# Are Municipalities Ready for Integrating *Blue Carbon* Concepts?: Content Analysis of Coastal Management Plans in the Philippines

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# Are Municipalities Ready for Integrating *Blue Carbon* Concepts?: Content Analysis of Coastal Management Plans in the Philippines

The blue carbon ecosystems are gaining salience in the international arena due to their intrinsic role in climate change mitigation. Reviews on management strategies and plans at the local level are largely overlooked, although they are crucial factors in translating commitments to contextualized actions for sustainable management. The primary goal of this study is to investigate the present coastal management plans for blue carbon ecosystem management strategies using content analysis of the local plans of select municipalities in the Philippines. The analysis generated eight (8) clusters based on keywords focusing on mangrove and seagrass ecosystems, namely: *ecological profile, ecosystem services, carbon sequestration, tourism, natural threats, anthropogenic threats, laws, policies, & ordinances, and management activities*. The *management activities* cluster has the most coverage while the *carbon sequestration* cluster is the least mentioned. There is also a distinct gap in the inclusion of mangroves compared to seagrasses in the coastal management plans where these ecosystems are present in the localities concerned. Mangrove ecosystems are frequently mentioned, covering all clusters while seagrass ecosystems are discussed to less extent in only five (5) clusters. This study also showed that the "blue carbon" concept is not yet fully incorporated in the current management plans where carbon sequestration cluster is only discussed under mangrove ecosystems in one of the sites while no discussions for seagrasses' "blue carbon" functions. The results of this study can serve as a benchmark for local policy-makers in updating their present management plans particularly in branching their focus on integrated management of seagrass ecosystems and advancing technical capacity and knowledge on blue carbon ecosystems.

Keywords: coastal management plans; content analysis; local level; blue carbon ecosystems; Philippines

## Introduction

The term "blue carbon" refers to organic carbon that is sequestered and stored by the oceans and coastal ecosystems, particularly by mangrove forests, seagrass meadows, and tidal marshes (Nellemann et al. 2009; Macreadie et al. 2019a). These coastal ecosystems are collectively known as blue carbon ecosystems, whose rates of extraction and storing of carbon dioxide are almost four times higher than that in tropical forests (McLeod et al. 2011;

Crooks et al. 2017). Managing these coastal resources is an effective and sustainable way of increasing carbon absorption to mitigate climate change. However, there is a global decline of these ecosystems due to conversion to other uses; it is estimated that half of the mangrove forests and tidal marshes and 29% of seagrass meadows are lost since the turn of the 19th century (Crooks et al. 2017). In response, global researches have been geared toward the management and protection of blue carbon ecosystems. Recent advancements on "blue carbon" studies include, for example, prospects for blue carbon payments for their ecosystem services and protection (i.e., Hejnowicz et al. 2015; Muenzel and Martino 2018; Vanderklift et al. 2019), blue carbon financing for greenhouse gas reduction strategies (i.e., Friedmann, Ochu, and Brown 2020), and reviews on existing knowledge, policies, frameworks, and methods for blue carbon management (i.e., Sebastian 2014; Howard et al. 2017).There is also an observed shift toward the social component of blue carbon ecosystems researches such as focusing more on "indirect drivers" and values or perceptions of local communities in assessing biodiversity-related issues (i.e., Fortes and Nadaoka 2015). "Indirect drivers" assessments are conventionally given less focus compared to "direct drivers" or "pressures" which are highly discussed in the Driver-Pressure-State-Impact-response (DPSIR) frameworks (i.e., Kohsaka 2010) or Millennium Ecosystem Assessment frameworks (MEA, 2005).

