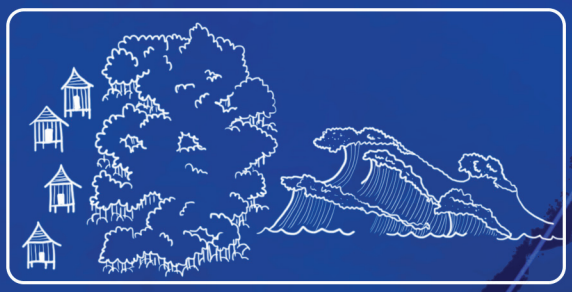
CONSERVATION INTERNATIONAL Philippines

REVISITING LEARNINGS AND ENVISIONING PHILIPPINE MANGROVES IN 2030

Proceedings of the 1st National State of the Mangrove Summit



Severino G. Salmo III
Dixon T. Gevaña
Sitti Zayda B. Halun
Jose Alan A. Castillo
Enrique A. Nuñez, Jr.
Ma. Josella M. Pangilinan
Noreen Marie G. Follosco
Armida P. Andres
Nilda S. Baling

REVISITING LEARNINGS AND ENVISIONING PHILIPPINE MANGROVES IN 2030

Proceedings of the 1st National State of the Mangrove Summit

Citadines Bay City Manila, Philippines | 9-11 October 2019

Severino G. Salmo III
Dixon T. Gevaña
Sitti Zayda B. Halun
Jose Alan A. Castillo
Enrique A. Nuñez, Jr.
Ma. Josella M. Pangilinan
Noreen Marie G. Follosco
Armida P. Andres
Nilda S. Baling

Conservation International Philippines Foundation, Inc.

Revisiting Learnings and Envisioning Philippine Mangroves in 2030
Proceedings of the 1st National State of the Mangrove Summit
Citadines Bay City Manila, Philippines | 9-11 October 2019

Editors:
Severino G. Salmo III, *University of the Philippines Diliman*
Dixon T. Gevaña, *University of the Philippines Los Baños*
Sitti Zayda B. Halun, *Mindanao State University - Tawi-Tawi College of Technology and Oceanography*
Jose Alan A. Castillo, *DENR Ecosystems Research and Development Bureau*
Enrique A. Nuñez, Jr., *Conservation International Philippines*
Ma. Josella M. Pangilinan, *Conservation International Philippines*
Noreen Marie G. Follosco, *University of the Philippines Baguio*
Armida P. Andres, *DENR Biodiversity Management Bureau*
Nilda S. Baling, *DENR Biodiversity Management Bureau*

Contributing Authors:
Alvin B. Baloloy, *University of the Philippines Diliman*
Mercedita G. Barbarona, *DENR 10*
Crizaldy M. Barcelo, *DENR 8*
Baharodin Baulo, *BARMM Ministry of Environment, Natural Resources, and Energy*
Eugenia N. Bautista, *DENR 8*
Gil Bigcas, *DENR 11*
Ariel C. Blanco, *University of the Philippines Diliman*
Eric D. Buduan, *Forest Foundation Philippines*
Reginaldo G. Bueno, *DENR 7*
Chester O. Casil, *DENR 1*
Bror Ragnar Lorenzo Isagani R. Collander, *DENR 8*
Emerin Dadea, *DENR 5*
Mark Anthony B. de la Peña, *DENR 8*
Rafaela Jane Delfino, *The Oscar M. Lopez Center*
Olive Ebido Gregorio, *LGU Masinloc, Zambales*
Nilda G. Ebron, *DENR 13*
Dixon T. Gevaña, *University of the Philippines Los Baños*
Mary Anne Concepcion D. Gonzales, *DA-BFAR*
Severino A. Lacandazo, Jr., *DENR 8*
Cirilo Lagnason, Jr., *DENR 12*
Rod Reynan G. Laspiñas, *DENR 6*
Rodel Lasco, *World Agroforestry Centre*
Nestor S. Lorenzo, *DENR CENRO Isabela*
Grizelda Mayo-Anda, *Environmental Legal Assistance Center, Inc.*
Augustus Rex F. Montebon, *Conservation International Philippines*
Maria Elena Parañaque, *DENR 4-B*
Januel Peras, *DENR 4-A*
Severino G. Salmo III, *Ateneo de Manila University*
Melecia B. Sumbeling, *DENR 8*
Chantal S. Tiga, *DENR 9*
Zarah Mae G. Velarde, *DENR 8*
Analyn N. Viray, *DENR 1*

Recommended citation:
Salmo, S. G. III, Gevaña, D. T., Halun, S. Z. B., Castillo, J. A. A., Nuñez, E. A. Jr., Pangilinan, M. J. M., Follosco, N. M. G., Andres, A. P., Baling, N. S., eds. (2021). Revisiting Learnings and Envisioning Philippine Mangroves in 2030: Proceedings of the 1st National State of the Mangrove Summit. Department of Environment and Natural Resources - Biodiversity Management Bureau and Conservation International Philippines.

Layout and design: Maria Victoria Doctor-Olavides

The editors wish to thank Rouenne Camille de Castro, Crystelle W. Amores, and Cheryl R. Ventura for their assistance in preparing these Proceedings.

Printed in the Philippines.

ISBN: 978-971-94594-4-6 (Softbound)
ISBN: 978-971-94594-5-3 (PDF)

Published by:
Conservation International Philippines Foundation, Inc.
4/F Units 4 A & D Culmat Building
1270-1330 E. Rodriquez Sr. Avenue
Brgy. Mariana, Quezon City, Philippines
ci-philippines@conservation.org
+632 8571 3761/ 3767

About the cover:
As in the rest of the tropics, communities in the Philippines interact with mangroves for essential ecosystem services such as fisheries, livelihood, coastal protection, and carbon storage, as well as other ecological and regulatory functions. But while critical to human well-being, these habitats are faced with urgent challenges, not least conversion for agriculture and other types of development, wood cutting and harvesting, pollution in the form of solid waste and sedimentation, and the climate-related threats of severe typhoons and sea level rise. Sustaining the ecosystem services provided by mangroves will require addressing these challenges through effective and coordinated science-based conservation, rehabilitation (e.g., restoration), and management. Partners and stakeholders have identified goals and relevant priority programs under three roadmap areas in (1) biodiversity, conservation, and restoration, (2) climate change (blue carbon and sea level rise), and (3) policy & governance. Through accelerated and concerted science-informed action, Philippine mangroves in 2030 are envisioned to have increased in cover by at least 20%, contribute to climate resilience as protective greenbelts and efficient blue carbon sinks, and be managed through a unified inter-agency mangrove action plan.

Cover art and design by Maria Victoria Doctor-Olavides

Message

Biodiversity Management Bureau,
Department of Environment and Natural Resources

Mangrove forests are among the most generous of all ecosystems because of the multiple goods and services they provide. They are limited and fragile; limited in the sense that not all of our coastal length can be planted with these and not all mangrove species planted thrive - there must be species-and-zone matching and a right mix of salt and freshwater, sand and clay. They are fragile in the sense that the whole country is not a mangrove area. Based on historical data, we had only 500,000 ha of mangroves, reduced to about 250,000 ha over the years because of the expansion of communities, conversion for other development, and conflicting institutional mandates both at the national and local levels.

It is a timely event and an opportunity to conduct this 1st National State of the Mangrove Summit to gather experts, scientists, managers, and researchers in mangrove rehabilitation, management, and protection to be able to address the challenges, threats, and issues to this ecosystem through collaboration among relevant National Government Agencies, NGOs, CSOs, local government units, the academic and scientific community, and practitioners.

The Biodiversity Management Bureau of the Department of Environment and Natural Resources truly appreciates the partnership with Conservation International Philippines, Forest Foundation Philippines, DA-BFAR, NAMRIA, civil society organizations, and development partners in initiating this platform for exchanging knowledge and expertise, stocktaking and updating data and information as well as relevant policies, and sharing best practices and lessons learned. From here, this collective drew up the next steps towards the rehabilitation and proper management of our mangrove resources. We cannot do this in silos, given the real and continuous threats due to expansion and development, not only in our rural areas but also in the very heart of our urban spaces.

The wealth of information and knowledge gained from this 1st National Mangrove Summit is a stride to our goal for a thriving, healthy and functional mangrove ecosystem. In the next Summit, we hope to come together again to report progress from these initial gains.

Ricardo L. Calderon
Assistant Secretary for Climate Change and
Director in concurrent capacity

Message

Ecosystems Research and Development Bureau,
Department of Environment and Natural Resources

I would like to extend my warm congratulations to the organizers of the 2019 National State of the Mangrove Summit for the successful staging of the event.

Indeed, this Summit has brought together the different stakeholders, National Government Agencies, NGOs, civil society groups, and academic and research organizations working in the country's mangrove forests with a common goal to share the latest information and knowledge, discuss the problems facing our mangroves, and come up with solutions that we can achieve through collaboration in the next 10 years.

We, at the Research Bureau of the Department of Environment and Natural Resources, will continue to do our share in generating new knowledge and producing peer-reviewed publications, technical guidelines, and other knowledge products to improve our understanding of the country's mangrove forests, and serve as scientific basis for sound decision-making. All these, along with ERDB's other relevant endeavors, are our humble contribution to the attainment of our collective vision for the mangrove forests of the Philippines.

Henry A. Adornado, Ph D.
Director

Message

Forest Management Bureau,
Department of Environment and Natural Resources

The Forest Management Bureau is one with the Department in its conservation, management, development, and proper use of the country's environment and natural resources, which includes our mangrove forests. Out of the 7.014 million ha of forest cover in the Philippines, 303,388 ha or 4.3% is mangrove forest. Through the implementation of our programs and projects, it is our goal to increase the extent of mangrove forests in the country, as we recognize the role of mangroves in addressing the adverse impacts of climate change, protecting coastlines against natural disasters, and providing livelihood and food security for many Filipinos.

The National Greening Program aims to increase the area of mangrove forests in the country by including mangroves as one of the main commodities planted under the program. In line with efforts to provide additional areas to be planted with mangroves, we continuously coordinate with the DA Bureau of Fisheries and Aquatic Resources, local government units, DENR field offices, and other relevant stakeholders and agencies for the reversion of abandoned, undeveloped, and underutilized fishponds to their original mangrove state. Likewise, we work hand in hand with concerned Offices for the implementation, enforcement, and enhancement of policies relative to mangroves and their management.

The 1st National State of the Mangrove Summit has been a significant opportunity for different stakeholders to come together and discuss the status of our mangrove forests nationwide, address current and emerging issues and concerns, and prepare action plans to pave a clear path on how everyone can contribute to the successful rehabilitation, conservation, and management of our existing mangrove forests.

We at the Forest Management Bureau acknowledge the success of the Summit and hope that it continues to result in fruitful collaboration towards mangrove conservation and management.

Nonito M. Tamayo, CESO IV
Director

Message

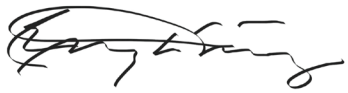
Conservation International Philippines

Mangroves are among the most vulnerable ecosystems, threatened by both natural and anthropogenic factors. But if conserved and managed properly, these habitats can be critical in the response to climate change impacts including typhoons and sea level rise. Further, mangroves have only recently been recognized for their role in sequestering carbon, which has implications on mitigation strategies and programs moving forward.

We are pleased to publish the proceedings of the 1st National State of the Mangrove Summit: "Revisiting learnings and envisioning Philippine mangroves in 2030," which was held in Metro Manila in October 2019. The Summit served as a platform for regions and provinces to report on the state of mangroves in their area, as well as their management practices. It was a venue to consolidate data, tackle important concerns and strategies, and formulate an initial action plan to improve mangrove research, conservation and restoration, and policy and governance in the country. A common understanding of the extent and state of ecosystem health of our mangroves enables us to effectively plan for the conservation and management of these important habitats. Further, the best practices and illustrated experiences shared during the Summit, and captured now in these proceedings, can guide the development and implementation of our roadmap for Philippine mangroves.

The Global Mangrove Alliance is rallying the world around a target of increasing mangrove coverage by 20% over current extent by 2030. It is an ambitious goal – one that requires collaboration among partners from all sectors in every corner of the world with mangroves. We are doing our part to increase that collaboration.

The Philippines can contribute significantly towards this goal. It underpins broader objectives including sustaining biodiversity, ensuring food security, climate change resilience, and improving human well-being. We need to improve and support science, strengthen policy and governance, enhance knowledge and capacity-building, integrate and scale up best practices, translate and communicate science to inform and raise awareness among key stakeholders, and develop novel valuation and financing mechanisms. It is through these actions that we aim for our mangrove vision of 2030.



Enrique Nuñez, Jr.
Country Executive Director

Contents

List of abbreviations

ADB	Asian Development Bank
AdMU	Ateneo de Manila University
ASEAN	Association of Southeast Asian Nations
AUU	Abandoned, Undeveloped, and Underutilized (fishponds)
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
BC	Blue Carbon
BDFE	Biodiversity-friendly Enterprise
BLGU	Barangay Local Government Unit
BMB	Biodiversity Management Bureau of the Department of Environment and Natural Resources
CALABARZON	Cavite, Laguna, Batangas, Rizal, and Quezon (Region 4-A)
CBFM	Community-based Forest Management
CCC	Climate Change Commission
CENRO	Community Environment and Natural Resources Office
CEPA	Communication, Education, and Public Awareness
CEP	Coastal Environment Program
CIP	Conservation International Philippines
CLUP	Comprehensive Land Use Plan
CMEMP	Coastal and Marine Ecosystems Management Program
COP	Conference of Parties (of the UNFCCC)
CRMP	Coastal Resources Management Project
CSO	Civil Society Organization
BFAR	Bureau of Fisheries and Aquatic Resources of the Department of Agriculture
DAO	Department Administrative Order
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOST	Department of Science and Technology
EbA	Ecosystem-based Adaptation
ELAC	Environmental Legal Assistance Center, Inc.
ENGP	Enhanced National Greening Program
E-NIPAS	Expanded National Integrated Protected Area System
EO	Executive Order
ERDB	Ecosystems Research and Development Bureau of the Department of Environment and Natural Resources
FAO	Fisheries Administrative Order
FARMC	Fisheries and Aquatic Resource Management Council
FFP	Forest Foundation Philippines
FLA	Fishpond Lease Agreement
FMB	Forest Management Bureau of the Department of Environment and Natural Resources
FPE	Foundation for the Philippine Environment
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GMA	Global Mangrove Alliance
GMW	Global Mangrove Watch
GP	Gratuitous Permit
IAMBlueCECAM	Integrated Assessment and Modelling of Blue Carbon Ecosystems for Conservation and Adaptive Management Project
IBCI	International Blue Carbon Initiative
ICM	Integrated Coastal Management
ICRMP	Integrated Coastal Resources Management Project
IEC	Information, Education, and Communication
INDC	Intended Nationally Determined Contributions
IP	Indigenous Peoples

IPAF	Integrated Protected Area Fund
IPCC	Intergovernmental Panel on Climate Change
LCCAP	Local Climate Change Action Plan
LGC	Local Government Code
LGU	Local Government Unit
LPPCHEA	Las Piñas – Parañaque Critical Habitat and Ecotourism Area
LPPWP	Las Piñas – Parañaque Wetland Park
M&E	Monitoring and Evaluation
MBFDP	Mangrove and Beach Forest Development Program
MIMAROPA	Mindoro, Marinduque, Romblon, Palawan (Region 4-B)
MPA	Marine Protected Area
MOA	Memorandum of Agreement
MSU	Mindanao State University
NAMRIA	National Mapping and Resource Information Authority
NEDA	National Economic and Development Authority
NGA	National Government Agency
NGO	Non-governmental Organization
NGP	National Greening Program
NIPAS	National Integrated Protected Area System
NSMNP	Northern Sierra Madre Natural Park
PA	Protected Area
PACBRMA	Protected Area Community Based Resource Management Agreement
PAMB	Protected Area Management Board
PASA	Protected Area Suitability Assessment
PBE	Philippine Business for the Environment
PBSAP	Philippine Biodiversity Strategy and Action Plan
PCSD	Palawan Council for Sustainable Development
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PENRO	Provincial Environment and Natural Resources Office
PES	Payment for Ecosystem Services
PMEF	Project Monitoring and Evaluation Framework
PO	People's Organization
PD	Presidential Decree
PSA	Philippine Statistics Authority
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RS	Remote Sensing
SCPWI	Society for the Conservation of Philippine Wetlands, Inc.
SDG	Sustainable Development Goals
SLR	Sea Level Rise
SOCCSKSARGEN	South Cotabato, Cotabato, Sultan Kudarat, Sarangani, General Santos (Region 12)
SPZ	Strict protection zone
SST	Sea Surface Temperature
UDP	Upland Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UP	University of the Philippines
UP MSI	Marine Science Institute at the University of the Philippines Diliman
USAID	United States Agency for International Development
VIP	Verde Island Passage
WWF	World Wildlife Fund
ZSL	Zoological Society of London

List of tables

List of figures

Preface

These Proceedings synthesize the rich information shared during the three-day 1st National State of the Mangrove Summit held in Manila, Philippines on 9-11 October 2019. The current document is divided into six main sections, followed by the annexes. The introduction describes the Summit including its background and objectives, as well as general design, which these Proceedings adopt as its outline.

The regional state of the mangrove reports are chapters that were contributed by the participating regional offices of the Department of Environment and Natural Resources. Syntheses for Luzon, Visayas, and Mindanao were written by members of the technical panels that led the discussion of these regional reports during the Summit. Similarly, presentations on national mangrove mandates and directions, and recent technical research and management practices were submitted by the authors. Those that do not appear as full chapters are presented as summaries of the oral and Powerpoint presentations that were delivered by the respective speakers during the Summit.

Results from the Summit workshops including key points for the roadmap onwards to 2030 are included in these Proceedings. Initial outputs on the roadmap thematic areas, (1) biodiversity, conservation, and restoration, (2) climate change adaptation and mitigation, and (3) policy & governance, have been integrated and are presented here. Other activities such as the launch of a monograph on the blue carbon assessment in the Verde Island Passage in 2018 and the post-Summit field trip to the Las Piñas – Parañaque Wetland Park have also been captured here (Annexes 4 and 5, respectively). The workshop results, important discussion points and resolutions, and other parts describing events at the Summit, were expounded from the process documentation report. The final section containing the summary and recommendations integrates key accomplishments, and enumerates immediate next steps to sustain the momentum gained from the Summit.

A specific objective of the Summit was to consolidate mangrove information from different provinces in the Philippines to determine the state of mangroves at the national level. The best available data are included in these Proceedings although several gaps and challenges were identified. In some regions, there was uniform representation of the different provinces; while in other regions, some provinces were either described in excessive detail, or not reported at all due to insufficient data. In terms of information on mangrove cover and ecosystem health, there is a need to clarify sources, describe the scope and data collection methods, and develop a standard system of mangrove assessment and monitoring. Unfortunately, some reports have been based on outdated (obsolete, or not updated) and/ or incomplete data. It is likely that these data do not accurately reflect the current state of the mangroves at the municipal and provincial levels, and correspondingly, at the regional and national levels. Hence, the proposed management actions may likewise be inadequate and/ or inappropriate. Management actions to be undertaken will initially benefit from the best available information documented here, but should be continuously enhanced with newer, more reliable, and consistent data.

The existence and health of mangroves are threatened by coastal development (e.g., coastal reclamation; see Section 7) because of conflicting and/ or divided priorities. While we recognize that conservation will support several ecosystem services (as reported in some regions), we also acknowledge that this alone may not be sufficient to effectively manage mangroves. A more proactive restoration program is needed to complement conservation. As we move towards 2030, we can look forward to several opportunities for synergy including the recently submitted Nationally Determined Contributions. The Global Mangrove Alliance and other international movements further align goals such as restoring mangroves by at least 20% by the year 2030. The combined global effort is anticipated to increase forest cover, biodiversity, and fisheries production, as well as enhance carbon sequestration and reduce greenhouse gas emissions, among others. We hope that the gains of the Summit, as documented in these Proceedings, will guide and inspire Filipino researchers, coastal managers and policy-makers to envision and realize a better Philippine mangrove!

The Editors
June 2021

Sanga-Sanga in Bongao, Tawi-Tawi, Philippines (Photo © Sitti Zayda Halun)

1 Introduction

I. Background and Objectives

The presence and health of Philippine mangroves are threatened by natural disasters, primarily typhoons and sea level rise. Around 20 typhoons per year (four to five of which are catastrophic) batter the country. In addition, the estimated rate of accelerated sea level rise in the Philippines is perceived to be at least three to four times higher than the international rate. Typhoons, sea level rise, or a combination of these will constrain mangrove growth and survival. If conserved and managed properly, mangroves have natural coping mechanisms that can be used to adapt to and mitigate these impacts. These coping mechanisms include coppicing, the growth of sturdy and inter-connected roots, viviparity, and wide seed dispersal range, among others. Healthy mangroves will contribute to the stability of the coastal zone, as well as sustain associated ecological and socio-economic services.

Mangroves have been recently recognized for their contribution in sequestering atmospheric CO_2. They have four to five times higher carbon stocks than any other forest type. Their capacity to store carbon may be harnessed in climate change mitigation, a potential that was recognized at the United Nations Climate Change Conference (UNFCCC COP22) in 2016.

The International Blue Carbon Initiative (IBCI) is a global program that is focused on mitigating the impacts of climate change through the conservation and rehabilitation of coastal ecosystems. Filipino mangrove researchers are members of this international network. At the local level, there have been some initiatives that aim to estimate blue carbon. On 1 October 2015, the Philippines submitted its Intended Nationally Determined Contributions (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC). The Philippines has committed to a reduction of 70% in greenhouse gas emissions by 2030, in relation to its business-as-usual scenario for 2000-2030 (INDC Philippines). The government is currently in the process of updating the country's INDC, with details on mitigation and adaptation measures needed to address the impacts of climate change.

In October 2016, organizations with mandates and/ or programs in mangrove conservation and management in the Philippines convened to craft a national strategy for Blue Carbon. These organizations were the Biodiversity Management Bureau (BMB) and Ecosystems Research and Development Bureau (ERDB) of the Department of Environment and Natural Resources (DENR) together with the Climate Change Commission (CCC), representatives from the UP Marine Science Institute, Ateneo de Manila University – Environmental Science Department, Conservation International, and Philippine Business for the Environment (PBE). Incorporating blue carbon in the country's adaptation and mitigation strategies will require focus on mangroves and their conservation. An initial 10-year road map was therefore drafted to provide general guidance on blue carbon and management in Philippine mangroves. The roadmap includes the formation of the Blue Carbon Technical Working Group (BCTWG) and the Blue Carbon National Steering Committee (BCNSC), which are meant to oversee the implementation of identified national blue carbon programs.

Aside from blue carbon, mangroves are also recognized for the various ecosystem services they provide (e.g., biodiversity, fisheries, shoreline protection, etc.). However, the delivery of these services is dependent on habitat extent and quality (i.e., ecosystem health). However, comprehensive and updated information on Philippine mangroves is lacking and mostly inconsistent. Policies at the local to national levels are outdated and conflicting. Good baseline and monitoring information, as well as effective governance are therefore necessary to develop national mangrove conservation and restoration programs.

Along with the need to understand the state and health of Philippine mangroves, several developments at the national, regional, and international levels should also be considered in the formulation of a national management plan. Programs through international movements such as the UN Sustainable Development Goals, Inter-governmental Panel on Climate Change, Global Mangrove Alliance, and the ASEAN, among others, can contribute to enhancing national policy and setting directions for research, conservation and restoration. Several of these programs target 2030 as a milestone, so alignment is possible if the Philippines is prepared in terms of clear policy direction, technical expertise, and coherent institutional mandates. These elements will enable the formulation of a clear and comprehensive plan that supports national needs and objectives.

An immediate need is the assessment of national mangrove status, complemented by a review of policies. The 1st National State of the Mangrove Summit has served as a platform for each region to share information on the state of their respective mangrove forests, as well as best practices in mangrove conservation and management. These reports have been consolidated at the regional and national levels, for use in crafting policies to enhance mangrove conservation and management.

This national Summit benefited from the successes of the subnational State of the Mangrove Summits. The first was for Northwestern Luzon on 23-24 October 2014, the second for Southern Luzon on 1-2 October 2015, and the third for Central and Eastern Visayas on 23 March 2018.

Participants were representatives from different sectors including national and local government, NGOs, and the academe. Support for these meetings was provided by DENR-BMB, Foundation for the Philippine Environment (FPE), and Conservation International Philippines (CIP). Information from the three summits was integrated to create a consolidated online mangrove database, though information for the rest of the country still needs to be included.

The National State of the Mangrove Summit has been envisioned as a regular event to be held every two years, serving as a platform to update and inform mangrove stakeholders, and to continuously enhance mangrove research and management in the country. This current Summit, with the theme "Revisiting Learnings and Envisioning Philippine Mangroves in 2030" aimed to discuss the status of mangrove forests in the country. Specifically, it aimed to accomplish the following objectives:

1. Provide a venue for regions and provinces to share and discuss the status of mangrove forests in the Philippines;
2. Invite experts in the field of mangrove ecology and climate change vulnerability to share state of the art knowledge on mangrove carbon stock and sequestration science, and conservation and management;
3. Consolidate more reliable data on mangroves from each province/ region;
4. Develop a plan of action/ resolution to improve mangrove research, conservation, policy and governance in the country; and
5. Call for a policy or program to institutionalize and harmonize mangrove conservation and management, research, and policy at the national level.

II. Approach and Process

The Summit was a three-day gathering, the detailed program of which is found in Annex 1. The main parts of the program were presentations by National Government Agencies, regional state of the mangrove reports, presentations from technical resources, workshops, and a post-Summit fieldtrip. Most of the content from these activities are presented in these proceedings.

Presentations by National Government Agencies

National government presentations were by DENR-BMB, DENR-ERDB, DENR-FMB, NAMRIA, and DA-BFAR. Each agency discussed their institutional mandate, and mangrove-related efforts including current data, regulations and policies, ongoing and upcoming management programs, and issues and challenges. Specifically, presentations were on marine biodiversity conservation; national mangrove mapping efforts; ongoing programs for sustainable mangrove management; Abandoned, Undeveloped and Underutilized fishponds; and the status of Forestlands released for Fishpond Lease Agreements.

Regional state of the mangrove reports

Reports on the status of mangroves and mangrove management were presented per administrative region. Each report was meant to contain an introduction including mangrove ecosystem services and benefits, the status of mangroves in the region including threats and concerns, mangrove protection and management, and summary and recommendations (see detailed outline in Annex 6). Presentations were divided based on major island groups Luzon, Visayas, and Mindanao; and delivered by representatives of each participating DENR regional office. A brief synthesis was provided for each subnational region, followed by a discussion led by a technical panel.

Technical presentations

Technical resource persons from the academe and other research & assisting institutions presented on various topics on mangrove research and management such as policy, spatio-temporal analysis of cover and extent, climate change impacts, carbon sequestration, management lessons and best practices (e.g., partnership mechanisms), gaps and challenges, and global conservation directions.

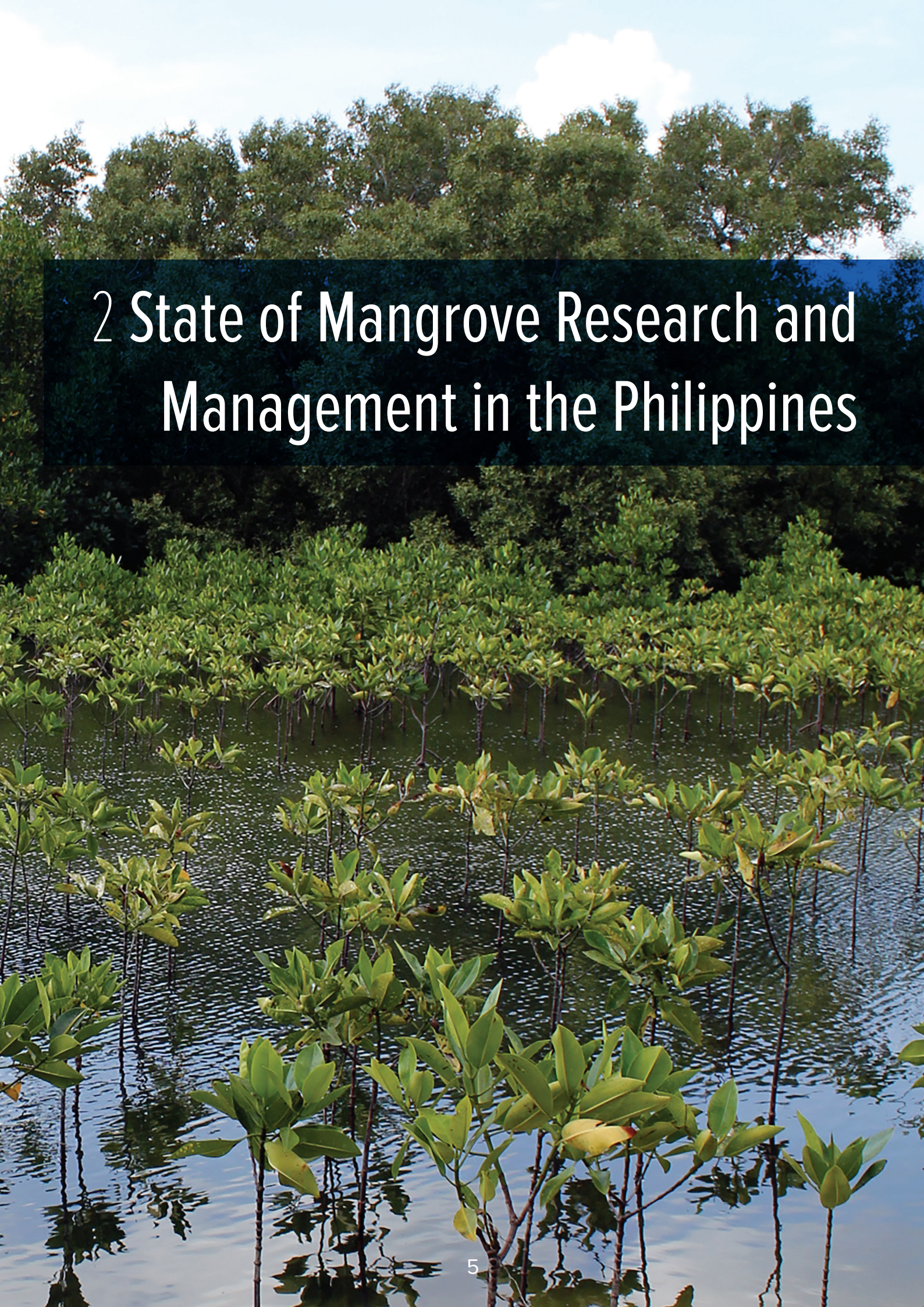
Workshops

The Summit convened two workshops. Workshop 1: "Revisiting Lessons, Challenges, and Opportunities for Mangrove Management" aimed to identify enabling factors, and gaps & issues that have contributed to the state of mangroves in the country. On the other hand, Workshop 2: "Roadmap to 2030 – Envisioning Philippine Mangroves" aimed to develop a vision and related priority programs for three thematic areas in mangrove management: biodiversity, conservation, and restoration; climate change (carbon sequestration and sea level rise); and policy and governance. Groups were asked to identify specific milestones and, where possible, appropriate indicators for Years 1, 2, 5, and 10 towards a national mangrove vision in 2030.

Post-Summit fieldtrip

To reinforce the discussion and resolutions during the Summit, participants were taken on a field visit to the Las Piñas – Parañaque Wetland Park (LPPWP). A talk on the establishment of the park, and a demonstration on carbon stock measurements and other basic mangrove assessment techniques were given (Annex 5).

Calatagan, Batangas, Philippines (Photo © Conservation International Philippines)



2 State of Mangrove Research and Management in the Philippines

Abandoned, Undeveloped, and Underutilized Public Lands Released for Fishpond Purpose

Mary Anne Concepcion D. Gonzales
Fisheries Regulatory and Licensing Division, Bureau of Fisheries and Aquatic Resources, Department of Agriculture

I. BFAR's mandate to issue FLAs

By virtue of the Philippine Fisheries Code, or Republic Act No. 10654, s. 2015, the Bureau of Fisheries and Aquatic Resources (DA-BFAR) is mandated to implement the existing rules and regulations governing the lease of public lands for mangrove-friendly aquaculture, primarily the Fisheries Administrative Order 197-1, series of 2012 (FAO 197-1, s. 2012) to accelerate fish production and contribute to the food security program of the government through self-sufficiency.

Areas issued with Fishpond Lease Agreements (FLA) are portions of public land transferred by the DENR to the Bureau for fishpond purposes through the following:

a. Certifications issued by the Director of the Bureau of Forest Development (BFD) now the Forest Management Bureau (FMB), for releases made before the issuance of Presidential Decree 705;
b. BFD/ FMB Administrative Orders; and
c. Individual releases of alienable and disposable areas under the Bureau of Lands, now the Land Management Bureau, made before the effectivity of Republic Act 8550

Section 87, Chapter VI of the Implementing Rules and Regulations of RA 10654, s. 2015 requires prior authorization for someone to engage in any fisheries activity. Since the administrative jurisdiction of these public areas released for fishpond development is under the Bureau, Section 2 of FAO 197-1, s. 2012 states that permit, contract or lease must be acquired accordingly for a person to be able to utilize these.

II. Tenurial instruments for the utilization of fishponds

The DA-BFAR currently issues three tenurial instruments in the utilization of fishpond areas:

1. Gratuitous Permit (GP) – granted by the Secretary upon the recommendation of the Director to any branch of government, academic, scientific or research institution, for scientific, research, educational or experimental breeding purposes
2. Aquasilviculture Stewardship Contract (ASC) – entered into by and between the Secretary and qualified fisherfolk cooperatives/ associations and micro, small, and medium enterprises for the use of public land for *mangrove-friendly aquaculture*
3. Fishpond Lease Agreement (FLA) – entered into by and between the Secretary and a qualified applicant for the use of developed public fishpond areas

III. Definition of terms: AUU fishponds

As part of the terms and conditions of the lease, leaseholders are required to develop the area for production on a commercial scale. Otherwise, their

Table 2-1. Tenurial instruments for the utilization of fishpond areas

Tenurial Instrument	Who May Apply	Length of Term
Gratuitous Permit (GP)	Academic/ scientific institutions; any branch of government	5 years (until needed)
Aquasilviculture Stewardship Contract (ASC)	Fisherfolk cooperatives/ associations; MSMEs, Philippine citizens	10 years (renewable)
Fisheries Lease Agreement (FLA)	Fisherfolk cooperatives/ associations; MSMEs; Philippine citizens; corporations/ associations	25 years (once renewable)

lease may be cancelled. Abandoned, Undeveloped, and Underutilized (AUU) fishponds are defined in Section 1 of FAO 197-1, s. 2012 as such:

a. Abandoned "refers to public land released for fishpond development where there is no occupation, possession or operational activity by the lessee or any of his or her lawful representative as manifested by any of, but not limited to, the following conditions: (1) failure by the lessee to submit to the Bureau within ten (10) days after six months from the approval of the lease the required initial report under oath relative to the fishpond development, operation and production, duly verified by the subleasing; or, (3) where there is absence of clear indication of fish production operations in the area."
b. Undeveloped "refers to public land released for fishpond development where the fishpond area is not enclosed by dikes; or enclosed by dikes but without functional water control structures; or enclosed by dikes with functional water control structures but the water level required for production on a commercial scale cannot be maintained either by high tides or by pumping; or a larger area enclosed only with a simple perimeter dike which has not been subdivided, which may or may not be vegetated with mangrove species."
c. Underutilized "refers to public land released for fishpond development where the fishpond area or portion thereof is not producing in commercial scale within three (3) years from the approval of the ASC or FLA, or not fully developed and producing in commercial scale within five (5) years as reflected in either (1) the submitted annual report on fishpond development, operation and production, under oath by the ASC holder or lessee and duly verified by the concerned Regional Office; or (2) as deduced from the information supplied in the Reports on Inspection and Verification, submitted by authorized representatives and duly endorsed by the Regional Director concerned, evidencing that such portion or the whole fishpond area is not producing on a commercial scale."

IV. Aquafarm Registration Tool (AquaR)

Section 57 of RA 10654, s. 2015 requires the Registration of Fish Hatcheries and Private Fishponds, and others. The Aquafarm Registration (AquaR) Tool has been developed for the registration and inventory of aquaculture farms and address the need of the DA-BFAR for evidence-based planning and decision-making. DA-BFAR Director Eduardo B. Gongona issued Memorandum dated 27 November 2018 to instruct DA-BFAR Regional Field Offices to adopt AquaR for the inventory of aquaculture farms. The adoption of AquaR aims to improve the efficiency of the Bureau in conducting monitoring activities of FLA areas, to maximize the use of public lands for fishpond purposes.

AquaR is a GIS-based, web- and mobile-enabled aquaculture resources mapping system with key functionalities such as farm inventory, monitoring, and productivity recording. Registered information on aquaculture farms in the country is stored in the AquaR online system, accessible at http://aquar.carsu.edu.ph/. Login details are required for users. Meanwhile, AquaR mobile application has been developed to aid in area verification and inspection of FLA areas, pursuant to FAO 197-1, s. 2012.

V. Cancellation of AUU FLAs

FLA areas found to be in violation of the terms and conditions of the lease will be subject to the cancellation procedures described in Section 31 of FAO 197-1, s. 2012. Grounds for cancellation are (1) violation or non-compliance with the terms and conditions of the FLA or ASC or with the rules and regulations governing them; (2) abandoned or undeveloped areas; and (3) underutilized areas. In certain cases (i.e., the first ground for cancellation), not all cancelled FLAs will be automatically reverted to DENR. These are cancelled from the violating lessee, and will be declared open and vacant to other interested qualified applicants.

Summaries of other NGA presentations given at the Summit

National Programs on Mangrove Biodiversity and Conservation

Presented by Angelita P. Meniado
Coastal and Marine Division, Biodiversity Management Bureau, Department of Environment and Natural Resources

The DENR Biodiversity Management Bureau (DENR-BMB) implements coastal and marine programs that integrate strategies for mangrove ecosystems. The Coastal and Marine Ecosystems Management Program (CMEMP), which is being implemented until 2028, is anchored on integrated coastal management, partnership building, sustainable tourism and ecotourism, protection, management and law enforcement, communication, education and public awareness, and valuation of ecosystem services. Based on the Department's data, total mangrove area in the Philippines is 303,372.69 ha, with at least 103,533.84 ha found in protected areas.

National policies and programs such as the E-NIPAS Act and its IRR, the Philippine Development Plan (PDP; 2017-2022), and the Philippine Biodiversity Strategy and Action Plan (PBSAP; 2015-2028) focus on or include provisions that strengthen the management and conservation of coastal and marine resources in the country. Under PBSAP, a key target is that there be no net loss in the presence and area distribution of coral reef habitats including mangroves. Foreign-assisted projects further support the DENR's work on coastal marine ecosystems. Examples are the ProCoast ("Sustainable protection of coastal ecosystems and communities from the impacts of climate change") through GIZ, the SMARTSeas PH Project ("Strengthening Marine Protected Areas to Conserve the Marine Key Biodiversity Areas in the Philippines") through the United Nations Development Programme and Global Environment Facility, and the South China Sea Strategy and Action Plan Project, which is awaiting clearance from the Office of the President.

Research and Initiatives for Sustainable Mangrove Management in the Philippines

Presented by Maria Lourdes Quiatchon Moreno
Coastal Zone and Freshwater Ecosystems Research Division, Ecosystems Research and Development Bureau, Department of Environment and Natural Resources

Mangrove research and management has developed over the years in the Philippines. Between the 1960s and early 1970s, great mangrove areas were cleared for timber products and conversion to fishponds. However, in the late 1970s, realization on the importance of mangroves to fisheries emerged within the national government, and the National Mangrove Committee (NMC) was established in 1976. The NMC created policies and recommendations for the conservation and sustainable management of the remaining mangrove forests in the country.

To further support mangrove management, the 145-ha Pagbilao Mangrove Experimental Forest was established in 1975. The goals were mainly for protection, and to enable scientific studies on mangroves. Efforts towards mangrove rehabilitation continued and intensified in the proceeding years, through the establishment of mangrove reserves and protected areas, the ADB-funded Fisheries Sector Program (1990-1994), the Coastal Environment Program (1993), the Coastal Resources Management Project (1996-2004), and the Integrated Coastal Resources Management Project (2007-2014).

The Ecosystems Research and Development Bureau (DENR-ERDB) has undertaken numerous programs and projects for mangrove conservation and management. These initiatives are anchored on the Research, Development, and Extension Framework on Environment and Natural Resources (2017-2022). Currently, the Bureau is implementing the Mangrove and Beach Forest Development Program (MBFDP), which started in 2015. Its primary aim is to recover the ecosystem goods and services that mangroves and beach forests provide especially their protective function as buffers against typhoons and storm surges. Accomplishments to date include the production of 140,186,391 propagules/seedlings, and the establishment of 44,891 ha of mangroves and 5,526 ha of beach forests. A Joint ERDB and BMB Technical Bulletin on guidelines for enrichment planting of mangroves and beach forests for biodiversity conservation and coastal resiliency has also been released.

Status of Forestlands Released for Fishpond Lease Agreements

Presented by Cecilia Arquilita
Forest Management Bureau,
Department of Environment and Natural Resources

The Forest Management Bureau (DENR-FMB) is among the agencies under the DENR specifically tasked to provide technical guidance to its central and field offices for the effective protection, development, and conservation of forestlands and watersheds including mangrove forests. Following instructions from DENR Undersecretary Analiza Teh, the FMB sent a request to all DENR Regional Directors in 2013 to develop an inventory on the status of areas identified for fishpond development. Based on data from the regions, as of 2014, there are a total 4,710 issued FLAs (1,290 existing and 3,420 expired) covering a total area of 61,616.59 ha. Of these identified areas, 48 FLAs with a total area of 989.13 ha were reverted to the administrative jurisdiction of DENR as of 2014.

One of the main challenges regarding FLAs is the failure to create the Inter-Agency Technical Working Group, which is intended to formulate the guidelines for the cancellation procedures of FLAs and the reversion to mangroves. In addressing such a gap, DENR-FMB has requested DA-BFAR to provide data and maps of the areas covered by FLAs. Once this information becomes available, it can then be overlain on NAMRIA's land classification maps for analysis and necessary action.

National Mapping of Mangrove Forests

Presented by Raul T. Magabo
Physiography and Coastal Resource Division,
Resource Data Analysis Branch,
National Mapping and Resource Information Authority

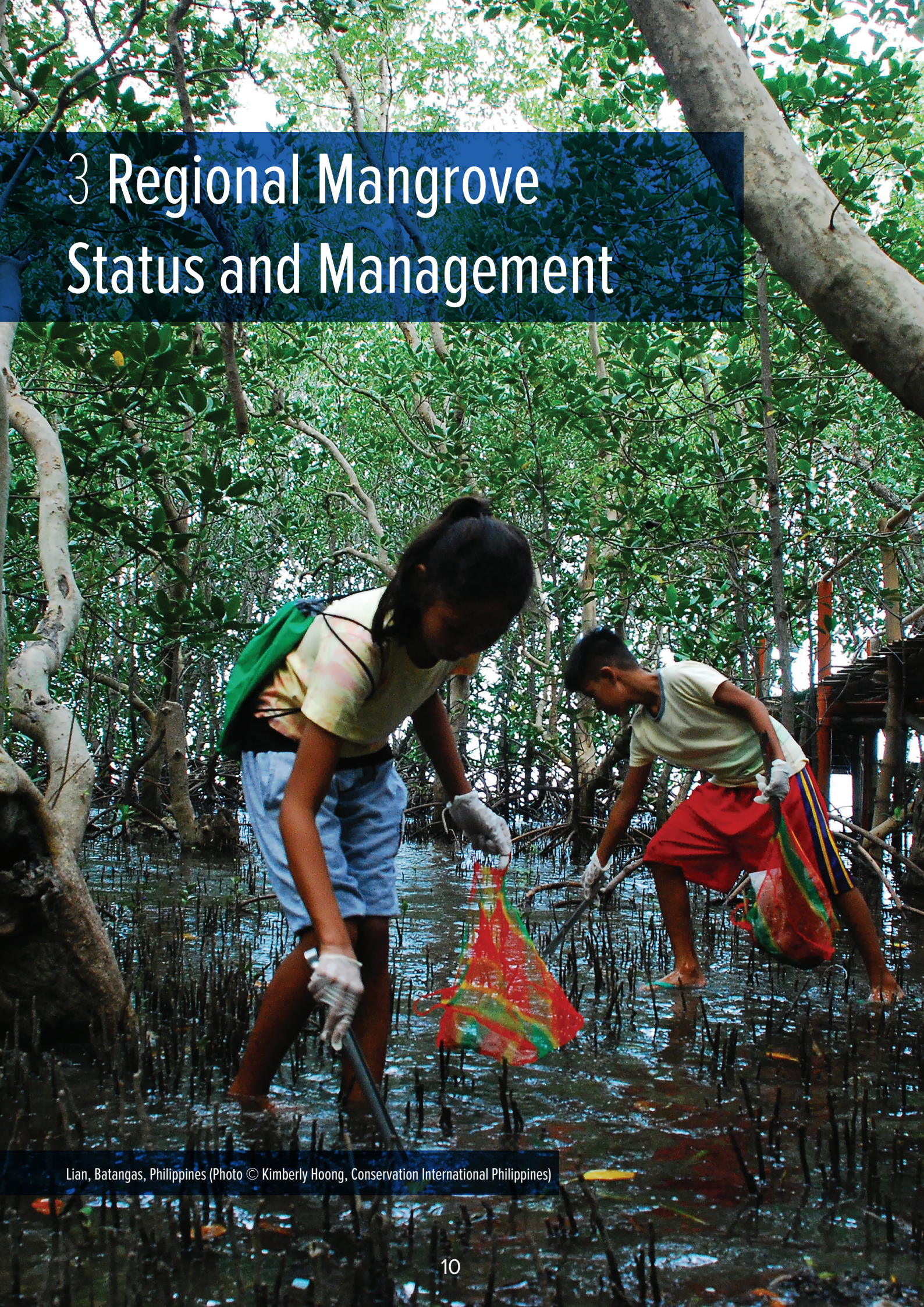
A mandate of the National Mapping and Resource Information Authority (NAMRIA) as the central mapping agency of the Philippines is to generate land cover information for the entire country. The Land Cover Mapping Project was implemented to produce updated land cover information from the latest remote sensing data, and generate land cover maps and statistics per province. Land cover mapping is undertaken every five years, the latest being the 2015 land cover maps, which were published in 2018.

In 2015, there were several updates to the tools and methodologies used. For instance, the satellite images were from Landsat 8 (30 m; 2013-2016), and the software for digital classification was OBIA (whereas, ArcMap was used in 2010). The number of categories was also aggregated: the 21 FAO land classifications in 2003 were reduced to 14 in 2010, then further reduced to 12 in 2015. These changes have led to a higher overall accuracy of 92% as compared to 89% in 2010. Land cover maps are currently being updated, with completion targeted for 2020 and publication in 2021.

The latest estimate of mangrove forest cover decreased from 310,593 ha in 2010 to 303,373 ha in 2015. Some contributory factors in the decrease include the interference of cloud cover, possible misclassifications, and the change in software. Of all the provinces, Palawan has the highest mangrove cover at 59,421 ha, followed by Sulu (26,531 ha), then by Quezon province (18,448 ha). Other provinces with the highest mangrove cover are Tawi-Tawi, Surigao del Norte, Bohol, Surigao del Sur, Eastern Samar, Masbate, and Cebu.

Chief issues and concerns during implementation are lack of funds for image acquisition, cloud cover, shortage of technical personnel, and security concerns especially in BARMM. On the other hand, the future plans and initiatives of the agency are to improve current procedures, collaborate with other institutions (e.g., the Advanced Science and Technology Institute at the DOST), utilize higher resolution satellite imageries from PEDRO facilities (e.g., Planet, WorldView, etc.) and other open-source images, and capacitate technical staff in digital image processing.

3 Regional Mangrove Status and Management



Lian, Batangas, Philippines (Photo © Kimberly Hoong, Conservation International Philippines)

State of the Mangroves in Luzon

Augustus Rex F. Montebon
Conservation International Philippines

I. Introduction

Luzon is the largest island of the Philippines. It has a total land area of 147,948 sq km which is roughly one-third the size of the country (IAEA, 2014). It is comprised of eight administrative regions that include the National Capital Region (Table 3-1); only the Cordillera Administrative Region is entirely land-locked and has no coastal area. The coastline of Luzon stretches to about 5,000 km and is indented by gulfs and bays. Notable bodies of water are Lingayen Gulf, Manila Bay, Tayabas Bay, Ragay Gulf, Lagonoy Gulf, San Miguel Bay, Lamon Bay, Baler Bay, and Honda Bay. In pristine form, gulfs and bays harbor lush mangrove forests especially at the bayhead. By estimate, the total mangrove cover in Luzon is at least 114,083 ha, with the largest cover in the provinces of Palawan and Quezon.

II. Status of mangroves in Luzon

Luzon prides itself on a long list of NIPAS protected areas. In Region 2 alone, there are 14 listed that cover 997,466 ha while there are 17 in Region 5 covering 60,876 ha of area. Locally protected mangrove areas are in place in several areas as well, particularly in Region 1, Region 3, Region 5, CALABARZON, and MIMAROPA. A better summary of these protected mangroves under LGUs is yet to be drawn up especially when high mangrove diversity has been observed in such areas. The number of mangrove species range from 21 to 27 (Table 3-1), and *Bruguiera sexangula*, arguably the rarest true mangrove species, occurs in some regions (Region 1, Region 5, and CALABARZON). On the other hand, the location and extent of mangroves, particularly those within protected areas, are not well known in key biodiversity areas in the regions.

The mangrove cover in Luzon, assumed to be greatly reduced over decades of wanton neglect and disregard, is being rehabilitated with a great push from the National Greening Program (NGP). This is true for the rest of the country where the six-year program (2011-2016) aimed to plant 1.5 billion trees in forest lands, mangrove and protected areas, ancestral domains, civil and military reservations, urban greening plan areas of LGUs, inactive and abandoned mine sites, and other suitable lands. Great strides have been achieved especially in Region 5 where 4,378 ha of mangroves was planted, which contributed to a total planting of 12,175 ha with other initiatives from 2011 to 2017. The NGP under MIMAROPA rehabilitated 23,881 ha in Palawan and 695 ha in Marinduque.

The high density of natural mangroves in MIMAROPA region, particularly in Palawan province, is reflective of stricter forest protection policy through the Strategic Environmental Plan for Palawan Law (Republic Act 7611). Further, mangrove conservation was intensified through the creation of the Palawan Council for Sustainable Development, which imposed policies to ban illegal cutting and tan bark collection from mangroves.

Issues and problems

Common to the Philippine situation is the decimation of mangrove forests mainly for land conversion and development. Conversion to fishponds to address food security, as well as coastal development, in the past decades reduced mangrove cover by about 70% (i.e., from 400,000 ha in 1920 to 120,000 ha in 1993). Anthropogenic activities contributing to the disturbance of mangrove areas up to the present also include harvesting for domestic use (e.g., building material, firewood, and charcoal), bonsai-making, and collecting the bark as a tanning agent. Informal settlers sometimes build their shanties inside mangroves for privacy, and the associated domestic waste is dumped directly into the surrounding forest. Others use the mangrove areas to corral and raise pigs. Collection of other edibles like crabs and other crustaceans disturb the mangroves especially when doing so results in trampling over seedlings and saplings. All these are symptomatic of weak management and enforcement, which also point to the minimal resources and capacity to implement such.

