



State of the Mangrove in CEBU

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I. Introduction

The Province of Cebu is a 1st Class Provincial Local Government Unit (LGU) located in Region VII (Central Visayas). It is the regional center for governmental services and is a major hub for business and trade in the Visayas and Mindanao regions. The province has a population of 2.93 million people with a growth rate of 1.94 % (PSA 2017). Majority of its inhabitants are residing within 60 km from the coastal zones. This makes Cebuanos exposed to natural disasters such as typhoon, land slide, storm surge, and sea level rise (SLR).

All of Cebu's 51 component cities and municipalities (including 144 barangays) are coastal. The province supports the region's fishing industry and contributes 74 % of fish supply in Central Visayas (White et al. 2004). The high fisheries production can be attributed to the five major fishing grounds surrounding Cebu: the Visayan Sea, Tañon Strait, Cebu-Bohol Strait, Camotes Sea, and the Danajon Double Barrier Reef. Demersal fisheries supply most of the fishes in the local wet markets. In 2016, Northern Cebu recorded a total of 2,129,665 metric tons of landed fish catch from combined commercial and municipal fishing.

The high fisheries production is related to the health and functionality of the three major marine habitats: mangroves, seagrass, and coral reefs. The conditions

of these marine habitats are directly proportional to the abundance of fishery resources. As generally understood, a healthy marine habitat will translate to higher fishery stocks.

To protect and conserve the coastal resources of Cebu, the province has partnered with non-government organizations (NGO) for the establishment of marine protected areas (MPAs). During the Coastal Resource Management Project (CRMP; of the DENR), about 70 MPAs were established. The number of MPAs has doubled in the last 10 years as many municipalities have seen the benefits of a successful MPA. The success of MPA management in most areas made Cebu as an MPA learning site. Three MPAs were included in the list of 10 Most Outstanding MPAs in the Philippines. The recognition continues as another MPA was awarded in 2017 as the Best Locally Managed MPA by RARE-Philippines and Oceana-Philippines.

The mangrove forest has played a major role in the replenishment of fishery stocks. It functions both as habitat and nursery for some target species. Another recognized function of mangrove in Cebu is the protection that it provides in coastal areas. Some areas in the province are frequently visited by typhoon, particularly Northern Cebu, which is known as a regular typhoon path in the Visayas. From 1965 to 1995, 79 typhoons hit Cebu, five of which were devastating. These typhoon occurrences damage properties and

agriculture. The occurrence of Super Typhoon (ST) Yolanda (international name: Haiyan) in November 2013 brought the biggest damage estimated at USD 261 million (FAO 2013). The bio-shield function of a mangrove forest has prompted the province to adopt mangrove rehabilitation as a major CRM program. It befits mangroves as natural barriers against strong winds, storm surges, and coastal erosion. The province adopted a 1 Million Mangrove Planting program that aimed to plant one million mangroves throughout Cebu. The program turned out to be unsuccessful as only 11 % survived. But the program has stirred different institutions to engage in mangrove planting and has become part of the corporate social responsibility (CSR) of many private corporations. To improve the survivability of the planted mangroves, the province adopted a scientific protocol on mangrove planting and has partnered with fisherfolk organizations to implement a community-based mangrove rehabilitation program.

II. Status of Mangroves

Mangrove assessments in Cebu were conducted only in selected areas by various organizations, mostly by NGOs. Thus, most of the sites assessed were within the areas covered by their project. There are data gaps in areas where there are no NGOs or mangrove management program. These datasets need to be consolidated.

In 2017, the PENRO had conducted mangrove assessment through participatory coastal resource assessment (PCRA) in the City of Carcar (Southern Cebu). The mangrove species composition, average height, percent crown cover, and regeneration were determined using the modified transect plot method (Coastal Resource Management Project-PCRA Manual). The following number of plots were established per site: Barangay Tuyom (15), Barangay Ocaña (10), Barangay Bolinawan (17), Barangay Valladolid (13), and Barangay Poblacion 3 (37). Nine mangrove species were identified, as: *Avicennia marina* (Am; "miyapi"),

Ceriops decandra (Cd; "lapis lapis"), *Ceriops tagal* (Ct; "tungog"), *Lumnitzera racemosa* (Lr; "culasi"); *Nypa fruticans* (Nf; "nipa"), *Rhizophora apiculata* (Ra; "bakhaw laki"), *Rhizophora mucronata* (Rm; "bakhaw baye"), *Rhizophora stylosa* (Rs; "bakhaw bato"), and *Sonneratia alba* (Sa; "pagatpat"; **Table 1**). The overall mangrove condition of Carcar City was good in terms of average height (6.31 m) and percent crown cover (54.57 %), and fair in terms of regeneration (< 1 individual/m²).