Blue carbon-related studies in the Philippines are similarly experiencing an increasing trend. Some of the recent researches include ecological surveys such as carbon stock assessment (Camacho et al. 2011; Gevaña, Pulhin, and Tapia 2019) and above-ground biomass mapping (Castello et al. 2017) and socio-political investigations like payment for ecosystem services (Thompson, Primavera, Friess 2017) and perceptions on ecosystem services (Quevedo, Uchiyama, and Kohsaka 2020a). However, the majority of these studies are focused on mangrove ecosystems. Globally, studies with scope of seagrass ecosystems in the context of “blue carbon” are increasing, yet, there are knowledge gaps in their carbon sequestration mechanisms and socio-political implications. Currently, blue carbon researches of subtropical and tropical seagrass remain sparse and limited (Thorhaug et al. 2017), poorly understood (Macreadie et al. 2019), and rarely included in coastal management plans (Duarte et al. 2008; Quevedo, Uchiyama, and Kohsaka 2020b). According to the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) Report, entitled: “Understanding strategic coastal blue carbon opportunities”, there are some recommendations for countries to incorporate blue carbon ecosystems into integrated coastal management climate response, biodiversity conservation, and blue economy plans as practical steps into advancing blue carbon interventions (Crooks et al. 2017).

In terms of studies analyzing management plans and policies in the context of “blue carbon” services, investigations are advancing. For instance, Lukman et al. (2019) reviewed 27 provincial spatial plans in Indonesia to determine the present focus in terms of mangrove management. The results of their content analysis show that there are nine (9) main topics or clusters on mangroves and of which the relatively new concept of “blue carbon” function is only discussed in three (3) provinces. Another study by Ganguly et al. (2018) evaluated the potential of seagrass carbon finance based on current national and international climate policy frameworks and recommended the inclusion of seagrass in informal climate change policies such as REDD+. Although much has been done in the past years, reviews on policies and management plans are still progressing. Thus, there is still no clear pathway on how existing coastal plans effectively captured “blue carbon” ecosystem management, particularly from the very local level, which is a critical phase 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, its effectivity, 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). Alden, Fermin, and Agbayani (2011) explored the socio-cultural aspects of fishermen in Anini-y, Antique particularly on their participation in coastal resources management and the manner to which 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 “blue carbon” ecosystems. 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 reveal the current directions of management implementation and their implications towards future management schemes. By doing so, this research could serve as a benchmark for future related investigations on other coastal management-related plans in other areas in the Philippines and other countries or basis for plans formulation that effectively encapsulate blue carbon ecosystems and their integrated management.

## Coastal resource management in the Philippines

### *Overview of coastal resource management*

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) (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. The continued overexploitation and degradation of these natural resources has resulted in developments of national policies and legal frameworks that support CRM in the country. Figure 1 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.

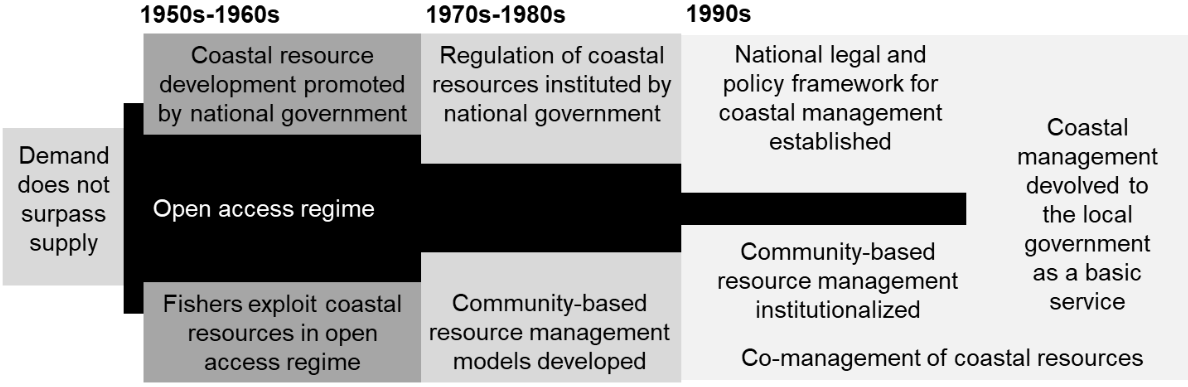


Figure 1. Evolution of coastal resource management in the Philippines (modified from CRMP 2004).

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, Eisma-Osorio, and Green 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 (i.e. national and local governments, non-government organizations, 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).

