a baseline for local government offices in drafting their tourism master plan. The positive correlations between locals' perceptions and their perceived tourism impacts highlighted the importance of the former to managing the effects of the latter. In the context of NbS, this study provided empirical evidence on how BCEs or BCEIs fit the criteria of a globally set framework of NbS (IUCN 2020). In the Philippines, where BCEs are abundant and valued for their services, the country has a huge potential to develop them in the context of disaster risk reduction and climate change mitigation strategies.

Overall, to enable holistic and sustainable management at enhanced level for BCEs, this research concluded that (i) identifying community perceptions are essential to defining their

role and level of involvement in the governance of BCEs, (ii) recognizing how the role and functions of different policy-makers provide valuable insights on the cause-effect relationships of environmental problems and threat-specific solutions, and (iii) determining the current BCEs management strategies allows policy-makers, coastal managers, and implementers to update and/or amend their present management plans particularly in advancing technical capacity and knowledge on the "blue carbon" concept. Finally, the social and policy perspectives of BCE assessments presented here can serve as a baseline to further advance the BCE-related studies (e.g., blue economy potential and application of Multi-criteria Decision Analysis) in other parts and even beyond the contexts of the Philippines and enable future comparisons across regional and global scales.

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Appendices

Appendix A. Statistical Analyses.

1. Sample Size Computation – **Cochran's Formula** (Bartlett et al. 2001)
95% confidence level with a 10% sampling error

$$n = n_0/(1 + n_0/N)$$

where $n_0 = (t^2 * p * q) / d^2$, and t = value of selected alpha level (in this study, α is 0.05, so the critical value is 1.96), p = estimated proportion of the population which has the attribute in question, q = 1 − p, and d = acceptable margin of error (in this study, 0.10), and N = population size

For example:

$$\text{Eastern Samar (Balangiga) } n = \frac{((1.96)^2(0.50)(1-0.50))/(0.10)^2}{1+\left(\frac{((1.96)^2(0.50)(1-0.50))/(0.10)^2}{14085}\right)}$$

Eastern Samar (Balangiga) n = 95

2. Correlation Analysis – **Spearman's rank correlation coefficient (*ρ*)**
Non-parametric test to analyze the relationship between two variables (Powers and Xie 2000; Lobo and Guntur 2018)

$$\rho = 1 - \frac{6\sum di^2}{n(n^2-1)}$$

where: ρ = Spearman rank correlation value
d = margin of each pair value
n = Spearman rank pair values

3. Comparative Analysis – **Mann-Whitney U test**
Non-parametric test to evaluate if there are significant differences between two populations (MacFarland and Yates 2016)

$$U_1 = R_1 - \frac{n_1(n_1+1)}{2} \quad or \quad U_2 = R_2 - \frac{n_2(n_2+1)}{2}$$

where: R = sum of ranks in the sample
n = the number of items in the sample

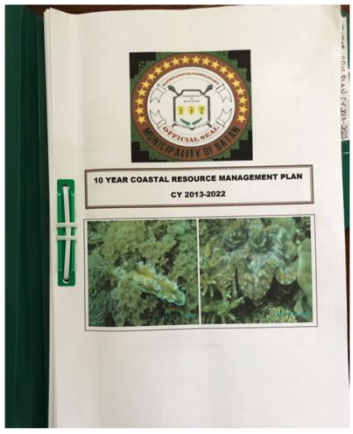
Note: For the correlation and comparative analyses, the computation was performed using the data analysis tool package of Microsoft Excel and free version of XLSTAT software.

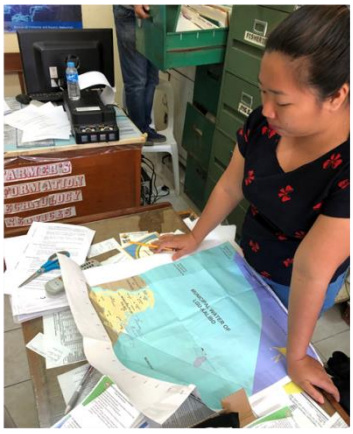
Appendix B. Photo Documentation of the Field Surveys.