Table 3-1. Mangrove status per region in Luzon, Philippines

Region	Land area[1] (sq km)	Coastline[3] (km)	Population, 2015[4]	Mangrove area[3] (ha)	Other remarks
National Capital Region (NCR)	**619.57**	**ND**	**12,877,253**	**65**	
Las Piñas-Parañaque Wetland Park				36	
Tanza Marine Tree Park				29	
Region 1 (Ilocos Region)	**13,012.60**	**708**	**5,026,128**	**874**	**26 true mangrove species, 15 associated species**
Region 2 (Cagayan Valley)	**28,228.83**	**455**	**3,451,410**	**5,742**	**21 species including associates**
Northern Sierra Madre Natural Park				659	
Cagayan province				5,083	
Region 3 (Central Luzon)	**22,014.63**	**1,250**	**11,218,177**	**1,901**	
Mangrove reserve zone				9	
Region 4-A (CALABARZON)	**16,873.31**	**ND**	**14,414,774**	**7,224**	**22 true mangrove species**
Cavite				151	
Batangas				541	
Quezon				6,532	
Region 4-B (MIMAROPA)	**29,620.90**	**ND**	**2,963,360**	**73,324**	
Palawan				63,821	
Region 5 (Bicol Region)	**18,155.82**	**4,171**	**5,796,989**	**24,953**	**19 true mangrove species in Camarines Norte, 22 in Camarines Sur, and 27 in Sorsogon**
Total	**128,526.66[2]**		**55,748,091**	**114,083**	

[1] Land area from "Regions of the Philippines," https://en.wikipedia.org/wiki/Regions_of_the_Philippines. Figures are sums of those of component LGUs derived from the Philippine Statistics Authority (ny).
[2] Other references have placed the total land area in Luzon to be 147,948 sq km (IAEA, 2014).
[3] Coastline and mangrove areal estimates are from this Summit.
[4] PSA, 2015

Natural factors including pests (e.g., aphids, barnacles, fungal infections) have been seen to affect certain local places, conceivably due to poor water quality brought by pollution. A more widespread impact observed by mangrove specialists is flooding and sedimentation with heavy rains. Increased sea surface temperature has also been identified as an issue although the actual impact has not yet been ascertained. Volcanic hazards do occur but are generally limited to areas with active volcanoes (e.g., Mt. Mayon and Mt. Bulusan in Region 5). Typhoons are the most devastating natural force, and Luzon is visited by 5-7 typhoons a year on average (PAGASA 2017-2010), the highest frequency among administrative regions in the country. The hardest hit areas are usually Region 5 (Bicol Region) and Region 2 (Cagayan Valley) although MIMAROPA and CALABARZON have been quite battered in recent years.

III. Summary and management recommendations

A big gap that must be filled to effectively aid management plans and strategies is the accurate mapping of the expanse of mangrove areas including detailed assessment of their cover and density. The dichotomy between natural mangroves and plantations should be seen in the mapping as well. While the NGP has gained headway in many places, systematic monitoring to assess survival and growth of planted seedlings must also be in place. Mangrove specialists also appeal for basic studies to be supported, to better understand the biology and ecology of mangroves. These studies should extend further to interactions with climate change impacts especially typhoons. Focus may also be placed on understanding how these habitats contribute to resilience in coastal areas including their role in stabilizing socio-economic conditions following a disturbance. Such understanding would be helpful in crafting inclusive strategies that may address drivers within the entire community, and to find solutions for marginalized groups such as informal settlers.

A policy review is suggested to develop better guidance in implementing integrated coastal area management, and address long-standing concerns such as the reversion of fishponds to mangroves. Other needs include strategic and effective coordination of mangrove initiatives among different players (i.e., NGAs, NGOs, CSOs, private sector, academe, and local communities), and improvement of local mangrove expertise to carry out the needed work including enforcement.

IV. References

IAEA. (2014). Country Nuclear Power Profiles: "Philippines." International Atomic Energy Agency, https://www-pub.iaea.org/MTCD/publications/PDF/CNPP2014_CD/countryprofiles/Philippines/Philippines.htm.

Philippine Statistics Authority. (2020). Provincial Summary: Number of Provinces, Cities, Municipalities, and Barangays by Region, as of 31 March 2020, https://psa.gov.ph/classification/psgc/downloads/SUMWEBPROV-MARCH2020-CODED-HUC-FINAL.pdf.

State of the Mangroves in Region 1

Chester O. Casil
National Greening Program, Regional

Analyn N. Viray
Coastal Resource and Foreshore Management Section, Conservation Development Division
DENR Region 1, San Fernando City, La Union

I. Introduction

Region 1, known also as the Ilocos Region, is located in northwestern Luzon. It is bordered by the Cordillera Administrative Region to the east, the Cagayan Valley to the north- and southeast, Central Luzon to the south, and the West Philippine Sea to the west. It has a total population of 5,026,128 (PSA, 2015). Its land area measures 13,012.60 sq km consisting of four provinces namely Ilocos Norte, Ilocos Sur, La Union, and Pangasinan. Of its nine cities and 116 municipalities, 53 are located within the coastal area with a total shoreline length of 708.17 km.

Lingayen Gulf is the most notable body of water in the region and it contains several islands, including the Hundred Islands National Park. Meanwhile, to its north is Luzon Strait, which is important for shipping and communication.

The Ilocos Region is teeming with rich coastal resources including corals, seagrasses and mangroves. Its mangrove resources perform an important role in providing numerous ecological services to both the marine environment and human communities. Mangroves bind sediments thereby reducing erosion; serve as a buffer that reduces the local risk associated with waves, storm surges, tidal currents, and typhoons; impede freshwater discharge; sequester carbon; and serve as habitat for various wildlife including fish and invertebrates. More recently, mangroves have been increasingly viewed as an ecotourism destination in the region.

II. Status of mangroves in the region

Previous efforts to assess mangrove resources in the region have been documented since 2006, but records only show species identified in selected municipalities. Considering these data gaps, the Department of Environment and Natural Resources (DENR) through its Coastal and Marine Ecosystems Management Program (CMEMP) initiated a comprehensive assessment and mapping of mangrove resources in the region in 2017. Areas with thick mangrove forests, based on information from the Municipal Coastal Database (MCD), have been initially prioritized. The activity is yet to be completed.

A total 290.167 ha of mangroves was mapped and assessed, covering 14 municipalities in the entire region (Table 3-2). This data covers the expanse of both natural and planted mangrove stands that can be found along shores, rivers, estuaries and fishponds. The extent of mangroves in the region has been attributed

Table 3-2. Mangrove area per municipality in 14 municipalities in Region 1

Province	Municipality	Mangrove area (ha)	Species[1]
Ilocos Norte	Pasuquin	40.879	Sa, Am, Xg, Ct, Lr, Af, Ac, Ea, Sh, Bc, Bg, Rs, Ra, Rm, Ll, Cd, Nf, Pa
Ilocos Sur	Santiago	1.815	Ar, Ac, Ea, Cz, Rm, Ra, Nf,
	Magsingal	0.099	Rm, Ra, Rs, Sa, Xm, Nf, Am, Lr,
La Union	Sto Tomas	19.927	Ra, Rs, Rm, Am, Sa, Lr, Bc, Ea
	Agoo	1.466	Rs, Rm, Ra, Am, Bc, Lr, Ea, Aa,
Pangasinan	Lingayen	8.396	Sa, Sc, Ra, Rm, Rs, Bc, Lr, Ac, Nf, Au, Ai
	Labrador	1.481	Am, Sa, Ra, Rm, Rs, Bc, Lr, Ac, Nf, Au
	Bani	17.613	Am, Bg, Ea, Ra, Rm, Rs, Sa
	Anda	31.643	Ac, Am, Ar, Bc, Bg, Bs, Cd, Ct, Hl, Lr, Ra, Rm, Rs, Sa, Xg, Xm
	Dasol	58.695	Am, Ar, Ea, Lr, Ra, Rm, Rs, Sa, Xm, Ac, Bc, Bs, Cd
	Infanta	22.173	Am, Ar, Bg, Cd, Ea, Lr, Oo, Ra, Rm, Rs, Sh, Sa, Xg, Nf, Pa, Xm, Hl, Bc, Ae, Ac, Aa, Bs
	Alaminos	40.703	Ai, Aa, Ac, Am, Ar, Bc, Bg, Bs, Cd, Ea, Hl, Il, Lr, Nf, Oo, Pa, Ra, Rm, Rs, Sh, Sa, Xg, Xm
	Bolinao	23.345	Ac, Am, Ar, Ra, Rm, Rs, Sa, Ai, Bc, Bg, Bs, Cd, Ea, Hl, Lr, Nf, Pa, Xg, Xm
	Sual	21.932	Af, Am, Ar, Bc, Bg, Cd, Ea, Lr, Oo, Ra, Rm, Rs, Sa, Xm, Ai, Aa, Ac, Ao, Bs, Kl, Nf
TOTAL		**290.167**	

[1] *Two-letter codes are abbreviations of genus and species names (see next page)*

Figure 3-1. Mangrove assessment and mapping in Pangasinan site

to reforestation projects by the local government units (LGUs), the Bureau of Fisheries and Aquatic Resources (DA-BFAR), as well as those by the DENR through its National Greening Program (NGP). Since 2013, a total 874 ha across 116 municipalities have been tended to as mangrove plantation and restoration sites under the NGP.

In the region, species composition and number of trees are highly influenced by location and degree of planting activity in the municipality. There were 26 mangrove species identified and validated during the assessment: *Avicennia marina, A. rumphiana, A. officinalis, Excoecaria agallocha, Lumnitzera racemosa, L. littorea, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, S. caseolaris, Xylocarpus granatum, X. moluccensis, Aegiceras corniculatum, A. floridum, Bruguiera cylindrica, B. gymnorrhiza, B. sexangula, Ceriops decandra, C. tagal, C. zippeliana, Scyphiphora hydrophyllacea, Acanthus ilicifolius, Acrosticum aureum, Pemphis acidula,* and *Nypa fruticans*. Further, seen near and in close association with these true mangroves are 15 species of mangrove associates and beach vegetation.

Perceived threats to mangrove ecosystems

Except for the plantations under the DENR-NGP, most of the mangrove resources are managed by the province and the local government units. Both anthropogenic and natural causes have threatened the mangroves in the region. Land clearing due to coastal development, mangrove conversion to fishponds for fisheries production, and bantigi (*Pemphis acidula*) collection for bonsai-making are chief issues. Individuals engaged in crablet collection, which is typically undertaken at night, may trample individual seedlings as well as the roots of mature trees. On the other hand, stray animals entering the forests may eat and/ or damage leaves.

Trash has also been a major setback due to surface run-off. Solid waste and other pollution are carried downstream and trapped in the mangroves. Sand-shifting seen in various areas in the region has also been observed to smother mangrove seedlings and saplings. Typhoons passing through the region can knock down trees and destroy plantations. The presence of aphids and stem borers, which can cause enormous damage to plants, has been noted in mangrove nursery areas.

III. Mangrove protection and management

Most of the mangrove protection and management initiatives are documented in Pangasinan where its great land area covers the most extensive mangrove area in the region. The Provincial Government of Pangasinan is currently operating a 2,000-sq m mangrove nursery in Brgy. Arnedo, Bolinao, Pangasinan. The nursery produces eight species of mangroves, providing the various requirements of the Province's Mangrove Reforestation Project. The Province has established a Mangrove Information Center that serves as a learning area and research facility for students and other mangrove enthusiasts.

The Mangrove Reforestation and Enhancement Program in Alaminos City started in 1998. It has been one of the priority programs of the City in order to maximize the ecological benefits of its mangrove resources. Later, the City moved to complement its mangrove conservation with ecotourism. The Bued Reforestation Area is in the process of being developed into a Mangrove Eco-Park. The Mangrove Propagation and Information Center was built in partnership with Metro Pacific Investment Corporation, and is now frequently visited by various tourists and guests. A three-story observation tower was also built for bird-watching activities.

In 2001, the LGU of Bani, Pangasinan established the Bangrin Marine Protected Area covering 33.9 ha of mangroves. This was legalized through Municipal Ordinance No. 1, s. 2001. In 2008, Bangrin MPA was declared one of the 13 bird watching sites in the Philippines by Recreational Outdoor Exchange, the Wild Bird Club of the Philippines, and the Department of Tourism. To cater to ecotourism activities in the area, a guardhouse and a 510-m mangrove boardwalk, which is currently under renovation, were built.

Figure 3-2. Solid waste including various plastic trash are carried to the mangrove areas.

Table 3-3. Location of mangrove nurseries in Region 1

Province	Location	Operations
Ilocos Norte	Davila, Pasuquin	LGU
Ilocos Sur	Ayusan, Vigan City	LGU
	Solot-solot, San Juan	PG Ilocos Sur
La Union	Carlatan, San Fernando	LGU
Pangasinan	Bued, Alaminos	LGU
	Arnedo, Bolinao	PG Pangasinan
	Bayambang, Infanta	LGU

Figure 3-3. Validation conducted on 16-20 October 2019 for NGP-supported plantations established in CY 2013-2017

LGU Pasuquin has been maintaining and protecting the most extensive mangrove area in Ilocos Norte. Its mangrove area is a total 40.88 ha with 18 different species. Through the Provincial Government of Ilocos Norte, a Mangrove Tourism Center was established but is not presently operational.

Other initiatives are the establishment of mangrove nurseries operated by different municipalities across the region (Table 3-3).

Monitoring and evaluation

Monitoring is mainly for mangrove plantations under the DENR-NGP, conducted by the Department itself. It is undertaken through third-party and in-house validation by the DENR-ERDB and DENR Field Offices respectively. Results of the in-house validation thus far are presented in Table 3-4.

Outcomes and impacts

The initiatives on mangrove rehabilitation and management in the region, whether spearheaded by DENR, the Provincial Governments, and/ or LGUs, have provided a visible increase in biodiversity. Such impacts are believed to provide benefits such as additional fish catch among fisherfolk, as well as livelihood opportunities for the coastal community.

Through mangrove projects and activities, the community is empowered, with linkages and synergies between private and public partners amplified. Social responsibility and concern for the environment have evolved among private companies in the region. Lastly, mangrove management has created a sense of pride in the communities especially when they are recognized for their best practices.

Table 3-4. Plantation monitoring information including area (ha) and number of seedlings planted in Region 1 (obtained through in-house validation)

PENRO	Year est.	Area (ha)	Seedlings planted	Seedlings validated	Target	Management
Ilocos Norte	2017	42	105,000	58,630 (59%)	Regular	LGU
Ilocos Sur	2017	145	36,250	142,426 (39%)	Regular	BLGU
La Union	2017	18.5	46,250	39,966 (85%)	Regular	PO/LGU
Pangasinan	2017	250.32	6,302,960	5,378,690 (86%)	Regular	PO/BLGU

IV. Summary and recommendations

Mangrove conservation programs spearheaded by the provinces and local governments are complemented by the DENR's existing coastal and marine management programs, which have expanded the range of mangrove protection beyond coastal areas. Through the encouragement of the DENR for LGUs to adopt the Integrated Coastal Management (ICM) Program, appreciation on the ecological benefits of mangroves has been better realized.

Threats that affect mangrove resources cannot be easily hurdled, but with persistence complemented with a synergistic approach, these can be addressed. The following are practical management recommendations to further support the conservation and management of mangrove ecosystems in the region.

1. Assess and validate all mangrove resources, whether these are natural stands or plantations. The region shall establish its mangrove geographical extent for effective planning purposes.
2. Intensify ridge-to-reef approach in planning.
3. Amplify best practices on mangrove conservation and management to create a ripple effect, and accelerate efforts that may be limited at the LGU level.
4. In relation to policy and legislation,
    - Conduct an analysis of existing policies and their impacts on mangrove management and conservation; and
    - Where needed, formulate appropriate policies on mangroves with the participation of all stakeholders and ensure strict enforcement of the same.
5. Thoroughly assess the ecological and socio-economic impacts of mangroves in the region.
6. Provide more trainings and fellowships through environmental partners, to build awareness and appreciation of mangrove ecosystems.
7. Study the ecological impacts of wood harvesting and other human activities (e.g., hydrological alteration, creating shrimp ponds, etc.) on different types of mangrove ecosystems; and develop innovative technologies to reduce the adverse impacts of human uses.
8. Undertake systematic research and monitoring to assess mangrove health, as well as relevant effects of climate change/ sea rise level, among others.

V. References

_____. (ny). "Ilocos Region." Wikipedia, https://en.wikipedia.org/wiki/Ilocos_ Region.
DENR 1. (ny). NGP Data Archive.
DENR 1. (2017). CMEMP Data on Mangroves.
DENR 1. (2019). CMEMP Data on Mangroves.
LGU Alaminos – City Agriculture Office Data Archive. (2019). Alaminos, Pangasinan.
LGU Bani – Municipal Agriculture Office Data Archive. (2019). Bani, Pangasinan.
NGP Data Archive. (ny). DENR-1, San Fernando City, La Union.
PG Pangasinan presentation during the Citizen Science Training, 2019.
Philippine Statistics Authority. (2015).

State of the Mangroves in Region 2

Nestor S. Lorenzo
Community Environment and Natural Resources Office
Department of Environment and Natural Resources, Palanan, Isabela

I. Introduction

Region 2 or the Cagayan Valley region is located on the northeastern part of mainland Luzon. It is bounded by three mountain ranges: the Sierra Madre Mountains on the east, the Cordillera Mountains on the west, and the Caraballo Mountains on the south. The region consists of five provinces: the valley provinces of Cagayan and Isabela, the mountain provinces of Quirino and Nueva Vizcaya, and the island province of Batanes. There are 10 congressional districts, with 89 municipalities, four cities, and 2,311 barangays.

Cagayan Valley has a total land area of over 2.6 million ha, which consists of more than 900,000 ha of Alienable & Disposable land and over 1.7 million ha of Forestland. Forest cover is more than 1 million ha, the largest in the Philippines. It is the fourth largest region in the country, accounting for about 9% of the national land area. Based on the 2015 census, Region 2 has a population of 3.4 million or about 3.4% of the total population of the country.

Rich in coastal resources, Region 2 has a total of 5,640 ha of mangrove, 4,089 ha of seagrasses, and 15,437 ha of coral reefs. It has 14 nationally proclaimed protected areas covering 997,466 ha: Batanes Protected Landscape and Seascape; Peñablanca Protected Landscape and Seascape, Magapit Protected Landscape, Palaui Island Protected Landscape and Seascape, Baua Watershed Forest Reserve, and Wangag Watershed Forest Reserve in Cagayan; Tumauini Watershed Natural Park, Fuyot Spring National Park, and Northern Sierra Madre Natural Park in Isabela; Salinas Natural Monument, Dupax Watershed Forest Reserve, Casecnan Protected Landscape, and Bangan Hill National Park in Nueva Vizcaya; and Quirino Protected Landscape.

The Valley is dissected by the Cagayan River, the longest river and largest basin in the country. It has a total stretch of about 520 km from its source in Kasibu, Nueva Vizcaya down to its mouth in Aparri, Cagayan. It has a drainage area of almost 2.8 million ha that extends to the Cordillera Administrative Region.

Benefits (direct income) and importance derived from mangroves

Mangroves play an important role in maintaining the ecological balance of coastal communities in Region 2. They provide a habitat and nursery for many species, thus supporting fisheries. Mangroves are an important source of seafood such as mollusks, gastropods, and numerous food fish. They serve as defense against strong typhoons and storm surges. In spite of their enormous importance, mangroves in the area are reduced and degraded due to continuous cutting.

The benefits derived from non-extractive/ destructive utilization of mangrove are greater and more sustainable than those from cutting (e.g., for charcoal, and poles and piles). The total estimated direct benefits derived from non-extractive uses of mangrove is Php 26,350/ month while the generated income from destructive/ extractive harvest is less than half that amount at only Php 12,321/ month. Nipa shingle gathering is considered non-destructive because harvesting can be done 3-4 times a year in the same stand/ frond, which should be able to replenish quickly. On the other hand, cutting of poles and piles, as well as cutting for charcoal, will certainly decrease the stocking of trees (Cabahug, 2000).

Mangrove forests are potential ecotourism sites. Positive attributes to serve as tourism attractions are the extensive network of mangroves through interconnected river systems, lush mangrove vegetation, highly diverse species composition, and the presence of crocodiles and other wildlife such as the flying lemur, birds, and reptiles. These, together with still intact terrestrial forests and good coastal conditions overall, may be considered worthwhile attractions in ecotourism programs. Through sustainable tourism, mangroves may then provide alternative income for the community. Such would be incentive to protect, rehabilitate, and manage coastal and mangrove resources.

II. Status of mangroves in the region

A. Province of Cagayan

Cagayan has a total coastal land area of 143,874 ha. There are 11 coastal municipalities in the mainland corridor along the Babuyan Channel. These municipalities are divided into western and eastern segments of the Cagayan River: Santa Praxedes, Claveria, Sanchez Mira, Pamplona, Abulug and Ballesteros on the western segment, while Aparri, Buguey, Santa Teresita, Gonzaga and Santa Ana are on the eastern segment. Calayan Municipality comprises the Babuyan Group of Islands and lies north of the main corridor. The municipalities of Peñablanca, Lallo and Baggao are on the Pacific eastern seaboard.

Cagayan's 455-km coastline constitutes ~73% of the regional coasts of Cagayan Valley. The province has among the longest coastlines in the country. Aside from its long coastline, the province also has extensive inland shores around large rivers and their tributaries, lakes, creeks and streams that provide rich fishing and aquaculture grounds. There are untapped coastal fishing grounds along the northern coasts or the Babuyan Channel corridor (from Santa Praxedes to Santa Ana), and along the Pacific eastern seaboard (from Santa Ana to Peñablanca).

Cagayan has approximately 3,967.9 ha of mangrove areas. These are distributed throughout the municipalities of Abulug, Aparri, Buguey, Calayan, Claveria, Gonzaga, Pamplona, Sanchez-Mira, Santa Ana, and Santa Teresita. The mangrove forest of Abulug covers an area of approximately 841.40 ha and located in the coastal barangays of Centro and Siguiran. The status of mangroves here is classified as fair because less than 41% of the area has living mangrove trees. There are some manifestations wherein severe cutting, heavy erosion and siltation are evident. In the Municipality of Aparri, latest data shows that a total aggregate area of 1,093.5 ha of mangroves is located in barangays Linao, Bisagu, Sanja, Bulala Sur, Navagan, Binalan, Caagaman, Gaddang, and Maura. The mangrove areas of Aparri are dominated by *Nypa fruticans* (nipa) equivalent to 98% while the remaining 2% are made up of the mangrove species *Bruguiera sexangula* (pototan), *Ceriops decandra*, *Ceriops* sp. (lapis-lapis), *Dolichandrone spathacea* (tui), *Excoecaria agallocha* (buta-buta), *Heritiera littoralis* (dungon-late) and *Sonneratia alba* (pagatpat), which are mostly found along rivers and creeks.

The majority of the mangrove areas in Buguey are either lost or degraded due to unabated reclamation, and massive conversion of mangrove forests into fishponds, residential, and other purposes. Conversion of mangrove areas into fishponds has left only small patches of mangrove stands in the area. However, good mangrove stands are still found in barangays Villa Leonora and Calamegatan. The mangrove areas of barangays Quinawegan, San Vicente, Santa Maria and Pattao of Buguey are dominated by *Nypa fruticans*, as observed during assessments of planting sites for mangrove reforestation and rehabilitation. There were also a few stands of mangrove tree species *Avicennia officinalis* (api-api), *Aegiceras corniculatum* (saging-saging), *B. sexangula*, *Rhizophora mucronata* (bakauan-babae) and *S. alba*.

In the Municipality of Calayan, mangroves are found in three of the four islands, namely Calayan Island,

Camiguin Island, and Dalupiri Island. In Calayan Island, some mangroves are found in barangays Dibay and Dilam, the latter with around 10 ha comprised of *Ceriops tagal* (tangal), *Rhizophora apiculata* (bakawan-lalaki), *R. mucronata, S. alba*, and other associated tree species. These same species of mangroves and associated trees were found in the 24-ha mangrove area in Camiguin Island, particularly along the coast of Brgy. Naguillian and the Nagtamurungan Creek. Dalupiri Island has patches of mangroves approximately 5 ha in area, notably inhabited by the Philippine crocodile (*Crocodilus mindorensis*), as documented by the Mabuwaya Foundation based in Isabela State University.

B. Province of Isabela

Mangroves in Northern Sierra Madre Natural Park (NSMNP) have an estimated aggregate area of 659.29 ha, which is distributed along coastal areas between Palanan and Maconacon (Garcia, 2002). The NSMNP Conservation Project reported that there are still old growth mangrove forests in Dimasalansan, the majority of important mangrove forests in Bicobian Bay (NSMNP, 2001). Mangroves are part of the national park, as declared in the NSMNP Act of 2001 (Republic Act 9125).

The Maconacon mangrove forest has secondary sparse stand growth with paired dominant association of *Sonneratia* and *Bruguiera* species. On the other hand, the existing secondary sparse mangrove forest in Brgy. Reyna Mercedes has sufficient "openings" that may be suitable for enrichment planting or assisted natural regeneration.

Mangroves in Divilacan are distributed in the coastal barangays Dipudo, Dibulos, Dimasalansan along the cove or port of Dimasalansan; and in barangays Bicobian and Tagbak along the port of Bicobian with an estimated aggregate area of 1,000 ha (NSMNP-CP, 2002). The old growth mangroves can be found in barangays Dimasalansan and Dibulos. The extent of old growth mangrove forest has decreased in area and cover because of harvesting for firewood, charcoal, and construction materials.

Mangroves in Palanan are mostly located along Palanan river. The dominant species observed in Culasi is *Nypa fruticans* while in Maligaya, mixed stands of *Avicennia* and *Rhizophora* species dominate the mangrove vegetation. It was observed that the mangrove vegetation along Palanan River changes through time due to the constant changes of river course. Most of the coastlines along the islets and riverbanks are now vegetated with grasses. The deposition of sediments along the islets and riverbank changes the substrate and the gradient of the islets and riverbank, hence influencing the transition of vegetation.

Overall, seven families represented by 21 species have been documented in Region 2 (Table 3-5).

Table 3-5. List of mangrove species in Region 2

Family	Genus	Species
Acanthaceae	*Acanthus*	*ilicifolius*
	Acrosticum	*aureum*
Avicenniaceae	*Avicennia*	*marina*
	Avicennia	*officinalis*
	Avicennia	*rumphiana*
Combretaceae	*Lumnitzera*	*littorea*
	Lumnitzera	*racemosa*
Meliaceae	*Xylocarpus*	*granatum*
Palmae	*Nypa*	*fruticans*
Rhizoporaceae	*Bruguiera*	*cylindrica*
	Bruguiera	*gymnorrhiza*
	Bruguiera	*parviflora*
	Ceriops	*decandra*
	Ceriops	*tagal*
	Kandelia	*candel*
	Rhizophora	*apiculata*
	Rhizophora	*mucronata*
	Rhizophora	*stylosa*
	Sonneratia	*alba*
	Sonneratia	*caseolaris*
Sterculiaceae	*Heritiera*	*littoralis*

C. Perceived threats to mangrove ecosystems

The continued decline of mangrove forests in Region 2 is a major concern of the DENR. Rehabilitation is supported by annual investment and Executive Order 26, which has earmarked almost Php 1 billion towards such efforts. Chief threats to mangroves in the region are detailed below:

1. Conversion. Mangrove area has been converted to human settlements, for agricultural expansion, and to fishponds such as in Cagayan. Most of these areas have been claimed as part of Alienable & Disposable lands. There is strong evidence of saltwater intrusion in some mangrove areas in Aparri.
2. Effect of increasing sea surface temperature. The increase in sea surface temperature has affected the survival of mangroves. Partners of the National Greening Program have conducted repeated re-planting but survival rates have been low.

3. Need for better rehabilitation strategies. There has been little to no success in terms of mangrove rehabilitation because of low capacity among site managers particularly on appropriate species-site, and techniques for restoration and silviculture. For instance, natural zonation patterns have not been considered in local mangrove rehabilitation. The majority of rehabilitation activities were project-driven, with plantation success only indicated by the number of seedlings planted and area covered.
4. Lack of awareness and subsequent low prioritization of mangrove management. Coastal communities have not fully appreciated the importance of healthy mangroves, so continue to engage in extractive practices such as gathering mangrove wood for firewood and charcoal.

Table 3-6. Mangrove rehabilitation programs in Isabela and Cagayan

Area	Extent (ha)	Process	Funding	Implementing organization	Year started/ completed
Isabela	**368**				
Palanan	**60**				
Brgy. Maligaya	50	Enrichment Planting	NGP	BLGU	2018
Brgy. Culasi	10	Enrichment Planting	NGP	BLGU	2012/2014
Divilacan	**308**				
Brgy. Dimasalansan	50	Enrichment Planting	NGP	Dimasalansan Womens	2013/2016
	130	Enrichment Planting	NGP	Dimasalansan Womens	2018
	17	Enrichment Planting	NGP	ANAK	2017
Brgy. Dicatian	50	Enrichment Planting	NGP	ANAK	2013/2016
	22	Enrichment Planting	NGP	ANAK	2017
	15	Enrichment Planting	NGP	BLGU	2012/2014
Brgy. Dilakit	9	Enrichment Planting	NGP	ANAK	2017
Brgy. Dipodo	15	Enrichment Planting	NGP	BLGU	2012/2014
Cagayan	**277**				
Abulug	**25**				
Brgy. San Julian	15	Rehabilitation	NGP	BLGU	2018
	10	Rehabilitation	NGP	BLGU	2017
Pamplona	**36**				
Brgy. Allasitan	15	Rehabilitation	NGP	BLGU	2018
Brgy Cabaggan	10	Rehabilitation	NGP	BLGU	2017
Brgy. Sta. Cruz	11	Rehabilitation	NGP	BLGU	2017
Sta. Ana	**216**				
Brgy. Caagaman	46	Rehabilitation	NGP	Caagaman Fisherfolk Assn.	2017
Brgy. San Vicente	170	Rehabilitation	NGP	BLGU	2017

III. Mangrove protection and management

In the Province of Isabela, mangrove rehabilitation has covered a total 368 ha, funded largely through the NGP (Table 3-6). The Municipality of Palanan thru BLGU Maligaya is presently managing 50 ha. On the other hand, the mangrove rehabilitation, maintenance, and protection of 10 ha in Brgy. Culasi was completed in 2014. In the Municipality of Divilacan, 178 ha of the total 308 ha for rehabilitation is presently being maintained. Activities for the remaining 130 ha have already been completed.

In the Province of Cagayan, a total 277 ha is being managed for mangrove rehabilitation, funded also through the NGP (Table 3-6). The greatest area is in Sta. Ana, Cagayan at 216 ha. On the other hand, the municipalities of Pamplona and Abulug manage 36 ha and 25 ha respectively.

IV. Summary and recommendations

The following are identified needs to support mangrove rehabilitation and management in Region 2:

1. Undertake baseline studies on mangrove extent and quality; mangrove ecology and biodiversity (e.g., establishment of permanent monitoring plots to assess growth and survival); impacts of typhoons on natural stands.
2. Regulate coastal development by strengthening EIA system monitoring and evaluation.
3. Enhance protection of remaining natural mangrove stands, as well as forests where visible improvements have been detected.
4. Enhance rehabilitation practices particularly by improving coordination among national government agencies, local government units, private partners, and other relevant and/ or interested stakeholders; and adopting science-based rehabilitation techniques (i.e., linking with the academe).
5. Assess land status to determine titled mangrove areas for reversion to forestland status.
6. Identify original mangrove areas that have been converted for agriculture, and to fishponds and other land uses, for reversion to natural state.

V. References

Cabahug. (2000).

Calicdan, M. A., Rebancos, C., Ancog, R. (2015). Assessment of mangrove flora of Palaui Island Protected landscape and Seascape (PIPLS), San Vicente, Sta. Ana, Cagayan Valley, Philippines.

DENR CENRO Palanan, Isabela R02. (ny). Annual accomplishment report C. Y. 2013-2017.

Garcia, K. B., Malabrigo, Jr. P.L., and Gevaña, D.T. (2014). Philippines' mangrove ecosystem: status, threats, and conservation .

NSMNP-CP. (2002).

Pasion, E. Q. and Tumaliuan, B. T. (2015). "State of the Mangroves in Cagayan," in State of the mangrove summit: northwestern Luzon proceedings by S. G. Salmo III , A. M. T. Favis, and M. N. S. Ting (eds.) Ateneo de Manila University, 113 p.

State of the Mangroves in Region 3

Olive Ebido Gregorio
Municipality of Masinloc, Zambales

I. Introduction

Region 3 borders the western side of the Gulf of Thailand. Its provinces are Bulacan, Tarlac, Nueva Ecija, Pampanga, Aurora, Bataan and Zambales. The regional coastline is 1,250 km, with mangrove forests of about 45,800 ha. It is one of the leading growth regions in the Philippines, strategically located between Metro Manila and Northern Luzon. Region 3 is comprised of 12 cities and 118 municipalities, with a total land area of 21,470.36 sq km (DENR 3, ny)

Importance of mangroves to the community

The coastal resources of Region 3 are rich in both the ecological, and the socio-economic sense. There are three mangrove protected areas in the region, located in Bulacan, Pampanga, and Zambales. In Pampanga, the mangroves are protected in the Sasmuan Bangkung Malapad Critical Habitat Ecotourism Area (SBMCHEA). The ecotourism area, which covers 146 ha, was established through a project funded by the Erickson and Smart Company and is managed by the LGU and Brgy. Batang Dos. A walkway has been constructed in the mangrove to cater to visitors.

The only mangrove protected area in Zambales is located in Sitio Panglit in Yaha Island, which is located in Brgy. San Lorenzo, Masinloc. A marine protected area was initially established thru Barangay Ordinance No 02-07, then supported by Municipal Ordinance No. 92-08 to expand protection to the mangroves in May 2011. The mangroves are a natural stand of 8.79 ha. Here, there are dozens of the hybrid *Rhizophora x lamarckii*, a cross of *R. apiculata* and *R. stylosa* (Panglit MPA Management Plan, 2011).

A mangrove protected area covering 10 ha was established in Hagonoy, Bulacan in 2018, and is co-managed by the LGU and BFAR. This mangrove serves as a fish drying area for toyo or tawilis, a source of livelihood of local fishers. It has been noted that the mangrove api-api is planted in the area (pers comm. Stephene Velasco, OIC MENRO). In Bulacan, Bulacan, a 24.5-ha mangrove eco-park was established in 2014. A boardwalk was constructed and installed, with funds from the DENR Central Office. Adoption of the ordinance has been endorsed to the Sangguniang Bayan for review (pers comm. Jose Jimmy, OIC MENRO, San Jose, Bulacan).

Mangroves in Subic Freeport provide important ecological functions and services. They serve as important feeding, spawning, and nursery grounds to various marine species, thus benefitting the fishing communities of Subic and Bataan. They are a habitat and refuge for birds, and home to the endemic wild duck *Anas luzonica*. The Freeport's mangroves, particularly in the Triboa Mangrove Park, provide recreational and aesthetic value. Further, they are a natural laboratory for scientists from both local and international academic and research institutions.

The indigenous people Pastolan Ayta depend on the Freeport mangroves for food and housing materials. The mangrove forests in Binictican-Malawaan and Boton are part of the group's ancestral domain and cultural heritage. Here, mollusks, crustaceans, and fish are gathered for subsistence consumption. The utilization of these resources by the Pastolan Ayta is in accordance with the Memorandum of Agreement between SBMA and the Pastolan Ayta Tribal Council (Mallari and Alcazar, 2015).

The Balanga Wetland and Nature Park in Brgy. Tortugas, Balanga is well known for the presence of migratory birds during the months of September to March, and thus

was declared as one of the Bird Watching Sites in the Philippines. Mangroves in Balanga also provide access to highly diverse mangrove plants and animals, making them ideal field work destinations for natural sciences students and researchers (Balbuena and Tabing, 2015). The mangrove protected areas promote the ecotourism industry, which serves as the supplemental livelihood of the communities managing the mangroves.

Mangroves are the first line of defense for coastal communities. They stabilize shorelines by reducing erosion, and provide natural barriers from typhoons and associated hazards such as storm surge and flooding. In 2014 when Pampanga was struck by Typhoon Glenda, mangroves acted as a natural buffer to protect two barangays in Sasmuan from the harshest impacts of storm surge (Ladrido, 2018).

An important benefit of mangroves and their conservation and management are the potential gains in climate change mitigation. The research project "A Comparative Analysis Among Disturbed, Restored and Natural Mangrove Stands in the Vulnerability and Adaptability Against Climate Change," led by the Ateneo de Manila University and funded by the Oscar M. Lopez Center, is being undertaken in Masinloc, Zambales. It aims to evaluate and compare the vegetation structure and productivity, and carbon sequestration capacity of planted mangrove relative to the performance of natural mangrove stands. The project is working on producing mangrove growth models to show the relationship of mangrove growth to carbon deposition, and to sea level rise adaptation. Its goal is to enhance Philippine research capability in understanding the role of mangrove ecosystem health in adaptation and mitigation to climate change and natural disasters (Project Profile, ny).

II. Status of mangroves in the region

Region 3 has a total mangrove area of 1,901 ha (DENR 3 and NAMRIA, 2017; Table 3-7)

Data on mangroves in Region 3 is notably insufficient and often with inconsistencies. Though total mangrove area recorded is 1,901 ha (DENR 3 and NAMRIA, 2017), it is uncertain if this includes the stands in Subic Bay Freeport Zone, which covers an area of 61.63 ha. These mangroves are situated inside the former US Naval Reserve, and were strictly protected and conserved by the Americans for decades until 1992. Hence, these stands are considered old growth mangrove forest (Mallari and Alcazar, 2015).

In certain parts of the region, mangrove areas appear to be increasing particularly in Masinloc, Zambales where rehabilitation and restoration are regular activities undertaken by the LGU. There are now 18 ha of abandoned fishponds with new mangrove regeneration, and 7 ha of abandoned fishpond eyed for mangrove reversion (Sikat Survey, 2012).

On the other hand, decreasing mangrove area has been observed in Bataan due to conversion to aquaculture ponds, expansion of built-up areas, and proliferation of informal settlers (Balbuena and Tabing, 2015). The same has been seen in Subic Bay Freeport where approximately 74% (30 ha) of the Binictican mangrove area and 43% (12.23 ha) of the Boton mangrove area have been converted and developed into an industrial and commercial area (Woodward-Clyde, 2000).

The arrival of investors in Masinloc saw the alteration of estuaries in Masinloc-Oyon Bay Marine Reserve, now the Masinloc-Oyon Bay Protected Landscape and Seascape (MOBPLS). As the population has grown along Masinloc's coast, there has been a corresponding increase in resource use and development. The main threats to mangroves have resulted from conversion, land use change, and the indirect effects of sediments and chemicals from runoff (from catchments degraded by clearing of upland vegetation and intensive agriculture). Insects such as caterpillar larvae have also been noted as a threat such as in the mangrove plantation of the AES

Table 3-7. Mangrove area (ha) in Region 3

Province	Mangrove area (ha)	Remarks
Bataan	343	Protected area park; bird-watching site in Brgys. Puerto Rivas and Tortugas
Aurora	479	
Bulacan	437	With a mangrove protected area
Pampanga	89	With a Critical Habitat Protected Area
Zambales	553	With a mangrove protected area (Masinloc)
Total	**1,901**	

Source: Conservation and Development Division, DENR Region 3

Table 3-8. Areas covered by mangrove rehabilitation funded by the DENR ICRMP

Location	Area (ha)	Beneficiaries	Survivorship	Species planted
Brgy. San Salvador	9	Samahang Pangkabuhayan	80%	*Rhizophora apiculata, R. mucronata, Avicennia alba*
Brgy. Taltal	3	Samahang Taltal Fish Vendor Association	75%	
Brgy. Bani	3	Bani Dunok Fishers Association	80%	
Brgys. San Lorenzo, Sto. Rosario, and Bamban	41	Samahang Magsasaka at Mangingisda ng Panglit	85%	
Total	**56**			

Source: DENR ICRMP Assessment, ny

(now SMC) Masinloc Power Partners Company Limited, Inc. in 2014 (Empeno and Ebido-Gregorio, 2015).

With the advent of the DENR's Integrated Coastal Resources Management Program (ICRMP) in the region, a mangrove rehabilitation project was initiated in Masinloc.

In 2003, about 231 ha of the 76,617 ha (0.3%) forest cover within Alienable & Disposable land was mangroves. On the other hand, of the 512,878 ha forest cover within Forestland, 137 ha was natural mangroves (0.03%; DENR, 2009).

In Aurora, threats to mangroves are cutting for fuel or charcoal, and illegal collection of *Pemphis acidula* for tourism and aesthetic purposes. With the influx of foreign and local investors, there have been moves to convert mangroves to sandy beaches. For instance, at Masinloc Raimers Beach Resort, the black sand and mud substrate characteristic of mangroves has been reclaimed with white sand to attract tourists.

III. Summary and recommendations

1. Regional management approach

There is a need for a region-wide approach for more comprehensive management and development of the coastal and marine environment, with focus on mangrove ecosystems. The DENR is positioned to initiate formalization of a mangrove management plan at the regional level.

2. Biodiversity conservation

Proactive conservation and better protection are important strategies to improve mangrove cover, and thus maintain associated ecosystem services such as coastal protection. These may be complemented with threat reduction (e.g., reducing coastal pollution), local community support (e.g., providing resettlement areas for informal settlers), and enhancing ecotourism programs (e.g., by developing high-quality guided tours, and support facilities and infrastructure). For the last, identified mangrove areas with excellent condition in the region may be recommended for utilization as an eco-park and educational hub.

3. Restoration

Restoration initiatives are necessary to address the global degradation of coastal ecosystems. In mangrove restoration, planting initiatives must be assessed for their sustainability. An ecosystem-based approach must be adopted, with considerations on appropriate species and suitable sites for planting. Restoration strategies must adequately involve the local community throughout the entire process. Community participation will greatly support the success of any restoration initiative. Inter-agency collaboration on reverting abandoned, underdeveloped, and underutilized fishponds (e.g., those with expired FLA) must also be given due attention. Restoration activities landward are needed to support vulnerable mangroves.

4. Addressing climate change

To fully realize the role of mangroves in addressing climate change, there is a need to encourage community action to participate comprehensively in adaptation efforts. Further, partnerships must be built and sustained to seize opportunities arising from networks. Revisiting the Blue Carbon Investment Plan would also be worthwhile.

5. Policy and governance

A region-wide integrated Comprehensive Mangrove Management Plan must be formulated to enable LGUs to act as co-managers of shared resources. Key governance opportunities include providing alternative land-based livelihood programs to reduce pressure on coastal resources; increasing local awareness on the benefits of mangrove ecosystems; and empowering

local stakeholders to implement national and local legislation for mangrove protection.

However, there is a need to increase productive collaboration and open communication among LGUs, academic institutions, development-oriented organizations (e.g., non-government organizations), and communities in and around mangrove areas. Settlers in mangrove areas must be empowered to manage their environment through massive information and education campaigns on proper waste disposal, coastal clean-up, mangrove planting, and other coastal resources management activities.

Local governments are encouraged to use evidence-based research in policy development and management; and share best practices for replication.

IV. References

Ateneo de Manila University. (ny). "A Comparative Analysis Among Disturbed, Restored and Natural Mangrove Stands in the Vulnerability and Adaptability Against Climate Change" Project Profile. Funded by the Oscar M. Lopez Center.

DENR 3 and NAMRIA. (2017).

____. (ny). A comparative analysis among disturbed, restored and natural mangrove stands in the vulnerability and adaptability against climate change. Ateneo de Manila University and Masinloc, Zambales.

Balbuena, K. J. A. and Tabing, E. S. (2015). "State of the mangroves in Bataan," in State of the mangrove summit: northwestern Luzon proceedings by S. G. Salmo III , A. M. T. Favis, and M. N. S. Ting (eds.) Ateneo de Manila University, 113 p.

DENR 3. (ny). "Regional Profile, Region 3 – Central Luzon," https://r3.denr.gov.ph/index.php/about-us/regional-profile.

DENR. (2009). 2009 Philippine Forestry Statistics. Forest Management Bureau, Department of Environment and Natural Resources, https://forestry.denr.gov.ph/index.php/statistics/philippines-forestry-statistics.

Empeno, O. E. Jr. and Ebido-Gregorio, O. (2015). "State of the mangroves in Masinloc, Zambales," in State of the mangrove summit: northwestern Luzon proceedings by S. G. Salmo III , A. M. T. Favis, and M. N. S. Ting (eds.) Ateneo de Manila University, 113 p.

Ladrido, P. (2018). "The role of mangroves in protecting coastal communities," 15 January 2018, CNN Philippines Life, https://cnnphilippines.com/life/culture/2018/01/15/The-role-of-mangroves-in-protecting-coastal-communities.html.

Mallari, R. J. P. and Alcazar, L. R. (2015). "State of the mangroves in Subic Bay Freeport Zone," in State of the mangrove summit: northwestern Luzon proceedings by S. G. Salmo III , A. M. T. Favis, and M. N. S. Ting (eds.) Ateneo de Manila University, 113 p.

Panglit MPA Management Plan. (2011)

Sikat Survey. (2012).

Woodward-Clyde. (2000). Subic Bay Metropolitan Authority Mangrove Reforestation Project. Subic Bay Freeport Zone, Philippines.

State of the Mangroves in Region 4-A

The Real-Infanta Mangrove in Quezon Province, Philippines

Januel Peras
DENR 4-A

I. Introduction

The mangrove is geographically located at 14.66-14.75°N to 121.60-121.73°E within the municipalities of Real and Infanta in Quezon Province. It lies 133 km east of Manila and can be reached via the Infanta-Famy Road in 2-3 hours. Local climate is Type II with an average monthly temperature range of 24.6 to 28.4°C in the months of January to June; the hottest months are May and June when temperature reaches 33°C. It has an area of about 3,000 ha and its condition is disturbed.

The Real-Infanta mangrove provides a range of important ecosystem goods and services. It is a habitat to various species of plants, mammals, birds, fish, and invertebrates, many of these with subsistence and commercial value to local communities. The mangrove is also known as a roosting area of the giant fruit-eating bat. Besides fishing, other livelihood is derived from the production of charcoal, firewood, timber, medicines, nipa products, and other useful items. Raw materials for vinegar and lambanog (palm liquor) are also sourced from the mangrove.

The Real-Infanta mangrove is also recognized for its role in coastal protection, serving as a buffer against typhoons and associated hazards such as floods, and a stabilizer to reduce coastal erosion.

II. Status of mangroves in the region

An assessment has been conducted in the Real-Infanta mangrove for selection of priority biodiversity conservation areas. Among its objectives was "to determine the totality of plant biodiversity in the Real-Infanta Mangrove Forest and their conservation status." The study covered areas within public forestland, its methods including a plant inventory, socio-economic survey, and mapping exercise. Key findings include:

- 73 plant species representing 41 families were recorded.
- 22 true mangrove species were listed. This is 71% of all true mangrove species known to occur in the Philippines.
- *Ceriops tagal* was the dominant species while *Bruguiera sexangula* was the rarest encountered.

III. Mangrove protection and management

Major threats affecting the Real-Infanta mangrove are conversion for aquaculture development (brackish water ponds), illegal practices such as mangrove harvesting and fishpond establishment, and land reclamation. The mangrove is also vulnerable to sea-level rise.

The Real-Infanta mangrove is being eyed for prioritization, in consideration of its high biodiversity, having already been identified as a priority area in other platforms (Ong et al., 2002; e.g., World Bank), its important role in providing ecosystem goods and services to local communities, and associated threats. The municipalities of Real and Infanta have passed respective local ordinances to protect the marine environment in their areas. In Real, certain provisions on mangroves are included in their comprehensive land use plan.

The recent biodiversity conservation area selection has identified priority areas for a strict nature reserve or protected area (31.55%), communal forest zone (19.39%), multiple-use zone (49.06%), and community-based forest management (CBFM) area (4.76%).

IV. Recommendations

The biodiversity conservation area selection has recommended the following needs and next steps:

1. Actual delineation and documentation of the boundary of the Real-Infanta mangrove forest
2. Inventory of all the fishpond operators within the Real-Infanta mangrove forest, including mapping of fishponds
3. Tripartite agreement between and among the Local Government Units, DENR and fishpond operators within the area for proper protection and maintenance of the Real-Infanta mangrove forest
4. Rehabilitation of denuded area and abandoned fishponds
5. Delineation of priority areas – strict nature reserve, communal forest, and multiple-use zones
6. Further research to document other biological resources of the area especially fauna

State of the Mangroves in Region 4-B

Maria Elena Parañaque
DENR Region 4-B MIMAROPA

I. Introduction

MIMAROPA is the center of the Philippine archipelago, consisting of five provinces: Oriental Mindoro, Occidental Mindoro, Marinduque, Romblon and Palawan, with two cities, 71 municipalities and 1,459 barangays. Palawan has the largest area among the island provinces and Marinduque, the smallest. MIMAROPA is bounded by the West Philippine Sea in the West, Tayabas Bay in the North, Sibuyan Sea in the East, and Sulu Sea in the South. It links the Philippines to the ASEAN region and East India through Palawan, the country's southwest frontier with Malaysia. The geographic reference center of the Philippines is located in Marinduque.

MIMAROPA has a total land area of 2,745,601 ha. Out of this, approximately 915,664 ha or 33.25% constitute Forestlands, of which about 73,324 ha or 8% is mangrove (Table 3-9).

Mangroves in the region provide the following ecosystem goods and services to the community:

- Nesting and breeding habitat for fish and shellfish, migratory birds, and sea turtles
- Livelihood and sustainable revenue-generating initiatives including ecotourism, sport fishing, and other recreational activities
- Water quality regulation
- Coastal protection by stabilizing the shoreline and reducing erosion, and serving as natural barriers to protect coastal communities from storm surge and flooding
- Essential food source for coastal communities

II. Status of mangroves in the region

Most of the mangroves in the region are in Palawan (see Table 3-10), with about 87% of the total mangrove area found here. Twenty-three true mangrove species from 19 families are present in 19 of its 23 municipalities. In Marinduque, mangroves are found mostly in four of its six municipalities. Based on initial data gathered in an on-going Protected Area Suitability Assessment (PASA), nine mangrove species from four families have so far been identified, with *Rhizophora* and *Avicennia* being the most dominant.

Over the years, these mangrove resources have been threatened by natural disasters such as typhoons and drought; and various human activities such as conversion for settlements or aquaculture, cutting for fuel (charcoal) and other uses, and bark tanning. These threats have depleted the habitat, reducing its capacity to provide ecosystem services especially to local communities.

Table 3-9. Mangrove cover (ha) and administrative information in MIMAROPA

Province	Cities	Municipalities	Barangays	Land Area (ha)	Forestland (ha)	Mangrove Forest (ha)
Oriental Mindoro	Calapan	14	426	436,472	86,981	3,949
Occidental Mindoro	-	11	163	587,985	104,986	1,594
Marinduque	-	6	218	95,925	15,132	2,877
Romblon	-	17	219	135,593	16,272	1,084
Palawan	Puerto Princesa	23	433	1,489,626	692,288	63,821
Total	2	71	1,459	2,745,601	915,664	73,324

Source: MIMAROPA Regional Development Plan 2011-2016; DENR-FMB, 2013

Table 3-10. Mangrove cover in 2010 (ha) and areas for rehabilitation (ha) in Palawan

Municipality	Existing mangroves in 2010 (ha)	Area for rehabilitation (ha)
Aborlan	1,562	87.42
Araceli	3,070	18.94
Balabac	6,487	1597.1
Bataraza	8,213	871.57
Brooke's Point	602	35.52
Busuanga	1,650	26.1
Coron	2,074	26.66
Culion	2,821	34.73
Dumaran	5,167	35.76
El Nido	2,887	12.38
Espanola	1,261	443.53
Linapacan	756	12.44
Narra	1,322	218.58
Puerto Princesa City	6,401	561.39
Quezon	2,031	731.05
Rizal	3,140	603
Roxas	4,693	23.18
San Vicente	1,013	23.44
Taytay	8,002	35.44

Source: PCSDS c/o J Pontillas; existing mangrove area is from NAMRIA (2010), and area for rehabilitation has been estimated via Google Earth.