Based on the present legal and policy frameworks of CRM, the formulation, planning, and implementation of CRM or ICM plans are participated by municipal or city governments while government agencies at the national, regional, and provincial levels are obliged to provide technical, financial, and resource assistance (White, Eisma-Osorio, and Green 2005). Some of the legal bases that require municipalities or cities to create ICM plans include the LGC of 1991, Fisheries Code of 1998, and Executive Order (EO) No. 533 (2006) that states ICM as a national management policy framework strategy for sustainable development of coastal resources. However, despite the high motivations and perceptions of local stakeholders to manage their resources, as they understand what they will lose if their coastal resources continue to degrade and no actions are taken (Mudge 2018; Quevedo, Uchiyama, and Kohsaka 2020a, 2020b), the decentralization of coastal management responsibility is a challenge for ICM in the Philippines. Not all coastal municipalities can manage their natural resources (CRMP 2004), as pointed out by Courtney and White (2000), some municipalities lack trained personnel, budget, planning-capacity, and technical knowledge. Given the new CRM responsibilities, local authorities need funds to hire skilled personnel and train current staff, hire consultants and purchase or access to vehicles and boats for site inspections (Lowry, White, and Courtney 2005). Because of this, coastal habitats in other coastal municipalities are not well protected, conserved, and managed.

***Mangrove and seagrass management***

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 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 and advances of 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 are strictly prohibited along with the brown algae (i.e., Sargassum spp.). Unlike mangrove ecosystems, seagrass ecosystem investigations are few and priorities for research development activities are usually directed toward other coastal resources (i.e., coral reefs) with immediate economic impacts (fishery industry) (Fortes 2012). Another important study of Fortes (2018) that reflects the weak seagrass ecosystem management strategies 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.

## Materials and methods

### *Coastal management plans*

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 (Figure 2). These sites were specifically selected to complement the previous works made by Quevedo, Uchiyama, and Kohsaka (2020a, 2020b; 2021c). Although their study 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 1 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 plan 6-year coastal management plan that has lapsed in 2019.

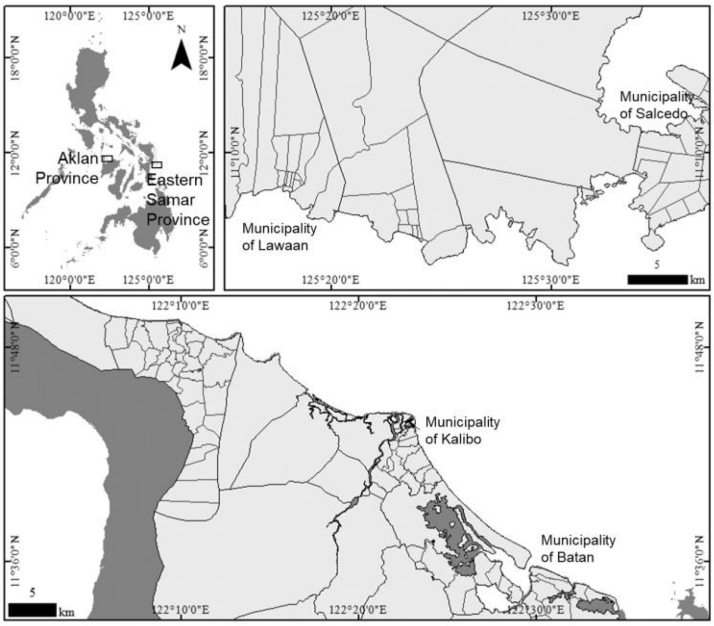


Figure 2. Location map of the study sites.

Table 1. List of the coastal management plans used in this study.

| 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 |

### *Content analysis*

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 toward 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 (i.e., policy plans) is an increasingly employed approach toward 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 3). Moreover, coding keywords were adjusted and modified to better capture the blue carbon ecosystems 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 eight (8) clusters is presented in Table 2. 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 blue carbon ecosystems.