Mangrove assessment from three plots was also conducted in Barangay Looc, Municipality of Santander, Southern Cebu (**Table 2**). Four mangrove species were identified: *Pemphis acidula* (Pa; "bantigue"), *Lumnitzera racemosa* (Lr; "culasi"), *Xylocarpus granatum* (Xg; "tabigi"), and *Ceriops tagal* (Ct; "tungog"). The overall mangrove condition was good in terms of average height (7.76 m) and percent crown cover (60.21 %) but was poor in terms of regeneration (< 1 individual/m²). Generally, Southern Cebu has a good mangrove condition but with low regeneration. This translates into less seedling production and slow natural regeneration capability.

For Northern Cebu, mangrove assessment was conducted in the Municipality of Daanbantayan using Mangrove Community Structure Survey (MCSS) Method. The activity was intended to assess the extent of typhoon damage in mangroves. However, this report only presented the species composition and density in the six barangays covered in the survey. The survey covered 81.82 ha where 14 species was recorded (**Table 3**). Barangays Bagay and Tominjao have the highest number of mangrove species with nine species. The species *Avicennia marina* dominated all sites. Barangay Tapilon has the highest density at 12,067/ha, however, it has few seedling density—indicating low regeneration rate (**Table 4**). Barangay Calape has the lowest density at 3,800/ha. Barangay Aguyo has the highest seedling density at 4,350/ha. The species *Rhizophora stylosa* has the highest density (11,458/ha) followed by *Avicennia marina* (6,374/ha) and *Ceriops decandra* (< 1,000/ha).

Table 1. Summary of results of mangrove vegetation assessment in Carcar City, Cebu.

Sites	Species	Average height (m)	Crown cover (%)	Regeneration (per m ²)
Overall	Am, Sa, Ra, Rs, Rm, Cd, Ct, Lr, Nf (9)	6.31	54.57	0.69
Tuyom	Am, Sa, Ra, Rs, Rm (5)	4.29	43.34	0.20
Ocaña	Am, Sa, Ra, Rs, Rm (5)	7.12	43.37	0.26
Bolinawan	Am, Sa, Ra, Rs, Rm, Cd, Ct, Lr, Nf (9)	6.90	50.15	2.02
Valladolid	Am, Sa, Ra, Rm (4)	6.66	83.06	0.06
Poblacion 3	Am, Sa, Ra, Rs, Rm, Cd, Lr, Nf (8)	6.55	52.92	0.93

Table 2. Summary of results of mangrove vegetation assessment in Barangay Looc, Santander, Cebu.

Plots	Species	Average height (m)	Crown cover (%)	Regeneration (per m ²)
Overall	Pa, Lr, Xg, Ct (4)	7.76	60.21	0.02
1	Pa, Lr	7.24	43.20	0.01
2	Xg	9.27	56.55	0.04
3	Pa, Xg, Ct	6.78	80.90	0.00

Table 3. List of mangrove species recorded in six coastal barangays in Daanbantayan, Cebu.

Species	Barangay/Site					
	Agujo	Bagay	Calape	Talisay	Tapilon	Tominijao
<i>Aegiceras corniculatum</i>		+				+
<i>Aegiceras floridum</i>						+
<i>Avicennia officinalis</i>			+			
<i>Avicennia marina</i>	+	+	+	+	+	+
<i>Bruguiera gymnorhiza</i>		+				+
<i>Ceriops decandra</i>	+	+	+	+	+	+
<i>Excoecaria agallocha</i>		+			+	
<i>Lumnitzera racemosa</i>	+			+	+	
<i>Nypa fruticans</i>					+	
<i>Rhizophora apiculata</i>	+	+		+	+	+
<i>Rhizophora mucronata</i>	+			+	+	+
<i>Rhizophora stylosa</i>	+	+	+	+	+	+
<i>Sonneratia alba</i>	+	+	+	+		+
<i>Xylocarpus granatum</i>	+	+			+	
Total	8	9	5	7	9	9

Table 4. Mangrove density per barangay of the six coastal barangays in Daanbantayan, Cebu.