Figure 3-4. Human-induced threats in mangrove areas in MIMAROPA

III. Mangrove protection and management

To address mangrove loss resulting from multiple threats, different reforestation, rehabilitation, and/ or protection programs and activities have been undertaken in the region. Chief aims are to conserve remaining stands, likewise improving cover for particularly denuded areas.

A. Mangrove protection

In Puerto Princesa City in Palawan, there is strict enforcement of laws and regulations in relation to mangrove protection. Such is made possible through the coordination of relevant agencies particularly the DENR Community Environmental and Natural Resources Office (DENR CENRO PPC) and the Palawan Council for Sustainable Development (PCSD). In 2018, a case of illegal occupation and destruction of 6.226 ha of mangroves in Sitio Barimbing, Brgy. San Manuel, Puerto Princesa was resolved in court, with the violators ordered to cease & desist their unlawful activities and pay a fine of Php 10 million towards the protection and rehabilitation of the same mangrove area (DENR CENRO PPC vs Rafael Cervantes). Due process was carried out, from investigation to petition, then finally to court resolution. The DENR CENRO PPC and PCSD have been tasked with monitoring compliance.

B. Rehabilitation programs

Mangrove rehabilitation programs have been implemented with active support from national government agencies, local governments, non-government organizations, people's organizations, indigenous peoples, civil society organizations, the private sector, and the academe. The DENR's National Greening Program (NGP) has greatly contributed to the rehabilitation of denuded mangroves. This has been complemented with Information, Education, and Communication (IEC) in local communities, to increase awareness on the protection and management of mangroves, and natural resources and the environment as a whole. Regular volunteer-driven activities such as coastal clean-up drives and mangrove tree-planting are conducted locally. Active involvement of all law enforcement agencies has led to effective protection of mangroves.

Since 2011, 23,881 ha of mangrove area in Palawan and 695.817 ha in Marinduque have been rehabilitated under programs supported by the NGP. The implementation of program activities such as site identification and assessment, protection, and maintenance has been met with certain challenges and difficulties, but the DENR and partner stakeholders have remained committed to the goals of mangrove conservation, rehabilitation, and management.

Table 3-11. Mangrove rehabilitation efforts in Marinduque and Palawan

Site	Extent (ha)	Process	Funding source	Implementing organization	Duration
Marinduque	2,877	695.817 ha rehabilitated	NGP	DENR	2012 to present
Palawan	63,821	23,881 ha rehabilitated	NGP	DENR	2011 to present

Figure 3-5. Mangrove rehabilitation activities undertaken in various sites in MIMAROPA

Table 3-12. Mangrove protection and management in Palawan

Community-Managed Marine Areas	Description	Date established	Governance/ management system	Policy and institutional support
Puerto Princesa, Palawan				
Brgy. Bacungan, Puerto Princesa City, Palawan	The area is primarily mangrove and is surrounded by the Bacungan River with a total area of 378.967 ha	21-Aug-03	Managed by the PO Bacungan Mangrove Ecotourism Service Cooperative, duly registered in CDA with 37 members; supported by funding from DENR-CBFM and CARP Cooperative Fund	• E.O. 263 • A CBFMA has been awarded to the Bacungan Mangrove Ecotourism Service Cooperative
Sitio Barimbing, Brgy. San Miguel, Puerto Princesa City, Palawan	Since 2010, about 6.2260 ha of mangrove in the area were illegally cut and cleared. Violators were issued Notices to Vacate, and illegal structures and fences were demolished and removed. A subsequent petition was filed, and resolved that the violators cease & desist all illegal activities and pay towards a Trust Fund for the rehabilitation and protection of the same mangrove. Rehabilitation activities have been ongoing (e.g., local celebration "Love Affair with Nature").	2016	DENR partnership with all law enforcement agencies and other stakeholders; with funding from the NGP	• P.P. No. 2152

continued...

Table 3-12 continuation...

Community-Managed Marine Areas	Description	Date established	Governance/ management system	Policy and Institutional Support
El Nido, Palawan				
Aberawan Marine and Mangrove Management Area (Brgy. Aberawan, El Nido, Palawan)	Protection covers 16.7 ha of marine area including coral reefs and seagrass; and 187.214 ha of mangrove.	2007 (marine area); 2010 (mangrove)	Managed by LGU and POs	• P.P. No. 2152 • Established thru a barangay resolution
Mabini Community-Managed Marine Area (Brgy. Mabini, El Nido, Palawan)	Protection covers a marine area of 54 ha, and mangroves with an area of 284.73 ha.	2009 (marine area); 2010 (mangrove)	Managed by LGU and POs	• P.P. No. 2152 • Established thru Municipal Ordinance No. 003, s. 2009
Manlag -Managed Mangrove Forest (Brgy. Manlag, El Nido, Palawan)	Covers 289.97-ha mangrove area	1981	Managed by LGU and POs	• P.P. No. 2152
New Ibajay-Community Managed Marine and Mangrove Area (Brgy. New Ibajay, El Nido, Palawan)	Protection covers a marine area including coral reefs and seagrass of 280 ha, and mangroves with an area of 381.1 ha.	2009 (marine area); 2007 (mangrove, only through barangay resolution)	Managed by LGU and POs	• P.P. No. 2152 • Established thru Municipal Ordinance No. 004, s. 2009 • The CMMA has been declared in Imorigue and Talawtawen in Brgy. New Ibajay
Villa Libertad Mangrove Management Area (Brgy. Villa Libertad, El Nido, Palawan)	Covers 33.7-ha mangrove area	2008	Managed by LGU and POs	• P.P. No. 2152 • Declared thru Barangay Resolution No. 18, s. 2008
Villa Paz Community-Managed Marine Area (Brgy. Villa Paz, El Nido, Palawan)	Protection covers 70.5-ha coral reef area, and 243.24-ha mangrove area.	2009 (coral reef); 2010 (mangrove, through barangay resolution)	Managed by LGU and POs	• P.P. No. 2152 • Municipal Ordinance No. 006, s. 2009

C. Monitoring and evaluation

The MIMAROPA DENR Field Office has designated and deployed NGP Site Coordinators, Forest Technicians (FTs), Forestry Extension Officers (FEOs) and Technical Inspection Committees (TIC) to oversee, guide, monitor, and evaluate the different site activities being implemented by partner stakeholders. Technical services such as nursery establishment, maintenance and protection, and other related rehabilitation activities have been extended. Technical guidance and support have been provided by relevant offices.

D. Outcomes and impacts of mangrove rehabilitation in terms of ecosystem and socio-economic contributions

The gradual increase of mangrove forest cover attributed to rehabilitation has contributed to the stability in the local coastal zone. Local communities have observed such an increase in mangrove cover, and subsequent improvement in biodiversity conditions (e.g., among fish, migratory birds, sea turtles, and other species). They have also noted better fish catch and protection from typhoons and strong winds.

More comprehensive assessment and monitoring is needed for stronger attribution of these gains to the current mangrove protection and rehabilitation activities. Nevertheless, these perceived gains may be considered strong incentive in the protection, conservation, and management of mangroves.

IV. Summary and recommendations

1. Threats to mangroves may be minimized through active partnerships among law enforcement agencies, local governments, NGOs, CSOs, local communities, and other stakeholders. Coordination among these agencies will improve effectiveness and efficiency in implementing mangrove protection laws and regulations.
2. Restoration initiatives must be sustained towards maintaining ecological balance and biodiversity conservation.
3. Coastal communities are susceptible to climate change, hence climate change mitigation and adaptation programs should be strengthened and implemented.
4. Coastal protection by mangroves (i.e., by reducing coastal erosion and serving as a natural buffer to typhoons and associated hazards) should explicitly be considered an incentive in habitat conservation, rehabilitation, and management.

V. References

Forest Management Bureau. (2013). Philippine Forest Facts and Statistics. Department of Environment and Natural Resources, Quezon City, Philippines, 34 p.

MIMAROPA Regional Development Plan 2011-2016

State of the Mangroves in Region 5

Emerin Dadea
DENR Region 5

I. Introduction

The Bicol Region is located at the southernmost tip of the main island of Luzon, and composed of six provinces: Albay, Camarines Norte, Camarines Sur, Sorsogon and the island-provinces of Catanduanes and Masbate. It is bounded by Lamon Bay to the north, the Pacific Ocean to the east, and the Sibuyan Sea and Ragay Gulf to the west. Camarines Sur has the largest land area while Catanduanes has the smallest. The total land area in the region is 1,763,249 ha, 31% of which is Forestlands. The rest is classified as Alienable & Disposable. As of 2015, the Department of Environment and Natural Resources has proclaimed 17 protected areas in Bicol, covering some 60,876.86 ha. Agriculture, fisheries, and forestry are major sources of income in the region.

In Bicol, 89 of its 114 cities and municipalities are coastal, with a 4,170.99-km coastline. Its coastal area is characterized by the presence of numerous bays and gulfs: Ragay Gulf, San Miguel Bay, and Lagonoy Gulf in Camarines Norte and Camarines Sur; and Albay Gulf and Sorsogon Bay in Albay and Sorsogon. The coastal area is highly susceptible to hazards such as typhoons, flooding, and storm surge. The region in general is also exposed to erosion and landslide, as well as volcanic hazards.

Among Bicolanos, mangroves are important because they (1) protect local communities from typhoons and storm surge; (2) stabilize the coast by reducing coastal erosion; (3) regulate water quality by filtering sediments and pollutants, preventing these from reaching other habitats such as seagrass beds and coral reefs; (4) provide food (e.g., fish, crayfish, shells, mud crabs, prawns, etc.), raw materials (e.g., nipa), and income; (5) support tourism and recreation (e.g., Block I Mangrove Forest Reserve in Brgy. Diamante, Prieto Diaz, Sorsogon); and (6) serve as a natural laboratory for education/ research studies.

II. Status of mangroves in the region

In 2010, total forest cover in the Bicol Region was 208,015 ha, 12% (24,953 ha) of which was mangrove (DENR-FMB, 2010; Table 3-13). Camarines Sur has the largest mangrove area at 7,264 ha, followed by Masbate with 6,638 ha, Sorsogon with 4,425 ha, Camarines Norte with 3,559 ha, Catanduanes with 1,995 ha, and Albay with 1,072 ha. Total mangrove cover in 2010 increased from 13,499 ha in 2003, largely because of protection and rehabilitation efforts in the region.

Table 3-13. Mangrove cover (ha) relative to total forest cover (ha) in Region 5, per province, 2010

Province	Total forest cover	Mangrove cover	
	ha	ha	% to total
Albay	42,099	1,072	3
Camarines Norte	28,104	3,559	13
Camarines Sur	61,346	7,264	12
Catanduanes	45,007	1,995	4
Masbate	6,778	6,638	98
Sorsogon	24,681	4,425	18
Total	**208,015**	**24,953**	**12**

The mangrove forests in the region are exposed to natural threats such as typhoons, storm surge and flooding, infestation by barnacles and other pests, and climate change; and human-induced threats such as the proliferation of illegal settlements and piggeries, pollution due to improper waste disposal, conversion into fishponds and agricultural land, coastal development particularly the construction of roads, houses, and seawalls, reclamation for industrial use (e.g., coal plants, roads/ causeway, and piers), and collecting/ gathering/ cutting of mangroves especially bakauan, pagatpat, and miyapi for fuel and construction.

Mangrove habitat assessments conducted from 2017 to 2019 in protected sites (e.g., declared under Presidential Proclamations 2151 and 2152) have shown a general decline in cover (Table 3-14). Chief issues are conversion to fishponds, agricultural land, and other uses, illegal cutting, and solid waste pollution. Nevertheless, biodiversity in assessed sites appears to be high with 19-22 recorded mangrove species including listed/ threatened species. Crown cover is good to excellent, with varying degrees of tree conditions and regeneration per square meter.

Table 3-14. Mangrove status in selected sites in Bicol (summary results of various habitat assessments, 2017-2019)

Site	Area declared for protection, ha	Area current, ha	Issues and concerns	No. mangrove species	General conditions and notable biodiversity
Camarines Norte[1]	2,420.36	1,319.81	Some conversion to fishponds, residential and commercial areas, and various infrastructure projects such as roads, bridges, etc.	19	Excellent crown cover (91.1%), poor regeneration per sq m, average height 4.91 m Species inventory includes threatened (listed) species *Avicennia rumphiana, Camptostemon philippinense,* and *Aegiceras floridum*
Camarines Sur[1]	3,458.48	2,791.32	Conversion to fishponds	22	Fair crown cover; fair regeneration per sq m
Basot Island Wilderness Area[2] (Caramoan, Camarines Sur)	49.43	23.26	Potential for ecotourism; threats include solid waste pollution, illegal cutting, coastal erosion, the presence of invasive species, and agricultural area expansion		
Quinalasag Island[2] (Garchitorena, Camarines Sur)	642.17 (1925)	94.37	Condition of neighboring seagrass beds is fair, and coral reefs good; identified threats are kaingin, illegal cutting, solid waste pollution, illegal fishing, and poaching		

continued...

Table 3-14 continuation...

Site	Area declared for protection, ha	Area current, ha	Issues and concerns	No. mangrove species	General conditions and notable biodiversity
Sorsogon[1]	2,791.53	1,512.83	Some conversion to fishponds, agricultural land (i.e., palay, coconut), residential and commercial areas, and various infrastructure projects such as roads, bridges, etc; fishponds are either active or abandoned	27	Fair crown cover (45.08%); excellent regeneration per sq m (11 seedlings/ sq m), average height 4.23 m Species inventory includes threatened (listed) species *Aegiceras floridum, Ceriops decandra,* and *Camptostemon philippinense*
Ticao Island, Masbate		1,031		19	Good crown cover, fair regeneration per sq m
Dampalit Island, Masbate		74.152		3	Fair crown cover
Mainland Masbate		755.53		22	Excellent crown cover, poor regeneration per sq m

Sources: Protected Area Sustainability Assessment, 2019; 2018; Coastal Habitat Assessment (outside NIPAS), 2018; Assessment of sites for potential ecotourism, 2017
[1] Mangrove Swamp Forest Reserve, by Presidential Proclamation 2152
[2] Wilderness Area, by Presidential Proclamation 2151

III. Mangrove protection and management

From 2011 to 2017, DENR V has rehabilitated about 12,174.71 ha of mangroves in the provinces of Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate and Sorsogon.

A. Rehabilitation and planting efforts

1. National Greening Program

Under the DENR's National Greening Program (NGP), 4,378.44 ha of mangroves were planted and rehabilitated in the six provinces of the region from 2011 to 2015. The seedlings or propagules planted were mostly bakauan babae, bakauan bato, bakauan lalake, miyapi, pagatpat, and bungalon.

2. Payapa at Masaganang Pamayanan

Payapa at Masaganang Pamayanan (PAMANA) is a convergence program of the national government, launched in 2011. It aims to reduce poverty and vulnerability in conflict-affected areas through sustainable rural development, among other objectives. In line with the plantation development under the program, DENR 5 contributed to the rehabilitation of 150 ha of mangroves in Brgy. Quidolog in Prieto Diaz, Sorsogon in 2013.

3. Barangay Forest Program

The Barangay Forest Program (BFP) of the provincial government of Albay was formally launched in March 2015 through the signing of a Memorandum of Agreement between DENR, the Department of Interior and Local Government (DILG), and the LGUs of Albay.

This collaborative program is targeting reforestation of 1,665 ha in 179 barangays in the province, with 88 barangays within the Quinali "A" Watershed, a key biodiversity area and project site of DENR-USAID's B+WISER Program. With support from this program,

DENR 5 together with the Barangay Local Government Units have planted 634,300 mangrove propagules/ seedlings in 253.72 ha in Bacacay, Legazpi, Libon, Malinao, Manito, Pio Duran, Rapu-Rapu, and Sto. Domingo.

4.National Greening Program - Mangrove and Beach Forest Development Program

The Mangrove and Beach Forest Development Program (MBFDP) is a component program under the NGP implemented in 2015 to protect mangrove and beach forests against the devastating effects of climate change. The scope of MBFDP is science-based mangrove and beach forest development in areas affected by typhoons and other disasters including Region 5. Under the MBFDP, a total 6,702.27 ha was planted with mangroves in the six Bicol provinces.

5. National Greening Program – Yolanda Reconstruction and Rehabilitation Project

Under the Yolanda Reconstruction and Rehabilitation Project (YRRP), DENR 5 rehabilitated 690.27 ha in the provinces of Albay, Camarines Norte, Catanduanes, Masbate and Sorsogon.

B. Mangrove initiatives other than mangrove planting

- Coastal clean-up in mangrove areas and tree planting in Prieto Diaz, Sorsogon and Garchitorena, Camarines Sur
- Mangrove patrolling by the Philippine National Police and Municipal Fishery Law Enforcement Team (MFLET) in Prieto Diaz, Sorsogon
- Communication, Education, and Public Awareness (CEPA) through on-site lectures/ orientations/ film showings in Garchitorena, Camarines Sur and Bongsanglay Natural Park in Batuan, Masbate
- Protection and maintenance of existing mangroves (under the NGP and the MBFDP)
- Mangrove assessment and monitoring through LAWIN in the Chico/ Naro Island Wildlife Sanctuary, Cawayan, and BAMS in Bongsanglay Natural Park, Batuan.

Table 3-15. Mangrove rehabilitation programs in Region 5, by province

Area	Extent, ha	Programs/ Projects	Year
Albay	**1,586.94**		
	22.72	MBFRP-YRRP	2017
	253.72	BFP	2015
	655.5	MBFDP	2015
	100	NGP	2013
	555	NGP	2012
Camarines Norte	**3,035.95**		
	10	MBFRP-YRRP	2017
	72	NGP	2017
	2,042.51	MBFDP	2015
	500	NGP	2014
	234	NGP	2013
	133	NGP	2012
	44.44	NGP	2011
Camarines Sur	**2,039.58**		
	908.58	MBFDP	2015
	300	NGP	2014
	700	NGP	2013
	91	NGP	2012
	40	NGP	2011
Catanduanes	**1,040.80**		
	107.8	MBFRP-YRRP	2017
	544	MBFDP	2015
	247	NGP	2014
	70	NGP	2013
	72	NGP	2012
Masbate	**2,695.60**		
	523.91	MBFRP-YRRP	2017
	1,730.69	MBFDP	2015
	215	NGP	2013
	226	NGP	2012
Sorsogon	**1,775.84**		
	25.84	MBFRP-YRRP	2017
	79	NGP	2017
	821	MBFDP	2015
	400	NGP	2014
	260	NGP	2013
	150	PAMANA	2013
	28	NGP	2012
	12	NGP	2011

- Coastal habitat assessment in Camarines Sur, in Brgys. Sumaoy and Binagasbasan, Garchitorena, and Brgys. Balaton and Mangogon, Lagonoy
- Threat monitoring as part of habitat surveys in Camarines Sur in May 2019, i.e., mangrove assessment for possible ecotourism site development in Siruma; monitoring MPA and established fish corral (sagkad) in the Calabanga portion of San Miguel Bay
- CMEMP flagship campaign activities, with focus on behavior change and reducing threats and pressures, e.g., Environmental Youth Camp in Hiwacloy, Goa, Camarines Sur in May 2019
- Hiring Bantay Dagat
- Regular monitoring activities in the Malabungot Protected Landscape (MPL) by Bantay Dagat, to reduce illegal fishing and illegal mangrove cutting in the area

Figure 3-6. Mangrove assessment and monitoring using LAWIN in Chico-Naro Island Wildlife Sanctuary, Cawayan, Masbate

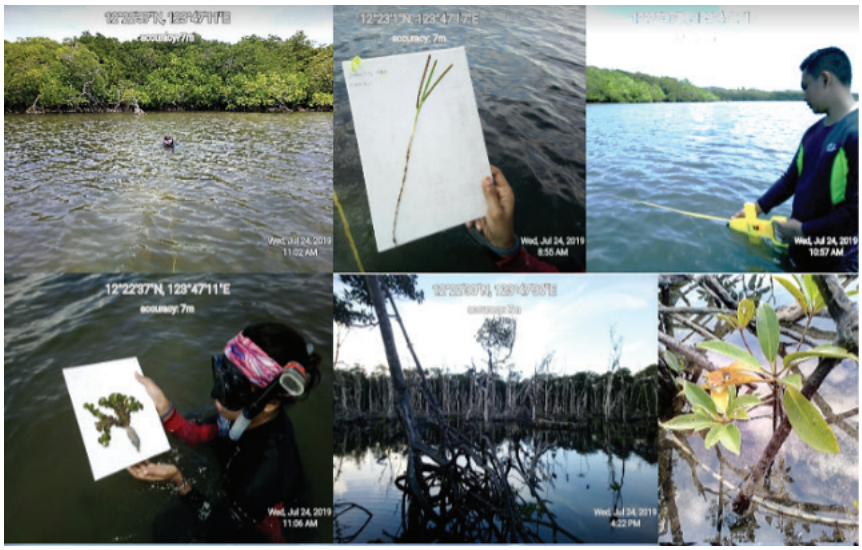


Figure 3-7. Monitoring mangroves and seagrass beds in Bongsanglay Natural Park (BongNP; Batuan, Masbate), by technical staff of PENRO Masbato and CENRO San Jacinto

Figure 3-8. Impact assessment and monitoring of ecotourism activities in Bongsanglay Natural Park (BongNP; Batuan, Masbate) by technical staff of PENRO Masbate and CENRO San Jacinto

Figure 3-9. Resource assessment in Malabungot Protected Landscape (MPL) in Garchitorena, Camarines Sur

C. LGU initiatives

In Prieto Diaz, Sorsogon, local ordinances "Ordinance Declaring Block I as 'Mangrove Forest Reserve' of the Municipality of Prieto Diaz, Sorsogon" and "Ordinance on [the] conservation and protection of mangroves in the Municipality of Prieto Diaz, Sorsogon" are in place to support mangrove conservation and management. On the other hand, at the provincial level, Masbate has institutionalized its environmental programs through the Masbate Provincial Environment Code of 2000.

D. Outcomes and impacts of mangrove rehabilitation

Impacts associated with mangrove protection and rehabilitation in the region are improved forest cover, resilience of coastal communities from storm surges, provision of income and livelihood, and food source and security through improved fisheries production.

IV. Summary and recommendations

Bicol Region is endowed with rich mangrove forests that serve both ecological and economic functions. However, the quality of these ecosystems is deteriorating due to several natural and human-induced threats. Nevertheless, mangrove cover in the region has increased from 13,499 ha in 2003 to 24,953 ha in 2010, due to protection and rehabilitation efforts implemented by multiple agencies including the DENR, DA-BFAR, and the provincial and local governments.

Challenges in mangrove conservation and management in the region are (1) protecting existing mangrove forests; (2) meeting increasing demands for fish and fishery products; (3) mitigating the impacts of climate change such as storm surge and flooding; (4) ensuring ecotourism sustainability (i.e., mangrove parks); (5) preventing further conversion of mangroves for unsustainable uses; and (6) strengthening stakeholders' collaboration in the management of mangrove forest and other coastal habitats.

Key recommendations

1. **Intensify conservation and management of existing mangrove forests.**
2. **Conduct Communication, Education and Public Awareness (CEPA) campaigns among local communities, to emphasize the importance of coastal and marine ecosystems.**

   Mangrove conservation and rehabilitation must highlight the value of mangroves in protecting human lives and property.
3. **Mangrove monitoring**

   Mangrove data in the region must be updated, with LGUs potentially taking the lead for relevant monitoring and assessment. In line with this, support must be provided to build technical capacity and augment resources.
4. **Strengthen enforcement**

   There is a need to build local capacity in enforcing mangrove-related laws and regulations. Local governments are encouraged to collaborate with assisting agencies to develop such capacity. Further, the deputization of Bantay Dagat and Bantay Bakawan will help address illegal fishing and illegal mangrove cutting.
5. **Intensify waste management up to the barangay level through efficient management and strong implementation of laws and ordinances.**
6. **Support mangrove ecotourism**

   Mangrove-based ecotourism is critical to the regional economy. Among the important destinations in the region are the Bongsanglay Natural Park in Batuan, Masbate, the Mangrove Forest Reserve in Prieto Diaz, Sorsogon, and the Mangrovetum and Buntod Reef Marine Sanctuary in Masbate City. However, urgent issues such as conflicting land use, human encroachment, and poor waste management must be addressed to sustain these and other ecotourism areas.
7. **Provide alternative livelihood to local communities to improve their quality of life**

   Alternative livelihood programs may be achieved through the collaborative efforts of LGUs, non-government organizations, and other assisting agencies.

V. References

DENR-FMB. (2010). http://forestry.denr.gov.ph.

State of the Mangroves in Visayas

Jose Alan A. Castillo
Ecosystems Research and Development Bureau, Department of Environment and Natural Resources

I. Introduction

The Visayas is one of the three main island groups in the Philippines and is located in the central part of the archipelago. It has the least area compared to Luzon and Mindanao. This group of islands is divided into three administrative regions: Region 6 (Western Visayas), Region 7 (Central Visayas), and Region 8 (Eastern Visayas). Its total land area is 71,503 sq km, and is composed of 16 provinces with a total population of 19,373,431 as of 2015 (PSA). A significant proportion of its population depends heavily on marine habitats and resources, including mangroves for their livelihood and sustenance. Among the regions, Eastern Visayas is the most frequently visited by typhoons and, in fact, the hardest hit by Super Typhoon Haiyan in 2013. This highlights the need to keep mangroves intact in order to protect the coastal communities from strong winds during typhoons while providing for their livelihood, food, and wood requirements.

Importance of mangroves in the Visayas

Mangroves in the Visayas, just like in other regions of the country, provide many ecosystem goods and services to the people in the area. These include wood, shingles, fisheries, coastal protection, erosion control, sediment stabilization, carbon storage and sequestration, and flood regulation, among others. Some places in the region were even named after mangrove species such as Dungon (*Heritiera littoralis*) in Iloilo and Tangalan (*Ceriops tagal*) in Aklan, a reflection of the relationship of the communities with the mangroves.

Mangrove forests provide livelihood opportunities for the community through ecotourism activities. Coastal communities, with support from different government institutions and NGOs, promote ecotourism as a form of conservation practice as well as a source of livelihood. One well-known mangrove tourism site is the Omagieca Mangrove Garden in Brgy. Obo-ob, Bantayan, Cebu located within the Bantayan Island Wilderness Area (BIWA).

II. Status of mangroves in the Visayas

In 2015, the total mangrove area of the Visayas islands is around 67,489 ha (DENR-FMB, 2019; Table 3-16). This figure is 22.2% of the country's total mangrove forest cover. The share of Eastern Visayas is almost half of this estimate.

There are some 27 species of mangroves that have been found in the Visayas. These include *Aegiceras corniculatum, A. floridum, Avicennia alba, A. lanata, A. marina, A. officinalis, Bruguiera gymnorrhiza, B. sexangula, B. parviflora, B. cylindrica, Ceriops decandra, C. tagal, Excoecaria agallocha, Lumnitzera racemosa, L. littorea, Xylocarpus granatum, X. moluccensis, Nypa fruticans, Osbornia octodonta, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, S. caseolaris, Pemphis acidula, Camptostemon philippinensis,* and *Scyphiphora hydrophyllacea*.

Table 3-16. Total mangrove forest cover in the Visayas as of 2015 (DENR-FMB, 2019)

Administrative region	Area (ha)	% in relation to total mangrove area in Visayas	% in relation to total mangrove area in the Philippines*
Region 6 (Western Visayas)	14,400	21.3	4.7
Region 7 (Central Visayas)	19,037	28.2	6.3
Region 8 (Eastern Visayas)	34,052	50.5	11.2
Total	**67,489**	**100**	**22.2**

** Total mangrove area in the Philippines as of 2015 is 303,373 ha (DENR-FMB, 2019)*

Threats and issues

Both man-made and natural threats still exist. Man-made threats include the conversion of mangrove areas to fishponds, pollution, illegal cutting, reclamation, grazing, docking of boats, and oil spill. There are cases of illegal activities such as reclamation and backfilling, as well as the construction of houses and infrastructure in mangrove areas. Mangroves have also been removed for the construction of dikes and tide embankments.

On the other hand, natural threats include typhoons, earthquakes and drought, barnacles, and pests and disease outbreaks from monoculture forestation.

III. Summary and management recommendations

Mangroves in the Visayas regions provide many ecosystem goods and services. This main island group shares nearly a quarter (22.2%) of the country's total mangrove forest cover. Some 27 mangrove species can be also be found here, with a few municipalities even named for certain species to highlight their value to the community. However, despite the numerous benefits being provided by mangroves, both man-made and natural threats remain.

To address the threats and improve mangrove management and conservation, the following recommendations are proposed:

1. Science-based technologies in mangrove rehabilitation such as site-species matching should be applied. For future reforestation initiatives, suitability assessment and species-site matching must be undertaken to inform target-setting, before the actual planting.
2. Continuous monitoring, maintenance, and protection for established plantations must be conducted to ensure higher survival rates.
3. There should be joint efforts to identify and rehabilitate degraded mangrove areas as well as AUU fishponds.
4. Land use plans should be improved and strictly implemented to prevent land-use conversion in mangrove areas.
5. It is important to continuously provide education on the significance of mangroves and the need for mangrove conservation efforts. Information, research, and best practices in mangrove conservation, protection and rehabilitation must be well documented and properly disseminated.

6. LGUs must be encouraged to adopt a mangrove and/ or MPA through local ordinances to protect ecosystem connectivity and ensure larval dispersal.
7. Mangrove ecotourism as a BDFE must be encouraged and properly funded.
8. Established NGP plantations must be properly maintained and given adequate protection.
9. Initial component MPAs in the region must be legalized as NIPAS sites to provide further protection and management.
10. To further ensure the success of mangrove rehabilitation efforts, there should be a convergence of LGUs and other government agencies such as the DOST, DA-BFAR, NGOs, and other organizations that are technically capable of mangrove management and protection. Continuous feedback and monitoring & evaluation should be undertaken. To sustain management impacts, stakeholder collaboration and consultation should be strengthened from planning to implementation, as well as in documentation, and monitoring & evaluation.
11. Solid waste management should be strictly implemented, and biodiversity-friendly livelihoods should be encouraged.
12. To ensure active participation and involvement from coastal stakeholders, there should be continuous education on mangrove plantation establishment and management. Lessons learned and best practices from successful mangrove initiatives should also be disseminated and replicated where appropriate.

IV. References

Philippine Statistics Authority. (2015). Philippine census.

DENR-FMB. (2019). Philippine Forestry Statistics. Department of Environment and Natural Resources, Quezon City, Philippines.

State of the Mangroves in Region 6

Rod Reynan G. Laspiñas
Development Management Officer
DENR Region 6

I. Introduction

Western Visayas or Region 6 consists of the islands of Panay and Guimaras, and the western half of Negros island. It is bordered by the Sibuyan Sea in the north, the Visayan Sea in the northeast, the province of Negros Oriental in the east, the Iloilo Strait and the Panay Gulf in the south, and the Sulu Sea in the west. The region has a land area of 2,022,311 ha and consists of six provinces (Aklan, Antique, Capiz, Guimaras, Iloilo and Negros Occidental) and two highly urbanized cities (Bacolod City and Iloilo City). It has a total of 117 municipalities, 83 of which are in coastal areas or have at least a portion of their area located along the coastline.

Importance of mangroves

Mangroves in the region provide regulatory functions namely coastal protection, erosion control, sediment stabilization and flood regulation. They contribute toward climate change mitigation through carbon sequestration. Mangrove areas serve as a conducive habitat for wildlife and fisheries since mangroves supply and regenerate nutrients. They also help in the treatment of dissolved and particulate wastes. Mangrove areas provide livelihood opportunities to the community through ecotourism activities. Some places in the region were even named after mangrove species such as Dungon (*Heritiera littoralis*) in Iloilo and Tangalan (*Ceriops tagal*) in Aklan.

II. Status of mangroves in the region

As of 2015, Region 6 has a total mangrove forest cover of 14,400 ha. Among the six provinces, Negros Occidental has the largest mangrove area in the region (5,497 ha) followed by Capiz (3,369 ha), Iloilo (2,228 ha),

Table 3-17. Planted mangrove areas (ha) under the National Greening Program in Region 6

Province	2011	2012	2013	2014	2015	2016	2017	2018	Total
Aklan	27	40	15	316.86	325.5	-	200	10.46	934.82
Antique	-	-	40	350.02	200.03	-	-	-	590.05
Capiz	-	-	65	378.36	511.1	76	186	-	1,216.46
Guimaras	10	20	30	-	350	-	150	50	610
Iloilo	15	171.1	20	453	1,141	55	400	302.88	2,557.98
Negros Occidental	48	15.3	97	281	1,339	30	-	265.12	2,075.42
Total	**100**	**246.4**	**267**	**1,779.24**	**3,866.63**	**161**	**936**	**628.46**	**7,984.83**

Aklan (1,584 ha), Antique (905 ha) and Guimaras (817 ha) (DENR-FMB, 2019).

There are at least 21 mangrove species in the region which include *Acanthus ilicifolius, Aegiceras corniculatum, Avicennia alba, A. marina, A.officinalis, A. rumphiana, Bruguiera cylindrica, B. sexangula, Camptostemon philippinense, Ceriops decandra, C. tagal, Excoecaria agallocha, Heritiera littoralis, Lumnitzera racemosa, Nypa fruticans, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, Xylocarpus granatum,* and *X. mekongensis*.

Perceived threats to mangrove ecosystem

Both man-made and natural threats affect the mangrove ecosystem in the region. Man-made threats include the conversion of mangrove areas to fishponds, pollution, illegal cutting, reclamation, grazing, docking of boats, and oil spill. Natural threats include typhoons and drought, and barnacles and other pests that may even cause disease.

III. Mangrove protection and management

Through initiatives such as the Upland Development Program (UDP), Community-Based Forest Management (CBFM), the Mangrove and Beach Forest Development Project (MBFDP), and the National Greening Program (NGP), mangroves were planted throughout the region. Under the UDP, 178 ha were planted with mangroves in 2010. In 2015, the MBFDP supported planting in over 3,467 ha. In 2010 to 2017, a total 146 ha within CBFM areas were covered. Then in 2011 to 2018, a total 7,984.83 ha were planted with mangroves through the NGP (Table 3-17). Aside from these projects and programs, there are also other unaccounted efforts such as mangrove plantations established by DA-BFAR, LGUs, NGOs and CSOs.

Eco-parks were established with the aim of utilizing desolate mudflats and AUU fishponds, strengthening community-based mangrove restoration and conservation, and promoting ecotourism. Some of the eco-parks established are the Katunggan It Ibajay Eco-park in Ibajay, Aklan, the Pedada Mangrove Eco-park in Ajuy, Iloilo, and the Katunggan Eco-park in Leganes, Iloilo. These eco-parks were established in cooperation with LGUs, POs and NGOs. Application of science and the practice of green-grey engineering solutions provided cost-effective mangrove rehabilitation projects. Ordinances establishing regulations for mangrove conservation and protection have also been enacted.

Outcomes and impacts of mangrove rehabilitation

Mangrove rehabilitation in the region has improved ecotourism, which in turn provided livelihood opportunities and an additional source of income for the local community. It also intensified biodiversity conservation and increased fish stocks. Given the regulatory functions of mangroves, climate change vulnerability has been reduced. Lastly, mangrove rehabilitation provided more research opportunities in the area.

IV. Summary and recommendations

Mangroves in the region provide regulatory and provisioning functions. The region has a total mangrove forest cover of 14,400 ha and at least 21 mangrove species. Various mangrove plantations have been established through government and non-government initiatives. However, both man-made and natural threats continue to affect the mangrove ecosystem in the region.

To address threats and improve mangrove management and conservation, science-based technologies in mangrove rehabilitation such as site-species matching should be applied. Continuous monitoring, and maintenance and protection for established plantations must be conducted to ensure higher survival rates. There should be joint efforts to identify and rehabilitate degraded mangrove areas as well as AAU fishponds. Land use plans should be improved and strictly implemented to prevent land use conversion in mangrove areas.

It is important to continuously provide education on the significance of mangroves and the need for mangrove conservation efforts. Information, research, and best practices in mangrove conservation, protection and rehabilitation must be well documented and properly disseminated.

V. References

DENR-FMB. (2019). Philippine Forestry Statistics.

State of the Mangroves in Region 7

Reginaldo G. Bueno
Conservation and Development Division,
DENR Region 7

I. Introduction

Central Visayas or Region 7 is composed of four island provinces namely Cebu, Bohol, Negros Oriental, and Siquijor. The region is bounded by the Visayan Sea in the North, Bohol Sea in the South, East Sulu Sea in the West, and Camotes Sea in the East. It has a coastline of 2,029 km. Out of its 132 municipalities, 109 are in the coastal area having 1,027 coastal barangays and 108 islands. Based on records of DA-BFAR, Region 7 has 125,000 registered municipal fishers and 5,000 commercial fishers as of 2018.

There are 296 marine protected areas in the region, 16 of which have mangroves. The mangrove forests in Central Visayas are among the most diverse forest ecosystems in the country. There are 27 species of mangroves in the region belonging to 11 families, which is more than half of the total mangrove species documented in the Philippines. The mangroves play an important role in the ecosystem and in the livelihood of the coastal and island barangays.

Importance of mangroves in the community

There are many benefits that can be derived from mangroves in the region. Coastal communities depend on marine habitats and mangrove ecosystems for food and resources. Mangroves are sources of valuable plant products for food and traditional herbal medicine. They serve as nesting grounds for hundreds of bird species, as nurseries for fisheries, and are home to a wide variety of reptile, amphibian, mammal, and invertebrate species. Mangroves have provided protection to the coastal communities against strong waves, storm surges, and

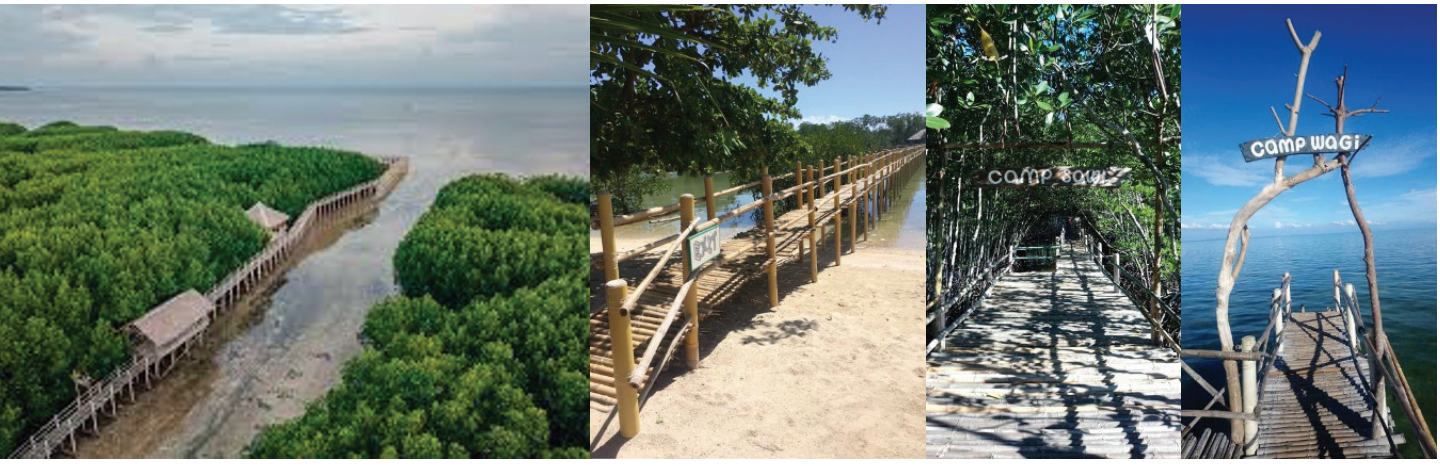


Figure 3-10. Omagieca Mangrove Garden in Brgy. Obo-ob in Bantayan, Cebu

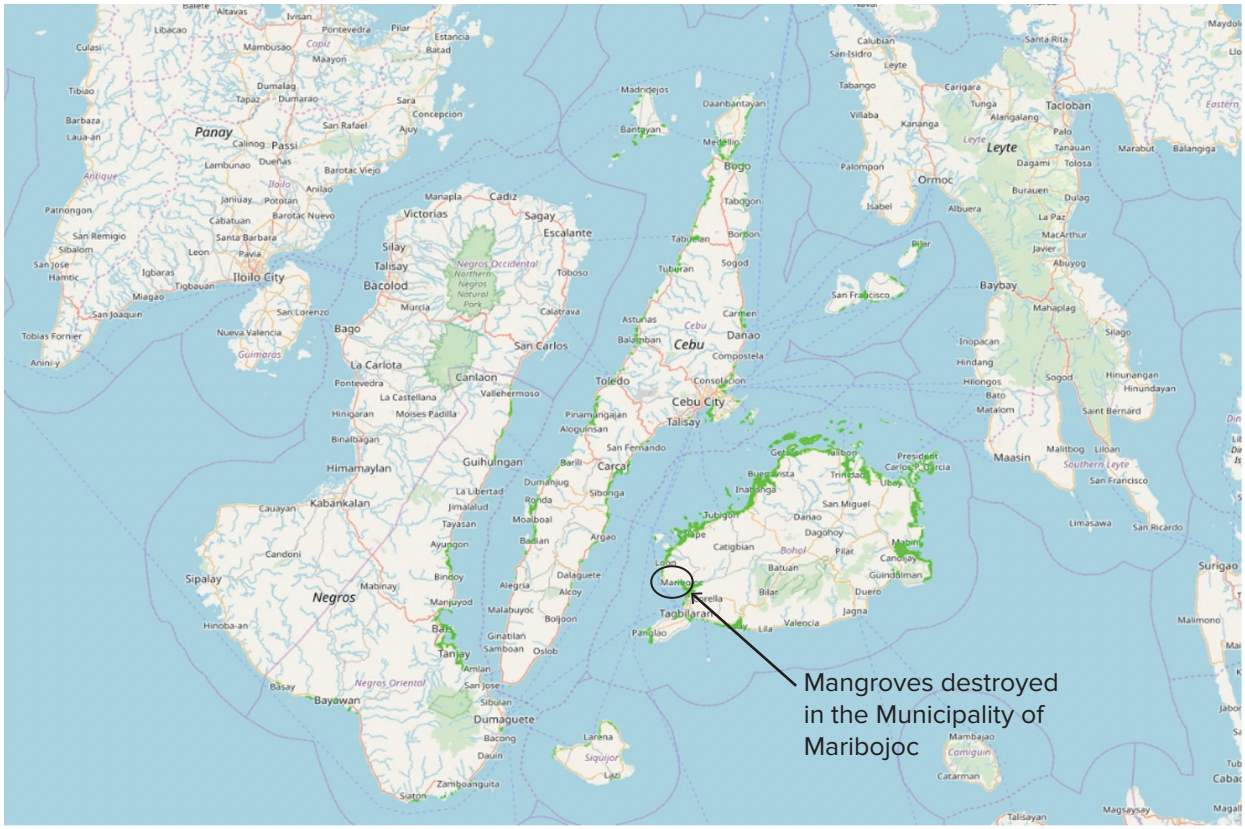


Figure 3-11. Map showing the location of mangroves damaged by the 2013 earthquake in Bohol

strong winds. They also serve as natural barriers against coastal erosion. Mangroves trap sediments, produce organic biomass, and reduce organic pollution.

Mangrove forests are also utilized by the community for ecotourism purposes. Coastal communities, with support from different government institutions and NGOs, promote ecotourism as a form of conservation practice as well as a source of livelihood. These sites provide tourists with recreation as well as educational values. One well-known mangrove area in the region is the Omagieca Mangrove Garden in Brgy. Obo-ob, Bantayan, Cebu located within the Bantayan Island Wilderness Area (BIWA; Figure 3-10). The movie "Camp Sawi" was shot in the area. The influx of tourists since has provided the community with more income.

II. Status of mangroves in the region

Based on the data from Philippine Forestry Statistics, the mangrove forest cover of Central Visayas in 1951 was 24,213 ha. In 1994, it decreased to 2,500 ha. Then in 2015, the mangrove forest cover increased to 19,037 ha and is expected to grow due to different interventions from the government and its partners for mangrove conservation. Most of the mangrove forest cover is found in Bohol (12,942 ha), followed by Cebu (4,454 ha), Negros Oriental (1,510 ha), and Siquijor (132 ha; DENR-FMB, 2019).

Twenty-seven species of mangroves have been found in the region: *Aegiceras corniculatum, A. floridum, Avicennia alba, A. lanata, A. marina, A. officinalis, Bruguiera gymnorrhiza, B. sexangula, B. parviflora, B. cylindrica, Ceriops decandra, C. tagal, Excoecaria agallocha, Lumnitzera racemosa, L. littoria, Xylocarpus granatum, X. moluccensis, Nypa fruticans, Osbornia octodonta, Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, S. caseolaris, Pemphis acidula, Camptostemon philippinense,* and *Scyphiphora hydrophyllacea*.

Perceived threats to mangrove ecosystem

Despite the rehabilitation efforts, natural and man-made threats still exist, causing mangrove degradation in Central Visayas. The northern part of the region is in the path of most typhoons, which cause destruction in the mangrove forests. In 2013, an earthquake in Bohol caused mangrove destruction and degradation (Figure 3-11). Aside from typhoons and earthquakes, other natural threats to mangroves are the presence of barnacles, algae, pests, and disease.

Mangroves are also being destroyed due to land conversion and reclamation projects. There are cases of illegal reclamation and backfilling (Figure 3-12), as well as illegal construction of houses and infrastructure in mangrove areas (Figure 3-13). In urban areas and island barangays, mangroves are still being cut for use as firewood and housing material. Pollution and heavy siltation are also prevalent. Activities like gleaning, boat landing, and unregulated tourism have also been known to disturb the mangrove habitats. Further, widespread uninformed mangrove reforestation has overlooked science-based practices such as species-site matching, and has resulted in monoculture planting.

Figure 3-12. Mangroves affected by illegal reclamation/ backfilling (Photo c/o DENR 7-ED)

Figure 3-13. Mangroves affected by illegal construction of houses and other structures (Photo c/o DENR 7-ED)

III. Mangrove protection and management

Mangrove rehabilitation programs and projects have contributed to the increase in mangrove areas in the region. One of the major rehabilitation programs is the DENR's National Greening Program that started in 2011. The program involves various stakeholders and organizations in implementing rehabilitation programs in both terrestrial and coastal areas. Programs such as the Coastal Environment Program (CEP), NGP Sustainable Integrated Area Development (SIAD), Japan Bank for International Cooperation (JBIC) Loan II, and the NGP Mangrove and Beach Forest Development Program were also implemented (Table 3-18).

Sites under the MBFDP include Guihulngan and Tanjay in Negros Oriental, Daanbantayan and Medellin in Cebu, Bien Unido in Bohol, and Larena in Siquijor. Other programs implemented were the Yolanda Rehabilitation and Reconstruction Program (YRRP) and the DENR's Coastal and Marine Ecosystems Management Program (CMEMP). The Yolanda Rehabilitation and Reconstruction Program was implemented to address the damage due to Super Typhoon Yolanda. CMEMP, which began in 2016, is a 10-year program geared towards effectively addressing the threats of degradation of the coastal and marine ecosystems. These and other relevant programs have rehabilitated a total 9,350 ha. Accounting for natural forests as well as the established plantations, there is a total 22,360.34 ha of mangrove area in the region as of 2018 (Table 3-19).

Table 3-18. Mangrove rehabilitation programs conducted by DENR and partners in Region 7

Area	Extent (ha)	Process	Funding sources	Implementing organization	Duration
CEP/ CMM/ JBIC/ Loan II					
Cebu	423	Contract with PO	OECF/ JBIC Loan II	DENR	2000-2004
Bohol	1,118	Contract with PO	OECF/ JBIC Loan II	DENR	2000-2004
Negros Oriental	339	Contract with PO	OECF/ JBIC Loan II	DENR	2000-2004
Siquijor	65	Contract with PO	OECF/ JBIC Loan II	DENR	2000-2004
NGP-SIAD					
Bohol	997.15	LOA with PO	DENR NGP	DENR, LGU, PO	2016-2018
NGP-MBFDP					
Cebu	1,595.23	LOA with PO	DENR NGP	DENR, LGU, PO	2015-2017
Bohol	3,274.60	LOA with PO	DENR NGP	DENR, LGU, PO	2015-2017
Negros Oriental	109.45	LOA with PO	DENR NGP	DENR, LGU, PO	2015-2017
Siquijor	122	LOA with PO	DENR NGP	DENR, LGU, PO	2015-2017

Table 3-19. Summary of mangrove rehabilitation programs in Region 7 (2010-2018)

Province	Natural forest (as of 2010)	Plantations established										Total (natural + plantations)
		2010[a]	2011[b]	2012[b]	2013[b]	2014[b]	2015[c]	2016[d]	2017[b]	2018[e]	Sub-total	
Cebu	1,671.00	423	77.02		77.93	140.6	1,595.23			264.16	2,577.94	4,248.94
Bohol	10,400.00		111.19	149.01	653.15	370.94	3,274.60	997.15	232.57	148.3	5,936.91	16,336.91
Negros Or.	879	339			68.19	53.72	109.45			60.6	630.96	1,509.96
Siquijor	60	65					122			17.53	204.53	264.53
Total	13,010.00	827	188.21	149.01	799.27	565.26	5,101.28	997.15	232.57	490.59	9,350.34	22,360.34

[a] *CEP/ CMM/ JBIC Loan II;* [b] *NGP;* [c] *NGP-MBFDP;* [d] *NGP-SIAD;* [e] *NGP-YRRP & CMEMP*

Monitoring and evaluation

Third-party validation conducted on the rehabilitation projects yielded survival rates generally higher than 60% (Table 3-20).

Outcomes and impacts of mangrove rehabilitation

In addition to the increase in mangrove area, benefits from mangrove rehabilitation have also been felt by the local communities and POs. Mangrove areas were developed into ecotourism projects that promoted biodiversity conservation and income generation. Livelihood projects in mangrove areas such as the establishment of fish cages were also implemented (Figure 3-15). Based on the NGP-MBFDP, a total of 8,412 jobs were generated.

The LGUs have continuously supported various mangrove initiatives. They have established locally managed MPAs and have created MPA technical working groups. Mangrove forests can also be found within NIPAS sites in the region particularly the Olango Island Wildlife Sanctuary, Tañon Strait Protected Seascape, Camotes Island Protected Landscape and Seascape (PLS), Apo Island PLS, Panglao Island Protected Seascape, Alburquerque Loay Loboc PLS, and Talibon Group of Islands PLS.