1. Sharing and discussing of survey questionnaire with LGU-affiliated assistants.

3. Key Informant Interviews

2. Household surveys (random sampling)





4. Courtesy call and retrieval of coastal management plans

Appendix C. Survey Questionnaires.

A. GENERAL INFORMATION EASTERN SAMAR

Name	
Address	
Age	
Gender	
Marital Status	[ ] Single [ ] Married [ ] Widow [ ] Others:
Means of Livelihood	
Highest Educational Attainment	[ ] College [ ] Senior High [ ] Junior High [ ] Elementary [ ] Others:
Years living in the area	[ ] 1-5 Years [ ] 6-10 years [ ] 11-15 years [ ] 16-20 years [ ] Others:

B. Mangrove Ecosystem and Seagrass Ecosystem - Awareness

Awareness of coastal communities on the importance of Mangrove Ecosystem and Seagrass Ecosystem

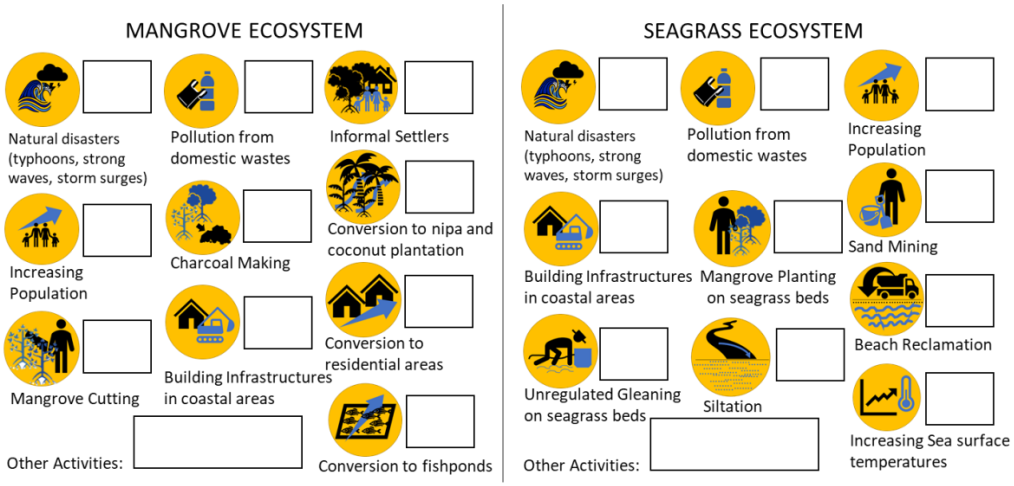
(Please rate the level of your awareness on the importance of these resources: 1=not aware, 2=slightly aware, 3=somewhat aware, 4=moderately aware, 5=fully aware)	Awareness level									
	Mangrove Ecosystem					Seagrass Ecosystem				
	1	2	3	4	5	1	2	3	4	5
1. Serves as nursery, feeding and breeding area of various life										
2. Provides habitat for a large number of marine and terrestrial life										
3. Source of food for consumption and selling										
4. Protect coastal areas from storm surge, strong waves and typhoons										
5. Help cleanse/purifies the air										
6. Help establish good water quality of the sea										
7. Help mitigate climate change by carbon sequestration										
8. Can be used as a recreational (tourism) or educational site										

C. Mangrove Ecosystem and Seagrass Ecosystem - Resource Utilization

Utilization of resource from the mangrove ecosystem and seagrass ecosystem (Please rate how do you utilize these resources: 1=never use, 2=once a year, 3=once a month, 4=once a week, 5=everyday)	Utilization frequency									
	Mangrove Ecosystem					Seagrass Ecosystem				
	1	2	3	4	5	1	2	3	4	5
1. Fishing/gleaning for own consumption										
2. Fishing/gleaning to earn income										
3. Using as a recreational site for bird/bat watching										
4. Using as a recreational site for paddling/snorkeling										