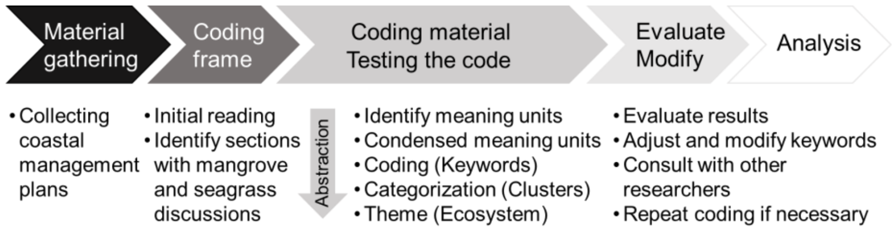


Figure 3. Flow of the methodology (modified from Lukman et al. 2019).

Table 2. List of keywords (codes) used to identify the clusters (categories).

| 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, |

## Results

The review of the coastal management plans shows that these municipal plans cover all of their respective coastal resources such as coral reefs, beach systems, mangroves forests, seagrass meadows, and others. However, in this study, the scope was limited to mangrove and seagrass ecosystems (the two main themes) in the content analysis. The clusters in each theme were analyzed and presented separately to show how local government units manage them individually. The following sections discuss the general content (clusters and cluster frequency per ecosystem) and clusters per municipality and their differences.

### *Clusters*

The content analysis of the management plans relating to mangroves and seagrasses ecosystems generated 8 clusters namely: *ecological profile, ecosystem services, carbon sequestration, tourism, natural threats, anthropogenic threats, laws, policies, & ordinances, and management activities*. Figure 4 shows the cluster ranks, cluster frequencies per ecosystem, and overall total cluster frequencies. Among the clusters, *management activities* are the most frequented topic (first) with a total cluster frequency of 42. In contrast, the least mentioned cluster is *carbon sequestration* (eighth), with a total frequency of one (1).

All eight (8) clusters are covered in the mangroves section of the plans while only five (5) are discussed under the seagrass ecosystems section (Figure 4). *Management activities* cluster is common for both ecosystems. Activities on mangrove management such as planting and coastal clean-up, among others, are stated more frequently with 38 iterations compared to conservation actions for seagrasses, with only four (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.

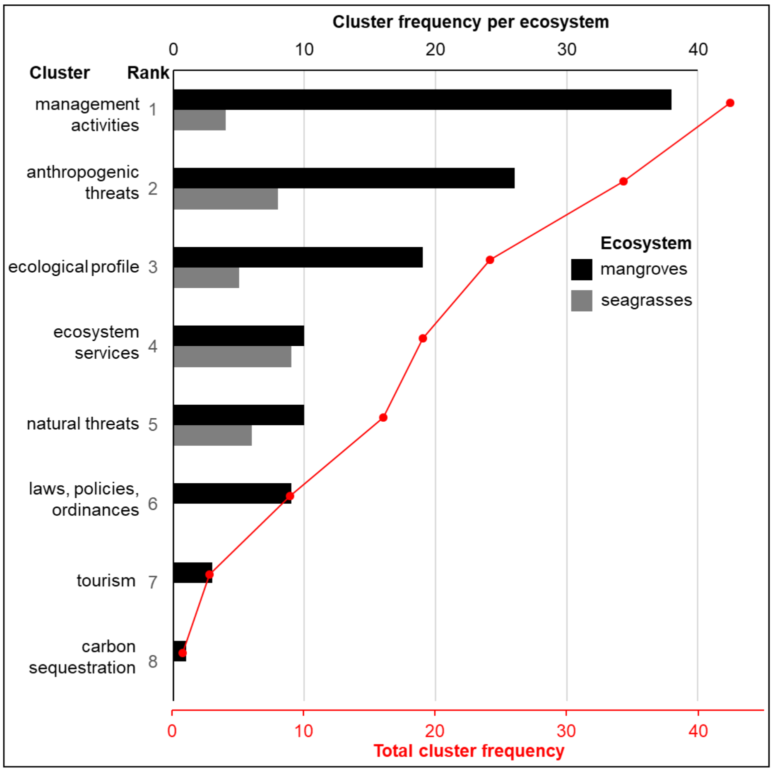


Figure 4. Cluster rank, frequency per ecosystem, and total cluster frequency. The cluster rank is based on the total cluster frequency.