Table 3-20. Survival rates in mangrove rehabilitation areas in Region 7 (by third-party validation)

Survival rate	Program	Reference
85%	NGP-SIAD	BEMO Bohol and DENR PENRO Bohol, 2017
71.31%	NGP-MBFDP	Monitoring and Evaluation (via third-party), 2016
67.73%	NGP	NGP monitoring, 2011-2018

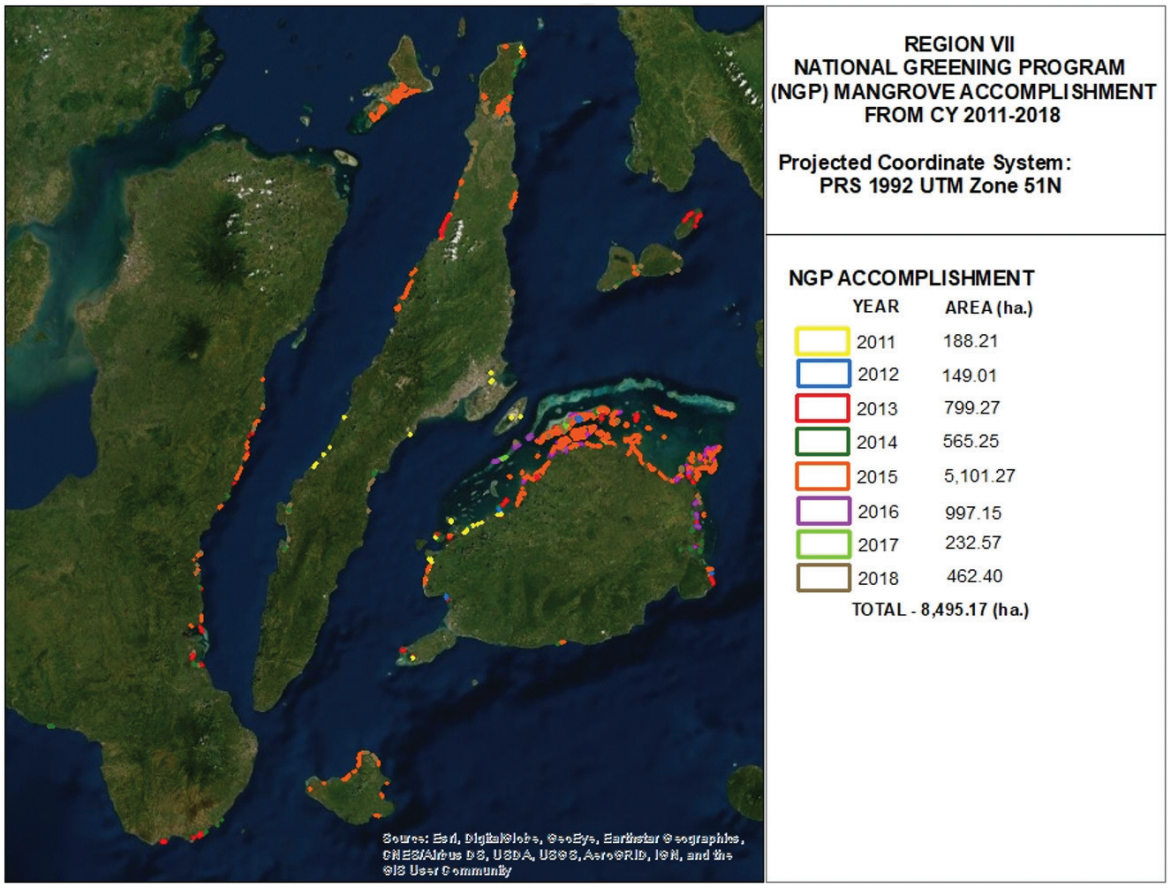


Figure 3-14. Mangrove forest areas under the National Greening Program in Region 7

Figure 3-15. Livelihood projects within the mangrove area of Brgy. Lambusan, San Remigio, Cebu

IV. Summary and recommendations

Continuous efforts toward mangrove management and conservation in Central Visayas have caused an increase in mangrove forest cover through the years. This increase in mangrove areas has also contributed to climate change adaptation and mitigation. The region now has a total of 22,360.34 ha of mangrove forest (natural and rehabilitated). However, mangrove forests in the region are still threatened by both natural disasters and human activities. These must be addressed.

To sustain mangrove management in the region, LGUs must be encouraged to adopt a mangrove and/ or MPA through local ordinances in order to protect ecosystem connectivity and ensure larval dispersal. Mangrove ecotourism as a Biodiversity Development Friendly Enterprise (BDFE) must be encouraged and properly funded. Established NGP plantations must be properly maintained and given adequate protection. For future reforestation initiatives, suitability assessment and species-site matching must be undertaken to inform target-setting, prior to the actual planting. Lastly, initial component MPAs in the region must be legalized as NIPAS sites to provide further protection and management.

V. References

DENR. (2016). MBFDP Third-Party Validation Report.

DENR. (2018). National Greening Program Annual Report.

DENR-FMB. (2019). Philippine Forestry Statistics.

Primavera, J. H., Savaris, J. P., Bajoyo, B. E., Conching, J. D., Curnick, D. J., Golbeque, R. L., Guzman, A. T., Joven, R. V., Loma, R. A., Koldewey, H. J. (2012). Manual on community-based mangrove rehabilitation: Mangrove Manual Series No. 1.

State of the Mangroves in Region 8

Crizaldy M. Barcelo, Eugenia N. Bautista, Melecia B. Sumbeling, Severino A. Lacandazo, Jr., Bror Ragnar Lorenzo Isagani R. Collander, Mark Anthony B. de la Peña and Zarah Mae G. Velarde
DENR Region 8

I. Introduction

Region 8 or Eastern Visayas lies on the east central part of the Philippine archipelago. The region is composed of three main islands Leyte, Biliran and Samar, which form the easternmost coast of the archipelago. It is comprised of six provinces namely Leyte, Biliran, Southern Leyte, Samar, Eastern Samar and Northern Samar; 12 congressional districts; 7 cities; 136 municipalities; and 4,390 barangays. The region has a total land area of 2,143,169 ha, of which 1,024,955 ha are Alienable & Disposable lands and 1,118,214 ha are Forestlands. Two primary forest types in coastal ecosystems – mangroves and beach forests – can be found in the region. These ecosystems provide services that benefit the community.

The region is bounded on the south by the Surigao Channel and Mindanao Island; on the north by the San Bernardino Strait and the tip of the Bicol Peninsula; on the west by the Surigao Channel, Camotes and Visayan Seas, and the Cebu and Bohol Islands; and on the east by the Leyte Gulf, the Philippine Sea, and the Pacific Ocean. Its coastline spans 3,114 km.

Importance of mangroves

Mangroves provide the region with several ecosystem services (Figure 3-16). Mangrove forests are a habitat for species of prawn, crab, shellfish, and fishes, which are an important food source. They also provide income to coastal communities through ecotourism, and by providing raw materials (e.g., for use in nipa shingle production).

Mangroves help in erosion control and shoreline protection. They can reduce the impacts of typhoons, waves, storm surges, and flooding. Robust mangrove forests are natural protection for communities vulnerable to climate change impacts such as extreme weather events and sea-level rise. Mangrove areas also serve as carbon sinks.

II. Status of mangroves in the region

The total mangrove area in Region 8 is 31,052 ha (NAMRIA, ny). Government projects and programs have contributed to the increase in mangrove areas through reforestation and rehabilitation activities. As of 2019, a total 20,553 ha of mangrove area have been planted or rehabilitated. From 2011 to 2018, a total 3,987 ha of

Figure 3-16. Ecosystem services associated with mangroves in Region 8 →

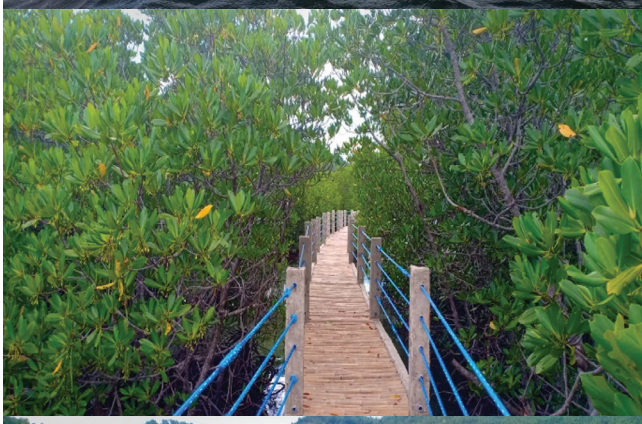


Table 3-21. Mangrove areas planted/ rehabilitated in Region 8, by province (as of 2019)

Province	Mangrove area (ha)	Area rehabilitated (ha) 2011-2018
Samar	9,688	6,344
Northern Samar	9,139	3,792
Eastern Samar	8,060	5,491
Leyte	6,349	4,009
Southern Leyte	438	383
Biliran	399	534
Total	**31,052**	**20,553**

denuded/ degraded mangroves were reforested through the National Greening Program (NGP). The Leyte Gulf Rehabilitation Project (LGRP) reported 2,859 ha of mangrove area planted in the aftermath of Super Typhoon Yolanda. Under the Mangrove and Beach Forest Development Project (MBFDP), 12,416 ha were rehabilitated. The Yolanda Recovery and Rehabilitation Program (YRRP) reported 1,086 ha of mangrove area planted. The Community-Based Forest Management-Comprehensive Agrarian Reform Program (CBFM-CARP) accomplished 205 ha of mangrove plantations. A total of 20,553 ha of degraded mangrove areas have been planted/ rehabilitated as of 2019 (Table 3-21).

There are 27 mangrove species known to thrive in Eastern Visayas namely *Avicennia alba, A. marina, A. lanata, A. officinalis, Camptostemon philippinense, Lumnitzera littorea, L. racemosa, Excoecaria agallocha, Pemphis acidula, Xylocarpus granatum, X. moluccensis, Aegiceras corniculatum, A. floridum, Bruguiera cylindrica, B. gymnorrhiza, B. parviflora, B. sexangula, Ceriops decandra, C. tagal, Rhizophora apiculata, R. mucronata, R. stylosa, Scyphiphora hydrophyllacea, Sonneratia alba, S. caseolaris, Dolichandrone spathacea,* and *Osbornia octodonta*. There is a dearth of information on the stand structure of mangroves in the region except for the provinces of Southern Leyte, Biliran, and Northern Samar, which have reported areal extents of 864.21 ha, 453.107 ha, and 6,813.39 ha, respectively.

Figure 3-17. Mangrove and beach areas damaged by Super Typhoon Yolanda in Brgys. Basey and Marabut, Samar

Figure 3-18. Threats to mangroves include encroachment of informal settlers (a, b), solid waste and water pollution (c), conversion for aquaculture and other uses (d), infestation by barnacles and other pests (e), and climate change impacts such as severe typhoons (f).

Eastern Visayas is situated in the Philippine Typhoon Belt. Strong typhoons have been known to cause damage to mangroves (Figure 3-17). Around 2,000 ha of degraded mangroves have been reported in CENRO Sta. Rita due to Super Typhoon Yolanda in 2013 and Typhoon Ruby in 2014 (Borja, 2019). PENRO Eastern Samar reported 3,700 ha damaged mangroves and beach forests due to Super Typhoon Yolanda. Seven hectares of old growth mangroves in Brgy. Sangalang, Biliran, Biliran were damaged in December 2017 due to Typhoon Urduja (Tubania, 2019). Pests and diseases also occur in mangrove areas in the region.

Man-made threats still persist in the region. Due to lack of appreciation of mangroves and their ecological functions, as well as the shortage of other means of livelihood in the coastal areas, some individuals resort to poaching and charcoal making. Mangrove areas are being converted for aquaculture, as well as for residential (e.g., informal settlers) and commercial purposes. Mangroves have been removed for the construction of dikes and tide embankments, which has increased siltation. Further, solid waste pollution a recurring issue.

III. Mangrove protection and management

Mangrove conservation and restoration in Region 8 can be traced back as early as 1989 to 1997 when the Family Approach Reforestation (FAR) Project was implemented and funded by the Asian Development Bank (ADB)/ Overseas Economic Cooperation Fund. The DENR Fisheries Sector Program component funded by ADB was executed in 1990 to 1995 in four priority bays of the region, namely San Pedro Bay, Carigara Bay, Ormoc Bay, and Sogod Bay. Under the Coastal Environment Program (CEP), mangrove enrichment planting was initiated in its sites, which are now the NIPAS MPAs Guiuan Marine Reserve Protected Landscape and Seascape (GMRPLS), Cuatro Islas Protected Landscape and Seascape (CIPLS) and Biri-Larosa Protected Landscape and Seascape (BLPLS) from 1997 to 1999.

From 1997 to 2003, the Japan Bank for International Cooperation (JBIC) conducted mangrove reforestation in Tarangnan and Calbiga, Samar and in Palompon, Leyte. The Community-Based Resource Management Project (CBRMP) was then implemented in the provinces of Eastern Samar, Leyte, Northern Samar, and Western Samar from 2000 to 2007, and involved mangrove rehabilitation activities. The CBFM-CARP undertook mangrove reforestation projects through CBFM POs in 2008, 2009, 2015, 2016, and 2019. The NGP/ Enhanced NGP (eNGP) has been implemented since 2011 and will run until 2028. The LGRP (2014), the MBFDP (2014-2015), and the YRRP (2018) were also implemented.

Table 3-22. Mangrove rehabilitation programs implemented in Region 8

Initiative	Extent (in ha)	Process	Funding Source	Implementing organization/s	Duration
FAR Project	No available data	Contract	ADB/OECF	NGOs, LGUs, Families	1989 - 1997
FSP-DENR Component	No available data	Contract	ADB	POs	1990 - 1995
CEP Enrichment Planting	No available data	By admin	DENR	POs	1997 - 1999
Mangrove Reforestation	No available data	Contract	JBIC	NGOs	1997 - 2003
CBFM-CARP	10	Contract	CARP	POs	2008
	25	Contract	CARP	POs	2009
	40	Contract	CARP	POs	2015
	60	Contract	CARP	POs	2016
	70	Contract	CARP	POs	2019
NGP/eNGP	3,987	Contract	Regular Fund	POs	2011 - 2028
LGRP	2,859		Central-Based		
MBFDP	12,416	Contract	Central-Based	LGUs/POs	2014 - 2015
YRRP	1,086	Contract	Central-Based	LGUs/POs	2018
Total	**20,553**				

Figure 3-19. Naungan-San Juan Mangrove Reserve and Bird Sanctuary

The Ormoc LGU together with the Naungan-San Juan Mangrove Planters Association (NSJMPA) established the 171-ha Naungan-San Juan Mangrove Reserve and Bird Sanctuary in 2017 (Figure 3-19). This mangrove eco-park, which serves as an ecotourism site, has 116 ha of mangrove area. It is being run by the PO in collaboration with CENRO Ormoc and the LGU.

The Municipality of Palompon has two mangrove protected areas in Brgys. Cambinoy (73 ha) and Tres Marias (1,234 ha; Figure 3-20). These are being managed by the Municipal Environment and Tourism Office, the Bililhong Ani sa Katunggan Hangtud sa Walay Katapusan (BAKHAW) MPC, and the Municipal Fisheries and Aquatic Resources Management Council (MFARMC). Other initiatives related to mangrove monitoring and management were also institutionalized by the Palompon LGU:

1. Mangrove growth and health monitoring
2. Sustaining the community-based mangrove study area
3. Launching modular-based mangrove open field school for elementary pupils
4. Pursuing collaborations with academic institutions for a scientific approach on mangrove research and management (establishment of rod Surface Elevation Table or rSET to monitor the effects of sea level rise on mangrove surface elevation)
5. Expanding partnerships with the scientific community and other sectors to encourage knowledge management
6. Sustaining the volunteerism project (community-based mangrove reforestation)
7. Introducing community-based tourism activities (e.g., mangrove paddling)

CENRO Sta. Rita in Samar identified mother trees of 21 mangrove species within the established 5-ha Seed Production Area/ Individual Plus Trees (SPA/ IPT) area in Brgy. Tinago (Figure 3-21). These species include *Xylocarpus granatum, X. moluccensis, Sonneratia alba, S. ovata, Rhizophora mucronata, R. apiculata, R. stylosa, Lumnitzera littorea, L. racemosa, Heritiera littoralis. Ceriops tagal, C. decandra, Bruguiera sexangula, B. gymnorrhiza, B. parviflora, Avicennia lanata, A. officinalis, A. marina, Aegiceras floridum, A. corniculatum,* and *Excoecaria agallocha*.

Figure 3-20. Tres Marias Mangrove Protected Area

Figure 3-21. Aerial view of the SPA/ IPT area in Brgy. Tinago in Sta. Rita, Samar

Another mangrove conservation initiative in the region is the established 105.7-ha Southern Leyte Bird Sanctuary in St. Bernard, Southern Leyte (Figure 3-22). Mangrove areas in Guiuan Marine Reserve PLS (456 ha), Cuatro Islas PLS, and Biri-Larosa PLS (4,830 ha) are also being protected. Patrols, surveillance, and monitoring are done regularly.

To enhance the level of awareness of LGUs, POs, fisherfolks, coastal communities, students and other stakeholders, IEC activities are being implemented (e.g., CEPA during participatory coastal resource assessments (PCRAs) in areas outside NIPAS MPAs, observance of environmental events such as World Wetlands Day and Month of the Ocean, and Citizen Science activities and lectures about mangroves particularly on their biology, ecological and economic benefits, and sustainable use and management).

Outcomes and impacts

Although the NGP has been criticized, successful reforestation efforts at the local level have yielded certain perceived benefits. The NSJMPA has benefitted from their implementation of the NGP by converting their muddy coastal areas into a 289-ha green mangrove plantation. They value the mangrove area because if properly managed, it will provide habitat for marine life, serve as breeding ground for fish and other marine creatures, and prevent shoreline erosion, among others. NSJMPA now boasts of their eco-park as an avenue for additional income generation. They prepare and serve food to tourists, operate boats to transport visitors, and generate income from cottage rentals, bird watching, kayaking, and other featured activities.

The Kauswagan San Panginabuhi ngan Kapalibutan (KSPK) in Biri, Northern Samar has also reported benefits from their mangrove conservation activities. They now enjoy the benefits of abundant catch of fish, crabs, prawns, and shellfish. The mangroves are also perceived to protect lives and property from typhoons and their impacts. In Biri, the mangrove plantation serves as an additional tourist attraction, to go along with the majestic rock formations in the area.

The coastal community of Barobaybay in Calbiga, Samar previously utilized mangrove trees as firewood and building material, which depleted the rich mangrove forests, diminishing their capacity to effectively provide ecosystem services and benefits. However, with the implementation of the NGP, the Barobaybay Mangrove and Marine Conservationist Association (BMMCA) now boasts a lush 153-ha mangrove plantation. The group has realized that, by saving mangroves, they have also saved themselves and built a better and stronger community (DENR Region 8, 2017).

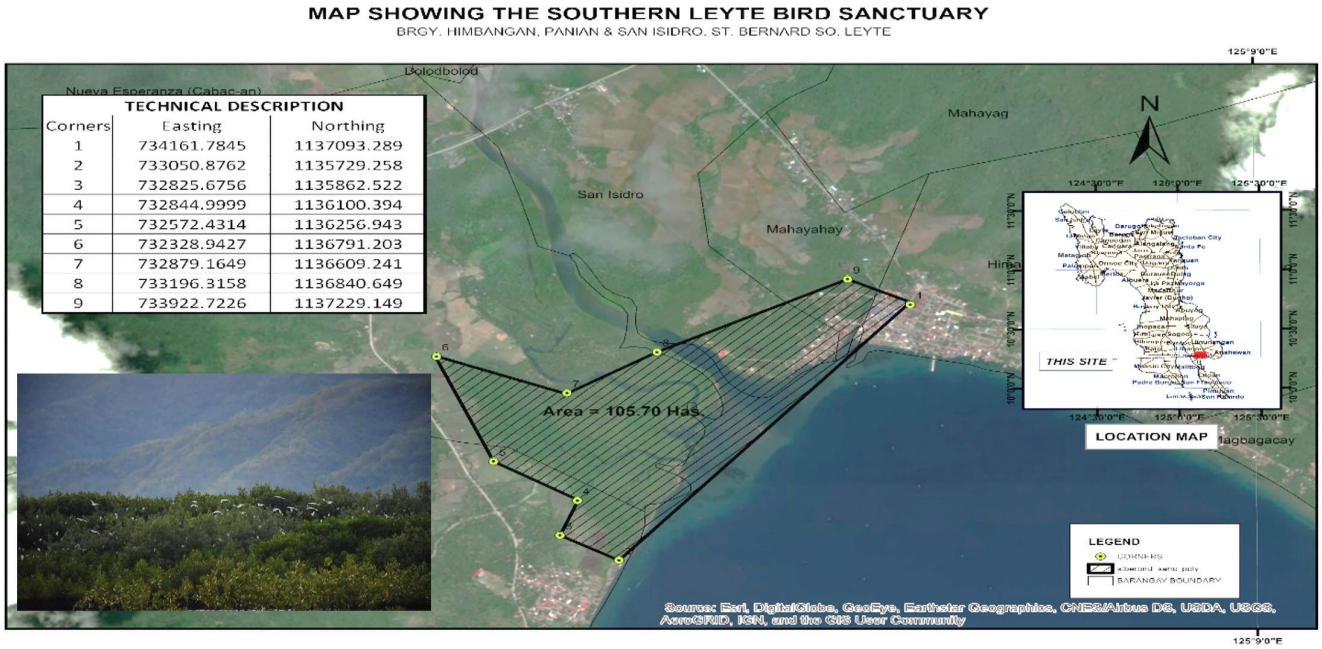


Figure 3-22. Map of Southern Leyte Bird Sanctuary and mangrove area (inset, lower left photo)

IV. Summary and recommendations

Although mangroves are protected by law, there is still a decline in mangrove cover due to poaching, charcoal making, encroachment by informal settlers, land conversion, construction of dikes, siltation, solid waste pollution, and natural stressors such as typhoons, pests, and diseases.

Mangrove rehabilitation and/ or reforestation has made much headway and impact in the region through the implementation of the MBFDP, NGP and other initiatives by LGUs, NGOs and CSOs. The combined accomplishments of various efforts have resulted in 20,553 ha of mangrove areas as of 2019. This is on top of rehabilitation and/ or reforestation efforts undertaken earlier than 2011.

To ensure the success of mangrove conservation initiatives, there must be strict implementation of science-based development strategies such as species-site matching to ensure high survival of planted mangrove seedlings. Planting *Avicennia* and *Sonneratia* species in sites where barnacle infestation occurs, particularly in the seafront and areas exposed to tidal waters, should be avoided. The use of 100% potted planting materials in the seaward orientation of the planting sites for high survival and good growth performance of the planted species should also be implemented.

To further ensure the success of mangrove rehabilitation efforts, there should be convergence of LGUs and other government agencies such as the DOST, DA-BFAR, NGOs, and other organizations that are technically capable in mangrove management and protection. Continuous feedback and monitoring & evaluation should be undertaken. To sustain management impacts, stakeholder collaboration and consultation should be strengthened from planning to implementation, as well as in documentation and monitoring & evaluation.

Solid waste management should be strictly implemented, and biodiversity-friendly livelihoods should be encouraged. To ensure active participation and involvement from coastal stakeholders, there should be continuous education on mangrove plantation establishment and management. Lessons learned and best practices from successful mangrove initiatives should also be disseminated and replicated where appropriate.

V. References

Borja, E. M. (2019). CENRO Sta. Rita Memorandum, 23 September 2019.

DENR. (ny). NGP/ MBFDP Reports.

DENR. (ny). PENROs/ CENROs Reports.

DENR Region 8. (ny). Regional Profile.

DENR Region 8. (2017). Greening Eastern Visayas: People's Organizations' Experiences in NGP Implementation, Vol. I. Tacloban City, DENR.

NAMRIA. (ny). Ground Validation Survey, 2014-2016.

Salmo, S. G. III, De La Cruz, M. D., and Gianan, E. L. D. (2019). State of the Mangrove Summit: Central and Eastern Visayas Proceedings. Ateneo de Manila University, 129 p.

Tubania, M. L. (2019). PENRO Eastern Samar Memorandum, 23 September 2019.

State of the Mangroves in Mindanao

Sitti Zayda B. Halun
Mindanao State University - Tawi-Tawi College of Technology and Oceanography

I.Introduction

Mindanao is the second largest island group in the Philippines with a total land area of 97,530 sq km and is located at the southernmost part of the archipelago. It is surrounded by four seas: the Sulu Sea in the west, the Philippine Sea in the east, the Celebes Sea in the south, and Mindanao Sea in the north. The island is subdivided into six administrative regions (Zamboanga Peninsula, Northern Mindanao, Davao Region, Caraga Region, SOCCSKSARGEN, and BARMM) with 27 provinces, 33 cities, 422 municipalities and 10,084 barangays. As of 2015, Mindanao has a total population of 24,135,775, and a great proportion of it relies on fisheries as their primary source of food and livelihood. But marine ecosystems such as mangrove forests are continuously threatened and degraded with various anthropogenic activities (e.g., illegal cutting, conversion to fishponds, reclamation projects, and coastal development) and natural disturbances (e.g., typhoons, storm surges, sea level rise). Thus, there is a need to protect and sustainably manage this highly valuable ecosystem.

Importance of mangroves

Mangroves are important in supporting biodiversity because they serve as a nursery for juvenile fishes, nesting ground for bird species, and habitat in general to a wide variety of organisms. As such, they are a critical component of commercial fishing in the region. These salt-tolerant species also provide several ecological services like erosion control, soil accretion, wastewater treatment, flood attenuation, and shoreline protection, as well as carbon sequestration and storage.

Mangroves are considered a renewable resource, with coastal communities relying on mangrove wood for construction material and fuel. Mangrove areas in Mindanao are also utilized for their educational and scientific values. For instance, the forests in Taytay and Molugan in El Salvador City, Misamis Oriental were adopted by Capitol University and Xavier University as their extension areas for research and development, and community outreach programs. Ecotourism development in mangrove areas has become a popular investment of local government units to provide livelihood to the local communities. Ecotourism activities in mangroves include kayaking, canoeing, stand-up paddling, and mangrove tours, among others. Among these developed mangrove areas are the Aqua Marine Park in Laguindingan; mangrove boardwalks in Alubijid and Gingoog City, Misamis Oriental and Maasim and Glan, Sarangani Province; Baliangao Protected Landscape and Seascape in Misamis Occidental; and the Mangrove Boardwalk and Training Center in Kauswagan Lanao del Norte.

II. Status of mangroves in Mindanao

The provinces in the Philippines with the largest remaining mangrove area are in Mindanao (Long and Giri, 2011). Of the total mangrove cover in the Philippines (256,185 ha), Sulu contributes 8%, Zamboanga Sibugay, 5.4%, Surigao del Norte, 4.62%, Tawi-Tawi, 4.4%, Zamboanga del Sur, 3.7%, Basilan, 2.97%, and Surigao del Sur, 2.19%.

Mindanao island has a total mangrove cover of 110,355.38 ha, of which 46% can be found in the Bangsamoro Autonomous Region of Muslim Mindanao (BARMM). The Caraga Region contributes 24.5% of the total mangrove cover in Mindanao, closely followed by Zamboanga Peninsula with 26,524 ha, Northern Mindanao with 5,216.9 ha, Davao Region with 3,123.22 ha, and SOCCSKSARGEN with 331.74 ha (Table 3-23).

Among the mangrove genera that can be found in Mindanao, *Rhizophora* and *Avicennia* were found to be dominant. Other genera include *Acanthus, Acrostichum, Aegiceras, Bruguiera, Ceriops, Dolichandrone,*

Table 3-23. Mangrove cover (in ha) in Mindanao

Region	Mangrove Area (ha)
Region 9	14, 387 (mangrove area) 11,941.73 (rehabilitated under NGP)
Region 10	5,776.35 (mangrove cover)
Region 11	3,123.224 (natural growth stands) 1,768 (planted)
Region 12	331.74 (SBPS mangrove area)
Region 13	27,049.74 (mangrove area)
BARMM	51,324 (mangrove cover)

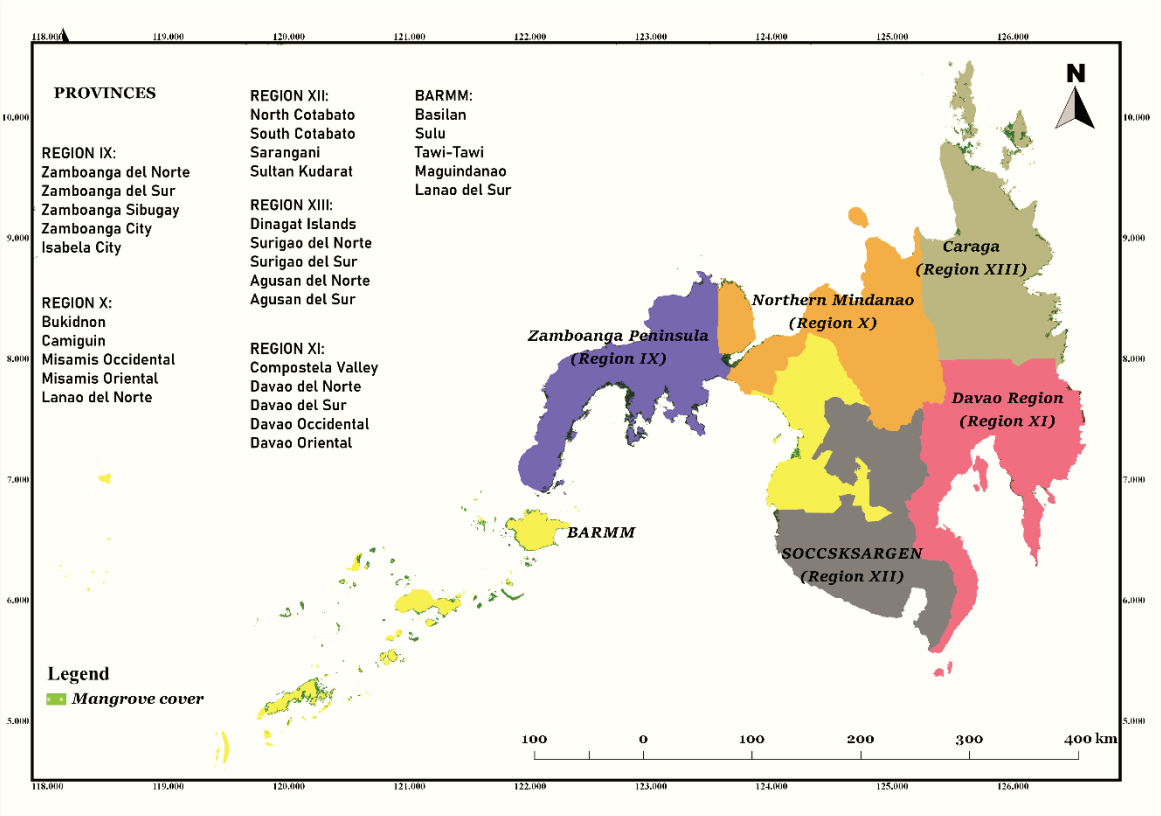


Figure 3-23. Map showing the mangrove cover in Mindanao.

Excoecaria, Heritiera, Lumnitzera, Nypa, Pemphis, Scyphiphora, Sonneratia, and *Xylocarpus*. Northern Mindanao is one of the regions in the Philippines to have high species richness (≥ 30 species). The lowest species richness, observed in Caraga and BARMM, is < 20 species (Fortes and Salmo, 2015).

Most coastal areas in Mindanao are highly susceptible to natural disturbances like typhoons and the dangers brought upon by rising sea levels. Considering such risk, the regions have employed various mangrove management strategies, from rehabilitation and establishing plantations to declaration of protected areas, to name a few. Through the implementation of the National Greening Program (2010 to present), a total of about 16,653.2 ha of mangroves that were planted with mostly *Rhizophora* species were rehabilitated in Regions 9, 10, and BARMM. These were undertaken by each region's respective DENR office, and are now maintained by various People's Organizations, project stakeholders, and LGUs. Some mangrove areas are under the NIPAS, and managed by a Protected Area Management Board and the DENR, which set policy guidelines and ensure sustainable resource development. Among these are the 153.77 ha in the Bacolod Kauswagan Protected Landscape and Seascape in Lanao del Norte and the 62.24 ha in the Baliangao Protected Landscape and Seascape in Misamis Oriental, both in Region 10. The Sarangani Bay Protected Seascape, which was established in 1996, has 331.74 ha of mangroves that is dominated by *Rhizophora* species. The Baganga Mangrove Swamp Forest Reserve in Davao Region has an estimated 1,469.27 ha with 17 species, dominated by *Rhizophora apiculata* and *Xylocarpus granatum*.

Threats to mangroves

Most mangrove areas are near coastal communities, and thus affected by anthropogenic activities such as mangrove clearing and/ or destruction for reclamation projects and coastal development; mangrove siltation due to mining; improper waste disposal; and cutting and collecting of mangrove trees and derivatives for construction material, firewood, and charcoal production. The continuous increase in population translates to an increased demand for food, shelter and other resources, which lead to overexploitation at the expense of the environment. Development in fast-growing cities like General Santos City, Sarangani could greatly impair the coastal environment because of the expansion of industrial facilities (i.e., factories), and the boom of the fishing industry. Clearing mangrove areas for aquaculture and salt farms has been a major factor of

mangrove loss especially in Region 9. Unstable peace and order in some areas in BARMM and the somewhat passive behavior of some LGUs regarding mangrove rehabilitation are also important concerns. Apart from anthropogenic activities, natural disturbances are known to be debilitating to mangroves. These include strong typhoons, storm surges, coastal erosion, pests and diseases, natural predation (e.g., by fiddler crabs), and climate change and sea level rise.

III. Summary and management recommendations

A great proportion of the Mindanao population relies on fishery resources for food and livelihood, thus, marine ecosystems like mangroves must be protected and managed sustainably. Throughout the years, the regions in Mindanao have been establishing various management strategies to at least reduce the degradation of mangrove ecosystems. But despite these great efforts, there are still gaps and issues regarding mangrove protection, management, and conservation that must be addressed.

Some of the recommendations to further support mangrove protection and management in Mindanao include:

1. Maintain and protect existing mangrove areas
2. Strictly implement solid waste management
3. Facilitate more effective collaboration among NGAs, NGOs, and LGUs and local communities
4. Adapt science-based policies and rehabilitation methods to ensure long-term success
5. Capacitate and educate not only field personnel, but also LGU officials
6. Harmonize conflicting policies and overlapping development plans of the national government and the local government units
7. Standardize protocols on mangrove rehabilitation, and Monitoring & Evaluation
8. Undertake continuous Information, Education and Communication campaigns about the importance of mangroves and the need for their conservation

IV. References

Philippine Statistics Authority. (2015) Philippine census.

___. (ny). “Distribution.” Philippine Mangroves: Biodiversity, Conservation, and Management, https://mangroveecology.com/ph-mangroves/distribution/.

Fortes, M. D. and Salmo, S. G. III. (2015). "Status of Mangrove Research and Management in the Philippines: Challenges and Opportunities," in State of the Mangrove Summit: Northwestern Luzon Proceedings by S. G. Salmo III, A. M. T. Favis, and M. N. S. Ting (eds). Ateneo de Manila University, 113 p.

Long, J.B., Giri, C. (2011). Mapping the Philippines’ Mangrove Forest Using Landsat Imagery. Sensors, 11 (3), pp. 2972-2981.

State of the Mangroves in Region 9

Chantal S. Tiga
DENR Region 9

I. Introduction

Zamboanga Peninsula or Region 9 is located in western Mindanao, extending southwest towards the Sulu Archipelago and Borneo. The region has an area of roughly 1.45 million ha and is bordered on the north and west by the Sulu Sea, and on the south by the Moro Gulf. It consists of three provinces – Zamboanga del Norte, Zamboanga Sibugay and Zamboanga del Sur, and two cities – Isabela City and Zamboanga City. The region was previously known as Western Mindanao before the enactment of Executive Order No. 36 on 12 August 2015. The peninsula is connected to the rest of Mindanao through an isthmus situated between Panguil Bay and Pagadian Bay.

The region has a vast coastline of 1,330 km. The peninsula is surrounded by numerous bays and islands of varying sizes. It has access to five of the richest fishing grounds in the country – the Sulu Sea, Moro Gulf, Sindangan Bay, Pilas Channel, and Celebes Sea. Its marine environment is home to diverse and export-oriented marine resources. As such, it is considered Mindanao's Coastal Fishery Center (NEDA Region 9, 2013).

Importance of mangroves

Mangroves provide numerous goods and services to the marine environment, as well as to human communities. They help reduce damage caused by floods, strong waves, and storm surges. Mangroves help prevent erosion by stabilizing sediments with their tangled root systems. They also maintain water quality by filtering pollutants and trapping sediments.

Mangroves support the community's revenue generation, food security, and other socio-economic needs. They serve as valuable nursery areas for fish, and shrimp and other shellfish, which are critical components of the region's commercial fishing industry. Many coastal and indigenous communities in the region rely on mangrove wood for construction and fuel. Finally, mangrove areas are important for tourism because of their high biodiversity including the presence of migratory birds and other endemic species.

II. Status of mangroves in the region

As of 2010, the region has a total mangrove forest cover of 26,524 ha, with highest cover in Zamboanga Sibugay, followed by Zamboanga del Sur, Zamboanga City, the City of Isabela, and Zamboanga del Norte (Table 3-24; DENR-FMB, 2010). Forty-one mangrove species have been observed in the region, with as many as 30 documented in Zamboanga del Sur, and 26 each in Zamboanga Sibugay and Zamboanga del Norte. A total 11,941.43 ha of mangrove area was rehabilitated under the DENR National Greening Program (NGP; Table 3-25).

Table 3-24. Status of mangroves in Region 9

Province	Mangrove area (ha)	NGP mangrove area rehabilitated (ha)	No. of species
Zamboanga Sibugay	14,018	8,200.50	26
Zamboanga del Sur	6,105	3,480.50	30
Zamboanga City	4,976		
City of Isabela	833		
Zamboanga del Norte	592	261	26
Regional total	**26,524**	**11,941.73**	**41**

Table 3-25. Mangrove rehabilitation under the National Greening Program in Region 9

Area	Extent (ha)	Process	Funding source	Implementing organization	Duration
Zamboanga Sibugay	8,170.50	Comprehensive site development	NGP	DENR	2012-2014 2013-2015 2014-2016 2015-2017 Ongoing efforts (started in 2017, 2018, and 2019)
Zamboanga del Sur	3,480.23	Comprehensive site development	NGP	DENR	2012-2015 2017-2019
Zamboanga del Norte	261	Comprehensive site development		DENR	2011-2013 2012-2014 2015-2017 Ongoing (started in 2017)
Zamboanga City	30	Comprehensive site development		DENR	2016-2018

Table 3-26. Survival rate of planted mangroves under the National Greening Program in Region 9

Year	No. seedlings, planted	No. seedlings, survived	Survival rate
2011	8,000	6,912	86.40%
2012	110,776	102,397	92.40%
2013	2,134,000	1,903,291	89.10%
2014	3,747,500	3,324,777	88.70%
2015	6,641,955	5,257,507	79.15%
2017	81,000	70,770	87.37%

Perceived threats to mangrove ecosystem

Human activities continue to threaten the mangroves in Region 9. Clearing for various uses such as agriculture, human settlements, public infrastructure (e.g., ports), and more recently for aquaculture and salt farms, has been a major factor of local mangrove loss. Mangrove wood is further used for fishpond construction, firewood, and charcoal production, with trees being cut and/ or harvested at an unsustainable rate.

Activities in other ecosystems have also affected the mangrove ecosystem. Erosion as a result of deforestation has resulted in increased sedimentation, affecting the filtering capacity in mangroves. Freshwater diversions for agricultural and household use have caused the mangroves to dry out. Illegal fishing, which persists in certain areas in the region, have destroyed coral reefs that serve as the first barrier against currents and strong waves. Without the effective buffering action of reefs, strong waves and currents can reach the coast and undermine the mangrove substrate. Seedlings would be prevented from taking root and may simply be washed away.

Aside from these man-made threats, there are also those brought about by climate change. Mangrove forests require a stable sea level for long-term survival, and are therefore extremely sensitive to sea level rise.

III. Mangrove protection and management

In light of the risk of more intense typhoons and their impacts on local communities, the Philippine government has included mangrove rehabilitation through Assisted Natural Regeneration (ANR) as a component under the DENR's National Greening Program (NGP). Mangrove rehabilitation was implemented by concerned stakeholders including members of registered POs. The NGP covered site validation and assessment, baseline/ benchmark data collection on validated sites, site preparation, nursery establishment and operation by the concerned community to produce the required number of planting materials, wildlings and propagules collection/ production, plantation establishment, community capacity building, maintenance and protection, and project monitoring and supervision. Under the NGP's comprehensive site development, a total 11,941.73 ha of mangrove area was rehabilitated (Table 3-25) and a total of 356 POs were mobilized. Seedlings planted have had a survival rate higher than 75%, even reaching up to 92.4% in 2012 (Table 3-26).

IV. Summary and recommendations

Zamboanga Peninsula has a total mangrove cover of 26,524 ha, with as many as 41 mangrove species. The region's marine environment and local communities benefit greatly from the mangrove ecosystems, but human activities that create associated threats to these habitats persist.

To ensure effective conservation and management of mangroves in the region, a mangrove protection task force must be created and mobilized. There should also be a co-management arrangement among different line agencies. Supplemental livelihood interventions should be in place, to reduce dependence on extractive activities in mangrove areas. Lastly, mangrove assessments should be conducted prior to rehabilitation to ensure baselining and mangrove speciation.

V. References

DENR-FMB. (2010). Forest cover of Zamboanga Peninsula, https://forestry.denr.gov.ph/index.php/forest-cover-region9.

NEDA Region 9. (2013). Regional Development Agenda - Zamboanga Peninsula.

State of the Mangroves in Region 10

Mercedita G. Barbarona
Coastal Resources and Foreshore Management Section,
DENR Region 10

I. Introduction

Northern Mindanao or Region 10 is comprised of five provinces – Bukidnon, Camiguin, Misamis Occidental, Misamis Oriental, and Lanao del Norte. The provinces are further subdivided into 14 congressional districts, seven component cities, 84 municipalities, and 2,022 barangays. All provinces in the region, except for Bukidnon, are coastal provinces. Out of the 2,022 barangays, 394 are classified as coastal barangays with a total coastline length of 701 km (Table 3-27).

Importance of mangroves

Mangrove ecosystems in Northern Mindanao serve many ecological and economic functions, and are also important in education. Mangroves act as a protective barrier for coastal communities. According to coastal residents, mangroves have protected them from flood risks in 2009 to 2012. Mangroves help maintain coastal integrity and improve water quality by filtering sediments and solid waste, among other pollutants. They also serve as an important habitat for various species such as migratory birds and shorebirds.

Ecotourism development in mangrove areas has become a popular investment for LGUs. Mangrove ecotourism sites in Misamis Oriental include the Aqua Marine Park in Laguindingan, Mangrove Boardwalk in Alubijid, and Pangasihan Mangrove Boardwalk in Gingoog City. In Misamis Occidental, there is the Sinacaban Aqua Marine Park in Sinacaban, and the Mangrove Boardwalk in Baliangao PLS. The Province of Lanao del Norte has the Mangrove Boardwalk and Training Center in Kauswagan, and Camiguin has the Katungan Park in Benoni, Mahinog. The mangrove plantation in Bonbon, Cagayan de Oro City is a favorite demonstration area for mangrove rehabilitation and is a famous site for planting activities among national agencies, NGOs, and private sectors.

Mangrove areas also serve as research sites for the academe. Capitol University and Xavier University in Cagayan de Oro City have adopted the mangrove plantations in Taytay and Molugan in El Salvador City, Misamis Oriental as their sites for research and development, and community outreach and extension. The mangrove area in Pangasihan, Gingoog City has been used as a study site for research students from Central Mindanao University.

II. Status of mangroves in the region

Misamis Occidental has the largest mangrove area in Region 10 with 2,653.73 ha, followed by Lanao del Norte (2,618.93 ha), Misamis Oriental (471.93 ha), and Camiguin (21.41 ha; Table 3-27).

In Misamis Occidental, diverse mangrove areas are found in the municipalities of Baliangao, Plaridel, and Lopez Jaena. In Lanao del Norte, the diverse mangrove areas are found along Panguil Bay, particularly in the municipalities of Lala, Kapatagan, and Kolambugan (Figure 3-24).

There are more than 27 mangrove species in Lanao del Norte, Misamis Occidental, and Misamis Oriental. The Province of Camiguin has limited mangrove species which are mostly *Rhizophora* and *Avicennia* species found in the municipalities of Guinsiliban and Mahinog.

Table 3-27. Mangrove cover (ha) and administrative information in Region 10

Province	Number of coastal municipalities/ cities	Number of coastal barangays	Coastal length, km	Mangrove area, ha
Misamis Occidental	14	237	110	2,653.73
Lanao del Norte	11	78	127	2,618.93
Misamis Oriental	25	164	273	471.93
Camiguin	5	42	64	21.41
Total	**55**	**521**	**574**	**5,766**

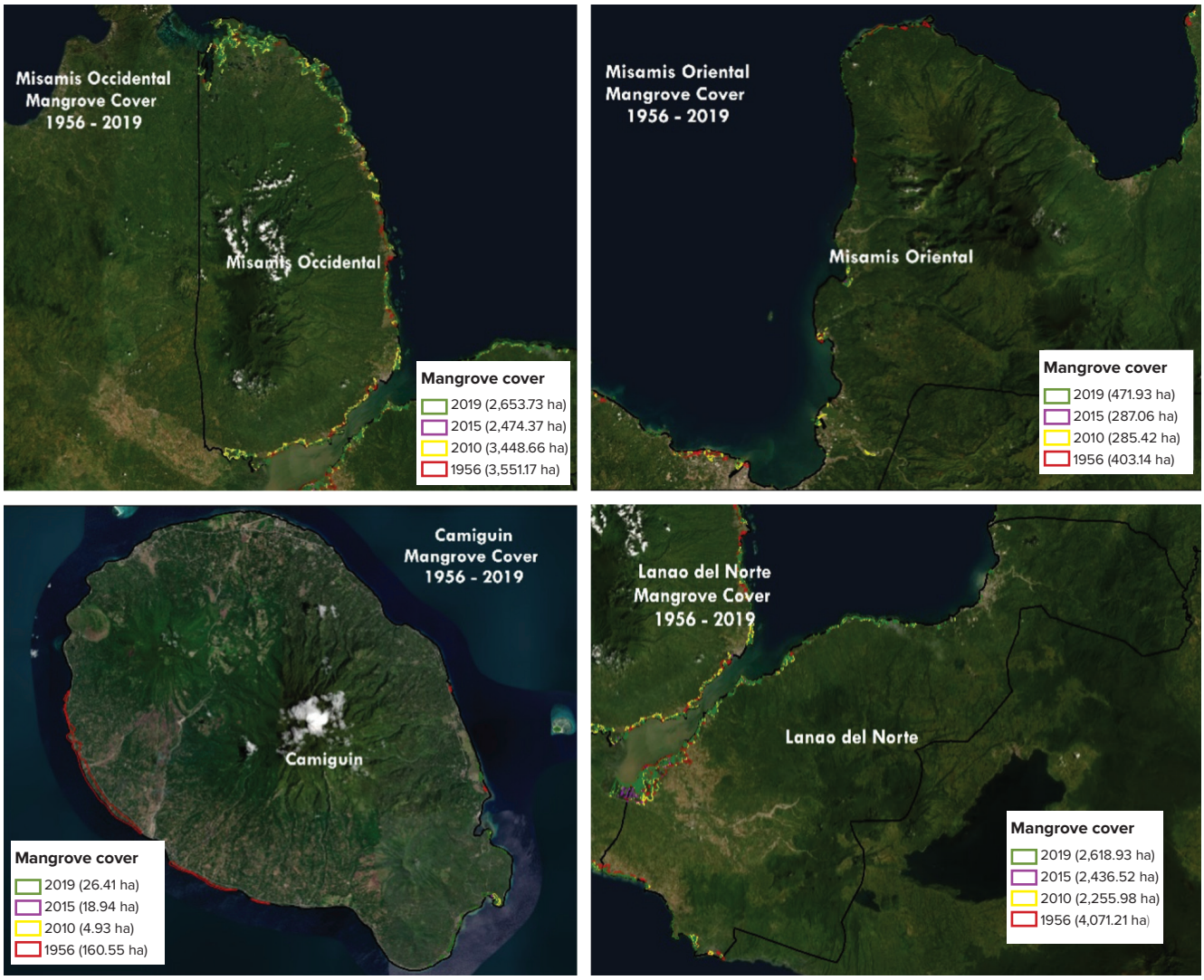


Figure 3-24. Mangrove cover by province (1956-2019)

Mangrove cover in the region has been declining through the years due to rapid development and industrialization. From a mangrove cover of 8,920 ha in 1956, it declined to 5,994.99 ha in 2010 then to 5,216.9 ha in 2015 (NAMRIA, 1956; NAMRIA, 2015). Approximately 3,700.27 ha of mangrove cover was lost in the last 50 years at a rate of 41.47%. Of the original mangrove area, 17% was converted into fishponds, 4% into built-up areas, and 20.47% into other land uses. Typhoons have also contributed to the decline in mangrove cover. From 2011 to 2015, several typhoons that hit Northern Mindanao including Typhoons Sendong (2011) and Pablo (2012) washed out many mangrove areas, uprooted old mangroves, and damaged newly planted trees. Both natural and anthropogenic factors have contributed to mangrove degradation in the region (Figure 3-25).

III. Mangrove protection and management

In the 1990s, DENR Region 10 piloted the Coastal Environmental Program (DAO No. 19, s. 1993) in 27 coastal municipalities. Mangrove plantations were established in selected pilot sites through community organizing and comprehensive site development schemes (Table 3-28).

From 2001 to 2010, mangrove rehabilitation was undertaken by DENR Region 10 through the Management of Coastal and Marine Ecosystems Program, and in 2011, through the Upland Development Program (UDP). These programs were then improved through the implementation of the National Greening Program (NGP) in 2010 up to the present. To date, the region has a total 1,180.47 ha of established mangrove plantations, which are maintained by various POs, project beneficiaries, and LGUs (Table 3-29).