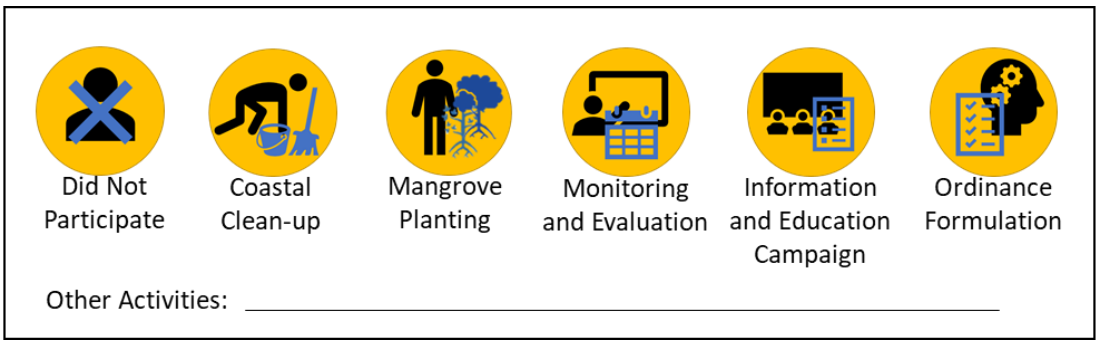
D. Mangrove Ecosystem and Seagrass Ecosystem – Threats and Management

1. Please rank (using numbers 1-10) from the list of these options that you think is most (1) to least (10) **damaging threat** to your mangrove ecosystem and seagrass ecosystem.



2. Who do you think should be responsible in managing the mangroves e in your barangay? Please select all applicable.	[ ] local residents [ ] local government [ ] national government [ ] Non-Government Organizations [ ] Private organizations [ ] Others:
3. Effectiveness of Local government's assistance on coastal management? [ ]1 = Not effective [ ]2 = Slightly effective [ ]3 = Moderately effective [ ] 4 = Very effective [ ]5 = Extremely effective	

4. Do you participate in any activities regarding the protection and management of mangrove and seagrass ecosystems? Please encircle one or all that is applicable.



A. GENERAL INFORMATION AKLAN PROVINCE

Name	
Gender	
Age	
Marital Status	[ ] Single [ ] Married [ ] Widow [ ] Others:
Highest Educational Attainment	[ ] Primary (Elem. level, elem. graduate, highschool level) [ ] Secondary (Highschool graduate, college level) [ ] Tertiary (College graduate) [ ] Others:
Means of livelihood	
Daily salary (Php)	[ ] below 100 [ ] 100-200 [ ] 201-300 [ ] 301-400 [ ] 400 and above [ ] others:
Years living in the area	[ ] since birth [ ] 5-10 years [ ] 11-15 years [ ] 16-20 years [ ] more than 20 years [ ] others:

B. Mangrove Ecosystem Services Awareness

(Please rate the level of your awareness on the importance of these resources: 1=not aware, 2=slightly aware, 3=moderately aware, 4=very aware, 5=extremely aware)	Awareness level				
	1	2	3	4	5
1. Serves as nursery, feeding and breeding area of various life					
2. Provides habitat for a large number of marine and terrestrial life					
3. Source of food for consumption and selling					
4. Protect coastal areas from storm surge, strong waves and typhoons					
5. Act as natural buffer to coastal erosion from both land and sea					
6. Help purify/cleanse the air					
7. Help mitigate climate change by carbon sequestration					
8. Can be used as a recreational (tourism) or educational site					

C. Mangrove Ecosystem - Resource Utilization

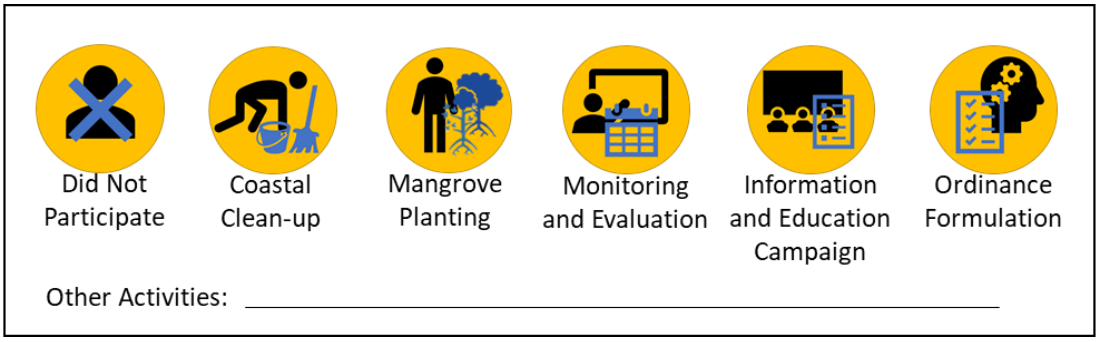
(Please rate how do you utilize these from 1=never, 2=once a year, 3=once a month, 4=once a week, 5=every day)	Utilization frequency				
	1	2	3	4	5
1. Fishing for own consumption					
2. Fishing for selling purposes (income source)					
3. Birdwatching site					
4. Walking at the boardwalks					
5. Using as an educational site					
6. Used as a site for religious practices/activities					