Barangay	Area (ha)	Density (count/ha)	Seedlings density	Tree density
Agujo	12.18	7,100	4,350	2,575
Bagay	24.24	6,314	2,843	0
Calape	10.27	3,800	0	2,133
Talisay	9.35	5,950	0	4,000
Tapilon	6.53	12,067	0	10,833
Tominjao	19.30	4,038	1,833	8,150

III. Mangrove Protection and Management

The recognition on the importance of mangroves motivated the provincial government to adopt a mangrove rehabilitation and protection program. The program was anchored on science as the basis for the formulation of mangrove management protocol. Lessons learned from ST Yolanda have shaped up mangrove planting into a major disaster risk reduction program from mere rehabilitation activity for fisheries production. A protocol anchored on the recognition of using appropriate species at the appropriate place and at the appropriate time became the basis for the formulation of the different components in mangrove rehabilitation and conservation project. In recognition of the protocol, the Cebu Province has identified in its mangrove rehabilitation and conservation program the activities that would integrate the science protocol in every mangrove planting project.

Mangrove Habitat Mapping

The province has no comprehensive historical information on the extent and distribution of mangroves. Previous mangrove rehabilitation programs failed to include inventory of remaining mangrove stands. Another reason was the absence or lack of a coordinated planting activities from different organizations that were engaged in planting. Mangrove rehabilitation programs implemented by NGOs also have limited information on the total number of planted areas and survival rate. Most of their projects focused on MPA establishment.

In 2016, the PENRO embarked on an inventory program that determined the extent of the coral reef, mangrove, and seagrass habitats in the province. The coastal maps were used to redesign existing MPAs and ensure that all habitats are part of the MPA.

The mapping used the standard coastal habitat survey in sync with geographic information system (GIS) operation. Pre-survey preparations involved analysis of available aerial/satellite images from free sources. These images were rectified and used as guide for daily mapping. The guide map contained pre-plotted coordinates of starting and ending points. Global Positioning System (GPS) units were recalibrated to receive coordinates. For mangrove habitat mapping, satellite images were used to determine the vegetation extent and distribution. Ground truthing was done to identify and plot the mangrove species distribution. In some municipalities, MCSS was used.

Daily GPS tracks were downloaded and converted as GIS Shapefiles (for ArcGIS) and DBF files (excel). These datasets were then converted as GIS point shapefiles and digitized to categorize the habitat. Coastal maps were supplemented with maps generated from LiDAR-Philippines Mapping project and were enhanced to include municipalities/cities that were not covered by their project. Eighty five percent (85 %; 3,933 ha) of the total mangrove cover in Cebu was already mapped. The remaining 15 % was also already surveyed but is still being processed. However, the mapping covered was limited in extent as availability of mangrove species data and zonation maps remains a challenge.

Establishment and Monitoring of Community-Based Mangrove Nursery

Another component of mangrove rehabilitation program is the establishment of Community-Based Mangrove Nursery (Fig. 1). For several years, mangrove planting in the province was dependent on the availability of seeds or propagules. These programs resulted to mono-specific planting and neglected other species that are more suitable in the planting site.

The importance of mangrove nursery to conform with scientific protocol is beyond dispute. Nurseries provide the required numbers and sizes of mangrove seedlings at a given time. They are essential for large-scale mangrove reforestation because they meet the need for taller seedlings for sites with deeper water or faster sedimentation (Primavera et al. 2012). Nurseries also serve as storage area for excess seedlings.

The province has adopted a standard protocol in the establishment of nurseries—site selection, wildlings collection, and maintenance and monitoring of seedlings in the nursery. All these steps were taught to fisherfolks during the mangrove nursery establishment training. Most of the nurseries established were large-scale nurseries accommodating hundreds to thousands of seedlings which are mostly for selling. The produced seedlings were mostly sourced from the wild (collected by POs) except in some nurseries where seeds were germinated. These seedlings were placed in individual



Figure 1. Community-based mangrove nursery.

containers, mostly polybags or recycled plastics. One significant part in seedling production that the province has not developed yet is the seed germination and grow-out techniques for *Sonneratia alba*.