Table 3-28. Coastal Environmental Program sites in Region 10

Province	Municipality/ city	Barangay
Misamis Occidental	Baliangao	Punta Sulong, Punta Miray, Poblacion, and Naburos Island
	Tudela	Cabulanonan
	Sinacaban	Sinonoc
	Lopez Jaena	Sibula and Katipa
	Plaredel	Pulo Bato and Panalsalan
Lanao del Norte	Sultan Naga Demapuro	Pandanan and Pikinit
	Bacolod	Binoni
	Kauswagan	Kawit
	Kulambugan	Mukas
Misamis Oriental	Laguindingan	Tubajon
	Alubijid	Baybay
	Balingoan	Lapinig and Mintabon
	Gingoog City	Pangasihan and Talisayan
	Guinsiliban	Cantaan
Camiguin	Mahinog	Rogne

Figure 3-25. Man-made and natural threats to the mangrove ecosystem in Region 10

Table 3-29. Mangrove rehabilitation and plantation sites established through the DENR's UDP and NGP/ eNGP in Region 10

Program	Area (ha)	Process	Implementing organization	Duration
Upland Development Program	66	Contract of Service	PO	2009
	8.11	Contract of Service	PO	2010
	4.06	Contract of Service	PO	2011
National Greening Program	75.28	LOA/MOA	PO/BLGU	2011-2013
	132.68	LOA/MOA	PO/BLGU	2012-2014
	198.02	LOA/MOA	PO/BLGU	2013-2015
	43.96	LOA/MOA	PO/BLGU	2014-2016
	469.85	LOA/MOA	PO/BLGU	2016-2018
Enhanced National Greening Program	51.01	LOA/MOA	PO/BLGU	2017-2019
	131.5	LOA/MOA	PO/BLGU	2018-2020
Total	**1,180.47**			

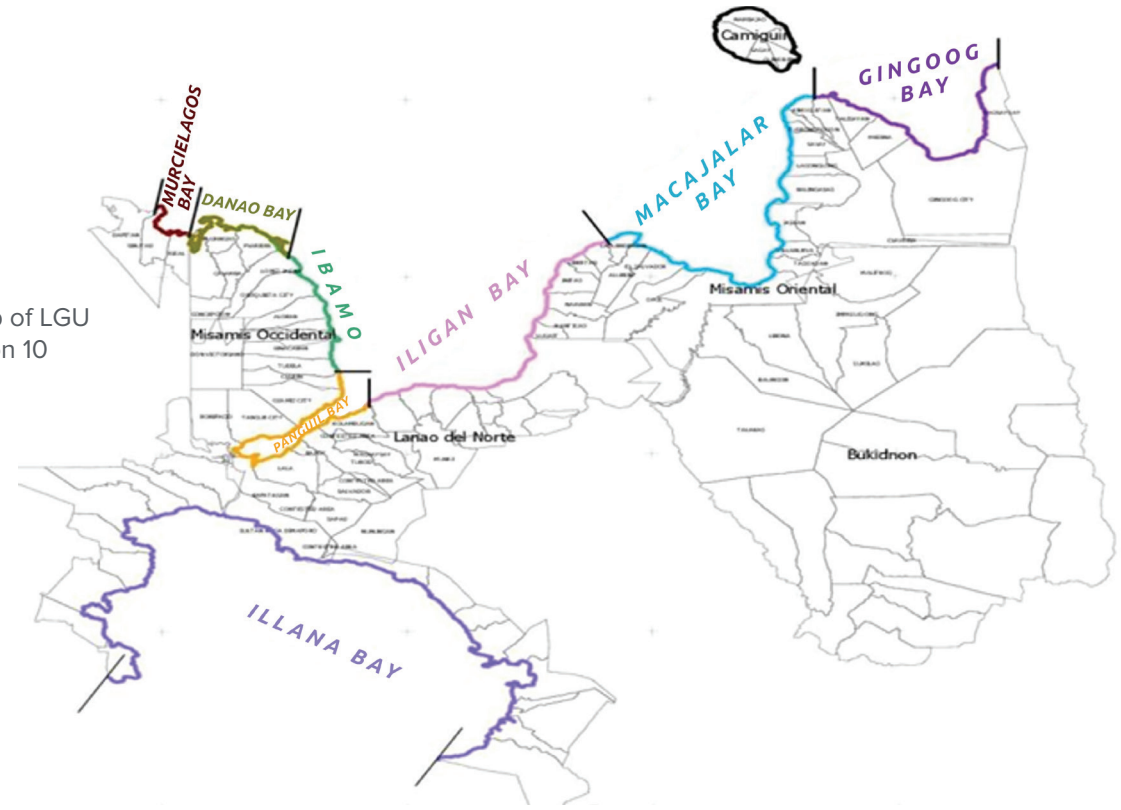


Figure 3-26. Map of LGU alliances in Region 10

A total 271.24 ha of mangrove area in Region 10 is within the following NIPAS sites: Bacolod Kauswagan PLS in Bacolod-Kauswagan, Lanao del Norte (153.77 ha); and Baliangao PLS in Baliangao, Misamis Oriental (62.24 ha). Mangrove areas in NIPAS sites are managed by the respective PAMB while protected mangroves outside NIPAS are managed by the LGUs and partner POs.

Under the Integrated Coastal Management Program (Executive Order No. 533, s. 2006), coastal LGU alliances were formed and organized in collaboration with DENR Region 10, (Figure 3-26). The Gingoog Bay Alliance, Macajalar Bay Development Alliance, and Panguil Bay Development Council are active while the Danao Bay Alliance and Eastern Iligan Bay Alliance are still in their formative stages. The alliances in the region form part of larger ICM alliances and MPA networks. At the local level in Camigiun, a Coastal Law Enforcement Team (CLET) was organized during the implementation of the Camiguin Coastal Resource Management Program (2008-2012), and still exists to date.

IV. Summary and recommendations

Mangrove cover in Northern Mindanao has decreased due to natural and anthropogenic factors. To address this, several mangrove rehabilitation programs were implemented by DENR Region 10. To date, a total 1,180.47 ha of mangrove plantations was established in the region. These are mostly protected and maintained by LGUs and partner POs, and by a PAMB within NIPAS sites. The mangrove cover of the region has increased by 10.52% from 5,216.9 ha in 2015 to 5,766 ha in 2019.

Mangrove protection and maintenance is a shared responsibility between the DENR, LGUs, and various stakeholders. For more effective mangrove management, there is a need for the DENR Central Office to develop comprehensive Implementing Rules and Regulations on the valuation and assessment of mangroves, as well as seagrasses and coral reefs. Funding support to local governments is necessary to strengthen the protection and management of the existing local marine protected areas and mangrove areas outside NIPAS sites. Most importantly, clear guidelines for the DA-BFAR to turn over AUU fishponds under Fishpond Lease Agreements must be resolved.

V. References

NAMRIA. (1956). Mangrove Cover.
NAMRIA. (2015). Land Cover.

State of the Mangroves in Region 11

Gil Bigcas
DENR Region 11

I. Introduction

Davao Region or Region 11 is located in the southeastern part of Mindanao surrounding the Davao Gulf. The region is bounded on the north by the provinces of Surigao del Sur, Agusan del Sur, and Bukidnon, in the east by the Philippine Sea, and in the west by the Central Mindanao provinces. There are five provinces in the region namely Davao del Norte, Davao del Sur, Davao Occidental, Davao Oriental, and Davao de Oro.

II. Status of mangroves in the region

Davao Region has a total estimated forest cover of 428,717 ha, of which 3,123.224 ha is mangrove natural growth (DENR, 2011; DENR, 2018; Table 3-30).

In 2018, a mangrove assessment was conducted in Baganga Mangrove Swamp Forest Reserve, an initial component of the E-NIPAS declared under Presidential Proclamation 2152 (Figure 3-27). Quadrats were established in representative stations across the entire municipality. The stands were in generally fair condition at 27.33% crown cover, with 17 true mangrove species observed (Table 3-31). *Rhizophora apiculata* had the highest relative density at 44%, followed by *Xylocarpus granatum* at 25%. Both species can adapt to a wide range of soil types, but the former is mostly found in muddy areas. Other associated flora observed were *Ficus* spp. (balete), *Cocos nucifera* (lubi), T*erminalia catappa* (talisay), *Acrostichum aureum* (palaypay), *Acanthus ilicifolius* (lagiwliw or bongirit), and *Morinda citrifolia* (noni, apatot, or sampinit).

Table 3-30. Distribution of forest and mangrove stands in Davao Region

Province	Forest cover, ha	Mangrove natural growth stands, ha
Compostela Valley (Davao de Oro)	144,653	176.477
Davao del Norte	53,146	322.607
Davao del Sur	68,593	276.923
Davao Occidental		166.267
Davao Oriental	162,325	2,180.95
Total	**428,717**	**3,123.22**

Note: Data may be updated with new information from maps, surveys, and ground validation. Notably, the mangrove area in Davao Occidental and Davao del Sur may further be delineated because they are now separate provinces.

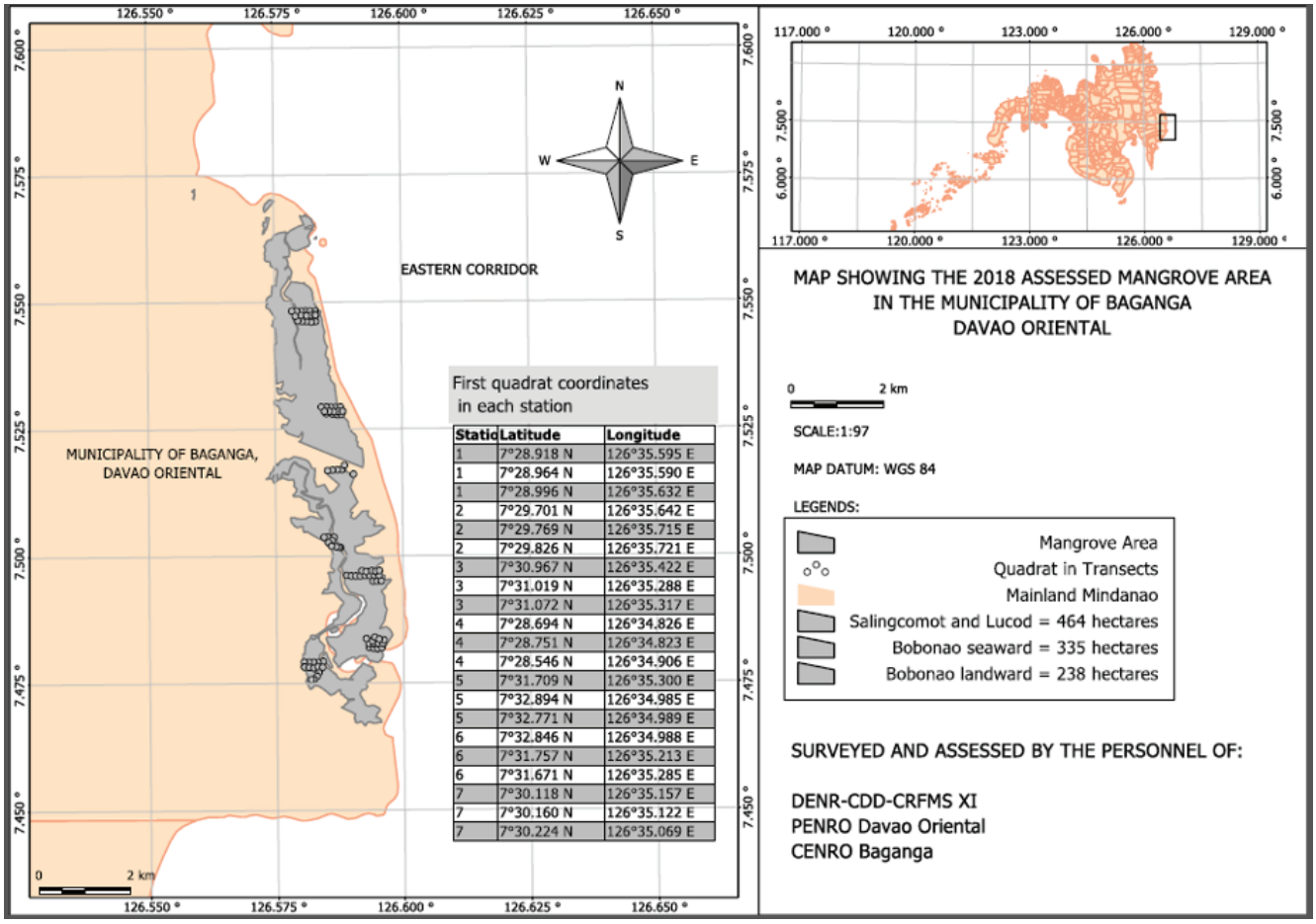


Figure 3-27. Map showing mangrove assessment sites in Baganga, Davao Oriental in 2018

Mangrove condition was fair, with an average of 2.72 mangrove wildlings per 100 sq m and an average mangrove height of 6 m (Figure 3-28). Moderate disturbance with noticeable mangrove cuttings was also observed.

During the onslaught of Typhoon Pablo in December 2012, the mangrove ecosystem in Baganga was heavily damaged. During the assessment, the team witnessed a wide area of dead and decaying mangrove trees in the inner portion of Brgy. Bobonao. Still, there were also recovering mangrove trees, as well as signs of mangrove reforestation activities. Unfortunately, evidence of cutting was also observed (a cut *X. granatum* or tabigi), so the illegal practice still apparently persists.

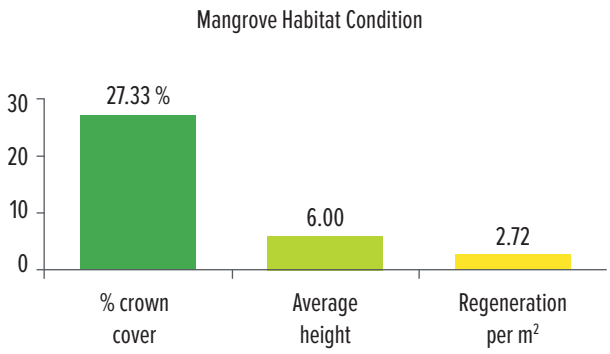


Figure 3-28. Mangrove assessment information for Baganga, Davao Oriental in 2018

Table 3-31. Mangrove profile and species abundance in Baganga, Davao Oriental (2018)

Family	Genera	Species	Local name	No. individuals
Avicenniaceae	*Avicennia*	*A. lanata*	piapi	1
Combretaceae	*Lumnitzera*	*L. littorea*	tabaw	29
		L. racemosa	kulasi	7
Lythraceae	*Sonneratia*	*S. alba*	pagatpat	1
		S. ovata	pedada	1
Meliaceae	*Xylocarpus*	*X. granatum*	tabigi	223
		X. moluccensis	piagau	22
Myrsinaceae	*Aegiceras*	*A. corniculatum*	saging-saging	13
		A. floridum	tinduk-tindukan	3
Palmae	*Nypa*	*N. fruticans*	nipa	34
Rhizophoraceae	*Bruguiera*	*B. gymnorrhiza*	busain	3
		B. sexangula	pototan	12
	Ceriops	*C. tagal*	tangal	3
	Rhizophora	*R. apiculata*	bakauan lalaki	396
		R. mucronata	bakauan babae	137
		R. stylosa	bakawan bato	17
Sterculiaceae	*Heritiera*	*Heritiera littoralis*	dungon	6
			Total	**908**

Other man-made and natural threats were also observed. Man-made threats include conversion for various uses, solid waste pollution, and cutting and collection of mangroves and its derivatives; while natural threats are the predation of fiddler crabs and regenerants, strong waves, and unfavorable weather conditions.

III. Summary and recommendations

Various management actions may be undertaken based on the assessment of Baganga Mangrove and Swamp Forest Reserve. A Memorandum of Agreement on Adopt-a-Mangrove must be forged among stakeholders. Initiatives for education and communication should also be in place. Regular maintenance activities such as community-led coastal clean-ups and habitat monitoring and assessment, among others, should further be conducted.

IV. References

DENR. (2011). Forest Management Service Data.
DENR. (2018). Coastal Resource and Foreshore Management Section Data.

State of the Mangroves in Region 12

Cirilo Lagnason, Jr.
Coastal Resource and Foreshore Management Section,
DENR Region 12

I. Introduction

Region 12 is known as the SOCCSKSARGEN Region for its four provinces South Cotabato, Cotabato, Sultan Kudarat and Sarangani, and a city General Santos. Sarangani Bay, which is within the Sulu-Sulawesi Marine Ecoregion, is located in the region. The bay is mainly characterized by waters of varying depths and is home to shallow marine habitats such as coral reefs, seagrass beds, and mangrove forests. It supports the fishing and tourism industries. A high proportion of the local population are dependent on fishing and fisheries-related activities (e.g., fish canning, aquaculture, mariculture, etc.) for their economic and social growth. Further, the biological communities and associated diversity in the bay have also been the subject of research and development efforts towards sustainable resource management.

In view of its biological and socio-economic importance, Sarangani Bay and its surrounding waters were declared a Protected Seascape through Presidential Proclamation 756 (1996). Since then, it has been managed by a PAMB, which sets policy guidelines and ensures sustainable resource development in the bay. However, in recent years, rapid population growth, economic development, and migration, especially in General Santos City, have resulted in greater demand for and pressure on coastal ecosystem goods and services. Increasing industrial and domestic waste and wastewater discharge from coastal communities has been affecting water quality. This has compromised the health and integrity of the bay, the ecosystems therein, and the local population that depend on it.

Importance of mangroves

Mangrove ecosystems include trees, palms, shrubs, vines, and ferns which are well-adapted to the dynamic conditions in waterlogged saline soils. These halophytes thrive along the intertidal, coastal, and estuarine margins and survive various conditions including variable flooding, extreme tides, high salinity, and highly toxic and anaerobic soils. Mangroves possess several specialized features which enable these plants to survive such stressors. It is even said that there may be no other group of plants with such morphological and physiological adaptations to extreme conditions.

Mangrove forests are considered to be the most productive ecosystems in the world. These ecosystems not only enrich coastal waters but serve as a source for long-term food security. Mangroves create unique ecological environments that host a rich assemblage of species. They are essential nursery grounds and breeding sites for fish, birds, crustaceans, shellfish, reptiles and mammals, which in turn support coastal fisheries. Under certain regulated conditions, mangroves may also be a renewable source of wood and commercial forest products, to support local economic activities.

Mangroves have various ecological values. They protect and stabilize coastlines by helping buffer the effects of climate change on coastal communities and ecosystems. They are considered nature's "bio-shields" because they reduce the impacts of wave action and storm surges. Mangroves aid in erosion control, flood regulation, sediment trapping, and nutrient recycling. Mangrove ecosystems also play a key role in global climate change mitigation with their inherent ability to efficiently sequester huge amounts of carbon in the atmosphere.

II. Status of mangroves in the region

Profiling and assessment have been conducted in Sarangani Province, in its six coastal municipalities Alabel, Glan, Kiamba, Maasim, Maitum, and Malapatan, with a total 57 coastal barangays; and the City of General Santos with nine coastal barangays. These activities were undertaken as a collaboration between coastal stakeholders and the local government including the mayors, MENROs, OMAGs, and barangay chairs. Primary data was gathered using standard scientific methods for each resource component (English et al., 1994; e.g., modified Belt-transect Line Plot Method). In-situ resource mapping was conducted in all the sampling sites. However, due to time and resource constraints, information on physico-chemical and other parameters were not collected. Nevertheless, to complement the primary data gathering, secondary data was collated.

The Sarangani Bay Protected Seascape (SBPS) has a total coastline length of 226.4 km, spanning six municipalities in Sarangani, General Santos City, and areas in South Cotabato (PENRO Sarangani). In 2011, mangrove forest cover along the SBPS was estimated to be 92.61 ha (Long and Giri, 2011). According to this recent survey (ny), the total mangrove area in the SBPS has increased to 331.74 ha, which is 2.5 times greater than the value in 2011.

Twenty-five major and minor mangrove species, belonging to 14 families, have been recorded in the SBPS (Figure 3-29). These are *Acanthus ebracteatus, Nypa fruticans, Avicennia alba, A. marina, A. officinalis, A. rumphiana, Dolichandrone spathacea, Lumnitzera racemosa, Excoecaria agallocha, Pemphis acidula, Aegiceras floridum, A. corniculatum, Xylocarpus granatum, X. moluccensis, Acrostichum aureum, Bruguiera cylindrica, B. gymnorrhiza, B. sexangula, Ceriops decandra, C. tagal, Rhizophora apiculata, R. mucronata, Scyphiphora hydrophyllacea, Sonneratia alba, S. caseolaris,* and *Heretiera littoralis*. This is typical in most mangrove ecosystems because Rhizophoraceae species tend to thrive in all types of mangrove formations (Jagadeesh et al., 2012). Species recorded and observed in the SBPS are typical of the distribution in the Philippines and in Southeast Asia.

Diversity appears to increase from the western to the eastern sites. The western district, which includes Maasim, Kiamba, and Maitum, has the least mangrove diversity at less than 10 species recorded per municipality. General Santos City, which is the heart of the seascape geographically, has an intermediate level of diversity. Finally, the eastern district with Alabel, Malapatan, and Glan has the greatest diversity at more than 10 species per municipality. Several studies have indeed shown that the inner parts of the bay harbor more species than the outer parts. Such findings may be attributed to

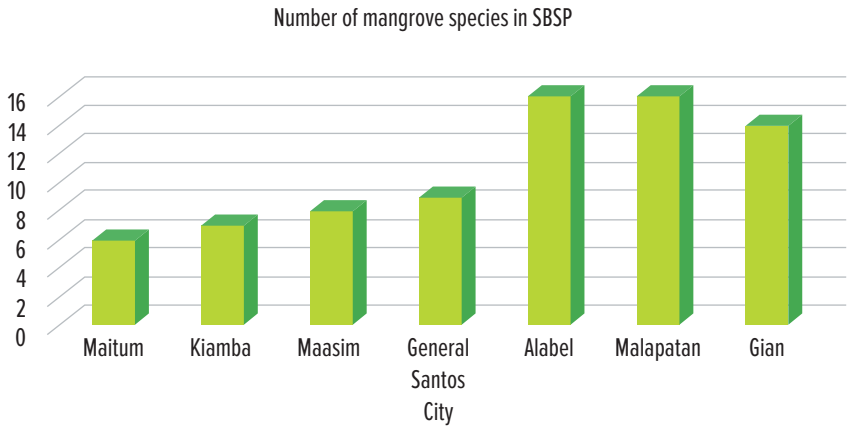


Figure 3-29. Total number of mangrove species per municipality/ city along the Sarangani Bay Protected Seascape

differences in water and nutrient inundation, and wave exposure, though this requires further study. Among the mangrove species in SBPS, *A. marina, R. apiculata, R. mucronata,* and *S. alba* are the most common across sites and have the highest density overall.

A. Glan

Of the other municipalities around Sarangani Bay, Glan has the longest coastline at 64.3 km. Mangrove diversity is high with dense primary and secondary growth forests. Thicker vegetation is evident in Glan Padidu towards Poblacion, but several mangrove patches were found in other barangays (e.g., Tango and Gumasa). Glan has the largest mangrove area in the SBPS at 103 ha, which is 31% of the mangrove area in the entire protected area. *Rhizophora apiculata* yielded the greatest values for density, frequency, and dominance in certain barangays as in Glan Padidu. This species is typical in shallow muddy substrates that are regularly inundated by seawater at high tide. On the other hand, the species *S. alba* and *A. marina* dominate other areas in the municipality. Several reforestation and rehabilitation projects have been implemented in the area.

B. Malapatan

Malapatan has a total mangrove area of 51.9 ha, with Brgy. Poblacion having the largest at 24.88 ha. The municipality has the greatest diversity, with 16 documented species. Among these, *S. alba* is dominant, with trees of varying size and age. Particularly, old, large trees of *S. alba* are abundant in the seaward zones, occurring alongside abandoned aquaculture ponds. Despite the high diversity, only a few individuals of the other species were abundant. The rest of the species were seldom encountered and seen only in few numbers. Mangrove trees are highly exploited in the area. Several activities such as cutting for firewood, housing materials, and other anthropogenic uses have been observed. Local settlers residing near the coast continue to expand towards the mangrove area.

C. Alabel

The total mangrove area of Alabel is 26.3 ha, the largest area found in Maribulan (13. 97 ha), which is adjacent to Buayan River. The only MPA in Alabel, which is the Kawas Marine Sanctuary, has a total mangrove area of 7.80 ha. Alabel has the same mangrove diversity as Malapatan despite it having the shortest coastline along the seascape with only three coastal barangays – Maribulan, Ladol, and Kawas. In Kawas, there are large patches of forests where *A. marina* comprises around 30% of the tress, followed by *R. apiculata* (23%) and *S. alba* (19.72%). Several individuals of *A. floridum* and an old *P. acidula* (~100 years) were also recorded (Figure 3-30). These species are characteristically small, and take time to grow and reach several meters high. A few individual species of genera *Ceriops* and *Bruguiera* are also present in the area.

D. General Santos

General Santos City, which is the only city in the SBPS, has a number of mangrove forests. These forests now occur in patches due to anthropogenic disturbances and their close proximity to urbanized and industrialized areas. These were formerly mangrove belts, but were converted to aquaculture sites and salt ponds in the 1970s particularly those in the northern coastline of the SBPS in Bula, Baluan, and Buayan (Figure 3-31). Some ponds are still operating while others have already been abandoned. In some barangays such as Calumpang, Tambler, and Bawing, mangrove areas were converted for industrial use (e.g., docking) and/ or reclaimed for ports and jetties. Of all the coastal barangays, Baluan has the largest mangrove area with 18.66 ha, which is dominated by *A. marina*, followed by *R. apiculata* and *S. alba*. Here, old growth *A. marina* trees are abundant, while in other barangays, commonly occurring *A. marina* and *S. alba* are present only in patches with generally lower diversity.

Figure 3-30. An old *Pemphis acidula* tree, estimated to be about 100 years old, in Brgy. Kawas, Alabel, Sarangani Province

Figure 3-31. Satellite image showing the mangrove forests, aquaculture, and salt ponds in the northern coast of the Sarangani Bay Protected Seascape in General Santos City (via Google Earth)

Figure 3-32. A community of Sama-Tausug living on the shoreline in Linao, Maasim

E. Maasim

Maasim has a total mangrove area of 29.7 ha, with one of the densest forests in the SBPS found here. Thick vegetation is mostly concentrated in Linao Cove and Tinoto Bay. The most abundant species in the area is *S. alba* (48%), followed by *R. mucronata* (29%) and *R. apiculata* (19%). Though not as diverse as the other sites in the western district, Maasim has relatively thicker mangrove cover. Several rehabilitation programs are being implemented in the area, and mangrove nurseries are also present and operational. A Tausug community that has been residing in Linao have long interacted with the mangroves in the area, relying on coastal resources such as fish, shellfish, crabs, and other marine invertebrates for food and other uses (Figure 3-32).

F. Kiamba

The municipality of Kiamba faces the Celebes (Sulawesi) Sea in the south. Long stretches of sand and fewer mudflats characterize the area, and are favorable to the growth of beach forest species as well as certain mangroves. Here, forest vegetation is fragmented. Six sites Salakit, Nalus, Kuli, Tambilil, Datu Dani, and Kling were assessed in Kiamba. Nalus had the greatest areal extent at 20.95 ha, and relatively thick mangrove cover dominated by *Avicennia* species and nipa. Local

residents harvest the leaves for use in crafting nipa shingles for the roofing of houses. *Rhizophora* species were also found in most of the sites except in Tambilil where only a handful of *S. caseolaris* trees were seen.

G. Maitum

Maitum also faces the Sulawesi Sea and shares the coastal features of Kiamba. However, compared to Kiamba, it harbors fewer mangrove species. There are at least five mangrove species found in Maitum. The total 27.9-ha mangrove area is fragmented as small patches along the coastline. The largest patch is in Kiambing, followed by Pinol, with *R. apiculata* and *R. mucronata* dominating in both sites. *N. fruticans* was also found in large numbers in the landward zone.

III. Summary and recommendations

The mangrove area of the SBPS is 331.74 ha, with the municipality of Glan having the largest area at 103 ha. The sites with greatest species diversity and density were Glan, Maasim, and Kiamba.

Demand for food, shelter, and other resources has increased, which has led to the overexploitation of coastal resources. In rapidly developing areas especially General Santos City, an increase in factory facilities and a booming fishing industry can likewise result in greater potential environmental impacts. As such, ecosystems management complemented by regulation of development activities and their potential impacts is imperative. The potential of mangroves to provide ecosystem services and benefits will only be fully realized if these habitats are properly cared for.
With recent findings and observations, the following management actions are recommended:

1. Expand Strict Protection Zones (SPZ) to mangrove areas. Mangroves have typically not been included in locally declared MPAs such as in Malapatan and Glan, and should now be considered for strict protection.
2. Adopt local ordinances to protect mangrove areas and penalize violators. Penalties on mangrove cutting (i.e., without PAMB permission) and other violations may be imposed via local regulations to support management strategies at the seascape-level.
3. Establish mangrove nurseries in each LGU in the SBPS. To ensure the sustainability of ecosystems services, nurseries should be built in every municipality and city. These nurseries, which may be developed in partnership with POs, should prioritize mangrove species present in the respective areas.
4. Explore ecotourism in mangrove areas. The mangrove boardwalk constructed in Maasim and Glan may be replicated by other municipalities where mangrove forest density is similar. Such value-adding structures can assist in generating income for the LGUs and local communities. This may be incorporated in their Ecotourism Management Plan, as provided by DAO 2013-19.
5. Restrict entry of informal settlers in mangrove areas. A chief factor in mangrove loss in the region is the conversion of forest area for residential use among informal settlers.
6. Validate active and expired Fishpond Lease Agreement (FLA) permits. Certain FLA areas such as in Malapatan have not been utilized and were left vacant for an extended time. These should be turned over to the DENR for reversion to mangroves.

IV. References

English, S., Wilkinson, C., Baker, V. (1994). Survey manual for tropical marine resources. Australian Institute of Marine Science, Townsville.

Jagadeesh, S., Umesh, R.P., Madhura, J.N., Udayakumar, M., Panneerselvam, R. (2012). Genomic relations among four Rhizophoraceae species under natural and afforested habitats of Pichavaram mangrove forest, Tamil Nadu. Journal of Environmental Science and Water Resources, 1(8), pp.183-191.

Long, J.B., Giri, C. (2011). Mapping the Philippines' mangrove forests using Landsat imagery. Sensors, 11(3), pp.2972-2981.

State of the Mangroves in Region 13

Nilda G. Ebron
DENR Region 13

I. Introduction

Caraga Region or Region 13 is considered the richest region because of exceptional natural resources, from its mountains to its coasts. It is anticipated to be an economic hub in the Southern Philippines for its vast potential in ecotourism, agriculture, mining, and other sectors.

The region is strategically located in the northeastern part of Mindanao, covering a total land area of 1.193 million ha, 71.22% of which is Forestland and 28.78% is Alienable & Disposable land. There are five provinces in the region: Agusan del Norte, Agusan del Sur, Surigao del Norte, Surigao del Sur, and Dinagat Islands. Agusan del Sur is a landlocked province while the rest are coastal provinces. The five provinces are further divided into 73 municipalities and cities, 50 of which are located along the coast. Its shoreline stretches to a total of 2,271 km.

Caraga Region is home to the 2nd largest mangrove protected area under the International Union for Conservation of Nature. Located in Siargao Island in Surigao del Norte, the mangrove has a total areal extent of 7,358 ha. Surigao del Norte, as a whole, has the 5th largest mangrove extent in the entire Philippines with about 11,867 ha.

Mangroves provide various ecological services to the region such as shoreline protection from strong waves and winds, and carbon sequestration. They provide food and livelihood to coastal communities, and support ecotourism and recreational activities. Most importantly, mangroves are an important habitat for various wildlife such as egrets, kingfishers, and crocodiles, and serve as nursery grounds for fishes.

II. Status of mangroves in the region

Caraga Region has a total mangrove extent of 27,049.74 ha (Figure 3-33). The greatest mangrove area is in Surigao del Norte with 13,913.46 ha, followed by Surigao del Sur (9,684.82 ha), Dinagat (2,230 ha), and Agusan del Norte (1,222 ha).

About 90% of mangrove stands are secondary growth, although old stands of mangroves still exist. Most of these mangrove areas are of riverine and fringing types dominated by *Rhizophora* and *Avicennia*. Overall, about 22 mangrove and mangrove-associate species are found in the Caraga Region: *Rhizophora stylosa, R. apiculata, R. mucronata, Avicennia alba, A. marina, A. rumphiana, A. officinalis, Xylocarpus granatum, X. moluccensis, Sonneratia ovata, S. alba, Acrostichum aureum, A. speciosum, Bruguiera cylindrica, B. gymnorrhiza, B. sexangula, B. parviflora, Ceriops tagal, Lumnitzera racemosa, Excoecaria agallocha, Heritiera littoralis,* and *H. javanica*.

Most of these mangrove areas are near coastal communities, and are thus affected by anthropogenic activities such as coastal development (e.g., reclamation, tourism, road construction, etc.) and mining. These have resulted in mangrove degradation and loss, leading to a decrease in cover from 29,258 ha in 2005 to 27,050 ha in 2010. However, recovery was observed in 2010 to 2015 because of various management activities including strengthened enforcement, rehabilitation, and collaboration among various agencies.

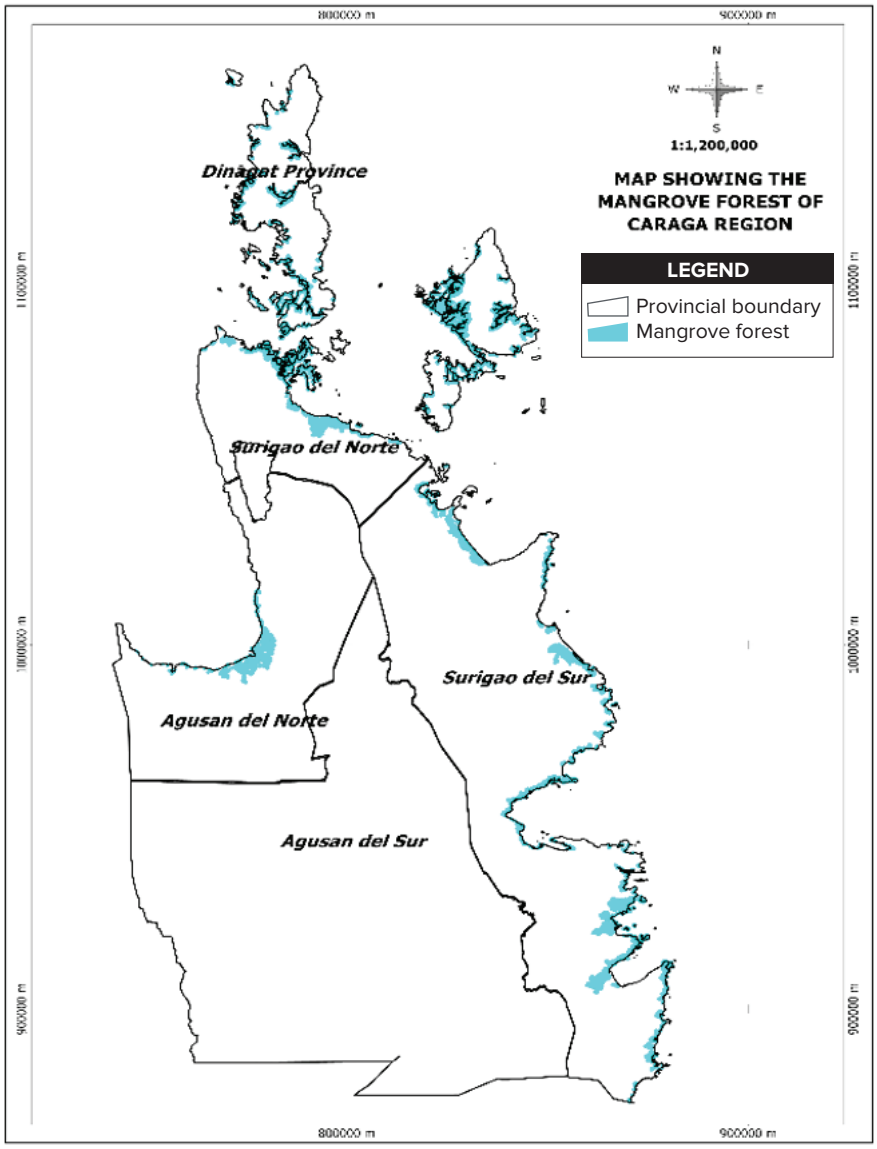


Figure 3-33. Map showing the mangrove forests of Caraga Region

III. Mangrove protection and management

Part of the protection and management strategies of the DENR is the implementation of various rehabilitation programs through enrichment planting and mangrove reforestation. These have been made possible through collaborative efforts and support from funding agencies. Rehabilitation programs include the Upland Development Program (UDP), National Greening Program (NGP), Mangrove and Beach Forest Development Project (MBFDP), Community-Based Forest Management-Comprehensive Agrarian Reform Program (CBFM-CARP), Yolanda Rehabilitation and Reconstruction Program (YRRP), and most recently, the Coastal and Marine Ecosystems Management Program (CMEMP).

Other mangrove initiatives being implemented are in compliance with Presidential Proclamation Nos. 2151 and 2152, the E-NIPAS, and CBFMAs. Monitoring and evaluation of mangrove plantations was also conducted in 2015, 2016, and 2017, and survival rates were determined (DENR and ERDB/ FTRRC; third-party assessments by Dexter Cabahug and Renato De Rueda).

IV. Summary and recommendations

Caraga Region has a total mangrove extent of 27,049.74 ha and at least 22 mangrove and mangrove-associate species. Mangroves provide the region with various ecological and economic services. However, they are being threatened by anthropogenic activities. Some recovery has been facilitated by protection and rehabilitation, but more efforts are still needed.

To further enhance and effectively manage the mangrove forests in Caraga Region, partnerships, governance and policy, enforcement, and research must be enhanced. LGUs and other concerned stakeholders must be involved as partners in mangrove protection and management (e.g., Adopt-a-Mangrove program).

In terms of governance and policy, mangrove protection and management must be considered as one of the assessment criteria under the environmental management category for the Seal of Good Housekeeping. There should also be a mechanism for effective reversion of AUU FLAs into potential sites for mangrove rehabilitation.

In relation to enforcement, all mangrove areas must be included as sites for LAWIN Forest and Biodiversity Protection System activities. Finally, research must be conducted on sedimentation in mangroves in mining-affected areas and mangrove valuation, among others. Risk assessments for road construction and other development projects along coastal areas must also be undertaken.

State of the Mangroves in BARMM

Baharodin Baulo
Biodiversity Management Services,
BARMM Ministry of Environment, Natural Resources, and Energy

I. Introduction

The Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) is situated in mainland Mindanao. It was expanded through Republic Act 11054 also known as the Bangsamoro Organic Law, ratifying Republic Act 9054. BARMM consists of five provinces, three cities, 116 municipalities, and 2,553 barangays.

Mangroves in the region are important for the ecosystem services they provide. They help stabilize buffer and coastal zones, reduce erosion, and serve as coastal defense. Mangroves are known as land builders because of their role in soil accretion. They also function as wildlife sanctuaries, and offer aesthetic, educational, and scientific value. However, the ecological and economic importance of mangroves have been underestimated. Basilan, Sulu, and Tawi-Tawi (BaSulTa), particularly, have great potential for mangrove rehabilitation. The economic benefits from related efforts would help address poverty in these provinces.

II. Status of mangroves in the region

Caraga Region has a total mangrove cover of 51,324 ha (NAMRIA, ny), with Sulu having the greatest area at 26,558 ha (Table 3-32).

Human and natural factors continue to threaten mangrove areas. Human activities detrimental to mangroves include charcoaling, illegal gathering of tanbark, and illegal cutting, among others. On the other hand, management concerns are political interference, and the unstable peace and order situation in the region. Development is also largely focused on infrastructure (e.g., roads and foot bridges, school building, etc.) rather than sustaining ecosystems and associated benefits. Natural threats on mangrove areas are typhoons and storm surge.

Table 3-32. Mangrove cover (ha) in BARMM (Source: NAMRIA, ny)

Province	Mangrove cover, ha
Sulu	26,558
Tawi Tawi	14,285
Basilan	8,956
Maguindanao	1,061
Lanao del Sur	464
Total	**51,324**

III. Mangrove protection and management

Mangrove reforestation has been undertaken in Basilan, Sulu, Tawi-Tawi, and Maguindanao, covering a total 3,531 ha (Table 3-33). A total 7.3 million propagules of *Rhizophora* species were planted in various locations (Table 3-34).

Mangrove rehabilitation activities have increased the biodiversity (e.g., fish, shellfish, etc.) in the region. They have supported the livelihood of communities that rely heavily on fishing and seaweed farming. These activities have also empowered communities and increased awareness on the value and importance of mangroves.

Table 3-33. Reforested mangrove area (ha) in BARMM

Province	Sites	Reforested mangrove area, ha
Sulu		**1,526**
	District I: Panglima Tahil, Pangutaran, Maimbung, and Parang	
	District II: Tongkil, Luuk, Panamao, Kalinggalan Caluang, Tapul, Siasi, Pandami	
Tawi-Tawi		**1,460**
	Bintawlan, South Ubian	505
	Sitangkai	191
	Tabawan, South Ubian	369
	Languyan	100
	Sibutu	295
Basilan		**469**
	Manaul, Sumisip	
	Tuberlongan, Maluso	
	Mataja Island, Hadji Muhtamad	
	Upper Bato-Bato, Akbar	
	Luuksumbang, Lamitan	
	Bato, Lamitan	
Maguindanao		**76**
	Sarmiento, Parang	
	Total	**3,531**

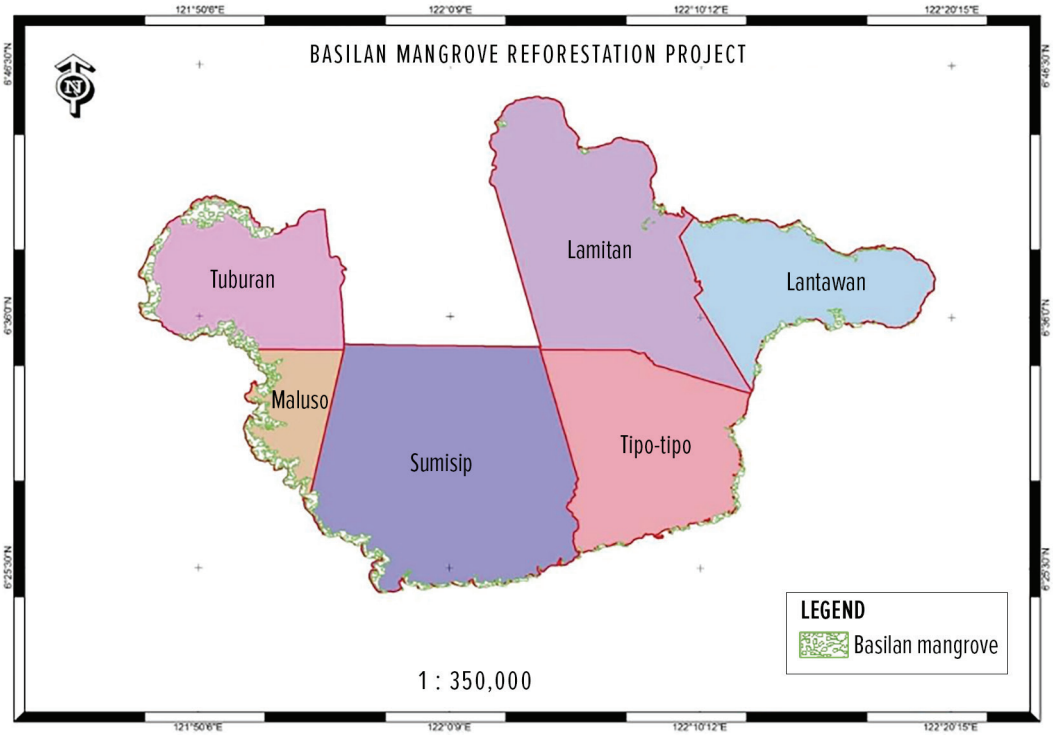


Table 3-34. Mangrove reforestation sites in Basilan

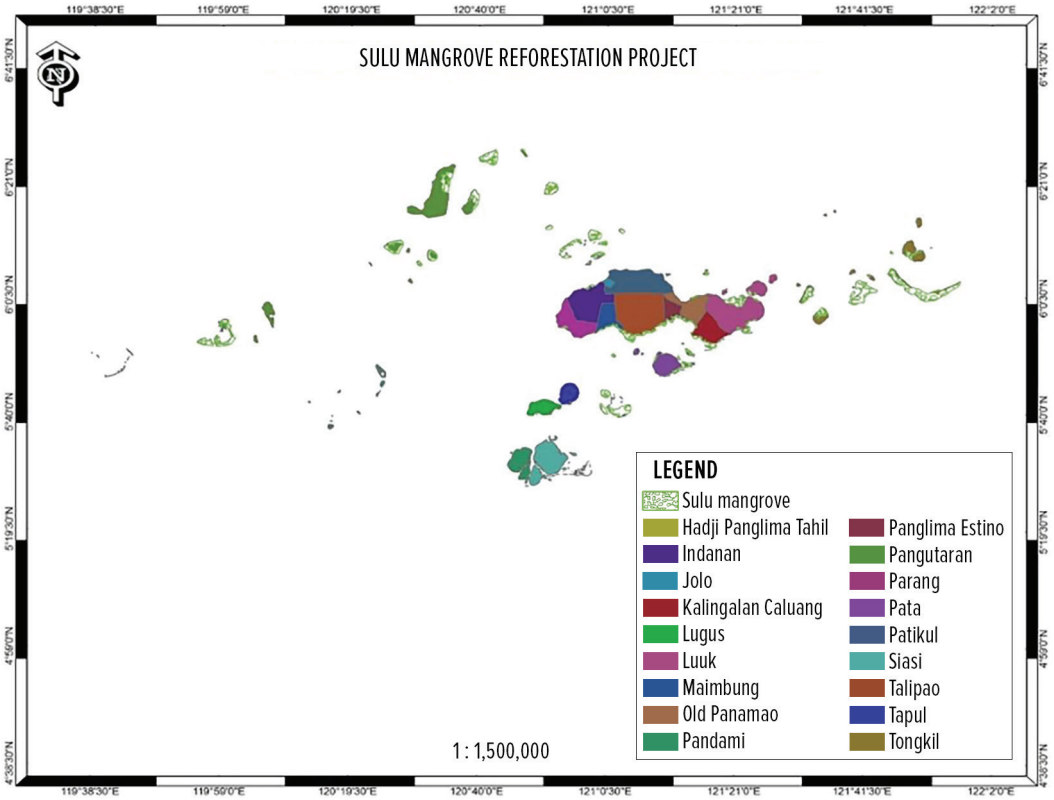


Figure 3-35. Mangrove reforestation sites in Sulu

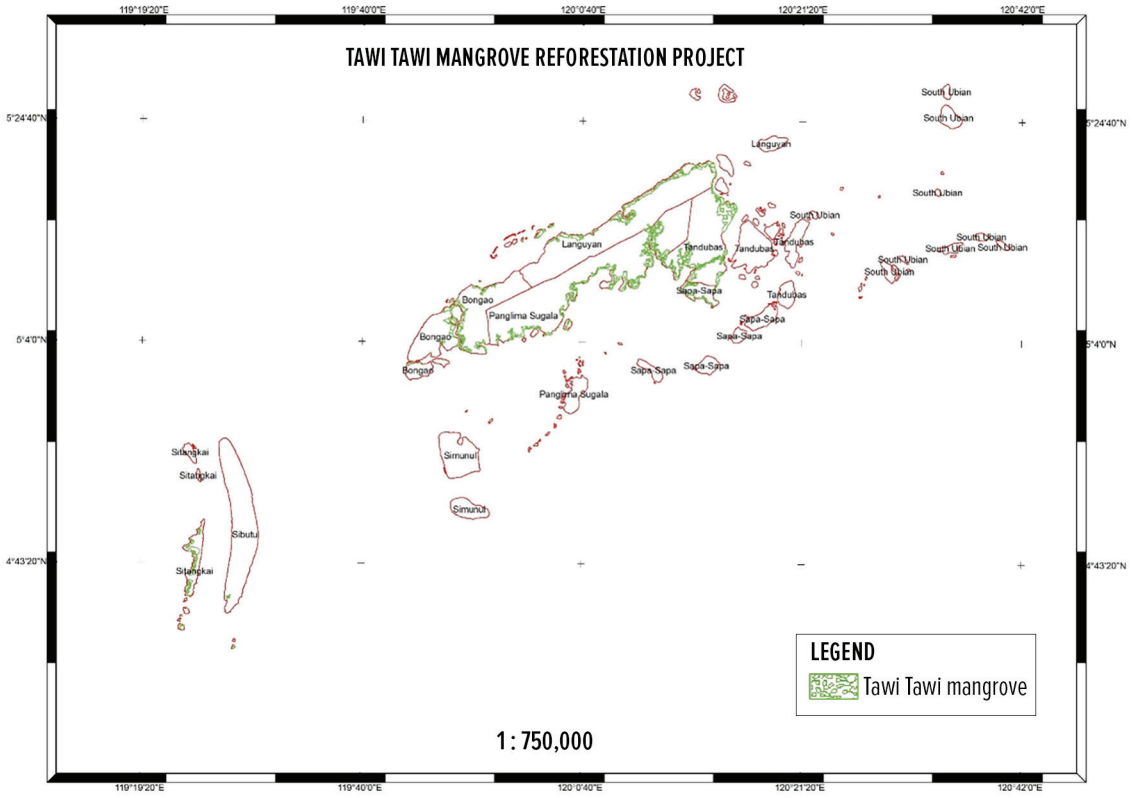


Figure 3-36. Mangrove reforestation sites in Tawi-Tawi

Table 3-34. Number of *Rhizophora* seedlings per plantation site in BARMM

Site	No. *Rhizophora* propagules
Basilan	**1,000,000**
Manaul, Sumisip	200,000
Tuberlongan, Maluso	200,000
Mataja, Lantawan	100,000
Bato, Lamitan	200,000
Upper, Bato Bato	200,000
Luuksumbang, Lamitan	100,000
Sulu	**3,815,000**
Jolo (CENRO D-1)	1,815,000
Siasi (CENRO D 2)	2,000,000
Tawi-Tawi	**1,740,000**
Bintawlan, South Ubian	1,262,500
Tumindao, Sitankai	477,500
Maguindanao	**760,000**
Sarmiento, Parang	760,000
Total	**7,315,000**

IV. Summary and recommendations

To enhance mangrove protection and management in BARMM, the following actions have been recommended:

- Capacitate personnel involved in relevant programs and projects (e.g., trainings).
- Engage implementing agencies to provide technical assistance in the various components of these programs and projects.
- Reduce political pressure and interference.
- Inform and educate various stakeholders especially local chief executives and personnel from relevant government offices on mangrove reforestation and rehabilitation practices (e.g., site selection, species-site matching, etc.)
- Intensify peace and order, and engage ex-rebel returnees as Bantay Gubat and/ or Bantay Dagat.

V. References

NAMRIA. (ny). Forest cover of the Philippines.
DENR. (2012). National Greening Program Data.

Silonay, Oriental Mindoro, Philippines (Photo © Conservation International Philippines)

4 Technical Reports

Policy Review and Recommendations for Mangrove Conservation and Management

Grizelda "Gerthie" Mayo-Anda
Environmental Legal Assistance Center, Inc. (ELAC);
Palawan State University (PSU) College of Law

I. Introduction

Mangroves are wetlands, protected and valued for a number of reasons. They are "coastal forests" – habitats with rich wildlife, are a source of food and other essential resources, and serve a critical role in climate change adaptation and mitigation. Numerous studies have shown that coastal forests can buffer the force, depth, and velocity of a tsunami, reducing loss of life and damage to property (Forbes and Broadhead, 2007).

II. Legal and policy framework

The Philippines has several laws and policies that support mangrove protection. Under the Philippine Constitution, the State owns all lands of the public domain and other natural resources (Regalian Doctrine; Art 12, Sec. 2, Constitution). This ownership is not limited to land but extends to "all natural wealth found in the bowels of the earth" (Republic vs. CA, 160 SCRA 228).

Laws relevant to mangroves include the Revised Forestry Code (Presidential Decree No. 705, 1975), the Expanded National Integrated Protected Areas System (Republic Act 7586 or E-NIPAS Act, 2017), the Strategic Environmental Plan for Palawan (RA 7611 or the SEP law, 1992) and the Local Government Code (RA 7160, 1991).

The Local Government Code (LGC) concretized the constitutional policy on government decentralization and democratization. Better participation in policy-making among local stakeholders is also an important feature of the LGC. Local communities, non-governmental organizations, and academic and scientific institutions can become partners of local government in planning and implementing resource management plans.

The LGC also provided for the devolution of environmental and natural resource management functions (Section 17, RA 7160). The LGUs' broad range of environmental and natural resource management powers within their territorial jurisdictions are related to protection, regulation, revenue generation, local legislation, enforcement, provision of services, extension and technical assistance, and the performance of inter-government relations and relations with NGOs and people's organizations.

The institutionalization of protected area management is strengthened by the recently amended Expanded National Integrated Protected Areas System Act (RA 11038 amending RA 7586, 2018) which recognizes the importance of the protected areas system as a mechanism for biodiversity conservation. The management of the protected area is exercised by the PAMB, a multi-sectoral policy and governing body composed of representatives from the DENR, the local government unit (including village officials), affected communities, academic institutions and the private sector. The E-NIPAS law broadened sectoral participation by increasing the number of representatives from the indigenous peoples and non-government organizations and including academic institutions.

Our existing legal framework on resource use and management provides that the development and management of natural resources shall be made accessible to poor and disadvantaged groups, who are often direct users of resources (farmers, forest dwellers, marginal fishers). The Constitution provides for small-scale use of natural resources and gives preferential rights to marginalized fishers to utilize municipal waters. Likewise, we have national policies promoting "social forestry" and community-based forest management.