Threats caused by anthropogenic and natural disturbances to blue carbon ecosystems 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). Natural calamities such as strong typhoons and its effects on blue carbon ecosystems, 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). However, these clusters are only mentioned under mangrove ecosystems

### *Municipal coastal management plans*

The results of the analysis also show how clusters are distributed per ecosystem per municipality. Figure 5 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). Among the municipalities, Lawaan has the most number of discussed clusters, with 8 and 5 clusters for 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, 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).

## Discussions

The existing municipal plans cover management strategies for the entire coastal ecosystems that can be found in their municipal jurisdictions. This study has revealed insights on how informed and comprehensively capacitated the concerned local government units are in managing their mangrove and seagrass ecosystems. Current directives toward **r**esource/ecosystem management include assessment of coastal habitats (ecological profiles, ecosystem services, and threats and its effects), implementation of local ordinances and policies, and a list of possible conservation and protection services. The following sections explore and discuss the current directions of the coastal management plans toward the mangrove and seagrass ecosystems at the local level and the implications of this study and how these results can be used as a potential benchmark for future management of blue carbon ecosystems at the local scale.

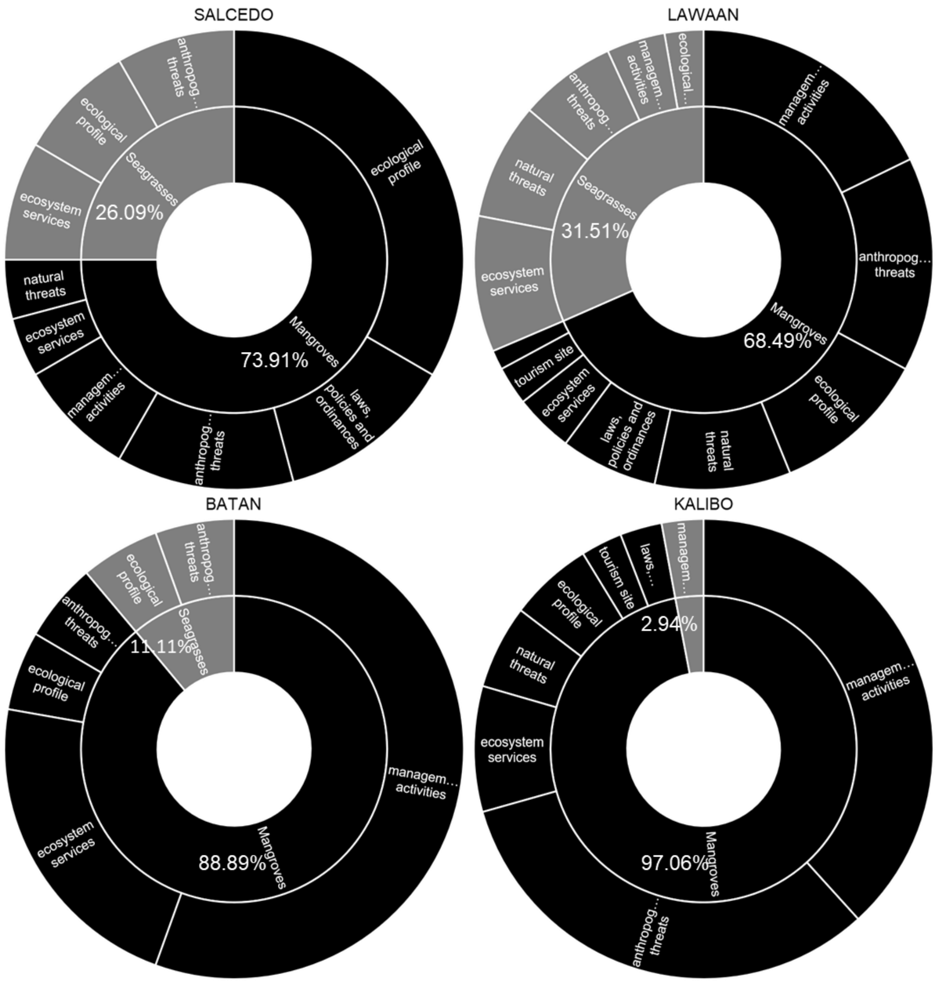

Figure 5. Cluster distribution per ecosystem in each municipality. The inner portions represent total frequencies of mangroves and seagrasses in percent while the outer portions show the clusters. The size of each portion depends on its cluster frequency.