D. Perceived management strategies of mangrove ecosystems

1. Who do you think should be responsible in managing the mangroves e in your barangay? Please select all applicable.	[ ] local residents [ ] national government Organizations [ ] Private organizations	[ ] local government [ ] Non-Government [ ] Others:

2. Are you aware of the local government's interventions/strategies in managing these resources? (1=not aware, 2=slightly aware, 3=moderately aware, 4=very aware, 5=extremely aware)	Awareness level				
	1	2	3	4	5
a. A dedicated program/plan for coastal management					
b. Various seminars/trainings regarding coastal management					
c. Presence of national and local laws					
d. Penalty for violating national and local laws					
g. LGU conducts monitoring and evaluation activities					

3. Did you participate in any activities regarding the protection and management of mangrove ecosystems in your area? Please encircle one or all that is applicable.



A. GENERAL INFORMATION BUSUANGA ISLAND

Name	
Address	
Age	
Gender	
Marital Status	[ ] Single [ ] Married [ ] Widow [ ] Others:
Means of Livelihood	
Highest Educational Attainment	[ ] College [ ] Senior High [ ] Junior High [ ] Elementary [ ] Others:
Years living in the area	[ ] 1-5 Years [ ] 6-10 years [ ] 11-15 years [ ] 16-20 years [ ] Others:

B. Mangrove Ecosystem and Seagrass Ecosystem - Awareness

Awareness of coastal communities on the importance of Mangrove Ecosystem and Seagrass Ecosystem

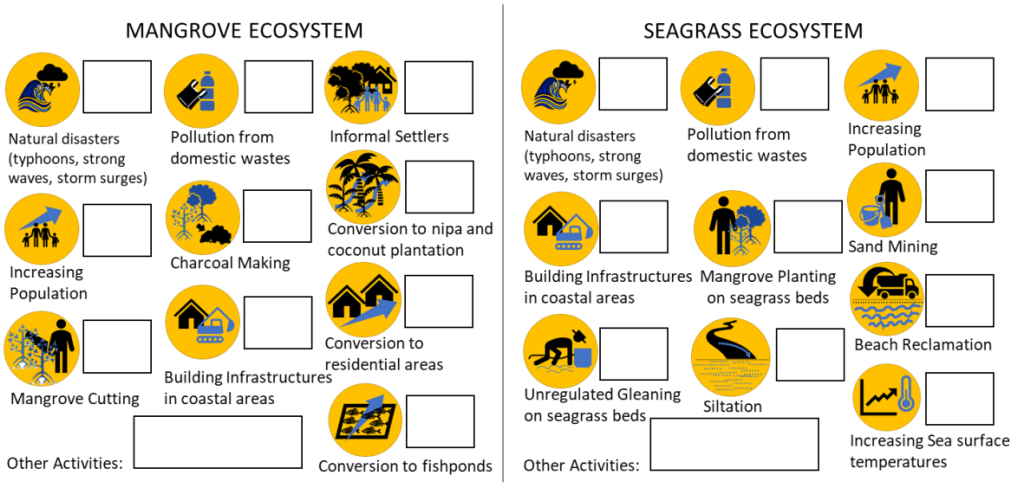
(Please rate the level of your awareness on the importance of these resources: 1=not aware, 2=slightly aware, 3=somewhat aware, 4=moderately aware, 5=fully aware)	Awareness level									
	Mangrove Ecosystem					Seagrass Ecosystem				
	1	2	3	4	5	1	2	3	4	5
1. Serves as nursery, feeding and breeding area of various life										
2. Provides habitat for a large number of marine and terrestrial life										
3. Source of food for consumption and selling										
4. Protect coastal areas from storm surge, strong waves and typhoons										
5. Act as natural buffer to coastal erosion from both land and sea										
6. Help establish good water quality of the sea										
7. Help mitigate climate change by carbon sequestration										
8. Can be used as a recreational (tourism) or educational site										