After the bagging of wildlings, nursery maintenance activities followed and were performed by PO members. Most of the daily activities were geared to ensure that seedlings are healthy and are pest-free. The PENRO CRM Section personnel conducted the monitoring of seedlings in the nursery. The growth rate and general observation per seedlings were recorded (Table 5). Marine biologists from PENRO-CRM Section performed the scientific monitoring every three months. Results and other observations were immediately reported to the management body.

Table 5. Mangrove nursery monitoring data.

Location	Monitoring	No. of bags	Ave. height (cm)	Ave. leaves	Next monitoring
San Remigio – Busogon (Bagged in Sept. 2017)	September 2017	100	9	4	January 2018
Borbon – Cadahuran (Bagged in June 2017)	September 2017	89	34	5	January 2018
Tuburan – Bagasawe	*	*	*	*	*
Liloan – Calero	August 2017	**	**	**	**
Bagadian – Zaragosa	August 2017	101	11	6	January 2018

*No data yet

**No data yet. Small scale backyard nurseries

Mangrove Planting and Management Training

To institutionalize the scientific protocol on mangrove rehabilitation, the provincial government has incorporated Mangrove Planting and Management Training (**Fig. 2**) as a tool to capacitate local communities and municipal/city LGUs. The training module was designed not only to capacitate participants but also to use resilient and seafront mangrove species, and eventually to integrate with local disaster and risk reduction plans. Marine biologists from the CRM Section conduct the training four times a year.

The training covered a comprehensive lecture on the ecology and biology of mangroves, basic management approaches (including nursery establishment and management), monitoring, and data analysis. The practicum part of the training provided the participants hands-on experience on wildlings collection, actual planting, and species identification.

Mangrove Planting and Monitoring

Mangrove planting followed the principle of “Right Species, Right Place, and Right Time”. If the site is suitable, the request for mangrove planting materials is granted by PENRO. Simple validation of the proposed site for planting followed. After site validation, the data processing, reporting, and map generation followed. The report included the type and number of mangrove seedlings that can be accommodated in the site, instructions on planting technique (as single or double seedlings), the best planting time based on the local tidal calendar, and list of materials needed for planting (**Table 6**).



Figure 2. Training on mangrove planting.

Crucial in the approval of the request is the concurrence of the municipal and barangay LGUs, and the PO. This ensures that there is an organization that will maintain the planting site. There is coordination with the local environmental office for all mangrove planting activities. The PENRO ensures that the planting site conforms with the local development plan of the municipality or city. **Fig. 3** shows the process from mangrove planting to monitoring.

After the site validation and coordination, mangrove seedlings were purchased by PENRO from the accredited mangrove nurseries. Delivery was usually facilitated by the supplier.

Monitoring of the planted mangroves started three months after the planting. Growth and survival rates were measured. The PENRO has adopted the Fixed-Point Quadrat Method in monitoring the growth and survival rate of planted mangroves. This was due to the limitation in the number of PENRO personnel doing the monitoring of large rehabilitation sites. An example of mangrove monitoring results is provided in **Table 7**.

Table 6. Site selection check list.

Biophysical	YES	NO
Outplanting: seafront		
• Exposed during neap tide (low tide)		
• Protected from wave action		
• Substrate firm (foot does not sink above the ankle)		
• Remaining mangroves		
First 3 criteria should be YES		
Outplanting: outer abandoned pond		
• Exposed during neap tide (low tide)		
• Protected from wave action		
• Substrate firm (foot does not sink above the ankle)		
• Remaining mangroves		
First 3 criteria should be YES		
Outplanting: inner abandoned pond		
• Not waterlogged		
• Substrate firm (foot does not sink above the ankle)		