***Current focus on mangrove ecosystems***

The mangrove ecosystems, its services, threats, and management plans are well represented by the eight (8) clusters generated from the content analysis (Figure 4). 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 (i.e., Mendoza and Alura 2001; Salmo, De la Cruz, and Gianan 2019), and Aklan—Batan, and Kalibo (i.e., 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 (i.e., 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 3).

Ecosystem services offered by mangroves are recognized in the coastal plans as well. However, only provisioning services (i.e., food source, 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, Uchiyama, and Kohsaka 2020a). Other ser vices 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, Uchiyama, and Kohsaka 2021c), thus, the tourism cluster was mentioned in their coastal plan. Although recreational activities in mangrove areas are already known globally, little attention is still given toward pursuing them compared to other ecosystems (i.e., coral reefs, beaches, others) (Spalding and Parrett 2019; Quevedo, Uchiyama, and Kohsaka 2021b).

Table 3. Mangrove and seagrass profiles retrieved in the present coastal management plans.

| Municipality, Province | Available Ecological Profiles from the Coastal Management Plans (*This study*) | |
|---|---|---|
| | Mangrove Profile | Seagrass beds Profile |
| Salcedo, Eastern Samar | 1,791.05 ha (Areas of mangrove forests - p.65)<br>15 locally-known true mangroves and 9 associated species - p.65<br>Species commonly found are: Rhizophra sp., Bruguiera sp., Lumnitzer sp., Scyphiphora sp., Xylocarpus sp., Nypa fruticans - p.66<br>Total stem density of mangroves - p.68<br>Total stem density of seedlings - p.69 | 1,419.69 ha - p.8<br>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 | Six marine protected areas (MPAs) in Lawaan have patches of seagrass beds. |

| | | |
|---|---|---|
| | Mangrove cover per barangay - p. 25<br><br>Diversity and distribution of mangrove species across the coastal barangays in Lawaan - p.25 | 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 (Sonnerata sp.) and piapi (Avicennia sp.) - p.24<br><br>Around 112 ha of mangroves remain in barangays Bay-ang, Camaligan, Lalab, Poblacion and Magpag-ong. - p.24<br><br>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 (Hydrochariticae) 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<br><br>Other species that naturally grows are Perada (Sonneratia sp.), Pagatpat (Sonneratia sp.), and Rhizophora sp. - p.21 | No available description |

Results of this study show that 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 toward carbon sequestration and the economic potential it could offer to coastal communities. This observation is also documented in the perception survey made by Quevedo, Uchiyama, and Kohsaka (2020a); people’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).

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 the "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 Salcedo and Lawaan as documented by Quevedo, Uchiyama, and Kohsaka (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 is attributed to anthropogenic activities with conversion to aquaculture ponds as the leading cause of mangrove degradation in the Philippines (Garcia, Gevaña, and Malabrigo 2013). 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, Uchiyama, and Kohsaka 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, which largely remain as anecdotes. 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 National Mangrove Forest Protection and Preservation Act (Senate Bill No. 326, 2016) and National Coastal Green Bill Act (Senate Bill No. 651, 2016) in the country which mandates a 100-meter-wide band (protection zones) of mangroves. Other activities for instance, in Lawaan, include monitoring and evaluation, and coastal clean-up. In Batan, strategies contain solid waste management and increasing awareness on mangroves while Kalibo town aims to manage their mangroves 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 the Lawaan 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 (i.e. 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.

### *Current focus on seagrass ecosystems*

Seagrass ecosystems are unsubstantially tackled in the coastal management plan of the four municipalities compared to mangrove ecosystems (Figure 5), with clusters including only profile, threats, and a few management actions (Figure 4). 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, its extent, as well as what species they have in their coastal areas (Table 3). Kalibo town has no available profile of their seagrass meadows based on the analysis done (Table 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 capacity (Deguit, White, and Courtney 2002) of local government units. 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 such as a source of food 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, Uchiyama, and Kohsaka (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 are gaining salience in recent years, particularly in the field of their ecosystem services, contribution to natural environment and people, and effective conservation and management strategies (United Nations Environment Programme 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, as causes of seagrass degradation. 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 the Lawaan 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, Patalinghug, and Divinagracia 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 beds 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 eight (8) years (Fortes 2012), management schemes are still lacking.