C. Mangrove Ecosystem and Seagrass Ecosystem - Resource Utilization

Utilization of resource from the mangrove ecosystem and seagrass ecosystem (Please rate how do you utilize these resources: 1=never use, 2=once a year, 3=once a month, 4=once a week, 5=everyday)	Utilization frequency									
	Mangrove Ecosystem					Seagrass Ecosystem				
	1	2	3	4	5	1	2	3	4	5
1. Fishing/gleaning for own consumption										
2. Fishing/gleaning to earn income										
3. Harvesting mangroves for firewood materials										
4. Using as a recreational site for bird/bat watching										
5. Using as a recreational site for paddling/snorkeling										
6. Used as a research or educational site										

D. Mangrove Ecosystem and Seagrass Ecosystem – Threats and Management

1. Please rank (using numbers 1-10) from the list of these options that you think is most (1) to least (10) **damaging threat** to your mangrove ecosystem and seagrass ecosystem.

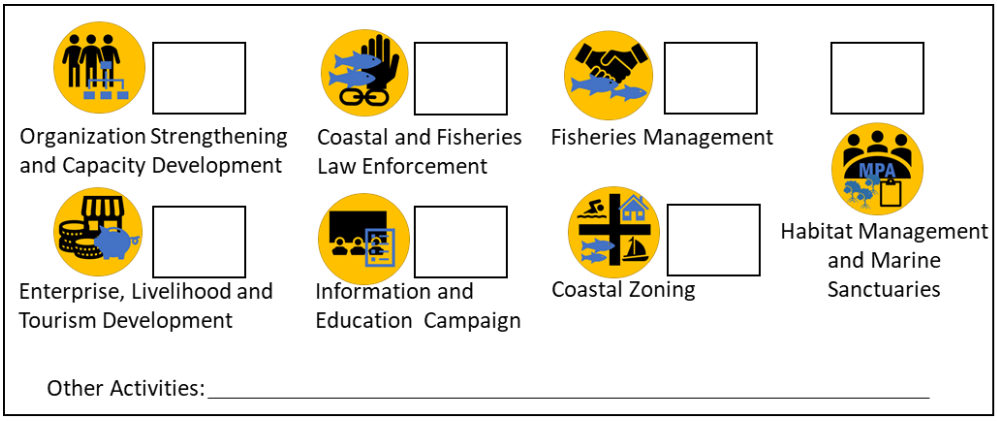


2. Perceived environmental change. What is your perception on the effect of tourism to the (a) mangrove and (b) seagrass ecosystems in your town? Please rate accordingly by checking the appropriate level; 1= very much degrading, 2= degrading, 3= no effect of change, 4= improving, 5= very much improving.

Blue carbon ecosystem	**1**	**2**	**3**	**4**	**5**
a. Mangroves					
Mangrove cover (general observation)					
Mangrove conservation efforts					
Accessibility to mangrove areas					
Food (fish, shells, etc.) availability					
b. Seagrasses					
Presence of seagrass beds					
Seagrass conservation efforts					
Accessibility to seagrass beds					
Food (fish, shells, etc.) availability					

Observations:_____

3. Please rank (using numbers 1-7) the activities you want to be prioritized in the coastal management plan of your municipality. 1 as the top priority and 7 least priority.