The Indigenous People's Rights Act (IPRA, RA 8371)[1] recognizes indigenous peoples'[2] ownership of their ancestral lands/, domains and also deals with the civil, political, social, cultural and tenure rights of indigenous peoples.

The Philippine Environmental Impact Statement System or PD 1586 provided in more detail the policy on the assessment of the environmental impacts of proposed projects which were provided in Section 4 of PD 1151. PD 1586 formally established the EIS system and provided for the proclamation of environmentally critical areas (ECAs) and environmentally critical projects (ECPs). Such ECAs and ECPs were identified in Proclamation No. 2146. Development projects that impact on the coastal zone such as mining, quarrying, tourism development, and reclamation affect mangroves and other coastal resources. Since Proclamation 2146 includes mangroves, national parks, and wildlife preserves and sanctuaries among the list of Environmentally Critical Areas, it can be used to ensure the protection and conservation of mangrove areas which are part of ECAs.

The State's "full control and supervision" proceeds from the recognition of the importance of the country's natural resources for national economic development as well as security and national defense (Miners vs Factoran, 240 SCRA 100). Laws and policies on governance and conservation have been passed with this rationale in mind.

In terms of implementation, the DENR is the lead national agency mandated to look into environmental concerns. They are supported by special government agencies like the Laguna Lake Development Authority (LLDA), Protected Area Management Boards, Palawan Council for Sustainable Development (PCSD), as well as the local government units.

The State has the power to grant licenses. They can also withhold these licenses when the entities/ corporations holding these licenses have violated the environmental laws and failed to protect and care for the environment (Ysmael vs. Deputy Executive Secretary, Oct. 1990). As part of its enforcement mandate, the State has the power to issue restraining orders and/ or injunctions (LLDA vs. CA, PAB vs. CA). Heads or officers of corporations may be held criminally liable for negligence in their operations and violations of environmental laws (Mustang Lumber vs. CA).

Local government units may issue ordinances protecting the environment (where the furtherance of the right to a healthful ecology was sustained in Tano vs. Socrates, 1997, and Social Justice Society, et al. vs. Atienza, Jr., 2007). The local legislature's enactment of laws to protect the environment, and regulate projects and activities of industries to protect the environment and promote health is likewise recognized (Province of Rizal vs. Executive Secretary, 2005).

LGUs have an important role in ensuring that our coastal environmental rights are upheld. They have the primary jurisdiction in the management, conservation, utilization, protection, development and disposition of our fishery and aquatic resources (RA 10654 or the Amended Fisheries Code). LGUs are empowered to enact appropriate local ordinances for these purposes, and enforce all fishery laws and regulations within the municipal waters (RA 7160).

Furthermore, under the Amended Fisheries Code, the LGUs have the authority and power to establish Barangay Fishery and Aquatic Resource Management Councils (FARMCs), assist in the organization of FARMCs, establish fishery refuge and sanctuaries (which cover mangrove areas), manage area use allocation or zoning, manage licensing and revenue generation, undertake enforcement, and ensure the provision of preferential treatment to marginal fisherfolks, fisherfolk association and cooperatives.

[1]The Constitution, under Article 2, Section 22, provides that the State recognizes and promotes the rights of indigenous cultural communities within the framework of national unity and development. It further provides that the State shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social and cultural well-being.

[2]The Constitution uses the phrase indigenous cultural communities or ICCs, but Philippine indigenous peoples' groups and support groups have been using the phrase indigenous peoples or IPs, consistent with international conventions, such as the United Nations Declaration on the Recognition of Indigenous Peoples. This study will thus be using indigenous peoples or IPs.

III. Initiatives and good practices

There are good examples of local government initiatives regarding the management and conservation of our mangroves and other coastal resources. An example of a successful initiative is the Community-Based Sustainable Tourism (CBST) project in Puerto Princesa City, Palawan known as the Mangrove Paddle Tour in Brgy. Sabang, Puerto Princesa City. Puerto Princesa City had also passed its Environmental Code for the protection of mangroves and classifying these areas as core zones or areas of maximum protection.

In other parts of the country, LGUs have also passed their own Local Environment Codes like the E-Code of Batangas City, Ordinance No. 16, 2010, and the Local Environment Code of Misamis Occidental in 2016. In these environmental codes, mangrove areas are valued and considered protected resources.

There are multisectoral enforcement efforts to save mangroves. Several barangay officials and fisher communities have been involved in the demolition of illegally-constructed fishponds. The recovery of about 6 ha of mangrove area in Brgy. San Manuel, Puerto Princesa which has been illegally occupied for more than 10 years is one such success story. Such recovery was made possible through the leadership of the DENR's National Anti-Environmental Crime Task Force (NAECTAF), in partnership with the city government and barangay officials. The barangay and local DENR-CENRO officials, in this case, were charged with harassment suits by parties involved in the illegal occupation of the mangrove area. With the support of non-government organizations (ELAC in this case), several strategy sessions and meetings with concerned government officials and agencies were held to discuss options and legal remedies to deal with these harassment suits. The use of SLAPP (Strategic Lawsuit Against Public Participation) under the new Supreme Court Rules for the Prosecution of Environmental Cases (RPEC) provided these barangay and DENR-CENRO officials with the defense to counter the harassment cases. Following this successful multisectoral enforcement effort, the city government and DENR have initiated mangrove reforestation efforts in the area since 2017.

IV. Some challenges

Disturbing trends have been observed as regards the implementation of national to local mangrove policies and regulations. There have been continuing conflicts between mangrove conservation policies and government development plans. Mangrove areas have been used as resettlement areas; included in the titling of alienable and disposable land; or converted for reclamation and other infrastructure development projects. Other enforcement problems include illegal logging, charcoal making, and debarking (stripping mangrove trees of their bark) for preparing tuba (palm wine) and tanning/ dyeing.

Other challenges include jurisdictional and institutional issues (overlapping mandates) and the pursuit of extractive and heavy infrastructure development in coastal areas (such as reclamation, port and road development, mining and quarrying). Tourism can likewise contribute to mangrove destruction when resorts and lodging areas are set up in mangrove areas or lead to the cutting of mangroves to build resorts. Other bureaucratic issues in government (e.g., corruption, incompetence, and lack of motivation among mandated officials and enforcement agencies) have hindered the efficient implementation of these laws, failing to ensure adequate protection of collective environmental rights.

V. Strategies and ways forward

In developing strategies to ensure the conservation and effective management of our mangroves, it would be worthwhile to consider other important perspectives on policy and governance. These approaches may include, among others, behavior and mindset change (educative value); science-driven and science-based (research) decision-making; transparent, accountable, and participatory processes; insightful management (e.g., stocktaking; building on good practices); incorporating citizen science and gender concerns; and institutionalizing monitoring and assessment.

The following should be key areas of work:

1. Develop or enhance strategies for the effective implementation and enforcement of mangrove laws and policies through:
    a. Reviewing, then enhancing DENR and DA-BFAR policies relating to mangroves, e.g., policies on abandoned, undeveloped, and underutilized (AUU) Fishponds, FAO 197-1 on silviculture, Mangrove Action Plan, National Greening Program, etc.
    b. Working with LGUs, Protected Area Management Boards, or similar bodies towards zoning or establishing coastal greenbelts
    c. Promoting and strengthening existing initiatives (communities, NGOs, etc.); and
    d. Developing appropriate local legislation and programs
2. Influence local, regional and national development plans, e.g., engage with NEDA and Regional Development Councils, Leagues of Municipalities/

Cities and Provinces, etc.

3. Support efforts on national policy reform, e.g., National Land Use Act, Sustainable Forest Resources Management Bills, Greenbelt bills, etc.
4. Information and Education activities on nature-based solutions to climate change
5. Policy support to municipal areas with critical habitats and are considered hotspots, and complementing/ supporting environmental and conservation projects of the League of Municipalities
6. Multi-agency engagements, e.g., establishing multi-partite monitoring mechanisms
7. Strengthen accountability efforts (including advocacy engagements)

Finally, there is a need for mangrove scientists and managers to collectively and urgently call for the concerned agencies of DENR, DA-BFAR, and DILG to issue comprehensive guidelines on the reversion of fishponds.

VI. References

Article 2, Section 2, The Constitution of the Republic of the Philippines, 1987
Article 12, Section 2, The Constitution of the Republic of the Philippines, 1987
Expanded National Integrated Protected Areas System (E-NIPAS) Act, Republic Act 7586, 2017
Expanded National Integrated Protected Areas System Act, amended, Republic Act 11038 amending Republic Act 7586, 2018
Forbes, K. and Broadhead, J. (2007). The role of coastal forests in the mitigation of tsunami impacts. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok.
Indigenous People's Rights Act (IPRA), Republic Act 8371, 1997
LLDA vs. CA
Miners vs Factoran, 240 SCRA 100
Mustang Lumber vs. CA
PAB vs. CA
Philippine Environmental Impact Statement System, Presidential Decree 1586, 1978
Philippine Fisheries Code, amended, Republic Act 10654, 2015
Philippine Local Government Code, Republic Act 7160, 1991
Proclamation No. 2146, 1981
Province of Rizal vs. Executive Secretary, 2005
Republic vs. CA, 160 SCRA 228
Revised Forestry Code, Presidential Decree No. 705, 1975
Social Justice Society, et al. vs. Atienza, Jr., 2007
Strategic Environmental Plan for Palawan, Republic Act 7611, 1992
Tano vs. Socrates, 1997
Ysmael vs. Deputy Executive Secretary, Oct. 1990

Historical and Current Distribution of Mangroves in the Philippines: Spatio-temporal Analysis

Alvin B. Baloloy[1], Ariel C. Blanco[1,2]

[1]Training Center for Applied Geodesy and Photogrammetry, University of the Philippines, Diliman, Quezon City, Philippines
[2]Department of Geodetic Engineering, University of the Philippines, Diliman, Quezon City, Philippines

ABSTRACT

Changes in mangrove distribution and extent have been observed in the Philippines due to drivers such as conversion to aquaculture, urban development, large-scale deforestation, global sea level rise, and lack of coastal protection measures. National mangrove extent trends were documented through historical and recent mangrove extent data. Although traditional approaches to field mangroves is limited to the spatial constraints of data collection and inaccessibility of mangrove stands, they can serve as good historical base maps. This paper discusses the current and historical distribution of mangroves using either field-based or Remote Sensing-based area estimation methods. Larger mangrove areas were reported in earlier years between 1918 (450,000 ha) to 1968 (448,310) with field estimates reported by then Philippine Council for Agriculture, Forestry and Natural Resources Research and Development and L.M. Lawas, respectively. Relatively, smaller yearly estimates were reported by the Bureau of Forest Development, now known as the Forest Management Bureau, starting in the years 1969 to1984 (295,190 ha to 233,514 ha). From year 1990 onwards, a significant shift from field-based mapping to Remote Sensing-based approaches was observed in the Philippines, providing a more rapid and less expensive approach. This includes the estimates of Long & Giri (1990, 2000), SEDAC (2010), USGS (2011), Phil-LiDAR CoastMap (2015), and Global Mangrove Watch (1996-2016). These mangrove estimates have different levels of accuracy based on factors such as satellite spatial and temporal resolutions, mangrove classification technique used, and the quality of ground validation data. The differences were explored by comparing the different mangrove layers. New advances were presented including the novel methodologies for rapid extent estimation, Sentinel-2 based mapping, and utilization of cloud-based platform for national-scale mapping. The available data from various sources were compared to identify the challenges and opportunities in mapping mangroves.

Keywords: mangrove estimation, Remote Sensing, Philippines

I. Introduction

International organizations have previously reported the state of the mangroves in the world through two publications: (1) Status and Trends in Mangrove Area Extent Worldwide and (2) The World's Mangroves 1980–2005. These were published by the Food and Agriculture Organization of the United Nations wherein national mangrove extent reports from various sources were compiled. More than 2,800 national and sub-national data sets have been collected, covering 121 countries with estimates extending back to 1918. Regression analyses based on earlier data provided new estimates for years 1990 and 1980 and an extrapolated estimate for 2000 for each country (FAO, 2003). Earlier global mangrove extent was also reported by the World Mangroves Atlas,

published in 1997 and was revised in 2010 (Spalding et. al., 1997). Aside from these publications, global estimates were made available online through the websites of different research institutions conducting mangrove extent estimation. The Global Mangrove Watch generated revised baseline maps of mangrove extent in the tropics and subtropics for 2010 and 2015. Map changes relative to existing pan-tropical and subtropical mangrove baseline data sets were then made using mid-1990's JERS-1 SAR data, ALOS PALSAR data acquired in 2007, 2008, 2009 and 2010 and ALOS-2 PALSAR-2 annually from 2015 onwards. Published reports from individual mapping studies have also contributed in monitoring and documenting the historical and current distribution of global mangroves. The global extent of mangroves reported by UNEP were computed using Global Land Survey (GLS) data and Landsat archives based on the hybrid supervised and unsupervised digital image classification techniques developed by Giri et al. (2011). The data are available at 30-m spatial resolution. According to the report, there is a total of 137,760 sq km of mangroves in the year 2000, found in 118 countries and territories in the tropical and subtropical regions of the world. The said estimate is 12.3% smaller than most estimates by the Food and Agriculture Organization (FAO). The estimates and maps generated by Giri et al. (2011) have been regarded as the most globally consistent due to a standard methodology applied to all datasets used.

In the Philippines, Long & Giri have mapped the spatial distribution and areal extent of the mangroves in the year 2000 using Landsat data and ISODATA clustering. They reported a total of 256,185 ha in the year 2000 based from 61 Landsat images processed. The methodology was also applied for circa 2010 where a loss in estimate was reported. Both field-based and Remote Sensing (RS)-based estimates were documented for Philippine mangroves. The Bureau of Forest Development (BFD), now known as the Forest Management Bureau (FMB), provided an extent estimate from the years 1969 to 1984. Recently, more national reports were based on Remote Sensing-assisted estimates using freely available data such as Landsat. Now, remote sensing of mangroves is no longer limited to extent mapping only, but is also useful in generating biophysical, zonation, and species maps, among others.

Differences in mangrove estimates are commonly observed between different sources as driven and affected by factors that will be discussed in this report. The latest extent of mangroves in the Philippines will be identified from the freely available dataset. Latest images for selected project sites of the IAMBlueCECAM/ BlueCARES Project will be included in the discussion. This study aims to summarize the historical and current distribution of mangroves in the Philippines, including the new technology needed in improving the previous methodologies in mapping mangroves.

II. Datasets and methods

The dataset collected for this study were obtained in different formats. Most data were downloaded as shapefiles wherein the total area was computed in ArcGIS. Some older estimates were obtained from previous publications (e.g., Primavera et al.) while some are in table format (e.g., FMB). Long & Giri data for the years 2000 and 2010 was downloaded as a shapefile from the PhilGIS website (http://philgis.org/). The maps were produced from Landsat images which first underwent reprocessing steps including ETM gap-filling, band stacking, and suitable area masking. All composite imagery was masked to include only areas where mangroves are mostly likely to occur. The classification technique applied is a supervised tree classification approach (Long et al., 2014; Figure 4-1). The decadal land-cover change maps from 1990 to 2010 were prepared to depict changes in mangrove area.

The Global Mangrove Watch (GMW) dataset was downloaded from https://www.global-mangrovewatch.org/. The downloaded years are 1996, 2007, 2008, 2009, 2010, 2015, and 2016. The Global Mangrove Watch is a collaboration between Aberystwyth University (U.K.), solo Earth Observation (soloEO; Japan), Wetlands International, the World Conservation Monitoring Centre (UNEP-WCMC), and the Aerospace Exploration Agency (JAXA). The downloaded global shapefiles were then clipped to the Philippines boundary only before computing the total area per year.

The Forest Management Bureau released online the mangrove estimates for the Philippines for the years 2003 and 2010. Collated in a Microsoft Excel file, the data was downloaded from https://data.gov.ph/dataset. The Excel file contains the region name, the province name, and the corresponding mangrove area in hectares. The older estimates from FMB (then BFD) were based from the reports of FAO, UNEP (1981) entitled "Tropical Forest Resources Assessment Project, Forest Resources of Tropical Asia." The report included the BFD yearly mangrove estimates from the year 1969 to 1984 (FAO-UNEP, 1981).

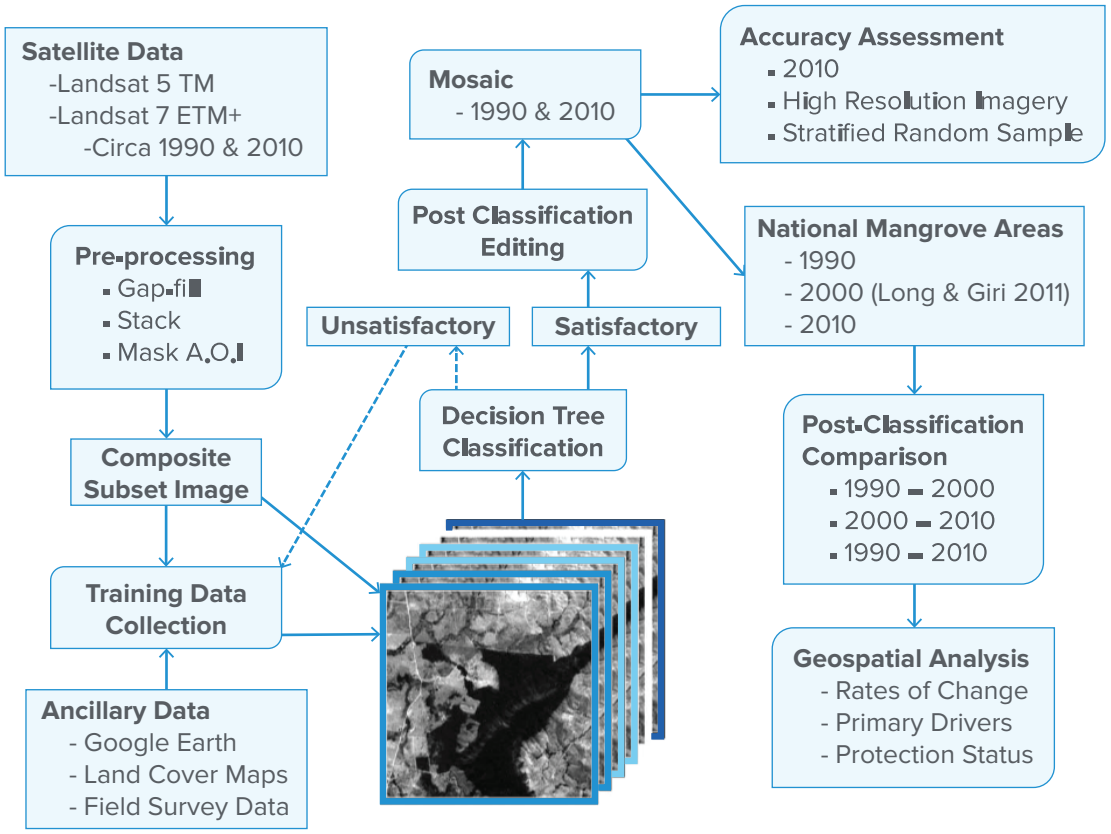


Figure 4-1. Mangrove mapping methodology implemented by Long et al. (Figure from Long & Giri, 2014)

Table 4-1. Total mangrove extent per region as reported in the Forest Management Bureau 2003 dataset

Region	Total Area (Ha)
CAR	0
Region 1	151
Region 2	8,602
Region 3	368
Region 4A	11,346
MIMAROPA	58,032
NCR	30
Region 5	13,499
Region 6	4,600
Region 7	11,770
Region 8	39,294
Region 9	21,720
Region 10	2,492
Region 11	2,010
Region 12	1,436
Region 13	26,731
ARMM	46,826
TOTAL	**248,907**

The Training Center for Applied Geodesy and Photogrammetry conducted mangrove extent estimation through the projects Phil-LiDAR 2-CoastMap (2015), CorVA (2016), PhilCoMaRS (2017) and IAMBlueCECAM-MaRS (2018). The map generated by the first two projects utilized Landsat data for 2015 (CoastMap) while historical to present data (10-year interval) from 1990 to 2018 were mapped by projects PhilCoMaRS and CoRVA. The estimates from CoRVA and PhilCoMaRS were collated by researchers from the Marine Science Institute. The maps generated by PhilCoMaRS can be accessed here at http://202.90.159.82/philcomars/. The IAMBlueCECAM project utilized a newer satellite system, the Sentinel-2 imagery, to produce 10-m-resolution maps of its priority sites by implementing the methodology below. Aklan and Palawan are part of the priority sites, with focus on mangrove parks. The other estimates are lifted from published papers, technical reports and available online articles (FAO-UNEP, 1981; FMB, Long & Giri, 2011; Gilbert and Janssen, 1997; Jara, 1984).

Mangroves can be mapped using field-based techniques and Remote Sensing. In the field approach, mangrove extent is estimated using sample field plots where data such as number of mangroves, species ID, and density are computed. This method is commonly used for small quadrat survey and inventory. In the Remote Sensing approach, mangroves are mapped using satellite data, aerial imageries from drones, and data from other non-contact surveying and mapping methodologies. Most applications related to mangrove mapping usually focus on the discrete differentiation

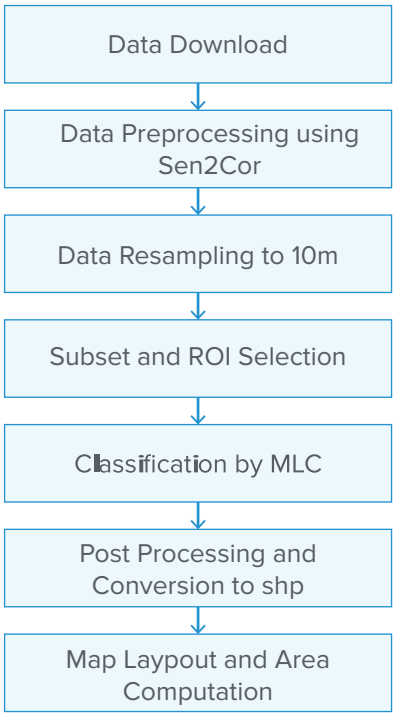


Figure 4-2. Mangrove mapping methodology implemented by the IAMBlueCECAM Project

between mangrove and non-mangrove areas (e.g., terrestrial vegetation, bare soil, water, and aquaculture). Different methodologies, work-flows, field techniques, survey protocols, and satellite-assisted mangrove mapping methods have already been developed and applied to Philippine mangroves.

III. Historical and current mangrove trend

The changes in mangrove extent were locally documented through historical and recent mangrove extent data. The trend is shown in Figure 4-3. The earliest estimate was reported by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development in year 1918, with 450,000 ha (PCAARD, 1991). This figure has been cited also by other authors and it is the real figure provided by Brown and Fisher, 1920. The next estimate was provided by Primavera (1995) based on the figure provided by the Fisheries Gazette of the Philippines. Although a decrease was observed, there is a 33-year gap between these earliest figures so we cannot determine the actual trend in between the estimation dates. The next estimate was also provided by Primavera (1995) based on BFAR figures. Around 63,000 ha of mangroves have been lost from 1951 to 1960.

The Bureau of Forest Development provided a yearly mangrove area estimate from 1969 to 1984 (Figure 4-4). A decreasing trend was observed throughout the dataset, except for the sudden increase in the total extent in year 1984. The data of Gomez (1980) in 1979 (220,241 ha) is close to the estimate of BFD for the same year (218,000 ha). Under its new name, the Bureau released a new estimate in 1997 with only 112,400 ha remaining mangrove area. The latest estimate, downloaded from the website, reported the total mangrove area to be around 248,907 ha.

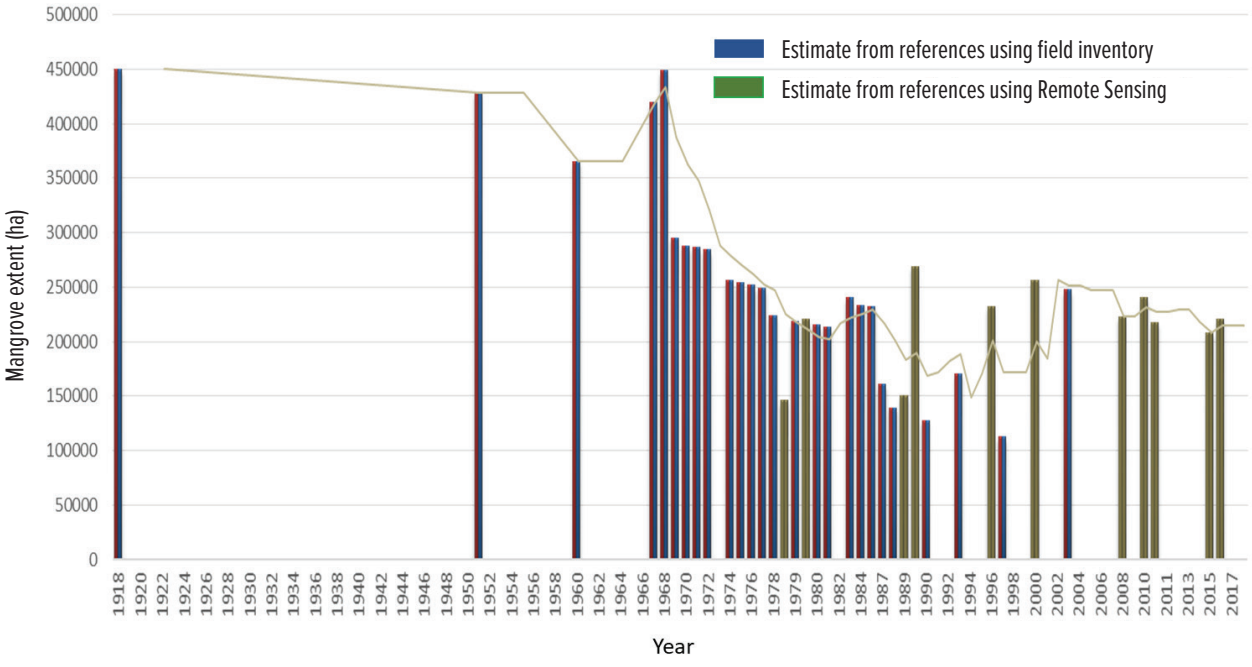


Figure 4-3. Historical and current mangrove extent estimates in the Philippines from various sources

A shift from field-based measurement to Remote Sensing-based estimates can be observed from 1989 onwards (see Figure 4-3). These estimates are both from local and global sources which utilized satellite data such as Landsat and SAR data. One of the most cited values in the Philippines are the estimates provided by Long & Giri. They have applied the supervised classification technique to historical Landsat datasets: 1990, 2000, and 2010. Similar to the BFD, a decreasing trend was observed between the earliest (1990) and latest (2010) estimates, with a loss of 28,172 ha (Figures 4-4 and 4-5). It is important to note however that some mangrove areas in the country have increased. A standard methodology was applied to highlight the actual changes in the mangroves.

Like the RS-based Long & Giri maps, the Global Mangrove Watch also provided regular mangrove maps and area estimates for the entire world, where Philippine estimates were clipped using available boundary shapefiles (Figure 4-8 and 4-9). The earliest estimate was made for 1996 (232,291 ha) and the latest for 2016 (220,984 ha). The estimate in 2016 is one of the latest among all available sources for the Philippines. From 1996 to 2016, the mangrove area has declined. From 1996 to 2010, around 9,000 ha of mangroves were lost. The GMW maps were generated using Random Forest (RF) classification of a combination of L-band radar (ALOS PALSAR) and optical (Landsat 5 and 7) data along tropical and sub-tropical. It was observed that although these estimates (i.e., BFD, Long & Giri, and Global Mangrove Watch) utilized different methodologies, all sources reported the same decreasing trend of mangrove extent. The LiDAR 2-CoastMap (2015) estimated 208,220 ha in 2015, the lowest estimate reported since FMB's estimate for 1997 (112,400 ha). The possibility of under-classification in the CoastMap data will be discussed in the next section.

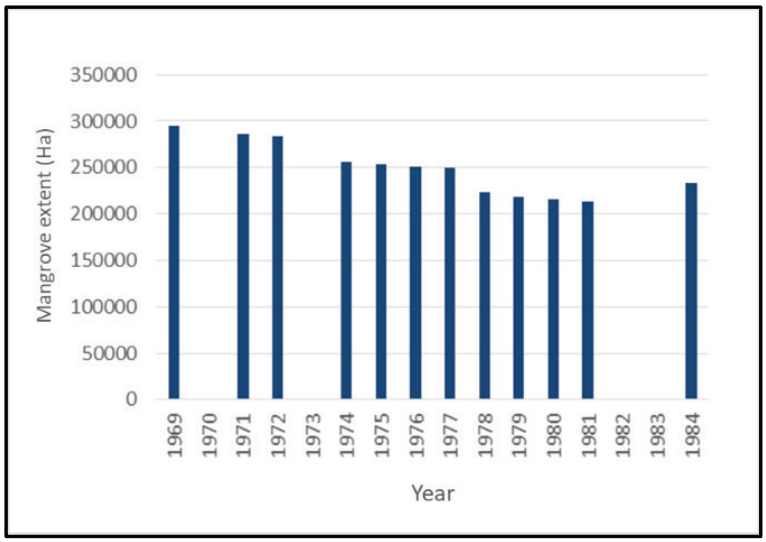


Figure 4-4. Historical mangrove estimates reported by the Bureau of Forest Development (now the Forest Management Bureau)

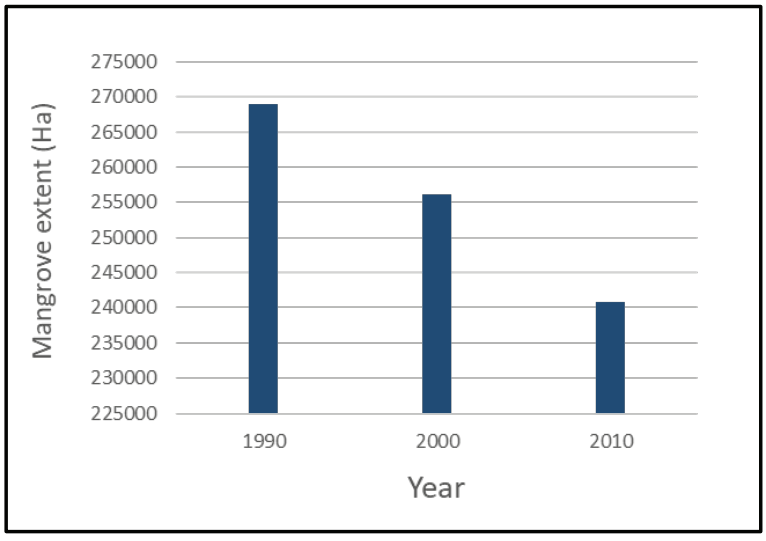


Figure 4-5. Historical mangrove estimates reported by Long & Giri (1990, 2000, and 2010)

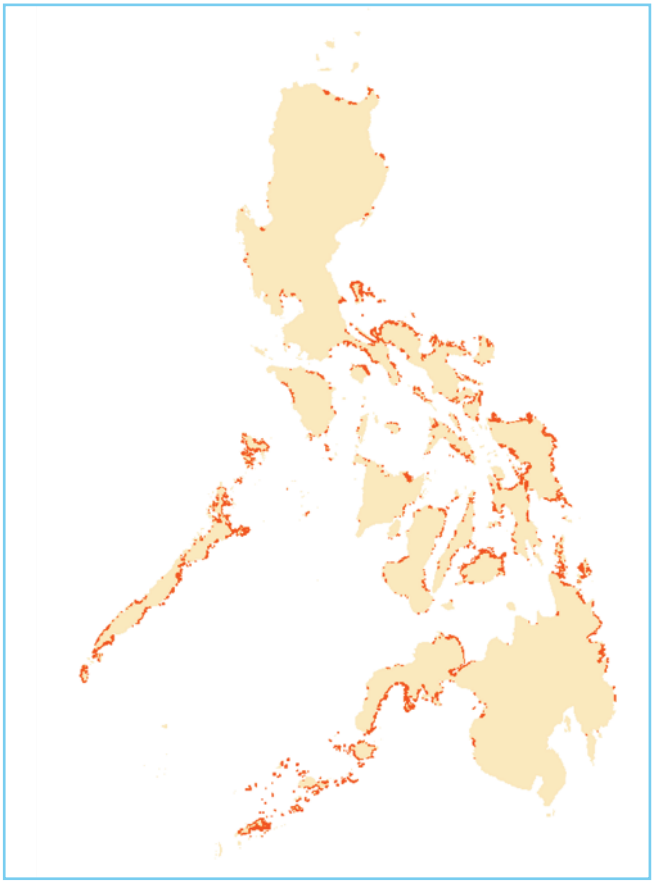


Figure 4-6. Mangrove extent map from the Forest Management Bureau (2003) with a total area of 247,362 ha

Figure 4-7. Historical mangrove estimates reported by Long & Giri (1990, 2000, and 2010)

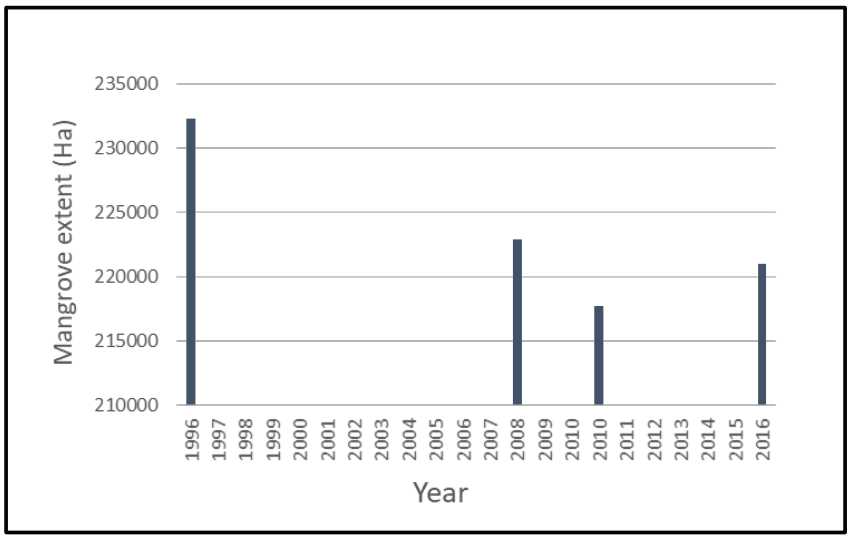


Figure 4-8. Historical mangrove estimates reported by Global Mangrove Watch

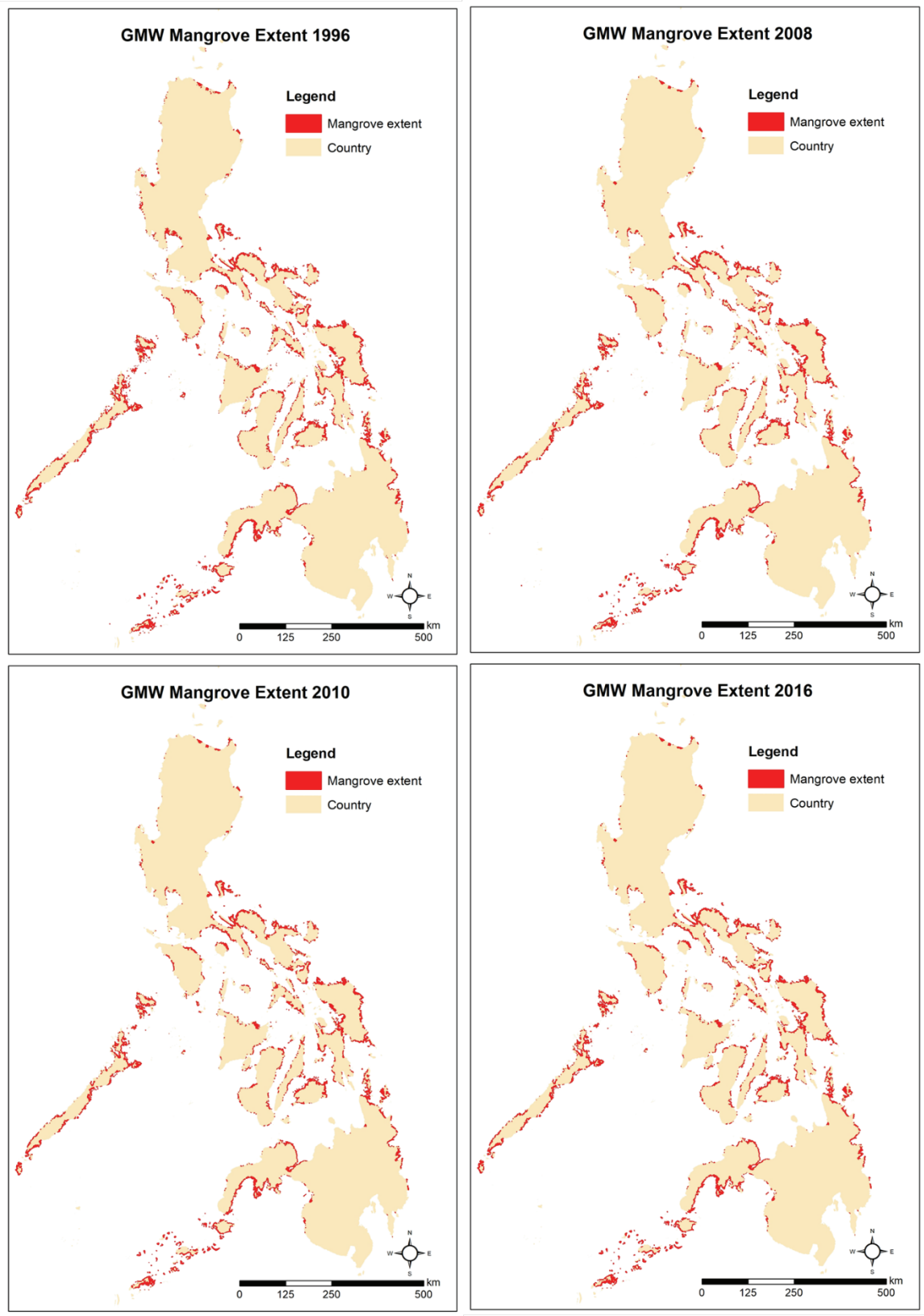


Figure 4-9. Mangrove extent map Global Mangrove Watch (1996, 2008, 2010 and 2016)

The IAMBlueCECAM-MaRS Project (2018) estimated the mangrove extent for its priority sites mainly Palawan and Aklan. The project utilized Sentinel-2 which has higher spatial resolution (10 m) compared to Landsat's 30 m resolution commonly used by other references. Further, it utilized the Maximum Likelihood Classification (MLC) technique using selected regions of interest (ROIs) within the mangroves and non-mangrove areas. Using higher resolution imagery as input for classification allows finer delineation of mangrove extent including the thin and less dense mangrove forest cover. The project estimated 1,298 ha for Busuanga, similar to JAFTA's 1,298 ha (1992), higher than PhilCoMaRS' 881 ha (2017), and lower than Long & Giri's 1,390 ha. For Coron, Palawan, the new estimate is close to PhilCoMaRS' 1,687 ha, estimated in 2017. The value was also compared to SPOT imagery where the latter generated a lower estimate value (636 ha; 2006). The mangrove area per barangay in Coron and Busuanga are shown in the table below.

Table 4-2. Mangrove extent per barangay in Busuanga, Palawan by the IAMBlueCECAM Project, compared with estimates from other sources

Barangay	IAMBlueCECAM Project (2018), ha	PhilCoMaRS (2017), ha	Long & Giri (2010), ha	JAFTA (1992), ha
Bogtong	256.01	156.69	191.09	96
Buluang	278.99	251.36	417.2	32
Cheey	10.89	9.78	27.08	?
Concepcion	47.46	26.26	37.32	135
Maglalambay	15.29	13.98	25.32	11.5
New Busuanga	117.31	105.25	174.88	92
Old Busuanga	72.29	44.17	103.33	96
Panlaitan	0	0	0	4
Sagrada	305.56	138.95	182.75	195.5
Salvacion	135.05	69.51	141.27	54
San Isidro	29.52	34.48	47.45	72
San Rafael	1.55	3.57	3.98	14
Santo Niño	29.03	24.27	38.45	74
Others (Old Name)				156; 266
TOTAL	**1,298.96**	**881.27**	**1,390.12**	**1,298.00**

Table 4-3. Mangrove extent per barangay in Coron, Palawan by the IAMBlueCECAM Project, compared with estimates from other sources

Barangay	IAMBlueCECAM Project (2018), ha	PhilCoMaRS (2017), ha	Long & Giri (2010), ha	SPOT (2006), ha
Banuang Daan	1.5	2.83	3.89	
Barangay I	0	0	0	
Barangay II	4.32	4.38	12.02	
Barangay III	1.35	3.35	3.55	
Barangay IV	0	0	0	
Barangay V	0	0	0	
Barangay VI	10.12	11.01	16.88	
Bintuan	593.18	547.47	813.91	151.58
Borac	136.9	122.7	198.5	14.28
Buenavista	45.81	43.83	78.65	17.17
Bulalacao	96.18	99.37	146.04	
Cabugao	20.57	23.56	33.05	9.54
Decabobo	77.96	65.18	130.63	8.01
Decalachao	192.23	138.53	336.55	83.23
Guadalupe	197.28	153.97	350.79	
Lajala	88.29	79.18	128.34	33.281
Malawig	0	0	0	
Marcilla	62.4	55.88	94.88	42.29
San Jose	117.09	103.18	176.75	19.21
San Nicolas	32.53	28.28	46.36	15.13
Tagumpay	54.06	57.72	75.09	17.64
Tara	8.21	7.47	16.8	3.09
Turda	146.82	140.74	224.35	39.149
Others (Old Names)				2.852; 11.95; 11.96; 65.90
TOTAL	**1,887.80**	**1,687.63**	**2.887.03**	**636.96**

The project reported a new estimate for Puerto Princesa with 4,349 ha in 2018. This estimate is lower than the estimate of NAMRIA (1986) with 5,917 ha and by the ECAN Zoning Project (2004) with 5,737 ha. The ECAN utilized SPOT images for mangrove classification. For the Katunggan-It-Ibajay (KII) Ecopark, the new estimate is 44.97 ha, very close to the previous estimate by SEAFDEC in 2010 (44.22 ha). The estimated mangrove area for the Bakhawan Ecopark in Kalibo Aklan is 78.62 ha.

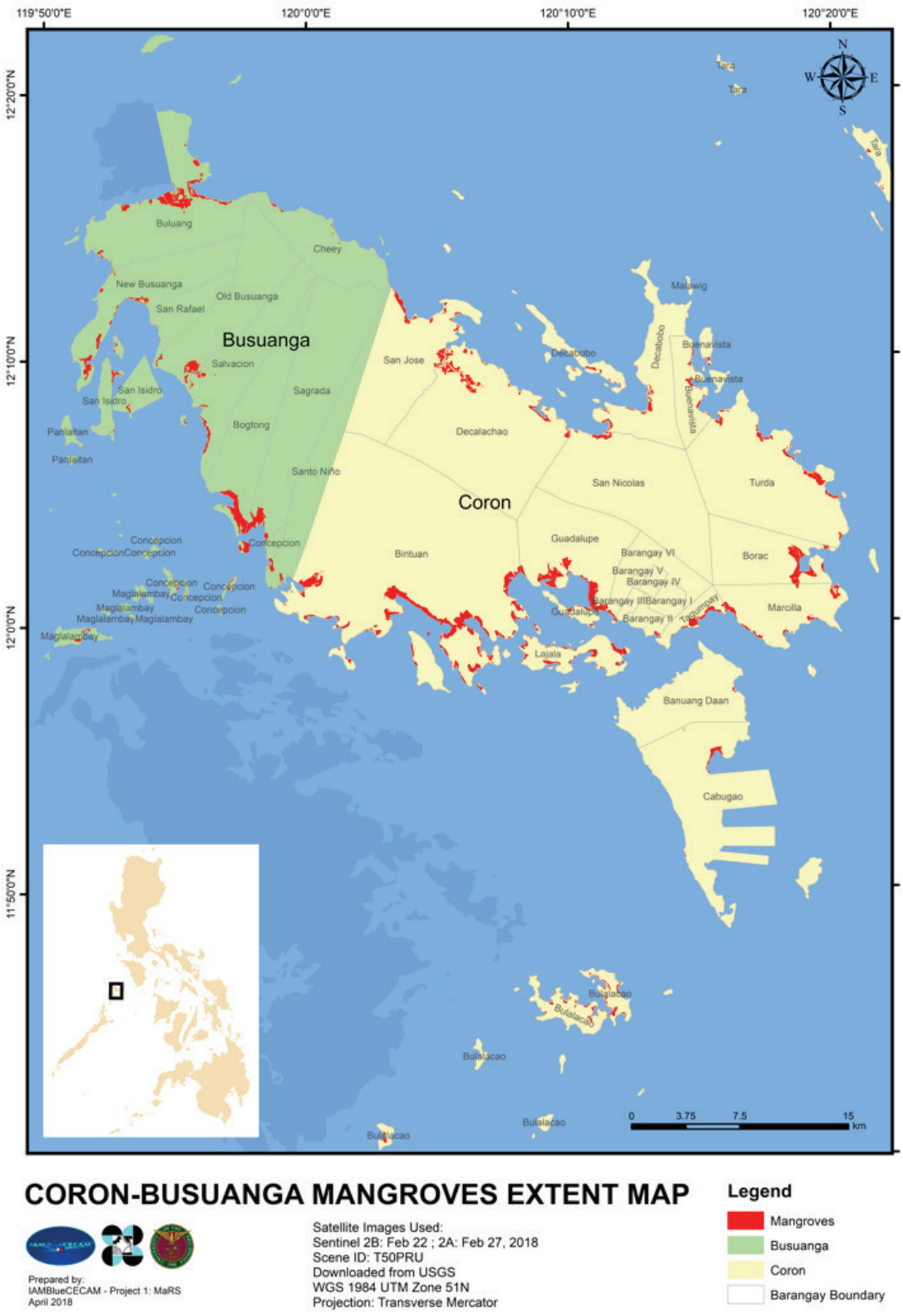


Figure 4-10. Sample 10-m mangrove extent map of the IAMBlueCECAM Project for Coron and Busuanga, Palawan for the year 2018. The mangroves were classified using Sentinel-2 imagery and MLC supervised classification technique. The project produced the extent maps for selected priority sites in Palawan and Aklan in the Philippines.

IV. Sources of variations in mangrove maps and estimates

As mentioned in the previous section, the different references used in this study utilized different inputs and classification techniques. Here, we summarize the main sources of variation in the estimates provided by the references used. Aside from the difference in the reported years, intra-variation can also be observed when an institution utilized different methodologies even though the main satellite input, in terms of the Remote Sensing approach, is the same.

A. Field-based versus Remote Sensing approach

The field-based protocols mainly utilize representative sample plots, usually in quadrats, in calculating the total area of mangroves. Delineating all mangroves on site, e.g., walking on mangrove boundaries with a GPS, is time-consuming and requires substantial manpower. In the plot approach, the total area from the quadrat will be multiplied or regressed with a fix or computed value/ multiplier to obtain total mangrove area of the whole site. The main challenge of this approach is the heterogeneity in the mangrove forest where density differs in each zone, as a factor of varying height, salinity, soil, distance from the shore, and species composition, among others. In the RS method, the mangrove extent will be completely mapped as long as it is visible in the chosen Satellite system. Field data was mainly utilized to validate results of the RS approach.

B. Difference in spatial resolution of Remote Sensing imagery

Different satellite systems offer varying spatial and temporal resolution in the output or product. Although many RS data can provide very high-resolution data like SPOT images, most of them are only commercially available. This is the main reason why most mangrove extent mapping techniques were developed using free only satellite data such as Landsat collection (Landsat 5 to 8). Satellite resolution is a vital factor for map accuracy, because it allows finer delineation of mangrove forests regardless of its density and distribution. Satellite data with 10-m resolution can separate mangrove pixels as small as 10 m on the ground, versus data with 30-m or 100-m resolution wherein mixing with other classes (land use/ land cover) can already be a problem. It is important to note, however, that spectral resolution is as important as the spatial resolution. PlanetScope with a resolution of 3 m is used less frequently in mangrove

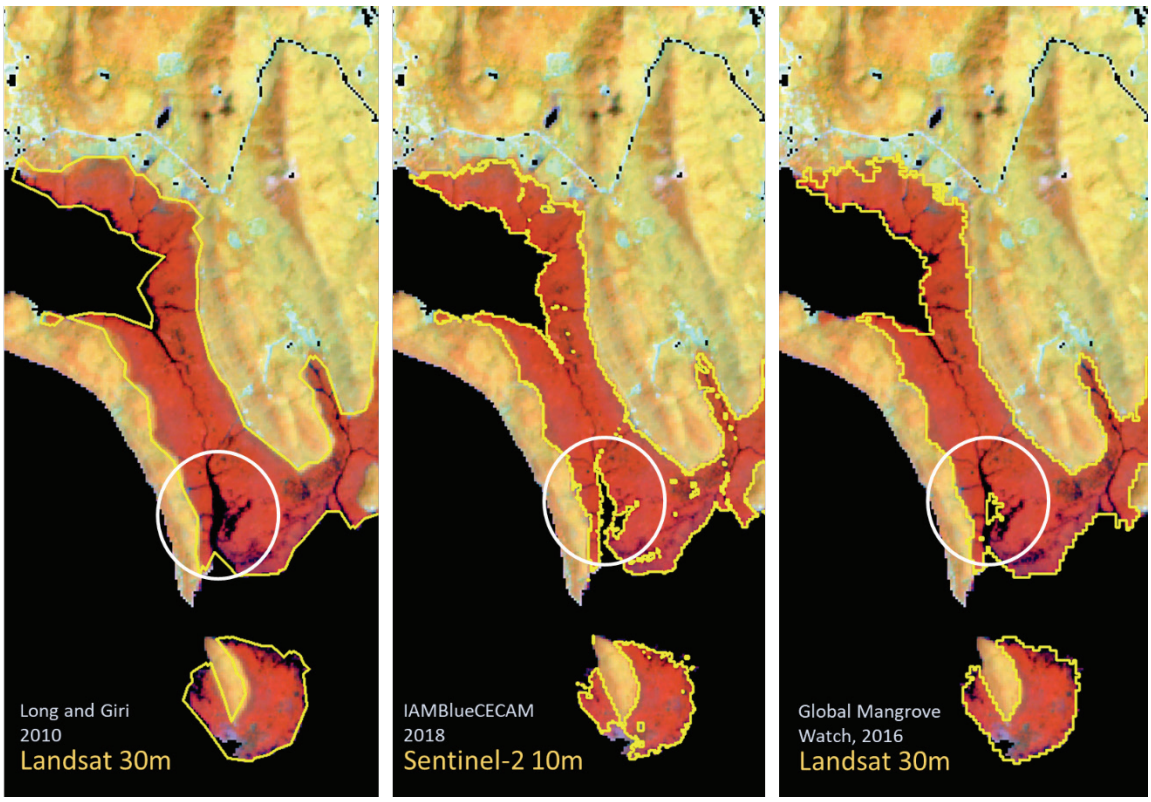


Figure 4-11. Mangrove extent maps of Busuanga, Palawan showing variation in delineating the mangrove cover by the different sources, using Landsat and Sentinel-2

classification mapping since it only has four bands (red, green, blue, Near Infra-red). Sentinel-2 and Landsat have more spectral bands especially NIR and SWIR which are very useful in isolating mangroves from non-mangrove cover. Notice how the Sentinel-2 map in Figure 4-11 allows delineation of the mangrove area within the white circle. This non-mangrove area (water) was still mapped as mangroves when Landsat was used by Long & Giri (2010). A small portion of the water was correctly classified as non-mangroves by the Global Mangrove Watch, although the delineation using Sentinel-2 is still better. It can also be observed that mangrove areas near the shore are over-estimated in the sources with Landsat as the reference satellite data.