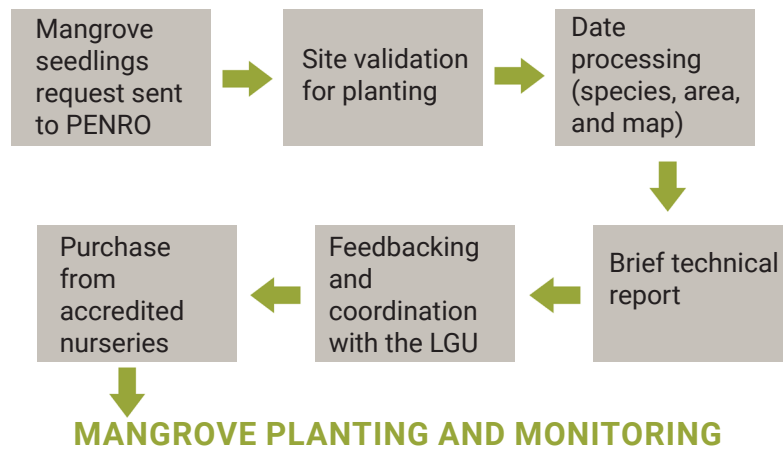


Figure 3. Site validation flow.

Table 7. An example of mangrove nursery monitoring result.

Location	Date	No. of seedlings provided	Date planted	Ave height (cm)	Leaves	Survival rate (%)	Area (sq. m)	Next monitoring
Agoho, Daanbantayan	Jan 2017	5,000	Aug 12, 2017	19	8	70	500	Feb/Mar 2018
La Purisima, Bogu City	Nov 2017	3,000	Mar 2017	No data		11	1,000	Feb/Mar 2018
Tambungon, San Remigio	Oct 2017	1,000	Jul 2017	24	7	89	1,000	Jan 2018
Bagatayam, Sogod	Nov 2017	2,000	May 2017 (1 st batch)	16	4	91	800	Apr–Jul 2018
	Jan 2018		2 nd monitoring	24	20	91	1,200	May–Jul 2018
	Feb 2018		Jan 2018 (2 nd batch)	23	10	87		
Antipolo, Tuburan	Feb 2018	800	Aug 2017	20	6	13	800	May–Jul 2018
Catmon	Oct 2017	2,000	2017	No data		2	2,000	N/A
	Jan 2018		2 nd monitoring	No data		0		
Guinsay, Danao	Oct 2017	4,350	Sept 2017 (1 st batch)	30	9	8	3,194	Mar/Apr 2018
	Feb 2018		Jan 2018 (2 nd batch)	30	8	29	1,156	Apr–Jul 2018
Calero, Liloan	Aug 2017	500	May 2017	35	11	74	500	Apr–Jul 2018
	Feb 2018		2 nd monitoring	29	15	7		
Cotcot, Liloan	Nov 2017	5,000	Oct 2017	13	6	85	5,000	Apr–Jul 2018
	Jan 2018		2 nd monitoring	15	9	17		
Calajoan, Minglanilla	Sept 2017	2,000	May 2017	37	7	20	500	May–Jul 2018
	Feb 2018		2 nd monitoring	38	19	8		

IV. Summary and Recommendations

The presence of national laws protecting mangroves leaves no gap in the protection and conservation of mangroves, even at the level of the local governments. The national policy on Integrated Coastal Resource Management has expanded the scope of mangrove protection beyond coastal areas. Yet, the problem on illegal cutting and other forms of destructions remains. Overlapping jurisdiction among agencies and coastal development remain the main reasons why mangroves are constantly in danger.

Below are the recommendations needed to attain sustainable mangrove management in the province:

1. Associated with coastal development is the claim on ownership of some individuals having title or tax declaration over mangroves. These claims gave them the presumption that they can cut mangrove trees for reclamation and fishpond development. There is a need to do an inventory of mangrove distribution and extent, and assess if these mangroves have land titles or part of claims. Mangrove community classified as alienable and disposable lands should be reclassified, and any title or tax declaration issued over these areas should be revoked.
2. All remaining intact or healthy mangroves should be declared as MPA to exclude or protect them from any destructive coastal reclamation projects.
3. There should be regular budget allocation for mangrove rehabilitation.

4. Mangrove rehabilitation training should be conducted as an annual activity that should be spearheaded by the provincial government.
5. Mangrove protection should be discussed in Coastal Law Enforcement Trainings.
6. Mangrove rehabilitation, integrated with livelihood development, should involve community members.
7. It should be emphasized (to municipal and city LGU) that the reclamation permits, Foreshore Lease Agreement, construction permit, or any other permits cannot be used to cut mangroves to give way to development.

V. References

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