Question	Mangrove Ecosystem	Seagrass Ecosystem
4. Who do you think should be responsible in managing the resource in your area? Please select all applicable.	[ ] local residents [ ] local government [ ] national government [ ] NGO's [ ] Private organizations [ ] Others:	[ ] local residents [ ] local government [ ] national government [ ] NGO's [ ] Private organizations [ ] Others:

5. Perceived strategies. Possible measures to promote sustainable tourism. Please rate accordingly; 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

Possible Measure	Rate
Strengthening environmental regulations	
Strict implementation of local plans and policies	
Cooperation with non-government organizations and private sectors for environmental conservation	
Prioritize the conservation of the natural resources	
Promote ecosystem-based tourism plan	
Promote protection of the environment and safety of tourists	
Follows carrying capacity of the tourist sites	
Cater the needs of tourists without taking for granted the needs of the local communities	
Include the welfare of local stakeholders and Indigenous People	
Hiring of local people for their alternative income source	
Sustainable and environment-friendly infrastructures	
Facilities development in areas with no mangroves and seagrasses	

Appendix D. Key Informant Interview Guide Questions.

A. Informant's details

Name, age, number of years living in the neighborhood
Designation, number of years in the service
Work mandate, primary task, extension service
Role in coastal management (Ask them to elaborate their answers)
Partner organizations, type of support (e.g., financial or technical)

B. Application of DPSIR Framework to Assess the Blue Carbon Ecosystems

1a. Based on your perception, what is the present condition (health) of the ecosystems? (Pointers: Improving? Degrading? Why?, Ask them to elaborate their answers) 1b. How about during the past years? (Pointers: What year they observed the changes?)

2a. What are the drivers and pressures of these observed environmental changes? (Pointers: Explain briefly the difference of drivers and pressures, give examples) 2b. What are the mechanism of these changes? (Pointers: Ask them to explain the cause-effect relationships of the observed drivers and pressures to state and impact) 2c. How about (mention a driver or pressure)? Did you observe this (driver or pressure) in your town? (Note: Due to language barrier, others may find it hard to contextualize their answers, so assist the by giving some examples and ask them to elaborate it clearly)

3a. Because of the presence of pressures, what are the observed impacts to the environment? (Note can be related with question no 1) 3b. What about the impacts to ecosystem services or the benefits? (Pointers: Giver examples if needed, ask them what are the observations) 3c. What is the level of impact? Who are most affected? How are they affected? (Pointers: Ask them to elaborate if it is not clear, ask the year of observed changes)

4a. Given the presence (state the driver, pressure, impact), how do you address them? What are the responses of your office? 4b. Are there any policies? Local ordinance? (Pointers: What does it (if there is/are) state? How is it being implemented?) 4c. What about the implementation strategies? Are there any issues on the implementation?

4d. How about coastal plans? Are you following them? If not, why?
(Pointer: Ask them about the details of the plan if they have)

4e. Are there any partner organizations supporting you in addressing these environmental problems?
(Pointers: Ask what organizations, the level of support)

Some examples of the drivers, pressures, impacts
Drivers: population growth, poverty, urbanization, institutional capacities,
climate change, typhoons, storms

Pressures: land conversion, resource exploitation, domestic waste pollution, lack of financial resources, weak implementation strategies, siltation, eutrophication, Illegal activities in coastal ecosystems

Impacts: decreasing ecosystem services (fish availability), ecosystem degradation, destroys mangroves and seagrasses, residents are do not follow the policies, increasing number of informal settlers in the coastal areas

Appendix E. List of DPSIR Definitions and Examples.