C. Difference in mapping techniques

Sources may utilize the same satellite data but may differ in the mapping and classification techniques (Table 4-4). The methodology may use the same pre-processing workflow but different in the classification method, whether it is a supervised or non-supervised technique. Long & Giri and PhilCoMaRS both used Landsat collection but Long & Giri have applied ISODATA classification while PhilCo MaRS utilized Maximum Likelihood Classification (MLC). Notice how CoastMap

Table 4-4. Sample references of mangroves estimates in the Philippines with different satellite input and classification techniques

Reference	Satellite Used	Classification Technique
Long & Giri	Landsat	ISODATA, SVM
Global Mangrove Watch	Landsat + ALOS PALSAR	Random Forest
PhilCoMaRS	Landsat	SVM, MLC
IAMBlue-CECAM	Sentinel-2	MLC
CoRVA	Landsat	SVM, MLC
CoastMap	Landsat	SVM

(Figure 4-12, top) properly delineated the mangrove areas versus the water class. The GMW misclassified the water as mangroves and thus will affect the total estimated area for the site. The figure shows that the classification technique used is important in increasing the map accuracy. Many papers have discussed the advantages of using one technique over the other, but universal accuracy cannot be established as accuracy

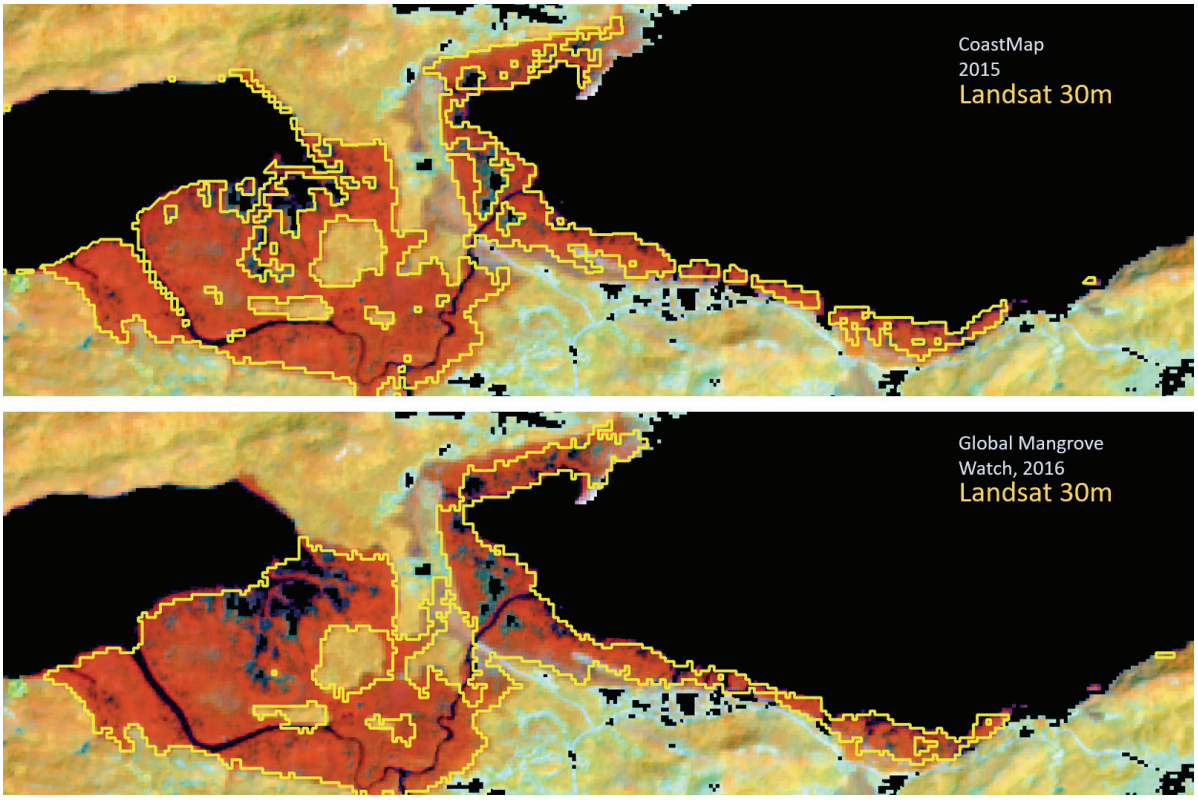


Figure 4-12. Mangrove extent maps of Calauit, Busuanga Palawan (CoastMap 2015 and GMW 2016) both using Landsat data but different classification methods

may be dependent on the region, mangrove forest types, and the actual dataset quality for a specific site.

D. Global versus local datasets and techniques

Global Forest Watch and Long & Giri are some of the references which utilize a global methodology where the developed workflows were applied to global datasets and were verified using distributed randomized points from representative countries. The accuracy of this type of data may vary from the maps and estimates of references using localized classification techniques in specific study sites. For example, IAMBlueCECAM and PhilCoMaRS made use of regions of interest (ROIs) carefully selected within the study sites only (Philippines). Some spectral properties of the mangrove ROIs in the country may differ if selected from the other countries, e.g., maxima and minimum value of NIR and SWIR to be considered within the mangrove class.

E. Re-mapping versus re-computation from previous estimates

The earlier estimates of the Bureau of Forest Development were based on an initial "base estimates" for a given year, wherein the estimate for the succeeding years was computed by applying a fixed annual deforestation rate to the results of a previous inventory. The GMW generated a baseline map of mangroves for 2010 using ALOS PALSAR and Landsat (optical) data, and changes from this baseline for six epochs between 1996 and 2016 derived from JERS-1 SAR, ALOS PALSAR and ALOS-2 PALSAR-2. These derived products may have different levels of accuracy from the base data, and also from those estimates computed from "scratch" annually without dependency on the previous dataset.

F. Errors and variations in ROI Selection

Supervised classification techniques are highly dependent on the quality of ROIs selected for each study site. Some references select two major classes only: mangrove and non-mangrove; while other references generate complete land cover/ land use maps wherein they separate the mangrove classes only at a later stage of processing. The number of ROIs is also dependent on the threshold needed for each classification technique, such as SVM.

G. Difference in map accuracies

The variation in the level of accuracy of each map is dependent on many reasons, including the factors discussed earlier: the satellite type and its spatial and spectral capability, the classification techniques used, the quality and quantity of regions of interests, and the application of global or locally trained methodologies, among others.

V. Challenges in mapping mangrove extent

The first main challenge in mapping mangroves is the availability of high-resolution satellite data. The current methodologies available are heavily dependent or based on free imageries such as Landsat and Sentinel-2. Common high resolution satellite data are not free. The second is the knowledge and technology needed for large-scale and wide-area mapping, especially for national or regional mapping. Some classification techniques are trained on specific study sites, which are sometimes not applicable to other mangrove forests in the country. Development of large-scale and wide-area mapping methods will allow more comprehensive and more frequent estimation of mangrove cover in the country. There is also a challenge in selecting the appropriate ROIs in the case of supervised classification techniques. Selection of ROIs can become biased and is affected by the user's knowledge and skill in identifying mangroves versus non-mangrove pixels. Aside from this, users are also limited by the capacity of the computers performing the mapping operations including the availability of memory and storage to handle big data and collation of satellite images. Institutions performing mangrove extent mapping also require skill to conduct efficient capacity-building to teach the technology to mangrove researchers and planners for map validation and updates. Moreover, there is still a need to have easier mapping techniques and mapping platforms that will solve the abovementioned challenges in mapping mangroves.

VI. Mangrove mapping: Way forward

In the future, upcoming new and free satellite systems can further improve the current RS-based maps in the country. Notice that the available free satellites such as Landsat and Sentinel-2 have become the main sources of estimates over the years. With the improvement in spatial resolution between Landsat and Sentinel-2, we may expect new satellite systems that can offer better spatial and spectral resolution in the next few years. At present, new mapping methodologies are being developed and tested using unmanned aerial systems (UAS). The IAMBlueCECAM Project has already utilized drone-acquired orthophotos to map the species in KII Ecopark. It has also utilized handheld LiDAR laser scanners to map individual tress in Bakhawan Ecopark, among other sites. Under the ongoing BlueCARES project, researchers will develop a new Remote Sensing-based methodology to map mangroves rapidly at different map scales, using Sentinel-2 data implemented in cloud-based platform.

New methodologies can be standardized for global or national scale usage. We can still develop more rapid and repeatable methodologies for mangrove mapping, regardless if we need a large scale or site-specific mangrove maps and estimates. Cloud-based mapping techniques such as those implemented in Google Earth Engine offer a promising platform for faster and easier mapping capability without the need for higher computer specs and data storage.

Aside from the advancement in mapping methodologies, we must aim to finally standardize the mapping protocols and techniques by the different sources/ institutions in the country, so we can produce non-contradicting maps and estimates for our mangrove extent and cover.

VII. Summary

This paper discussed the current and historical distribution of mangroves using either field-based or Remote Sensing-based area estimation methods. Different sources of mangrove extent data in the Philippines reported that the trend of mangroves areas in the Philippines is decreasing. Larger mangrove areas were reported in earlier years, between 1918 (450,000 ha) to 1968 (448,310 ha) (PCAARD and L.M. Lawas). Latest estimates reported an extent of 220,984 ha (2016; Global Mangrove Watch). From year 1990 onwards, a significant shift from field-based mapping to Remote Sensing-based approaches has been observed in the Philippines. These Remote Sensing techniques further vary in the satellite data used, and the classification technique implemented to isolate the mangrove cover.

The main sources of differences in extent maps in the Philippines are (1) the mangrove mapping approach, (2) the satellite data used, (3) the classification methodology implemented, and (4) varying map accuracy depending on the satellite and methodology used. There is also a variation between estimates from re-mapping versus re-computation from previous estimates, with application of a fixed annual deforestation rate to the results of a previous inventory.

With the need for higher resolution maps in a national scale, the main challenges include the availability of high-resolution satellite data, the capacity of workstations/ computers to process the mangrove maps, the capability for more frequent mangrove mapping to update base maps, and the simplification of methodology to be transferred to LGUs and other non-academic institutions. Future mapping techniques will be highly dependent on whatever new satellite system (in the future) that can provide free and higher resolution data. With the challenge of processing big data in the absence of high-end computers, mangrove mapping will be implemented in cloud-based platforms such as Google Earth Engine, which is promising in terms of usability and performance.

VIII. Acknowledgements

We would like to thank all sources of secondary data on mangrove area used in this paper. The authors would also like to acknowledge the Training Center for Applied Geodesy and Photogrammetry (TCAGP) and the EnviSAGE laboratory of the Department of Geodetic Engineering, College of Engineering. Likewise, we would like to acknowledge the funding agencies of the mentioned TCAGP-implemented projects including the IAMBlueCECAM Project (DOST-PCIEERD) and BlueCARES Project (DENR-BMB and JICA).

IX. References

Aizpuru, M., Achard, F., Blasco, F. (2000). Global Assessment of Cover Change of the Mangrove Forests using satellite imagery at medium to high resolution. In EEC Research project n 15017-1999-05 FIED ISP FR – Joint Research center, Ispra.

Bunting, P., Lucas, R., Rosenqvist, A., Rebelo, L., Hilarides, L., Thomas, N., Hardy, A., Itoh, T., Shimada, M., Finlayson, M. (2018). The Global Mangrove Watch – A New 2010 Baseline of Mangrove Extent. Remote Sensing. 10. 1669. 10.3390/rs10101669.

Bureau of Forest Development. 1969-1983. Philippines Forestry Statistics. Diliman, Quezon City.

BFAR. (1970). Fisheries Statistics of the Philippines. Bureau of Fisheries and Aquatic resources, Department of Agriculture, Quezon City, Philippines.

FAO, UNEP. (1981). Tropical Forest Resources Assesment Project. Forest Resources of Tropical Asia.

Fernando, E.S. (1990). The vegetation of the Philippines Islands and the Situation of the Flowering Plants. In proceedings of the IV International Congress of Systematic and Evolutionary Biology, 01-07 July 1990.

Food Agric. Organ. U. N. (FAO). (2003). Status and trends in mangrove area extent worldwide. Work. Pap. FRA 63, FAO, Rome, Italy.

Food Agric. Organ. U. N. (FAO). (2007). The world's mangroves 1980–2005. Work. Pap. FRA 153, FAO, Rome, Italy.

Fortes, M.D. (1993). Sustainable use of mangroves in the Philippines: reality or an impossible dream? In Proceedings of the Asia-Pacific Symposium on Mangrove Ecosystem, Yuk-Shan Wong and Nora, F.Y. Tam, eds. The Hong Kong University of Science & Technology, 1-3 September, 1993. 368 pp.

Gilbert, A. J., Janssen, R. (1997). The use of Environmental Functions to Evaluate Management Strategies for the Pagbilao Mangrove Forest. CREED Working Paper Series No. 15.

Giri, C., Ochieng E., Tieszen, L. L., Zhu, Z., Singh, A., Lovel, T, Masek, J., Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data (version 1.3, updated by UNEP-WCMC). Global Ecology and Biogeography, 20: 154-159.

Global Mangrove Watch, (2018). "Global Mangrove Extent (v2.0)." www.global-mangrovewatch.org.

Gomez, E.D. (1980). The present state of Mangrove ecosystems in Southeast Asia and the Impact of Pollution: Regional, Philippines. South China Seas Fisheries Development and Coordinating Programme, FAO, UNEP, Manila, 128 p.

Jara, R. S. (1984). Aquaculture and Mangroves in the Philippines. In: Ong Jin-Eong and Gong Wooi-Khoon, 1984. Productivity of the Mangrove Ecosystem: Management Implications, p. 97-107, 4-6 October 1983, Penang Malaysia.

Kelleher, G., Bleakley, C., Wells, S. (1995). A global representative system of marine protected areas. Vol. II-III-IV Great Barrier Reef Marine Park Authority, IBRD, The World Bank, IUCN.

Lawas, L.M. (1974). Economic study on alternative uses of mangrove swamps: bakawan production or fish ponds. In: Proceedings of Indo-Pacific Fishery Council, p.65-69, 15th Session, 18-27 October 1972, Wellington, New Zealand, Section 2 Bangkok, FAO.

Long J.B., Giri, C. (2011). Mapping the Philippines' mangrove forests using Landsat imagery. Sensors 11 (3), pp 2972– 2981.

Long J., Napton. D., Giri, C., Graesser, J. (2013). A mapping and monitoring assessment of the Philippines' mangrove forests from 1990 to 2010. Journal of Coastal Research.

Melana, E. E. (1994). Mangrove ecosystem: concept and some implications to rehabilitation and management. In proceedings of the Conference: FSP-DENR Component Trainor's Training for CBMFM on Nov.21-Dec 2, Held at Owen's Hotel, Lucena City.

Natural Resources Management Center. (1978). Mangrove inventory of the Philippines using LANDSAT data. Diliman, Quezon City, Philippines.

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development. (1991). The Philippines recommends for mangrove production and harvesting. Philippines Recommends series No. 74, PCARRD / DENR, 96 p.

Primavera, J. H. (1995). Mangroves and brackishwater pond culture in the Philippines. Hydrobiologia, 295: 303-309.

Saenger, P., Hegerl E.J., J.D.S., Davie. (1983). Global status of mangrove ecosystems. Commission on Ecology Papers No. 3, IUCN, Gland, Switzerland, 88 p.

Spalding, M., Blasco, F., Field C., eds. (1997). World Mangrove Atlas. Okinawa, JP: Int.Soc. MangroveEcosyst.

Tech. Staff, Philippine National Mangrove Committee. (1986). Country report: Philippines. In: R.M. Umali et al. Mangrove of Asia and the Pacific: Status and Management. Technical Reports UNDP/UNESCO Regional Mangrove Project RAS/79002, Quezon City, Philippines.

World Resources Institute. (2000). World resources 2000-2001: people and ecosystem—the fraying web of life. Washington, DC., UNDP, 400 p.

Climate Change and Mangrove Forests: Impacts and Adaptation

Rodel Lasco[1,2] and Rafaela Jane Delfino[1]

[1]The Oscar M. Lopez Center, Pasig City, Philippines
[2]World Agroforestry Centre (ICRAF), Los Baños, Philippines

Mangrove forests are among the most valuable ecosystems in the world. These forests are habitat to diverse coastal flora and fauna while providing protection to local communities. Climate change is expected to affect mangrove forests through warmer temperatures, rising sea level, changing precipitation, and altered ocean currents, among others. The IPCC (2019) warns that sea level rise will result in loss of coastal and marine ecosystem services including those provided by mangrove ecosystems.

The Philippines will experience one of the highest magnitudes of increase in ocean temperature and sea level rise. Mangrove areas in the Philippines are among the most vulnerable ecosystems to climate change together with the small islands in the Pacific (Cruz et al., 2017).

The importance of mangroves in the country is highlighted by the degree of coastal protection it provides. A World Bank study showed that if the current mangroves in the Philippines were lost, 24% more people would be flooded annually, i.e., an additional 613,000 more people (Losada et al., 2017). Damage to residential and industrial property would increase by 28%, equivalent losses growing to more than US$1 billion annually. The same study estimated that one hectare of mangroves provides more than US$ 3,200/ year of direct flood reduction benefits. In addition, mangrove forests provide the most protection for frequent lower intensity storms (e.g., 1-in-10 year storm events). For more catastrophic events, such as the 1-in-25 year storm, mangroves provide more than US $1.6 billion in averted damages.

Our study in the aftermath of Super Typhoon Yolanda (Haiyan) provides anecdotal evidence on the effectiveness of mangroves in reducing damage due to storm surge (Delfino et al., 2016). Based on interviews with 870 households in Samar and Leyte, we found that the peoples' perception on the coastal protection function of mangroves differed according to the state of mangroves. Coastal communities with mangroves experienced less typhoon-related housing damage than those living in areas without mangroves. Areas with the highest mangrove area, width, and species richness were also the sites where most respondents observed the protective role mangroves play (e.g., Ormoc City, General MacArthur, and Quinapondan). In addition, awareness of the benefits of mangroves is high but participation in mangrove rehabilitation remains low.

Future research on Philippine mangroves should focus on the impacts of climate change to mangrove forests and their ecosystems services. The role of mangroves in local communities' adaptation and resilience (e.g., surge protection) should also be investigated. In addition, adaptation options for mangroves to sea level rise should also be developed.

References

Cruz, R. V. O., Aliño, P. M., Cabrera O. C., David, C. P. C., David, L. T., Lansigan, F. P., Lasco, R. D., Licuanan, W. R. Y., Lorenzo, F. M., Mamauag, S. S., Peñaflor, E. L., Perez, R. T., Pulhin, J. M., Rollon, R. N., Samson, M. S., Siringan, F. P., Tibig, L. V., Uy, N. M., Villanoy, C. L. (2017). 2017 Philippine Climate Change Assessment: Impacts, Vulnerabilities and Adaptation. The Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc. and Climate Change Commission.

Delfino, R. J. P., Carlos, C. M., David, L. T., Lasco, R. D., Juanico, D. E. O. (2016). Perceptions of Typhoon Haiyan-affected communities about the resilience and storm protection function of mangrove ecosystems in Leyte and Eastern Samar, Philippines. Climate, Disasters and Development Journal, http://dx.doi.org/10.18783/cddj.v001.i01.a03

IPCC. (2019). Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press.

Losada, I.J., Beck, M., Menéndez, P., Espejo, A., Torres, S., Díaz-Simal, P., Fernández, F., Abad, S., Ripoll, N., García, J., Narayan, S., Trespalacios, D. (2017). Valuation of the Coastal Protection Services of Mangroves in the Philippines. World Bank, Washington, DC.

Carbon Sequestration of Mangroves in the Philippines

Dixon T. Gevaña
Department of Social Forestry and Forest Governance
College of Forestry and Natural Resources, University of the Philippines Los Baños

I. Introduction

The coastal ecosystem plays an essential role in mitigating climate change and its impacts. Collectively termed blue carbon ecosystems, mangrove forests, salt marshes, and seagrass meadows have been regarded as powerhouses of carbon sequestration. The role of blue carbon ecosystems, particularly mangroves, is now being incorporated in the climate change mitigation modalities particularly in the Reducing Emission from Deforestation and Forest Degradation or REDD. Greater interest on their rehabilitation has also increased.

Mangroves provide countless ecosystem benefits and services. They enrich coastal waters, produce commercial forest and marine products, stabilize coastlines, regulate tidal actions, and sequester vast amounts of carbon to help mitigate climate change, to name a few. By estimate, global mangroves contain about 4-20 billion tC (Donato et al., 2011). The bulk of this stock is stored in sediments amounting to at least 5 billion tC. They sequester carbon at the rate of 1.15–1.39 t/ ha annually (Bouillon et al., 2008). Ironically, continuous deforestation emits 35 million tC/ yr globally (Siikamäki et al., 2012). If mangroves are converted to aquaculture ponds, the emission rate could reach as much as 112-392 tC/ ha/ yr. According to Kauffman et al. (2014), carbon emission from converting mangrove areas to shrimp ponds could reach as much as 1,135 tC/ ha, a value that is almost equal to their maximum storage capacity.

This paper describes the blue carbon storage and sequestration potential of mangroves in the Philippines. Prospects and challenges on their sustainable management and research are also discussed.

II. Blue carbon stock potential of mangroves in the Philippines and Southeast Asia

Healthy mangrove stands can store two to four times of carbon than that of other terrestrial forest ecosystems. Evidence has shown that they can keep as much as 1,023tC/ ha (FAO 2010; Donato et al.2011). The bulk of this value is stored in the sediment. Related blue carbon ecosystems such as seagrasses and salt marshes likewise have comparable capacities at about 512 tC/ ha and 917 tC/ ha, respectively. If taken together, blue carbon habitats sequester two to four times more than the rate of other tropical forest ecosystems.

Table 4-5 provides a summary of blue carbon estimates of mangroves in Southeast Asia, highlighting values reported in the Philippines (Gevaña et. al. 2018). In view of natural mangrove sites, values range from 22.6 tC/ ha (in Tha Po Village, Surat Thani Province) to 939.3 tC/ ha (in Sulawesi, Indonesia). In the case of the Philippines, the largest estimate was reported in Palawan (653 tC/ ha) for vegetation pool alone. The apparent disparities among these estimates are reflective of the carbon pool levels assessed. This means that those studies that accounted both vegetation and sediment carbon pools have relatively larger values than those that only included vegetation carbon stocks. Further, stand density (trees per unit area) is likely to have contributed to varying estimates.

Table 4-5. Summary of mangrove blue carbon stock estimates for Southeast Asia (as cited by Gevaña et al., 2018)

Country	Site	Vegetation Type	Est C-stock (tC/ ha)	Year	Carbon Pool	Reference
Philippines	Pagbilao, Quezon	Natural-mixed spp.	70 - 139	2006	Vegetation	ENFOR (2007)
	San Juan, Batangas	Natural-*Rhizophora* spp. dominated	115.5	2009	Vegetation + Sediment	Gevana and Pampolina (2009) Gevana et al. (2008)
	Puerto Princesa, Palawan	Natural-*Rhizophora* spp. dominated	239 - 653	2010	Vegetation	AKECOP (2010)
	Banacon Island, Bohol	Plantation (55 years old) - *Rhizophora stylosa*	370	2011	Vegetation	Camacho et al (2011)
	Pinabacdao, Samar	Natural - mixed spp.	188.5	20143	Vegetation	Abino et al. 2013
	Ibajay, Akalan	Natural - mixed spp.	562.5	2013	Vegetation + Sediment	Thompson et al. (2014)
	Leganes, Iloilo	Rehabilitation site - mixed spp.	212	2016	Vegetation + Sediment	Duncan et al. (2016)
	Honda Bay, Palawan	Natural mixed spp.	178	2018	Vegetation	Castillo et. al (2018)
	Cotabato City	Natural - mixed spp.	491	2019	Vegetation	Dimalen and Rojo (2019
	Silonay, Mindoro Or.	Natural - mixed spp.	356	2019	Vegetation + Sediment	Salmo and Gianan (2019)
Indonesia	Karimunjawa, Java Sea	Natural - mixed spp.	269.9	2010	Vegetation	Wicaksono et al. (2015)
	Nusa Penida, Bali	Natural - mixed spp.	90.7	2014	Vegetation	Kusumaningtyas et al. (2014)
	Segara Anakan, Java	Natural - mixed spp.	586	2009	Vegetation + Sediment	Murdiyarso et al. (2009)
	Bunaken National Park, Sulawesi	Natural - mixed spp.	939.3	9009	Vegetation + Sediment	Murdiyarso et al. (2009)
Myanmar	Bogalay, Ayeyarwady Delta	Plantation (6 years old) - *Avicennia* spp. and *Sonneratia* spp.	240	2012	Vegetation + Sediment	Thant et al. (2012)
Malaysia	Delta Kelantan in Kelantan	Natural - mixed spp.	305.34	2017	Vegetation + Sediment	Nazri (2017)
Thailand	Yeesarn, Samut Songkram	Plantation (12 yr-old) - *Rhizophora apiculata*	40.1	2012	Vegetation	Kridiborworn et al. (2012)
	Tha Po Village, Surat Thani Province	Natural - mixed spp.	22.6	1998	Vegetation	Sathirathai (1998)
	Pak Phanang, Nakhon Si Thammarat Province	Plantation (4,10,14,20 and 25 years old) - *Rhizophora* spp.	121.7	2009	Vegetation	Sriladda and Puangchit (2009)
	Suksamran Subdistrict, Ranong Province	Natural - mixed spp.	155	2013	Vegetation	Jachowski et al. (2013)
Vietnam	Quang Ninh	Natural - mixed spp.	26.6	2010	Vegetation	Vu et al. (2014)
	Mui Ca Mau National Park	Natural - mixed spp.	768.7	2012	Vegetation	Tue et al. (2014)
Brunei	Brunei Bay	Natural - mixed spp.	169.4	1961	Vegetation	Verwer and van der Meer. (2010)
Timor-Leste	East Dili	Natural - mixed spp.	221.5	2007	Vegetation	Alongi and Carvalho (2008)
Singapore	Palau Semakau	Natural - mixed spp.	36.6	2014	Vegetation	Friess et al. (2015)
	Pasir Ris	Natural - mixed spp.	105.4	2014	Vegetation	Friess et al. (2015)
	Palau Ubin	Natural - mixed spp.	54.8	2014	Vegetation	Friess et al. (2015)

In view of plantations, estimates range from 40.1 tC/ ha to 370.0 tC/ ha. The low value recorded for the 12-year-old *Rhizophora apiculata* stand in Samut Songkram, Thailand is indicative of its young age and small stem diameter (3.41 cm) and height (11.4 m). Stand density is around 22,089 trees/ ha. In Banacon Island, Philippines, larger carbon stock was observed for a 55-year-old *Rhizophora stylosa* plantation. This is reflective of relatively larger stem diameter and height i.e., 7.3 cm and 12.7 m, respectively; as well as stand density at 11,580 trees/ ha.

Studies that accounted for both vegetation and sediment carbon pools have values ranging from 115.5 tC/ ha to 939.3 tC/ ha. This underscored the significant contribution of sediment to the total blue carbon stock. Murdiyarso et al. (2009) reported that 87.5% of Sulawesi mangrove carbon stocks is stored in sediment. Likewise, Duncan et. al (2016) measured a very large share (97%) of sediments in Iloilo, Philippines. In general, sediment carbon stock increases as the organic matter layer becomes thicker. Protecting the aboveground vegetation is therefore crucial to avoid this huge blue carbon stock from washing away.

III. Blue carbon prospects in international climate change agreements

In the 2008 UNEP Blue Carbon Report, coastal habitats were found to have been sequestering 1.6 to 4.6% of the total annual anthropogenic emissions (7,200 Tg). Because of this valuable ecosystem service, there has been increasing interest to explore how blue carbon can be included in the current and emerging climate change frameworks. Initial efforts to highlight blue carbon opportunities was in the publication of Article 4(d) of the United Nations Framework Convention on Climate Change (UNFCCC) which states that "all parties shall promote sustainable management, and promote and cooperate on the conservation and enhancement, as appropriate, of sinks and reservoirs of all GHG not controlled by the Montreal Protocol, including... oceans as well as other coastal and marine ecosystems." The UNFCC serves as the main framework for establishing legally binding commitments (e.g., Kyoto Protocol) and contributions (e.g., Nationally Determined Contributions or NDCs) among countries in pursuing concerted efforts to fight climate change. Further, blue carbon conservation was highlighted in the 15th Conference of Parties (COP 15) in 2009 stating that "healthy mangrove forests, saltwater marshlands and seagrass meadow are extremely effective at storing atmospheric CO2, thereby mitigating climate change." Other relevant international regimes and organizations that promote the role of blue carbon ecosystems in climate change mitigation and adaptation include:

- Intergovernmental Panel on Climate Change (IPCC) – national carbon trading activities and related work;
- Convention on Biological Diversity (CBD) – ecosystem-based approaches to climate change mitigation & adaptation to improve resilience of coastal & marine ecosystems;
- Ramsar Convention on Wetlands – urgent action to reduce degradation, promote restoration, and improve management practices in peatlands and other wetland types;
- United Nations Open-ended Informal Consultative Process on Oceans & the Law of the Sea (UNICPOLOS or ICP) – recognition of the carbon captured by mangroves, salt marshes, seagrasses;
- UN Conference on Sustainable Development (Rio +20) – "keep the green economy blue";
- UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities; and
- Verified Carbon Standard (VCS) – requirements for crediting wetlands conservation projects under the VCS Program.

Unfortunately, the current UNFCCC processes do not include adequate measures in conserving and restoring blue carbon ecosystems as a climate mitigation strategy. This implies that mangrove conservation efforts cannot yet be counted as part of the country's means to satisfy climate change mitigation commitments (now part of the Intended Nationally Determined Contributions). Such limitation is also reflective of the non-inclusion of blue carbon in the Land Use, Land Use Change and Forestry (LULUCF) framework (Grimsditch, 2011). This framework accounts for the carbon budget (i.e., emissions and reductions) due to the management of carbon sinks. In order for the carbon to be included in LULUCF, the IPCC should amend its guidelines. The IPCC is the recognized body that submits and validates protocols for UNFCCC. They rely heavily on peer-reviewed science as basis for developing such guidelines. Unfortunately, with the apparent scientific gaps of accounting blue carbon fluxes, mangroves together with other coastal habitats have yet to be included in this platform.

In view of existing climate change mitigation regimes such as REDD and Clean Development Mechanisms (CDM), blue carbon presents great potential. However, there are certain preconditions that must be satisfied. First, the methodologies for measuring, reporting, and verifying (MRV) carbon sequestration and emissions by habitat degradation should be established. This is

a perquisite for REDD Plus Projects. Second, the blue carbon projects need to demonstrate *additionality* (i.e., the project must demonstrate that the reduction in GHG emissions would not happen if the project was not implemented); *minimized leakage* (i.e., the decrease in GHG emissions by the project does not result in an equivalent increase in emission by another entity; and *permanence* (i.e., minimizing the risk that GHG emissions will occur after the project has been sold as a carbon offset). Ensuring these criteria implies well-tested protocols to account blue carbon. Lastly, a careful economic feasibility study must be done to ensure that benefits to the local people or communities will outweigh the cost of setting up and maintaining the carbon offset program or project.

In summary, what can be done to help facilitate the inclusion of blue carbon in the climate change agreements? More research is needed to develop accurate methodologies or protocols in accounting blue carbon fluxes (carbon loss and takes), and popularize the role of coastal blue carbon ecosystem services. In the extensive literature review done in the Philippines, Fortes and Salmo (2017) construed that limited work has been undertaken to develop methods in blue carbon accounting. Such a gap therefore necessitates: 1) pursuing more collaborative research among blue carbon scientists; 2) mainstreaming blue carbon conservation in bigger international development platforms such as the UNCED's Sustainable Development Goal and Millennium Development Goals; and 3) staging more blue carbon talks through international conferences. One of the best examples of a collaborative initiative is the Blue Carbon Partnership (more on http://bluecarbonpartnership.org). The group brings together governments, research institutions, and nongovernment organizations for potential collaboration, to enhance understanding of coastal blue carbon ecosystems. So far, this partnership includes 33 institutions including the IUCN, Conservation International, the Center for Forestry Research (CIFOR), the Ramsar Convention, and the Australian Government, among others. It coordinates efforts to increase the capacity of governments and their partners to develop and implement policies and projects by:

- Building awareness in the international community on the importance of blue carbon ecosystems in climate change adaptation and mitigation, and providing multiple ecosystem services in general;
- Sharing knowledge, expertise, and experience to build capacity in blue carbon policy, science, and practical action; and
- Accelerating practical action to protect and restore blue carbon ecosystems in identified priority regional "hot-spots".

The Blue Carbon Partnership is not a funding body, but instead aims to better connect the efforts of governments, research organizations and non-government organizations. It also aims to build on the significant initiatives already ongoing in this field. About 50 countries have recognized the value of blue carbon in their Nationally Determined Contributions to the Paris Agreement (NDCs). The partnership, over time, will build awareness and capacity to enable additional countries to include blue carbon in their NDCs. Future actions will include catalyzing project development at larger scales in priority regional 'hotspots' and linking blue carbon projects with climate finance.

IV. Blue carbon and Payment for Ecosystem Services

Fisher (2014) has suggested that empowerment of local communities and livelihood improvement are crucial elements for PES schemes to succeed. Notwithstanding the growing appreciation of the effectiveness of community-based approach in mangrove management, there is still a number of challenges that most countries of Southeast Asia need to overcome. These include (1) unclear tenure rights; (2) poor ecological consideration in mangrove reforestation; and (3) poor coastal management planning (Primavera, 2000; Walters, 2004; Locatelli et al., 2014; Thompson et al., 2017; Wylie et al., 2015; Pulhin et al., 2017). Friess et al. (2016) has listed some recommendations for providing a good platform for mangrove PES including community-based blue carbon mechanisms. First, there should be stronger incorporation of mangroves into marine protected areas to potentially help resolve some policy and resource management conflicts in exclusively placing mangroves under protection. Second, community-based or co-management practices can reconcile varying interests of local stakeholders and address conflicting policy objectives on mangrove use. Third, private-sector initiatives can provide good support to protect and restore mangroves, so PES projects must be encouraged.

V. Towards global mangrove alliance targets

Sustainable and concerted management of global mangrove forests is critical for the achievement of the goal of additional 20% vegetation cover by the year 2030. Pursuing this demands serious effort to raise awareness on mangrove value, and secure local commitments in creating and calibrating policies and programs that will (1) prioritize the protection of existing cover and (2) actively restore degraded areas. Research should continuously provide the foundation for these.

Over the next decade, research will largely be dealing with the following relevant themes:

1. Standardization and improvement of methods for quantifying and monitoring carbon sequestration rates;
2. Landscape-seascape integrated assessment approach for mangrove management planning;
3. Understanding blue carbon dynamics with ecosystem transitions (e.g., fishpond to mangroves, mangroves to fishpond and other land uses) and watershed sedimentation processes;
4. Spatio-temporal methods to track changes in cover (e.g., development and use of innovative and accessible, if not freely available, tools);
5. Basic ecophysiological studies on stand growth/ NPP, C and N fluxes, and water use efficiency, etc.; and
6. Case studies to document and mainstream success and best practices in carbon offset projects.

VI. References

Bouillon, S., Borges, A., Castaneda-Moya, E., Diele, K., Dittmar, T., Duke, N., Kristenses, E., Lee, S., Merchand, C., Middleburg, J., Rivera-Monroy, V., Smith, T., Twilley, R. (2008). Mangrove production and carbon sinks: A revision of global budget estimates. Global Biogeochemical Cycles, 22, 12pp.

Camacho, L., Gevaña, D., Carandang, A., Camacho, S., Combalicer, E., Rebugio, L., Youn, Y. (2011). Tree Biomass and Carbon Stock of a Community-managed Mangrove Forest in Bohol, Philippines. For Sci and Tech, 7(4): 161-167.

Carandang, A., Camacho, L., Gevaña, D., Dizon, J., Camacho, S., de Luna, C., Pulhin, F., Paras, F., Peras, R., Rebugio, L. (2013). Economic valuation for sustainable mangrove ecosystems management in Bohol and Palawan, Philippines. For Sci and Tech. DOI: 10.1080/21580103.2013.801149.

Donato, D., Kauffman, J., Kurnianto, S., Stidham, M., Murdiyarso, D. (2011). Mangroves are among the most carbon-rich forests in the tropics. Nature Geoscience, 4: 293-297.

FAO. (2010). Global Forest Resources Assessment (2010) FAO Forestry Paper No. 163. Food and Agriculture Organization, Rome, Italy, 378 p.

Friess, D., Thompson, B., Brown, B., Amir, A., Cameron, C., Koldewey, H., Sasmito, S., Sidik, F. (2016). Policy challenges and approaches for the conservation of mangrove forests in Southeast Asia. Conservation Biology, 30(5), 933–949, doi:10.1111/cobi.12784

Gevaña, D., Pulhin, F., and Pampolina, N. (2008). Carbon stock assessment of a mangrove ecosystem in San Juan, Batangas. Journal of Environmental Science and Management, 11(1): 15-25.

Gevaña, D., Pampolina, N. (2009). Plant diversity and carbon storage of a *Rhizopora* stand in Verde Passage, San Juan, Batangas, Philippines. J Envi Sci and Mgt, 12(2):1-10.

Gevaña, D., Camacho, L, Carandang, A., Camacho, S., Im, S. (2015). Land use characterization and change detection of a small mangrove area in Banacon Island, Bohol, Philippines using Maximum Likelihood Classification Method. Forest Science and Technology, 11(4): 197-205.

Gevaña, D., Camacho, L., Pulhin, J. (2018). Conserving Mangroves for Their Blue Carbon: Insights and Prospects for Community-Based Mangrove Management in Southeast Asia. In: C. Makowski and C. Finkl (eds), Threats to Mangrove Forests. Coastal Research Library, Vol. 25, Springer Nature, 579-588.

Gilmour, D., Fisher, R. (1991). Evolution in Community Forestry: Contesting Forest Resources. Community Forestry at Crossroads: Reflections and Future Directions in the Development of Community Forestry In: M. Victor, C. Lang, and J. Bornemeir (eds.), Proceedings of an International Seminar, 17-19 July, Bangkok. RECOFTC Report, 16: 27-44.

Jachowski, N., Quak, M., Friess, D., Duangnamon, D., Weeb, E., Ziegler, A. (2013). Mangrove biomass estimation in Southwest Thailand using machine learning. Applied Geography, 45: 311-321.

Kauffman, J., Heider, C., Norfolk, J., Payton, F. (2014). Carbon stocks of intact mangroves and carbon emissions arising from their conversion in the Dominican Republic. Ecol. Appl., 24: 518-527.

Kusumaningtyas, M., Daulat, A., Suryono, D., Ati, R., Sudirman, N., Hutahaean, A. (2014). Blue carbon stock of mangrove ecosystem in Nusa Penida, Bali. Paper presented at the 12th Biennial Conference of Pan Ocean Remote Sensing Conference (PORSEC 2014), 4-7 November 2014, Bali, Indonesia, 8 p.

Locatelli, T., Binet, T., Kairo, J. G., King, L., Madden, S., Patenaude, G., Upton, C., Huxham, M. (2014). How blue carbon and payments for ecosystem services (PES) might help save mangrove forests. Ambio, 43: 981-995.

Lugo, A., Snedaker, S. (1974). The ecology of mangroves. Annual Review of Ecology and Systematics, 5: 39-65.

Murdiyarso, D., Alongi, D., Kauffman, J., Kurnianto, S., Stidham, M., Kanninen, M. (2009). Carbon storage in mangrove and peatland ecosystems: A preliminary account from plots in Indonesia. CIFOR Working Paper No. 48, Center for International Forestry Research (CIFOR), Indonesia, 40 p.

Nam, V. (2017). Payment for Forest Environmental Services in mangrove of Ca Mau Province, Viet Nam. Paper presented in the International Conference on Sustainable Mangrove Ecosystems in Bali, Indonesia, 18-21 April 2017, www.itto.int/mangrove2017/presentations/.

Nazri, N. (2017). Blue carbon stock assessment of mangrove vegetation and sediment in two selected mangrove sites in Peninsular Malaysia. Masters Thesis. University of Malaya, Kuala Lumpur, Malaysia, 1-20.

Pham, T.T., Bennet, K., Vu, T. P., Brunner, J., Le, N. D., Nguyen, D. T. (2013). Payments for forest environmental services in Vietnam: From policy to practice. Occasional Paper 93. Bogor, Indonesia: CIFOR

Primavera, J. (2000). Development and conservation of the Philippine mangroves: Institutional issues. Ecol Econ, 35: 91-106.

Pulhin, J., Gevana, D., Pulhin, F. (2017). Community-Based Mangrove Management in the Philippines: Experience and Challenges in the Context of Changing Climate. In: Gupta and Shaw (eds), Participatory Mangrove Management in a Changing Climate. Springer Nature, 247-262.

Salmo S. G. III and E. L. D. Gianan (2019). Post-disturbance carbon stocks and rates of sequestration: Implications on "blue carbon" estimates in Philippine mangroves. Philippine Science Letters 12(2): 122-132.

Siikamäki, J., Sanchirico, J., Jardine, S., McLaughlin, D., Morris, D. (2012). BlueCarbon: Global Options for Reducing Emissions from the Degradation and Development of Coastal Ecosystems. Resources for the Future, Washington DC.

Sriladda, C., Puangchit, L. (2009). Carbon sequestration of mangrove plantations at Pak Phanang, Nakhon Si Thammarat Province. In: The conference on mangrove ecology, 12-14 September 2008, Cha-um, Petchburi, 379-389.

Thant, Y., Kanzaki, M., Ohta, S., Than, M. (2012). Carbon sequestration by mangrove plantations and a natural regeneration stand in the Ayeyarwady Delta, Myanmar. Tropics, (12)1: 1-10.

Verwer, C., van der Meer, P. (2010). Carbon pools in tropical peat forest- Towards a reference value for forest biomass carbon in relatively undisturbed swamp forest in Southeast Asia. Wageningen, Altera, Altera-report, Netherlands, 67 p.

Thomas, S. (2014). Blue carbon: Knowledge gaps, critical issues, and novel approaches. Ecological Economic, 22-38.

Thompson, B., Clubbe, C., Primavera, J., Curnick, D., Koldewey, H. (2014). Locally assessing the economic viability of blue carbon: A case study from Panay Island, the Philippines. Ecosystem Services, 8: 128-140.

Thompson, B., Primavera, J., Friess, D. A. (2017). Governance and implementation challenges for mangrove forest Payments for Ecosystem Services (PES): Empirical evidence from the Philippines. Ecosystem Services, Elsevier (23): 146-155.

Ullman, R., Bilbao-Bastida, V., Grimsditch, G. (2013). Including blue carbon in climate market mechanisms. Ocean and Coastal Management, 83: 15-18.

Visseren-Hamakers, I. J., Gupta, A., Herold, M., Peña-Claros, M., Vijge, M. J. (2012). Will REDD+ work? The need for interdisciplinary research to address key challenges. Curr Opin Environ Sustain, 4: 590-596.

Walters, B. (2004). Local management of mangrove forests in the Philippines: successful conservation or efficient resource exploitation. Human Ecology, 32(2): 177-195.

Wicaksono, P., Danoedoro, P., Nehren, H., Nehren, U. (2015). Mangrove biomass and carbon stock mapping of the Karimunjawa Islands using multispectral remote sensing. International Journal of Remote Sensing, 37(1): 26-52.

Wylie, L., Sutton-Grier, A., Moore, A. (2015). Keys to successful blue carbon projects: Lessons learned from global case studies. Marine Policy, 65: 76-84.

Mangrove Management: Lessons and Experiences

Eric D. Buduan
Forest Foundation Philippines

I. Background

The Forest Foundation Philippines (formerly known as the Philippine Tropical Forest Conservation Foundation) was established in 2002 through bilateral agreements between the governments of the Philippines and the Unites States of America. The Foundation is a grant-making organization that provides financial and technical support to organizations and individuals that empower people to protect forests. Since 2005, more than 450 projects including those aimed at mangrove conservation were supported. For 2017 to 2021, the Foundation has employed the sustainable forest landscape approach as guided by its Results Framework in Sierra Madre, Palawan, Samar-Leyte and Bukidnon-Misamis Oriental to attain the outcomes "Grow Forests, Grow Livelihoods, Grow Partnerships and Grow Advocates." As the Foundation's core business, grants must directly contribute to conserving and protecting forests, address the livelihoods of the communities, develop partnerships with communities, civil society organizations and mandated government institutions, and engage the younger generations especially millennials to widen advocacies on forest conservation.

Given the number of mangrove-related projects supported by the Foundation and implemented in various sites in the country, experiences and lessons were drawn and compiled to enhance mangrove conservation and management. These insights hope to address the practice of planting mostly *Rhizophora* species, direct planting of propagules, planting in inappropriate sites, and low survival of seedlings.

II. Management principles and approaches

A. Use of science-based interventions

Mangrove conservation must be guided by science that considers appropriate sites and species. Areas naturally covered with mangroves must be the priority for restoration while remaining mangroves must be protected. The tidal zone and substrate of the restoration site must determine the species to be used for restoration. In areas where *Sonneratia* (pagatpat) or *Avicennia* (miapi) dominate, planting *Rhizophora* species is discouraged because of high mortality. Mangrove areas converted to aquaculture ponds but are now abandoned, undeveloped or underutilized must be reverted back to mangroves. Moreover, non-mangrove seaward areas especially seagrass beds should not be planted on. Mangrove plantations in seaward areas are prone to mortality due to wave action, presence of debris, and barnacle infestations. For restoration of seaward mangrove areas with infestation of barnacles, *Sonneratia alba* (pagatpat) must be planted instead of *Rhizophora* spp. (bakawan). Pagatpat can survive barnacle infestation due to the regular shedding of its bark, resulting to natural removal of the barnacles (Figure 4-13).

Table 4-6. Mangrove species matched to appropriate zone and substrate

Location/zonation	Substrate	Appropriate species
Downstream/ estuaries	muddy	*Sonneratia alba* (Pagatpat)
Seaward	muddy	*Sonneratia alba* (Pagatpat)
Seaward	sandy/coralline	*Avicennia*, *Rhizophora stylosa*
Landward	muddy	*Rhizophora*
Upstream	muddy	Nipa

Table 4-6 indicates the appropriate species for planting based on the location (zonation) and substrate of the planting site as reference for mangrove restoration efforts.

As a requisite for ensuring species-site suitability, there is a need for mapping to determine baseline information, priority areas for restoration and protection, and basis for management planning and zoning. This shall also serve as reference for the quantification of impacts after the project implementation.

Figure 4-13. Pagatpat showing its shedding bark (Photo c/o Forest Foundation Philippines)

B. Addressing the community's economic needs

Any conservation effort must be linked to the economic needs of the community especially those directly dependent on the mangrove forest. Mangroves serve as nurseries, breeding ground and habitat for fish, shells, shrimps and other resources that are collected or gleaned by fisherfolks for food or sale. Thus, efforts on conserving and restoring the mangroves definitely impact on the economic conditions of these people. However, while restoration and regeneration of mangroves are underway, support for additional or alternative sources of income consistent with mangrove conservation are needed, e.g., fish and crab culture. The Foundation supported the culture of oyster (talaba), fish (lapu-lapu; Figure 4-14), and mud crab in Zamboanga Sibugay. Aside from contributing to food availability, these are now contributing income to the communities. Expansion and replication to other coastal communities are being done for economies of scale and as incentive for enhanced mangrove conservation. Having direct impact on the economic conditions of the community results to stronger concern and attitude towards conservation.

Figure 4-14. Lapu-lapu culture in Kabasalan (Photo c/o Forest Foundation Philippines)

Aside from contributing to economic development, mangrove conservation also contributes to the resilience of the communities against natural calamities. A project in Zambales exemplified how mangroves helped protect the communities from strong waves and tidal surges, as compared to a concrete structure (i.e., sea wall).

C. Complementing restoration and protection

Mangroves are habitat to diverse flora and fauna. Restoration coupled with protection ensure the regeneration of mangrove biodiversity such as shrimps, fish, shells, and birds. In one of the mangrove conservation

Figure 4-15. Flying foxes in mangrove forest (Photo c/o Forest Foundation Philippines)

Figure 4-16. PO members planting pagatpat seedlings (Photo c/o Forest Foundation Philippines)

Figure 4-17. Bantay Dagat in action (Photo c/o Forest Foundation Philippines)

Figure 4-18. Mr. Roberto Ballon, mangrove champion and chair of the PO KGMC in Brgy. Concepcion, Kabasalan, Zamboanga Sibugay (Photo c/o Forest Foundation Philippines)

sites in Siay, Zamboanga Sibugay, the population of flying foxes thriving in Kabog Island significantly increased with the mangrove forests being protected. Aside from being important ecologically, the island is now an ecotourism destination that provides additional livelihood opportunities to the coastal communities.

D. Community participation and stewardship

Community participation is crucial to ensuring stewardship and sustainability of any mangrove conservation effort. Thus, communities must be engaged as partners, rather than simply project beneficiaries. Communities directly depending on the mangroves create the associated pressure and issues, but are also the key to the effective conservation and management of these habitats. Any mangrove conservation effort must include community engagement, capacity building and advocacies, to transform the local stakeholders into stewards of mangroves and other coastal resources.

E. Community-based monitoring and protection

Mangrove conservation is not only about planting, but must include sustained monitoring and protection even beyond the project duration. This is linked to community participation and stewardship, on which the sustainability of monitoring and protection is based. The project must ensure adequate capacities of communities in monitoring and protection. This includes providing initial incentives, while long-term support from mandated agencies is being worked out, and the direct benefits from the mangrove forest being conserved are yet to be realized. Existing volunteer Bantay Dagat have been tapped to monitor and protect, not only the coastal areas, but also the mangroves (e.g., existing forest and restoration areas). Identified timber poachers have been given opportunity and incentive to reform and help in forest monitoring. In the mangrove, there is a designated area for utilization and harvesting, but these activities require permission and approval from the managing people's organization.

F. Effective leadership by a local champion

Similar to a sea voyage wherein reaching the desired destination greatly depends on the skill and capacity of the captain, an organization needs an effective leader. The success of the people's organization KGMC in Brgy. Concepcion in Kabasalan, Zamboanga Sibugay is thanks, in no small part, to the leadership of Mr. Roberto Ballon. Mr. Ballon's leadership and dedication to mangroves and fishery and coastal resources management has enabled the organization to attain its present status, and be recognized locally and nationally. He is a champion, not only at the local level, but in the entire Region 9. He has even extended his knowledge, expertise, and passion to other coastal communities in the country. Mr. Ballon is also the chairperson of the Coalition of Municipal Fisherfolks Association of Zamboanga Sibugay (COMFAZ), a federation of 34 coastal POs of Sibuguey Bay. The success and experiences of KGMC in Brgy. Concepcion, Kabasalan have been replicated across the eight municipalities around Sibuguey Bay. COMFAZ has enabled the communities to have a stronger voice and influence in lobbying support for enhancing coastal resource management in the Bay with the LGUs, DENR, DA-BFAR, and DILG.

G. Tenure and institutionalization

Crucial to any natural resource management is tenure over the area. Partners of Forest Foundation in Zamboanga Sibugay have a mangrove co-management agreement with the Department of Environment and Natural Resources and the local government, as legal basis for mangrove conservation efforts. Through this agreement, support for coastal resources management including mangrove conservation is allocated in the LGU Annual Investment Plan. This assures institutionalization and sustainability of mangrove conservation.