***Blue carbon ecosystems management and policy implications***

The results of this study can shed light on the present direction of coastal management plans toward blue carbon ecosystems at the local level in the Philippines. Since only four municipal (Salcedo, Lawaan, Batan, and Kalibo) coastal plans were analyzed, future studies could look at and analyze other and more coastal plans in the Philippines. Despite the limited number of documents investigated, the following points are observed:

(1) Although mangroves and seagrasses are important blue carbon ecosystems, there is a gap in the management between these resources at the local level. Management strategies, as seen in the analysis (Figure 4), are more focused on mangrove forests, whereas management strategies of seagrass meadows are largely unexplored. More attention is given to mangrove forests due to their coastal protection services. These benefits have been particularly observed and experienced by coastal communities when super typhoon Haiyan hit the study sites in 2013. Anecdotes and scientific investigations in the affected areas 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 are limited in human resources and budget in biodiversity, environmental management fields (Kohsaka and Uchiyama 2017). Intersectional policy collaborations, such as coastal and terrestrial management policies, is also a challenging issue (Uchiyama and Kohsaka 2019). Considering the issues of municipal governments, national agencies in the Philippines like the DENR should invest more in information and educational 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.

(2) In the existing coastal plans, legal frameworks are 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 integrated with coral reefs and other ecosystems under the coastal ecosystem network. Inconsistency of the content of the plans across the municipalities can be influenced by several factors; however, this study did not explore these factors. There is an opportunity to consider future studies on factors affecting plan formulation and eventual 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 (Table 1), non-government organizations (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 ICFM plan of Salcedo (Table 1), NGOs are recognized to be vital in the planning of CRM and organizing the local stakeholders while government agencies like he 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, Uchiyama, and Kohsaka 2021c). 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.

(3) The coastal management plans did not account for the indirect drivers (i.e. population growth, urbanization) that have potential and non-negligible effects on mangrove and seagrass ecosystem losses. Mostly discussed are the direct drivers such as human-induced (i.e. mangrove tree harvesting, unregulated gleaning) and natural (i.e. typhoons, strong waves) disturbances. The local government units have their own protocols (i.e. local ordinances) to manage and control the effects of direct drivers. Future investigation can consider in-depth interviews of local government units and applying, for instance, a DPSIR framework (Quevedo, Uchiyama, and Kohsaka 2021a).

(4) Lastly, the role and recognition of blue carbon ecosystem services and their scale-dependence need to be addressed. The “blue carbon” concept is increasingly better understood in the 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 and NGOs is showing strategic “blue carbon” opportunities in the seas of East Asia and it has recommended incorporating blue carbon ecosystems 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. Whereas, 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 blue carbon ecosystems. 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 blue carbon ecosystem strategies in the country which can be used as frameworks or guidelines for local level application and implementation.

Although the results presented are rather limited and at a local scale only, this study can serve as a benchmark for policy-makers and coastal managers in updating their present management plans particularly in branching their focus on integrated management of seagrass ecosystems and advancing technical capacity and knowledge on blue carbon ecosystems. 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 blue carbon ecosystem 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 paper. For instance, the data here can serve as a basis to be shared within the Coral Triangle Region where high concentrations of blue carbon ecosystems can be found. Content analysis can be applied to the coastal zoning policy currently being adopted at Karimunjawa Island, Indonesia where locals identified it to be effective in blue carbon ecosystem management (Quevedo et al. 2021). Moreover, in future research, factors such as incentives (i.e., payment for ecosystem services) that can be shared among local stakeholders and accelerate the management of blue carbon ecosystems can be explored further following the early works of, for example, Thompson, Primavera, and Friess (2017), Gevaña, Camacho, and Pulhin (2018), and Satizábal et al. (2020).

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Declaration of Interest

The authors declare no conflict of interest.

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