DPSIR framework (theme)	Definitions	Examples
Driving forces	directly or indirectly cause a change in the ecosystem; can be physical, chemical or biological in nature (MEA 2005) natural and anthropogenic forces (MEA 2005; Harwell et al. 2010) social, demographic, and economic developments in societies (Gabrielsen and Bosch 2003) social and political aspects (Maxim et al. 2009)	population size, macroeconomic polices,invesments in research, individual needs (Kristensen 2004; MEA 2005); population growth, coastal urbanization, tourism (Mateus and Campuzano 2008; Lewison et al. 2016); stakeholders' authority, institutional ineffeciency (Maxim et al. 2009); land cover change, climate change, air and water pollution, irrigation (MEA 2005)
Pressures	anthropogenic forces that induces environmental impacts (Maxim et al. 2009); result of a driver-initiated mechanism resulting an effect to an ecosystem that can change the environmental state (Oesterwind et al. 2016) pollution, alteration of hydrological regime, geomorphological changes, and changes in biology and its uses (Mateus and Campuzano 2008)	overfishing, destructive fishing methods, shipping pollution (Butler et al. 2014); increasing levels of contaminants (Lewison et al. 2016); CO_2 emissions per sector, the use of rock, gravel and sand for construction, land usage for road developments (Gabrielsen and Bosch 2003); extraction of marine resources for consumption, selling and other purposes (Oesterwind et al. 2016); port structures, dredging, marine litter, eutrophication (Fortes and Santos 2004)
State changes	actual condition of the environment that can be quantitatively-qualitatively defined (Gabrielsen and Bosch 2003); physico-chemical characteristics of ecosystems, living conditions of humans, effects of pressures on humans (OECD 2003; Kristensen 2004)	temperature, fish stocks, atmospheric CO_2 concentrations (Gabrielsen and Bosch 2003); quality of seawater, sediment, and marine biota (Zhang and Xue 2013); ocean acidity, nutrient and other contaminants loading (Yee et al. 2015)
Impacts	effects on biotic and abiotic components of ecosystems (Butler et al., 2014); effects on human systems related with environmental changes (Gobin et al. 2004); consequences of changes in the state of the ecosystemsservices (Gabrielsen and Bosch 2003)	physiological and behavioral anomalies, changes in chemical compositions of water or air, alteration of ecosystem services (Edwards 2002); changes in ecosystem services like food and water supply, climate regulations, recreational, primary production (MEA 2005)
Responses	correlated with decision making, policies, actions undertaken by different stakeholders (Maxim et al. 2009); can be changes in the existing policies and enforcing alternative actions, capacity building, or conducting further research (Lewison et al. 2016); environmentally sustainable, technologically feasible, economically viable, socially desirable, legally permissible, and administratively achievable (Mateus and Campuzano 2008)	actions to protect and conserve biodiversity (EEA 2007); policy measures addressing macroeconomics, environment, and other specific sectors (Kristensen 2004); community education for fisheries, establishing marine protected areas, improved legislations (Butler et al. 2014)

Appendix F. An Example of Coding Texts to Themes.

Translated transcript - Municipal Agriculturist	Theme classifying (DPSIR indicators)	Condensed text	Rephrasing (Coding)	Theme
population growth - overexploitation of resources	driver, pressure	population growth		driver
		overexploitation		pressure
people are dependent on coastal resources	state	dependent on coastal resources	residents' well-being	state
upland activities, run-off from agricultural activities	driver, pressure	upland activities		driver
		agricultural debris run-off		pressure
siltation/flooding	pressure	siltation		pressure
		flooding		pressure
seagrasses very vulnerable to siltation	state, impact	seagrasses		state
		siltation destroys seagrasses		impact
tourism activities like resort and building constructions	driver, pressure	tourism		driver
		infrastructures development		pressure
increasing fishing activities since no other means of livelihood	driver, pressure	no livelihood	poverty	driver
		increasing fishing activities	overexploitation	pressure
increasing number of residents in coastal areas, these are fisherfolks who prefer to live near coasts)	driver, pressure	increasing number of residents	population growth	driver
		living in coastal areas	land conversion	pressure
pollution from domestic wastes	pressure	domestic waste pollution		pressure
illegal use of coastal resources	pressure	illegal use of coastal resources	illegal activities	pressure
		coastal ecosystems degradation		impact
		coastal ecosystems		state
1997 to early 2000s - charcoal production using mangroves were rampant	pressure, state	charcoal production	illegal activities	pressure
		mangrove forests		state
declaration of a MPA which covers mangroves and seagrass beds	responses	MPA declaration		responses
giving of alternative source of livelihood like vegetable farming, backyard farming	responses	alternative source of livelihood		responses
IEC activities for fisherfolks and farmers	responses	IEC activities	environmental awareness	responses

Appendix G. List of Keywords Applied in Deriving the 8 Clusters.

Cluster (Category)	Keywords (Codes)
ecological profile	cover, area, abundance, distribution, land classification, associated, species, location
ecosystem services	food, livelihood, breeding, spawning, supporting, health, coastal protection, filter wastes, wave breaker habitat, export nutrients, wildlife support
carbon sequestration	carbon, sequestering
tourism	site, ecotourism industry, boardwalks, eco-park, tourism development
natural threats	degradation, water dynamics changes, shoreline erosion, climate change, typhoons, siltation, flooding, sea level rise, pests, hot temperature, monsoon, predation, inundation, tolerance to physical conditions
anthropogenic threats	land conversion, overexploitation, unregulated, household wastes, illegal logging, illegal fishing, coastal infrastructures, mining, firewood, charcoal, cutting, wrong species, informal settlers, encroachment, planting on seagrass beds, development,
management activities	reforestation, community-based, man-made plantation, planting, construction, protection, rehabilitation, monitoring, evaluation, formulation, implementation, advocacy program, integrated, capacity building, awareness campaigns, coastal zoning, regulate fishing, sustainable, management, stakeholders, coastal clean-up, budget allocation, assessment, restoration, conservation, enforcement
laws, policies and ordinances	mandate, community-based forest management, conservation code, guidelines, regulation, forestry code, prohibited activities,

List of Publications

1. Quevedo JMD, Uchiyama Y, Kohsaka R. 2020. Perceptions of local communities on mangrove forests, their services and management: Implications for Eco-DRR and blue carbon management for Eastern Samar, Philippines. Journal of Forest Research 25: 1–11. doi: 10.1080/13416979.2019.1696441.

2. Quevedo JMD, Uchiyama Y, Kohsaka R. 2020. Perceptions of the seagrass ecosystems for the local communities of Eastern Samar, Philippines: Preliminary results and prospects of blue carbon services. Ocean and Coastal Management 191: 105181. doi: 10.1016/j.ocecoaman.2020.105181.

3. Quevedo JMD, Uchiyama Y, Kohsaka R. 2021. A blue carbon ecosystems qualitative assessment applying the DPSIR framework: Local perspective of global benefits and contributions. Marine Policy 128: 104462. doi: 10.1016/j.marpol.2021.104462.

4. Quevedo JMD, Uchiyama Y, Kohsaka R. 2021. Community perceptions of long-term mangrove cover changes and its drivers from a typhoon-prone province in the Philippines. Ambio. doi: 10.1007/s13280-021-01608-9.

5. Quevedo JMD, Uchiyama Y, Kohsaka R. 2021. Linking blue carbon ecosystems with sustainable tourism: Dichotomy of urban-rural local perspectives from the Philippines. Regional Studies in Marine Science 45: 101820. doi: 10.1016/j.rsma.2021.101820.

6. Quevedo JMD, Uchiyama Y, Kohsaka R. 2021. Local perceptions of blue carbon ecosystem infrastructures in Panay Island, Philippines. Coastal Engineering Journal. doi: 10.1080/21664250.2021.1888558.

7. Quevedo JMD, Uchiyama Y, Lukman KM, Kohsaka R. 2021. How blue carbon ecosystems are perceived by local communities in the Coral Triangle: Comparative and empirical examinations in the Philippines and Indonesia. Sustainability 13(1): 127. doi: 10.3390/su13010127.

8. Quevedo JMD, Uchiyama Y, Lukman KM, Kohsaka R. 2021. Are municipalities ready for integrating blue carbon concepts? Content analysis of coastal management plans in the Philippines. Coastal Management 49(4): 334–335. doi: 10.1080/08920753.2021.1928455.

9. Lukman KM, Quevedo JMD, Kakinuma K, Uchiyama Y, Kohsaka R. 2019. Indonesia Provincial Spatial Plans on mangroves in era of decentralization: Application of content analysis to 27 provinces and “blue carbon” as overlooked components. Journal of Forest Research 24(6): 341–348. doi: 10.1080/13416979.2019.1679328.

10. Lukman KM, Uchiyama Y, Quevedo JMD, Kohsaka R. 2020. Local awareness as an instrument for management and conservation of seagrass ecosystem: Case of Berau Regency, Indonesia. Ocean and Coastal Management 203: 105451. doi: 10.1016/j.ocecoaman.2020.105451.

11. Lukman KM, Uchiyama Y, Quevedo JMD, Harding D, Kohsaka R. 2021. Land use changes assessment by triangulating framework: Perception interviews, land-use/land cover observation, and spatial planning analysis in Tanjung Batu and Derawan Island, Indonesia. Human Ecology. doi: 10.1007/s10745-021-00253-w.