H. Partnerships and networking

Forest Foundation's support is limited to forest conservation, so partnerships with other funding organizations are necessary to address other needs of the communities. Implementation of projects funded by the Foundation and the success of the mangrove conservation efforts has enabled the partner PO KGMC (Zamboanga Sibugay) to establish a track record, and build networks, linkages, and partnerships. This enables them to partner with other organizations (local and international) to address other PO/ community concerns such as education, health, enhancement and expansion of the enterprises, support for infrastructure, and continued capacity building.

III. Planting practices

A. Mangrove nursery management

Nurseries serve as a production and nurturing area for seedlings prior to planting, ensuring the production of the desired quality and required quantity, as well as the availability of the suitable species. Depending on the species, seedlings require at least 4 months in the nursery prior to planting to meet the suitable size and quality of plant-ready seedlings. The quality of the seedling significantly affects its survival and growth once planted in the field. Nurseries are provided with nets or fences to protect the seedlings. The nursery may be established in areas reached by the high tide, but protected from wave action. This eliminates the need for labor-intensive watering.

Figure 4-19. Elevated potted seedlings (Photo c/o Forest Foundation Philippines)

Mangrove seeds or small-sized fruit are initially propagated in seedbeds or seedboxes then transferred to containers (e.g., plastic bags) while bigger seeds and propagules can be planted directly in the containers. If there is limited area for land-based nurseries, floating nurseries can also be established using bamboo poles for rafts. In case of pest infestation on the seedlings (especially crawling animals like crabs and snails), the seedbeds and potted seedlings may be elevated.

Figure 4-20. Mangrove nursery in Lian, Batangas (Photo c/o Forest Foundation Philippines)

Nurseries can also be developed as an enterprise of the community or fisherfolk association, as exemplified by the Lian Kingfisher Association in Brgy. Lumaniag in Lian, Batangas. The association produces seedlings (mostly *Avicennia*) and sells these at Php 15/ piece, which includes preparation of the planting site. Sales are to groups interested in mangrove planting, like students and civic organizations. The income from selling seedlings is shared between the association and the members/ owners of the seedlings.

B. Innovations

Project implementation has involved innovations to adapt to the realities of field conditions. These innovations have significantly enhanced mangrove conservation efforts not just in the project sites but in other areas as well. The propagation of pagatpat seeds, a practice conventionally deemed difficult, ensures continuous production of appropriate species for plating. The use of coconut husk minimizes the use of plastic bags. Finally, the fabrication of PVC paddle boats reduces the use of wood for boat construction and contributes to recycling.

1. Propagation of pagatpat

Species suitability is a crucial factor in the survival and growth of seedlings. However, in most mangrove reforestation projects, only *Rhizophora* species are being planted and mostly through direct planting of the propagules. The planting of *Rhizophora* in inappropriate sites has resulted in low survival and the proliferation of monocultures. One of the causes of mortality is the infestation of barnacles on the planted seedlings. Planting species naturally growing in the area is constrained by the availability of seedlings, which is itself attributed to a lack of knowledge on propagation. Small seeded mangrove species such as pagatpat and miapi require propagation to produce viable seedlings. In Kabasalan, Zamboanga Sibugay, Forest Foundation and its partner PO KGMC have developed techniques to propagate pagatpat seeds into plant-ready seedlings. This propagation technique has resulted in mass production of pagatpat seedlings that are planted in appropriate sites, significantly contributing to successful mangrove restoration in Zamboanga Sibugay as a whole. The technique is disseminated through training, learning visits, presentation in mangrove fora/ conferences, and through various print and online resources (e.g., brochures, social media, etc.; Figure 4-21). Audiences have included, not only partners and networks of the Foundation, but also broader stakeholders of mangrove conservation.

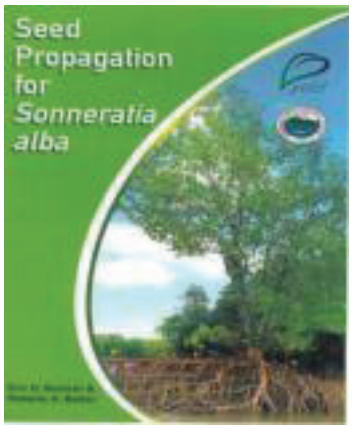


Figure 4-21. Cover of brochure on pagatpat seed propagation (via Forest Foundation Philippines)

2. Use of coconut husk as rooting/ potting medium

Consistent with efforts on nursery operations to produce ready-to-plant seedlings, the use of coconut husk as potting media was explored. This is an alternative to plastic bags that are costly and not environment-friendly. This was innovated by SIKAT, a partner NGO, and its own partner POs in Siargao, Surigao del Norte. Similar to the principles of marcotting, the coconut husks are wrapped around the lower end of the propagule. The husk absorbs water during watering (or during high tide if the nursery is placed in areas reached by tide water) and retain the moisture needed for the germination and survival of the propagule. The seedlings produced are lighter and easier to transport compared to seedlings placed in plastic bags with oil. Since the coconut husks are biodegradable, the germinated propagules are planted directly without disturbing the root system. This results to high survival of the seedlings. The use of coconut husk was also attempted for propagating *Avicennia* seeds and has so far proven feasible. When using for *Avicennia* seeds, however, the coconut husk must be trimmed to a smaller size, because it tends to float when planted especially in areas exposed to waves.

Figure 4-22. Coconut husk as potting medium (Photo c/o Forest Foundation Philippines)

3. Fabrication of PVC paddle boat

As an alternative to wood, the use of PVC drums for the fabrication of paddle boats were also done in Siargao. Compared to wooden paddle boats, the fabricated boats are lighter and float better, so can be used even in shallow water. Their production cost is also lower. These PVC-made boats are now widely used in Brgys. Del Carmen and San Benito in Siargao, Surigao del Norte, and have also been introduced in Busuanga, Palawan. This innovation reduces the use of wood for paddle boat construction, and supports recycling efforts. It is ideal for navigation in mangrove forests or rivers where the water is relatively calm. However, their use is not recommended in open sea where wave exposure is greater.

Figure 4-23. PVC paddle boats being loaded with mangrove seedlings (Photo c/o Forest Foundation Philippines)

4. Complementary initiatives

Coastal communities mostly derive raw materials for houses, fish-drying facilities, fish cages, and fish corrals from the mangrove forest. These include fuelwood, poles, posts, and roofing materials. With the increasing population in the coastal areas, demand for these materials also increases. Without a source that can be sustained and/ or for alternative materials, the mangrove forest will continue to be threatened.

Bamboo is also a raw material used for community structures, and usually sourced outside of the community itself. However, due to declining quantities of naturally growing bamboo stands and the increasing remoteness of possible sources, quality and quantity are declining while prices are increasing. To help reduce dependence on the mangrove forest for wood and other raw material, and ensure availability of alternative materials, projects have also supported propagating bamboo, and maintaining planting and woodlot establishments. Bamboo cuttings are planted along river banks or intercropped with existing coconut farms. Woodlots planted with fast-growing tree species are established in private lands, typically covered by an agreement between with the land- owner and the PO.

Figure 4-24. Bamboo cuttings to be planted as alternative material to mangroves (Photo c/o Forest Foundation Philippines)

IV. Threats and challenges

The lessons and innovations discussed above have contributed to the achievement of mangrove conservation efforts of the Forest Foundation and its partner organizations. However, threats to mangroves and challenges in management still persist, requiring broader interventions, greater awareness, and more capacity building. The impacts of climate change affect, not only the lives and properties of people, but also the natural environment.

Figure 4-25. Siltation in mangroves and estuaries (Photo c/o Forest Foundation Philippines)

A. Siltation

Mangroves help in addressing siltation, because their root systems effectively trap sediments and their own survival is dependent on sediment flow. However, if siltation is excessive and overcomes a certain tolerance threshold, the mangroves may suffer enough to result in damage or mortality. Mangroves in estuaries and aquaculture areas are especially prone to the damaging impacts of siltation.

The conversion of forests for agriculture, and poor soil and water conservation upland significantly contribute to soil erosion and siltation. Hence, forest conservation and sustainable farming must be promoted in the uplands to complement mangrove conservation.

Figure 4-26. Brgy. Concepcion, Kabasalan, Zamboanga Sibugay (Photo c/o Forest Foundation Philippines)

B. Increasing pressure on resources

In Brgy. Concepcion in Kabasalan, Zamboanga Sibugay, the management of the mangrove forest has resulted in increased abundance of fish and shellfish, thereby improving catch per unit effort. Fisherfolks can fish in nearshore areas, rather than travelling farther offshore, reducing their exposure to severe sea conditions and crimes committed in the high seas. These benefits have attracted residents that migrated to return and re-establish in the community. New settlers have also placed additional pressure on the recovering ecosystem, and may eventually impact on the carrying capacity of the mangroves and coastal resources.

C. Planting for publicity

Tree planting is a default activity for many environmental and conservation programs. Unfortunately, there have been a number of grand and much-publicized tree planting activities that have aimed for international recognition, but are otherwise ineffective and unsuccessful. Such planting for publicity, if unavoidable, must be properly designed to make good use of resources and contribute meaningfully to conservation. Planting must be complemented by maintenance and protection for at least three years. Mangrove planting, and other conservation activities, must not be used only for publicity or visibility on social media.

Figure 4-27. Impact of Super Typhoon Yolanda on a mangrove forest in Samar (Photo c/o Forest Foundation Philippines)

D. Natural calamities

As an effect of climate change, natural hazards such as typhoons are projected to become fewer in number but stronger in intensity. Mangroves protect landward areas from strong winds and waves, but suffer the brunt of these impacts. The devastation of Super Typhoon Yolanda in Samar and Leyte showed how mangroves reduce the damage to coastal communities, but also how these habitats themselves are severely affected. Nevertheless, the resiliency of pagatpat was also observed in these affected mangroves.

Synthesis and Lessons from the Regional State of the Mangrove Summits

Severino G. Salmo III
Ateneo de Manila University
Loyola Heights, Quezon City, Philippines

I. Introduction

Mangroves have long been recognized for the ecological and socio-economic services they provide. These ecosystems have been further emphasized for their role in the development of adaptation and mitigation strategies against the impacts of climate change. Their performance of ecosystem services, however, depends on the coverage and ecosystem health of the forest (Duke et al., 2007).

The sustained existence and ecosystem health status of mangrove forests will be vital in the long-term productivity and stability of the coastal environment in the Philippines (Salmo III et al., 2018). Despite conservation and restoration programs, mangroves in the Philippines have long been ecologically disturbed primarily because of rampant cutting for timber products and massive conversion to aquaculture ponds (Primavera, 2000). These local threats compounded by the impacts of catastrophic typhoons and sea level rise will aggravate the demise of mangroves (Lovelock et al., 2017).

The identification and development of mangrove management programs rely on information that is updated, adaptive, and responsive to the needs of society. Such information is supposedly the basis for the development of national and local policies. Unfortunately, coherent and harmonized information on Philippine mangroves is lacking, or are obsolete and inconsistent. For example, basic information on biodiversity status and spatio-temporal changes on mangrove areas are lacking and oftentimes conflicting. While there have been massive restoration programs, most of these are largely undocumented, hence, difficult to assess if these programs are successful or not. Clearly, without coherent and systematic information, then development of a sound management program will be problematic.

These issues led to the conceptualization of a State of the Mangrove Summit. Regional mangrove summits were each held for northwestern Luzon (2015), southern Luzon (2017), and central and eastern Visayas (2019). These summits aimed to: (1) provide a venue for provincial representatives to share and discuss the status of mangrove forests in the Philippines, especially in light of climate change vulnerability; (2) involve experts in the field of mangrove ecology and management, climate change vulnerability, and carbon sequestration; (3) consolidate more accurate data from each province; and (4) come up with a plan of action to enhance mangrove management. Ultimately, the outcomes of these summits were intended to serve as technical inputs for a National State of the Mangrove Summit. The results of these summits have already been made available as Summit Proceedings. This document aims to synthesize the process, lessons, and recommendations

from each regional summit. Eventually, this document may contribute in the development of national research and management programs for Philippine mangroves.

II. Process and methods

A. Pre-summit

Prior to the summit, a survey form was sent to each provincial government. The survey yielded information on:

- Geographic and socio-economic profile (e.g., population in coastal areas, barangays, and threats);
- Mangrove assessment status (including information on areas of old-growth and planted stands, presence of mangrove protected areas, importance of mangroves to the community, mangrove products utilized, managers, causes of decline, effects of decline, steps taken to address decline, and presence of mangrove protection/ planting rehabilitation reports); and
- Provincial mangrove projects/ programs (specifying the type of project, objectives, funding groups, implementing groups, partners, budget, area replanted/ rehabilitated, growth and survival rate, presence of monitoring programs, community engagement, and community benefits).

B. Summit

Each province was requested to submit an oral presentation and written report, following the prescribed outline. Oral presentations were delivered during the mangrove summits. A workshop was held to synthesize mangrove status, issues, and recommendations per region. The participants were also tasked to identify challenges involved in updating the mangrove status in their jurisdictions, enhancing regional collaboration, and defining their common goals.

C. Post-summit

The Secretariat reviewed the submitted documents for formatting and copy-editing to achieve consistency (while retaining the original content and context) throughout the proceedings. In cases where the reporters did not provide data, the Secretariat labeled it as “no data provided.” While some reports were submitted in May 2018, there were other provinces that were not able to submit. In this case, the Secretariat prepared the report using their PowerPoint presentations and survey files as bases. The information gathered from the survey was organized into a matrix and formatted into a comprehensive and accessible online database to supplement existing mangrove information. These individual reports constitute the bulk of the proceedings, which are also available at https://mangroveecology.com.

III. Synthesis, lessons, and recommendations

The proceedings from the three regional summits yielded information on mangrove cover (including species composition), issues/ threats, management approaches and challenges, and growth and survival rates. A synthesis of regional mangrove status was also provided for each summit (Table 4-7).

A. Experiences and challenges in conducting the Summit

The Mangrove Summit can be considered as a pioneering initiative in synthesizing information on Philippine mangroves. Funding was uncertain during the preparation stage particularly for the first summit. Fortunately, financial and institutional support was obtained from organizations (primarily the Foundation for the Philippine Environment, Conservation International Philippines, and the Oscar M. Lopez Center) that shared in the common goal of collating and synthesizing information on Philippine mangroves. The second and third summits were relatively easier to plan and organize because of the experiences and lessons gained from the first summit. The proceedings from the first summit also inspired the participants to see the documentation on mangrove status and management in their respective jurisdictions. Also, the availability of technical resources that shared their expertise helped in providing region-specific mangrove topics.

Most provinces were enthusiastic to participate, but some were skeptical probably because of the added task of synthesizing the needed information and the thinking these are already available anyway. There were also concerns arising from having limited to no information, or lack of personnel to consolidate the information at the provincial level, among others. These concerns also contributed to the delayed submission of the survey forms and the manuscript on provincial mangrove status.

B. Need for updated/ accessible mangrove information

There are provinces with available mangrove information, some even with updated data from regular annual mangrove monitoring reports. However, there are other provinces that do not have such information or systematic documentation despite being beneficiaries of some NGA-assisted programs. The massive mangrove rehabilitation programs since the early 1990s could have been a good starting point where growth and survival datasets may have been reported. Part of the problem is that the information supposedly derived from mangrove conservation and planting initiatives were not shared or turned over to the provincial government. Another issue is the conflicting information, for example on mangrove cover and species inventory. Different agencies used

different sampling/ mapping methods; hence results are not comparable or are, oftentimes, conflicting.

The compiled information from the three summits is as yet incomplete to provide a state of the mangrove for the entire Philippines. Mangrove status reports from the other biogeographic regions, particularly in Visayas and Mindanao, are needed.

Nonetheless, the information from the three summits have provided a basis and guide in consolidating and updating mangrove information. The online platform offers a systematic database that can be regularly updated by online users. However, a dedicated institution would make the data compilation more efficient.

Table 4-7. Summary of the three regional mangrove summits

Attributes/ Region	Northern Luzon	Southern Luzon	Central/Eastern Visayas
Number of participants	65	41	33
Partners and support	CHED/ FPE/ CI/ BMB	CHED/ FPE/ CI/ BMB/ ERDB	Oscar M. Lopez Center
Technical presentations	• Mangrove mapping • Climate change vulnerability assessment • Institutional networking • "Blue Carbon"	• Status of mangroves/ mangrove management • Mangrove Mapping • Resiliency against SLR • Integrating mangroves in ICM • Blue Carbon initiatives • Status of mangrove research and management	• Carbon sequestration and vulnerability to SLR • Simulation of impacts of SLR • Community-based biophysical monitoring
Status/ issues	• 6,010 ha (decreasing); 19 species • Insufficient/ inconsistent data • Mangrove plantations • Conversion to fishponds • Urban and commercial development • Typhoons and SLR • Mining • Conflicting policies	• 73,711 ha (increasing); 23 species • Insufficient/ inconsistent data • Increased forest cover • Habitat conversion • Urbanization; pollution • Conflicting policies	• 45,256 ha (decreasing); 26 species • Hazards: typhoons, SLR • Mining • Conflicting policies; weak law enforcement
Recommendations	• Regional mangrove summits • Systematic mangrove monitoring • Blue carbon as "ecosystem service" • Restoration of AUU fishponds • Database	• Strengthen institutions • Restoration of AUU fishponds • Systematic monitoring system • "National Mangrove Committee"	• Regional mangrove summits • Strengthen institutions • Harmonize policies/ programs • Enhance public awareness; integration in curriculum • Systematic monitoring program

C. Moving forward: the need for a National Mangrove Summit

The mangrove summits provided an impetus for a national mangrove summit. On the other hand, these gatherings facilitated the formation of regional networks where information and best management practices may be shared among managers from various organizations and sectors. The synthesis from the three regional summits has showed commonalities and region-specific issues as well as management recommendations. Status reports both at the provincial and regional levels identified some programs that will be needed to enhance mangrove research, management, and policy. Roadmaps that prioritize research and management programs can be designed from these reports and can serve as inputs for national programs.

The regional mangrove summits should be sustained and regularly convened. The outcome of these summits should serve as technical and management inputs for a national mangrove summit. In this way, the network of regional and national mangrove managers can be sustained, and information can be regularly updated and consolidated. More systematic and timely collaboration among agencies (e.g., the academe, NGOs and NGAs) will be needed, not only for funding and other resources, but more importantly, to help institutionalize the national mangrove summit as a regular event.

IV. References

Duke, N. C. et al. (2007). A world without mangroves. Science, 317: 41-43.

Lovelock, C. E., et al. (2017). Mangrove dieback during fluctuating sea levels. Scientific Reports 7 (1680).

Primavera, J. H. (2000). Development and conservation of Philippine mangroves: institutional issues. Ecological Economics, 35: 91-106.

Salmo, S. G. III, Tibbetts, I., Duke, N. C. (2018). Nekton communities as indicators of habitat functionality in Philippine mangrove plantations. Marine and Freshwater Research, 69: 477-485.

Salmo, S. G., III, De La Cruz, M. D., Gianan, E. L. D. (2019). State of the mangrove summit: Central and Eastern Visayas Proceedings. Ateneo de Manila University, 129 p.

Salmo, S. G. III, Favis, A. M. T., Ting, M. N. S., Lim, A. B. U. (2017). State of the Mangrove Summit: Southern Luzon Proceedings. Ateneo de Manila University, 113 p.

Salmo, S. G. III, Favis, A. M. T., S. G. S., et al. (2015). State of the mangrove summit: northwestern Luzon proceedings. Ateneo de Manila University, 113 p.

Summaries of other technical presentations given at the Summit

History, Lessons, and Prospects on Mangrove Research and Management in the Philippines

Presented by Miguel D. Fortes
Marine Science Institute,
University of the Philippines Diliman, Quezon City

Much of the knowledge on Philippine mangroves comes from work by government institutions and the academe. Through the years, mechanisms for coastal resources management have been evolving, with a shift of responsibility from national to local (i.e., devolvement as per the Local Government Code), and to open access regimes. Heightened attention to mangrove research and management has been shaped by historical milestones ("periods of awakening") including the baselining of 450,000 ha of mangroves in 1918, National Coastal Resource Development in 1950-1960, the National Mangrove Program in 1977-1979, and the emergence of Blue Carbon in 2009, among others (Fortes & Salmo, 2017).

The trajectory of prospects in mangrove research is currently in relation to climate change, carbon dynamics of mangroves (e.g., sequestration, storage, and release), and holistic approaches (e.g., mangroves as a "bioshield"). However, major challenges in mangrove research and management persist, particularly gaps on the state and conditions of mangroves across the country (e.g., total area extent, status of threatened species, genetic diversity, etc.), a present imbalance between harnessing mangrove ecosystem services against potential impacts and tradeoffs, and the "broken bridge" between science and policy. Further, there are also overarching concerns regarding conflicting and/ or overlapping mandates and legislation, communication to various audiences (e.g., local communities, managers and other users, the general public, peers and other scientists, etc.), and the need for transdisciplinary and inclusive approaches in both research and management. Moving forward, the mangrove management program should consider not only biophysical interconnections, but also the related socio-economic and governance dynamics.

Finally, to realize the vision for Philippine mangrove research and management in 2030, it is important to develop and sustain partnerships to spearhead the creation of national and regional mangrove actions, mobilize transdisciplinary groups, and seek access to more resources and opportunities for mangrove programs that are inclusive and effectively uphold the law.

Lessons and Challenges in Mangrove Conservation/ Restoration in the Philippines - the ZSL Experience

Presented by Jurgenne H. Primavera
Zoological Society of London

With feedback that mangroves shielded coastal communities from the impacts of Super Typhoon Haiyan, the national government planned to spend Php 1 billion to plant 2,000 ha of mangroves. This prompted a concerned group of non-government organizations and members of the academe to question such a program. Results from assessments on mangrove damage and recovery conducted post-Haiyan showed a mismatch between the resources earmarked and/ or utilized for mangrove planting and rehabilitation with actual data on mangrove status and condition. Some LGUs reported damaged and dead mangroves when, in fact, sites still showed a possibility for recovery. Certain mangrove species may appear dying or dead but have great potential and capacity to recover. Based on these post-Haiyan findings and insights, it was recommended that the Php 1 billion be used to protect mangroves, establish mangrove nurseries, strengthen community-based management, establish coastal greenbelts, and revert abandoned ponds. However, when the funds were released a year later, 60% was still spent on propagules, proceeding with business-as-usual strategies. Scientific recommendations were not considered – only 2% went to nurseries, and 1% to community capacity building, which was equivalent to a mere Php 30 million.

Mangroves especially natural forests are resilient such that recovery is possible even after severe damage. There is no need to replant mangroves; it is more cost-effective to instead protect existing and recovering mangroves. Persistent issues in conventional mangrove reforestation practices are the use of wrong species, planting on seagrass beds, misguided planting, and planting by convenience. These result in low survival, and disrupt the natural habitat of faunal species. Rather than actual need and the motivation for positive impact, capital drives the desire for many mangrove-planting initiatives. Science-based planting, i.e., planting appropriate species in suitable environmental sites and conditions, must instead preside over any mangrove-planting initiative.

A paradigm shift is needed. Monitoring should be performed, not only at the start of planting, but regularly over a period of time to consider survivorship. Survival rate and actual hectares of forest growth would be more effective indicators of success rather than number of seedlings planted and the amount of space (ha) covered. Monitoring should be strengthened especially through systematic documentation of all findings. Other recommendations to improve mangrove-planting initiatives are the use of coastal engineering and other science-based innovations in ensuring survival (i.e., breakwaters, bamboo fences, etc.), and social networking. The volunteer system to encourage planting should be explored, to facilitate a true sense of ownership of and responsibility for the mangrove rehabilitation among participants.

Restoration must focus on the reversion of Abandoned, Undeveloped, and Underutilized (AUU) fishponds (especially public fishponds, those with FLAs, and tax declarations), because it is ecologically easier. However, political dynamics and, in many cases, lack of political will can make AUU fishpond reversion challenging to administer in practice. DENR as the lead national agency for mangrove conservation and management should assert its rights to recover former mangrove areas and/ or reverted fishponds, and DA-BFAR must cooperate by law (i.e., through the Fisheries Code). Most fishponds are tax declarations, only a few with FLAs left, so the NGP should allot more resources in reverting these tax declaration areas. There is also an urgent need to harmonize mangrove-related mandates and regulations among concerned agencies such as the DENR, DA-BFAR, DILG, and DoF; and update laws on forest conservation, rehabilitation, and/ or reversion. Non-government organizations and the academe must come together, with the former providing funding and other resources and the latter developing the science and research. For the 2030 scenario, it is hoped that the government will develop coastal greenbelts, and increase mangrove to fishpond ratio from 1:1 to 4:1.

The practice of planting mangroves over seagrass beds is a management malpractice where an established ecosystem (i.e., the seagrass) is compromised for the perceived benefits of a monoplantation (Photo © Dixon T. Gevaña).

Government-CSO-Business Partnerships for Mangrove Management: Challenges, Lessons and Future Scenarios

Presented by Francisco A. Arellano
Maynilad Water Services, Inc.

The water services company Maynilad is "committed to excellence and leadership in protecting the environment." In going beyond corporate social responsibility, it has implemented a range of environmental initiatives such as coastal clean-up activities and climate change-related programs particularly managing its GHG emissions and carbon footprint. Its program "Plant for Life," which began in 2010 with activities for the Ipo Watershed, now aims to rehabilitate mangroves in the Cañacao-Bacoor-Manila bays. The program focuses on five key components: planting for life, partner engagement, capacity building and empowerment of the community, estimating carbon sequestration in mangroves, and off-setting the company's carbon footprint. Among the cooperating partners are the LGUs of the sites in Cavite, the barangay councils, the DENR PENRO and CENRO, NGOs and other private entities, government (e.g., Philippine Navy, Philippine Air Force, Philippine Army, the PNP, etc.), the academe, and the local community (e.g., marginalized families, the Church, etc.) Plant for Life is operating in sites in Cavite City, Bacoor, Kawit, Noveleta, and Rosario.

As part of the Plant for Life focus areas, carbon sequestration potential in the rehabilitated mangroves has been determined, in collaboration with multiple stakeholders. So far, over 87,000 propagules have been planted in 8.6 ha across the five sites from 2013 to 2016. The carbon sequestration study aimed to assess the ecological condition of the mangrove forest adapted by Maynilad for rehabilitation, measure available biomass and sediment carbon stocks in Maynilad's sites, and recommend measures to optimize benefits associated with mangroves and their rehabilitation.

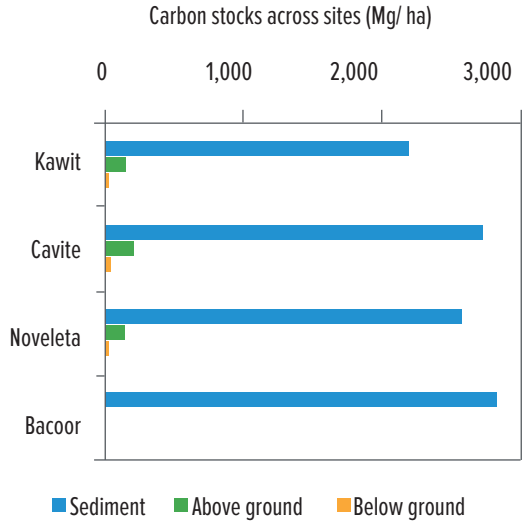


Figure 4-28. Carbon stocks (Mg/ ha) across Plant for Life mangrove-planting sites adopted by Maynilad

Sampling sites were established in planting areas in Bacoor, Kawit, Noveleta, and Cavite City. Carbon stock in each of these sites was nearly 2,500-3,000 Mg C/ ha, with the highest values measured in Bacoor and Cavite (Figure 4-28). The greatest amount of stored carbon was found in the sediment.

Various lessons and insights have emerged from Maynilad's experience in mangrove rehabilitation in Cavite. The Plant for Life Program has served as a catalyst in strengthening the partnerships among the community, civil society, academe and government. It has helped in building the capacity of partners in problem identification, species-site matching, monitoring, and evaluating mangrove rehabilitation areas. In addition, the program paved the way to leverage resources, and for knowledge exchange and transfer among the partners. Moving forward, Maynilad aims to sustain what they have started by strengthening collaborations, improving monitoring and evaluation mechanisms, and conducting more studies on mangrove rehabilitation.

Global Climate Change Related to Mangroves: International Blue Carbon Initiative, Global Mangrove Alliance, RISCO

Presented by Ma. Josella Pangilinan
Conservation International Philippines

Nature is 30%+ of the solution to climate change but natural climate solutions are undervalued and underrepresented in global climate action, receiving only 2% of global climate finance. There is a need for heightened action on climate change, and increased deployment of natural climate solutions. Climate change is a global crisis; thus, each country's efforts contribute to the bigger picture.

Some of the global efforts that Conservation International is involved in are the Global Mangrove Alliance (GMA), the International Blue Carbon Initiative (IBCI), and the Restoration Insurance Service Company Project (RISCO). The GMA aims to connect isolated initiatives into a global portfolio that leverages best practices and development opportunities, and to capitalize on the diverse strengths and experiences of its members to ensure successful science-based conservation and restoration of mangroves. There is a need to convince national government to form a similar alliance at the domestic level and to work together to contribute to increasing global mangrove cover. The IBCI aims to mitigate climate change through coastal ecosystem management, bringing together governments, research institutions, non-governmental organizations, and communities from around the world. Lastly, RISCO is a social enterprise that invests in mangrove conservation and restoration in countries where there is blue carbon potential, and communities are particularly dependent on coastal resources and vulnerable to storms and flooding. Proposed revenue streams will be from insurance companies keen to reduce their risk exposure, and the sale of blue carbon credits. CI is seeking to pilot RISCO at a coastal site in the Philippines with large mangrove cover exposed to storms and flooding, and that has shown potential for mangrove restoration and blue carbon credits.

Discussion

The following key points were discussed during the open forum following the technical presentations.

1. Opportunities for mangrove research and management

- Success in securing funds for mangrove research and management is improved when proposals and objectives are aligned with funding agencies' own goals and targets. Funding agencies are more inclined to fund projects that adopt an integrated approach to achieve multiple benefits (e.g., ridge-to-reef, landscape, river basin, etc.), and target policy and/ or institutional change. Other factors for successful proposals are timing, prioritization, and effective communication.
- A desired outcome of the current Summit is to encourage the national government to become part of the Global Mangrove Alliance and/ or establish a similar network among concerned agencies at the national level.

2. Blue carbon research

- Cutting mangroves for blue carbon samples must be considered in the context of the ban on mangrove cutting. Such "pruning" most be limited to scientific and research purposes only, and not set precedent for any other use. Further, this should only be done in plantations and avoided in natural stands.
- When determining mangrove carbon stocks, models that at least consider tree diameter and height are recommended.
- In terms of the credibility of resource accounting, the rule of thumb is 90% or higher confidence.
- Literature is available on the amount of carbon sequestered by different species.

3. Mangrove restoration and monitoring

- At the moment, demand and pressure to deliver on national targets by the NGP hampers the incorporation of better science in planting practices. Prior to planting, capacity building on mangrove zonation and site-species matching, among other key topics must be undertaken. Administrative challenges such as procurement has also created difficulties in seedling production, so should be addressed.
- The Forest Foundation of the Philippines has been discussing a management review of the NGP (e.g., assess impacts and targets, milestones, etc.) with the DENR since 2012, though updates are still forthcoming. Such a review can improve the NGP by aligning its strategies with mangrove conservation and sustainable development goals in general.

4. Challenges to achieve 2030 targets

- Although AUU fishpond reversion is a major strategy in increasing mangrove cover by 20% in 2030, it comes with complex challenges. For instance, clear and comprehensive guidelines have yet to be established, ideally as a result of mutual and joint agreement among concerned agencies such as the DENR, DA-BFAR, and DILG. That said, the objective of increasing cover should be further supported, not only by reforestation, but by conservation and protection (i.e., investment in protected areas).
- The National Mangrove Action Plan is seen as the harmonizing framework for mangrove conservation and management towards the 2030 targets. The Plan must be owned and championed by the DENR, DA-BFAR and DILG, ideally as part of the larger Philippine Development Plan. It should comprehensively and coherently address the issues identified in this Summit and other previous dialogues including AUUs, titling of mangrove areas, and coastal greenbelts, among others. Finally, the Plan must be developed with a climate change/ resilience lens.

5 Workshop Outputs

Participants and organizers of the 1st National State of the Mangrove Summit in Manila, Philippines in October 2019
(Photo © Conservation International Philippines)

Part of the Summit were workshop sessions to facilitate better understanding of the factors driving the status of mangroves in the different regions, and to initiate the development of the 10-year mangrove roadmap towards 2030.

Workshop 1: Revisiting Lessons, Challenges, and Opportunities for Mangrove Management

In Workshop 1, entitled "Revisiting Lessons, Challenges, and Opportunities for Mangrove Management," participants were grouped per subnational region (i.e., Luzon, Visayas, and Mindanao). Discussion focused on enabling factors, and gaps and issues that have contributed to the state of mangroves in the participants' respective areas. Finally, recommendations were given to address the identified gaps and issues. Specifically, the questions to guide the discussion were:

1. What were the facilitating and constraining factors that contributed to the state of the mangroves in your group? What were the common (or unique) factors among geo-political regions?
2. What were the gaps and issues (e.g., research, policy, funding) that contributed to the state of the mangroves in your region?
3. Provide specific suggestions to address the gaps and issues.

Table 5-1. Mangrove management per region: facilitating factors, gaps and issues, and recommendations

	Luzon
Facilitating factors	• The Philippines is party to international agreements that support mangrove management programs. • There are established protected areas and existing national level laws and policies such as the E-NIPAS law. • MPA networks have been established in certain sites, at different governance levels (e.g., provincial networks as in Occidental Mindoro and Palawan) • Some sites have updated NAMRIA mangrove maps. • Funding support and/ or opportunities are available (e.g., IPAF and NGP).

Across the three subnational regions, common facilitating factors are the availability of funding and co-financing support; the growing body of knowledge and best practices on mangrove conservation, rehabilitation, and management; and the existence of MPAs and MPA networks at various scales, from provincial to bay-wide or MKBA levels. On the other hand, gaps and issues mentioned for all of the groups are largely in relation to data including updating maps and obsolete information, the need for field/ ground validation, standardization of assessment and monitoring methods, replicating best practices beyond model sites, and building technical capacity among local managers and POs, among others. Key management concerns are the overlapping and/ or conflicting mandates of relevant National Government Agencies and other management bodies, and the use of a top-down approach for target-setting and consequent interpretation at the local level. To address these gaps and concerns, chief recommendations identified are to harmonize mangrove-related policies and mandates, facilitate better access to existing and available funding support, strengthen protection and management, and promote knowledge and learning exchange to regularly update relevant mangrove monitoring information (e.g., maps, areal extent, cover, biodiversity inventory, etc.) The outputs for Workshop 1 per subnational region are summarized in Table 5-1. Facilitators for the workshop were Dr. Dixon Gevaña (Luzon), Ms Ma. Josella Pangilinan (Visayas), and Dr. Sitti Zayda Halun (Mindanao).

Visayas	Mindanao

• The geography (islands/ archipelagic) in the Visayas presents both opportunities and challenges.
• Political will
• Availability of funds (e.g., maintenance and protection activities in NIPAS; engagement of POs in NGP from seedling production to plantation establishment to M&E; green-grey engineering)
• Growing body of knowledge on mangroves
  ◦ The impact of Super Typhoon Yolanda has awakened national consciousness on the importance of mangroves
  ◦ Many lessons have originated and been compiled from Panay because of the presence of local experts
 	
Opportunities:
• Presence of other academic institutions (e.g., Silliman University) and NGO programs (e.g., ProCoast, Blue Carbon)
• Growing consciousness on the need to create networks and local mangrove alliances
• Documentation, replication and sharing of best practices in mangrove conservation (from barren mudflats/fishpond to mangrove areas)
• Use of technological advancements in monitoring (e.g., drones)
• ACCCoast data on FLAs
	• Strong Public-Private Partnerships and corporate social responsibility on mangrove planting and MPA establishment, e.g., partnerships with resorts and other establishments and sectors
	• Existing coastal LGU alliances and MPA networks (e.g., networks in Region 10)
	  ◦ Strong political will
	  ◦ Incentive-based management (e.g., Malinis at Masaganang Karagatan (MMK) Program, Para El MAR by the MPA Support Network, CDO Limpyo Dagat Contest)
	  ◦ Technical working group focused on CRM
	  ◦ Local champions and POs with their own initiatives (e.g., Ka Dudoy)
	  ◦ Inspiration from success stories and aspiration to replicate
	• Tenurial instruments (e.g., Community-based Fisheries Management Area)
	• Ecotourism sites
	• Availability of funding and co-financing, with support from, among others, the academe, NGOs, and CSOs (e.g., RARE, EcoFish, Haribon, WWF, Forest Foundation, etc.); the DENR through its Biodiversity-Friendly Enterprise (BDFE) Program; and DA-BFAR through its Philippine National Aquasilviculture Program (PNAP)
	• Strong community engagement, with active involvement from armed groups and returnees; schools (e.g., NSTP-led mangrove planting); and through various communication avenues such as social marketing (e.g., mascots) and media (e.g., radio programs, Facebook, etc.)

continued...

Table 5-1 continuation...

	Luzon
Gaps and issues	Needs: • Local policies such as MPA management plans in areas outside of the NIPAS • Validated baseline maps/ data on mangrove areas • Updated maps/ data on mangrove and fishpond areas. • Diverse funding opportunities (e.g., other funding outside IPAF and NGP) • Better coordination among agencies on reforestation projects to avoid duplication of efforts, e.g., technical guidance on site assessments and reforestation activities Management issues: • Overlapping and/ or conflicting national policies on conservation and utilization in mangrove areas, e.g., the overlapping mandates of the DENR and DA-BFAR on mangroves, AUUs, and fishponds • Ineffective and inefficient law enforcement to curb persistent threats such as titling of mangrove areas, conversion for human settlements, and illegal cutting

Visayas	Mindanao

Natural conditions and hazards:
• The island geography in Visayas results in fragmentation
• Intense typhoons may likely recur and impact existing plantations and stands
 	
Gaps and concerns in relation to data:
• Limited replication of lessons and best practices (e.g., distill lessons from Panay, and scale these up in other sites)
• Consolidation and validation of data on mangrove cover and areal extent (e.g., documentation from other mangrove rehabilitation initiatives should be reported along with data from NGP-supported projects)
• Standardization of methods on determining mangrove cover and areal extent
• Baseline assessments and regular monitoring of natural stands
• Knowledge transfer, i.e., capacity building for POs on the ground
 	
Issues in relation to a roadmap for rehabilitated mangroves:
• Top-down approach in target setting (i.e., national provides funds and sets targets for local implementation)
• Mangrove restoration not perceived as a science (i.e., developing the needed science as part of the roadmap)
• Monitoring & Evaluation used mainly to secure funding (i.e., reporting planted areas for NGP funding) rather than for adaptive management and tracking impacts and targets
• Target-driven planting (e.g., to comply with national-level targets, some LGUs plant in large areas without considering survivability)
• Site identification guided only by desktop/ table mapping
• Planting in unsuitable areas such as seagrass areas
• CRFMS has not been involved in mangrove restoration activities
 	
Issues in relation to policy and legislation:
• Activities under the national government's Build, Build, Build program pose major threats to mangroves
• Administrative issues hindering reversion of AUU fishpond areas
• Titling in mangrove areas
	• Gaps and concerns in relation to data:
	  ◦ Lack of resource valuation
	  ◦ Limited research on species richness, faunal species inside mangrove areas, etc.
	• Peace and order for specific areas (but not all of Mindanao)
	  ◦ Strong vested political (yet conflicting) interests in some areas
	  ◦ Foreign-funded projects are hampered by travel advisories
	• Conflicting interpretation of laws, mandates, policies, and targets of NGAs and LGUs
	• Limited technical capacity (e.g., personnel, pool of experts)
	• Limited funding for protection and conservation

continued...

Table 5-1 continuation...

	Luzon

Recommendations	• Consolidate and harmonize policies and funding support
	  ◦ Improve CLUP creation/ updating process to identify possible overlapping areas (e.g., fishponds, mangroves, Alienable & Disposable, etc.)
	  ◦ Integrate coastal management plans with other local and national plans
	  ◦ Develop management plans for Mangrove Protected Areas
	  ◦ Emphasize disaster risk reduction as a value of mangroves and their conservation and management
	  ◦ Create partnerships and conservation agreements with POs, NGOs, LGUs, etc.
	  ◦ Provide sustainable funding and financial assistance
	• Enhance management of protected areas
	  ◦ Declare more mangrove forest reserves
	  ◦ Establish networks within coastal provinces and provide legal basis through agreements among member LGUs.
	  ◦ Strengthen Protected Area Suitability Assessment (PASA)
	  ◦ Create localized agreements on managing NIPAS areas
	  ◦ Strictly implement site management plans
	• Share knowledge to update base maps and other relevant mangrove data
	  ◦ Use mangrove inventory to update NAMRIA maps to include current conditions of mangrove areas
	  ◦ Undertake ground validation of land cover maps
	• Create technical bulletins on mangrove rehabilitation, e.g., best practices on site and species suitability, ensuring higher survivorship, etc.
	• Build capacity through training and IEC, among others, to emphasize the value of mangroves and their management in providing quality ecosystem goods and services
	• Closely monitor all activities, projects, and programs
	• Provide sustainable livelihoods and enterprises (e.g., promote mangrove eco-tourism to empower communities)
	• Strengthen law enforcement (e.g., better articulate process to file cases on illegal cutting of mangroves)

Visayas	Mindanao

• Influence Regional Development Council as the regulatory body for development projects (e.g., raise awareness on the impacts of Build, Build, Build projects on mangroves)
• Update reports on the status of and monitoring activities in mangroves within protected areas
  ◦ Establish monitoring plots and use effective graphs to track changes over time
  ◦ Change unit of work measurements (UWM) in target settings to incorporate suggestions of experts and scientists
  ◦ Map fishpond areas at the regional level, and analyze and prioritize areas viable for mangrove restoration
  ◦ Cluster remaining natural mangrove stands (i.e., the creation of "Blue Carbon clusters"), and determine respective capacity for carbon sequestration to leverage for management
• Prioritize strategies of protection and rehabilitation before considering carbon financing, i.e., ground validation of available baseline data per region to establish the scope of coastal and marine ecosystems (with focus on both areas inside and outside the NIPAS)
• Strengthen foreshore management plans to regulate development projects to prioritize mangrove protection
• Assess NGP sites and consider if these are suitable for transfer to management under the CBFM
	• Undertake comprehensive capacity building and human resource development
	• Promote scholarships and trainings, not only among executives and managers, but more importantly to field personnel
	• DENR-BMB funding should not be limited to PAs, but also be made available to local and regional non-PA areas
	• Convene a Mindanao-wide mangrove summit or, ideally, a mangrove conservation network to create a pool of mangrove experts

Workshop 2: Roadmap to 2030 - Envisioning Philippine Mangroves

In Workshop 2 "Roadmap to 2030 – Envisioning Philippine Mangroves", participants were grouped thematically to develop strategies for the mangrove roadmap to 2030. The three thematic areas were on biodiversity, conservation and restoration, climate change, and policy and governance.

The technical papers presented earlier in the Summit served as inputs to the exercise. The discussion of each group was guided by the following process:

1. Identify priority programs;
2. Draw a roadmap from 2019 to 2030, and identify milestones for Years 1, 2, 5, and 10;
3. Describe the research and policy needs to implement the identified programs; and
4. Describe facilitating and constraining factors that will affect the implementation of these programs.

Goals identified by the group on biodiversity, conservation and restoration were to increase mangrove cover inside and outside protected areas, support the reversion of AUU fishponds, and increase the number and sizes of mangrove reserves, among others. In addition to the activities and milestones to achieve these goals, the group also listed possible means of verification to track milestones, and the agencies responsible for implementation.

On the other hand, the group on climate change has envisioned that, by 2030, mangroves are

Table 5-2. Vision and milestones towards Philippine mangroves in 2030, per thematic group

Vision/ priority programs	Mile	
	Year 1	Year 2
A. Biodiversity, conservation, and restoration		
• Available/ updated mangrove data, e.g., cover, density, biodiversity, etc. • Reduced mangrove losses, i.e., zero conversion • Increased mangrove forest cover, inside and outside reserves • Increased number and/ or sizes of mangrove reserves with ecotourism programs • Reversion of AUUs • Coherent/ specific policies, e.g., PAs, NGP sites	• Baseline map establishment (i.e., clear delineated) • Baseline biodiversity assessment with valuation • CEPA • Re-activate and convene the National Mangrove Committee • Identify FLA areas for new NGP sites • Moratorium on FLA conversion (i.e., DILG-led, DA-BFAR, DENR) • Local legislation	• CEPA • Enrichment planting of existing NGP sites • Capacity-building of field officers, LGUs, POs, CSOs, etc. • Fund sourcing (e.g., DENR, international agencies, etc.)
Means of verification	Reports, maps, and list of FLAs; Joint Memorandum Circular	Reports; trainings, workshops
Responsible agencies	DENR, DA-BFAR, DILG, NEDA, LGUs, and the academe	DENR, DA-BFAR, LGUs, funding agencies, and the academe

conserved and restored towards climate-resilient and sustainable coastal communities. It emphasized that this vision be guided by science. Priority programs identified are the development of a management plan incorporating climate-responsive and adaptive mangrove-related strategies, and the active involvement of local communities and stakeholders, among others.

Finally, priority programs identified under policy and governance are to review national policies on mangroves, and identify funding support for local MPAs outside NIPAS, among others. To support these goals, they have identified actions that will involve the contributions of multiple agencies such as reviewing and harmonizing relevant policies for the creation (and eventual implementation) of a unified inter-agency mangrove action plan, coordinating with the Regional Development Councils to reduce the impacts of development plans on mangroves, and participating in mangrove management bodies at various levels. Comprehensive workshop results from all three thematic groups are found in Table 5-2.

Results from Workshop 2 were later synthesized to prepare an initial roadmap, which was meant to be reviewed and confirmed by all partners. However, the process of finalizing the roadmap has been delayed due to the covid-19 pandemic and its impacts. The draft roadmap, which includes vision statements for each thematic area, has been included here as Annex 3.

s t o n e / s	
Year 5	**Year 10**
• MPA establishment thru LGUs • Ecotourism development and other BDFEs • CEPA • Creation of a Mangrove Council at the provincial/ municipal level • Awards (e.g., Seal of Good Local Governance) • 2nd Biodiversity Assessment • Mangrove Operational Management Plan (operations manual)	• Increase mangrove forest reserve coverage by 20% (i.e., from existing 303K ha mangrove cover area to 363K ha + no net loss + 60K ha of PA + enrichment of biodiversity in PAs and NGP) • Biodiversity assessment (build on and compare with results of planned Year 1 and 5 assessments) • Increase community income via ecotourism and BDFE • Sustainable financing (e.g., AIP and other institutional budgets) and management of PAs (CBFMA) • System for equitable benefit sharing, PES, and carbon credits • Identified mangrove champions
Reports; meetings; operations manual	Reports; meetings
DENR, LGUs, and the academe	

continued...

Table 5-2 continuation...

Vision/ priority programs	Mile	
	Year 1	Year 2
B. Climate change: carbon sequestration and sea level rise		

Vision:
Guided by science, mangroves are conserved and restored towards climate resilient and sustainable coastal communities.
 	
Priority programs:
• Science-based management plan that will incorporate climate-responsive and adaptive mangrove-related strategies based on projected rate of SLR
• Increased mangrove forest cover, i.e., mangroves are restored in proper zones, with a 4:1 mangrove: fishpond ratio.
• Local community and stakeholder involvement
	• Baseline mangrove vulnerability assessment against SLR
	• Map, identify, and inventory important mangrove areas, i.e., natural stands, areas for restoration, areas for blue carbon conservation, AUU fishponds for reversion
	• Review existing guidelines on LCCAP, CLUP, ICM
	• Shorten the process of reversion of fishponds to mangroves
	• Institutionalize systematic mangrove monitoring
	• Stakeholder education and involvement
		• Integrate mangrove management as a strategy for climate change adaptation and mitigation (LCCAP, CCAM)
		  ◦ Localized study/ learning sites on adaptation of mangroves to SLR
		  ◦ Establish and institutionalize blue carbon conservation areas
		  ◦ Study on PES
		  ◦ Institutionalize incentive system for locally managed mangrove areas/ greenbelt
		• Restoration of degraded mangrove using appropriate species (Y3-Y5)
		  ◦ Implementation of mangrove greenbelt
		  ◦ Institutionalization of mangrove nursery with appropriate species
		• Development and institutionalization of mangrove monitoring tool

s t o n e / s

Year 5	Year 10
• Protection of existing mangrove greenbelts • Relocation of coastal communities within greenbelts, with provisions for settlements and livelihood • CEPA • Impact assessment • Innovative technology to monitor impacts of climate change • Apply for Blue Carbon financing	• CEPA • Monitoring and evaluation of mangrove greenbelts • Impact assessment • Climate financing mechanism

continued...

Table 5-2 continuation...

Vision/ priority programs	Mile	
	Year 1	Year 2
C. Policy and governance		
• Review of national policies on mangroves • Enhanced implementation of CBFM • Management sharing scheme with the people's organizations • MPA establishment at the LGU level to be replicated in other areas • Funding for local reserves outside of NIPAS	1. Review of National Policy on Mangroves • Inter-agency effort to review and harmonize policies • Come up with a single reference of national mangrove management program, e.g., PDP (NEDA) *Milestone/s:* Unified Inter-agency mangrove action plan • Develop mangrove base maps (c/o NAMRIA) • Reversion of AUUs • Review of existing, conflicting policies • Awareness on Eco-DRR and CCA functions of mangrove ecosystems and capacity building *Research needs*: nutrient and carbon status in AUU fishponds; food security; benefit sharing and social justice 2. Mangrove enforcement • Scale-up enforcement • Influence leagues of local government to support enforcement • Continuous education of LGUs • Legal counsel for DENR personnel *Milestone*: Every MPA has enforcement teams with funding support from LGUs/ NGAs 3. Database • Validation of mangrove areas/maps *Milestone*: Validated mangrove maps	1. Legal protection for existing natural and restored/rehabilitated mangrove *Milestone*: Passage of mangrove-specific ordinances, environmental code 2. Coordinate with Regional Development Councils to reduce the impacts of development on mangroves (CSOs/ academe to assist) *Milestone*: Mangrove-sensitive development projects

s t o n e / s

Year 5	Year 10
Full implementation and funding of Mangrove Action Plan (with inter-agency support from DENR, DA-BFAR, and DILG) *Milestones:* • % (TBD) increase in mangrove areas protected from baseline • Institutionalized best practices on mangrove management	Institutionalization of mangrove management bodies (and provision of incentives) for local mangrove management. *Milestones:* • % (TBD) allocated municipal development plan for environmental program • 20% increase in mangrove areas protected from baseline

Mangroves recolonize an abandoned fishpond in Infanta, Quezon (Photo © Dixon T. Gevaña).

6 Summary & Recommendations

The 1st National State of the Mangrove Summit has successfully met its objectives. The regional presentations provided a synthesis of the status of mangroves and mangrove management approaches per province. Details have yet to be completed for provinces that are in the process of initiating data collection. On the other hand, many of the maps and most of the data are outdated or referenced from other reports. Nonetheless, these presentations are a comprehensive starting point for the national state of the mangroves.

The regional presentations were complemented by presentations from key National Government Agencies with direct institutional mandates on mangrove management. Key topics were historical research and management priorities, relevant policies, ongoing programs, and future needs. One of the common concerns among NGAs is the lack of consistent and updated data, which has also been raised by local coastal managers. Another identified issue is the incoherent policies and overlapping functions among institutions.

Ten technical studies were presented by invited experts. These studies focused on a range of topics including conservation/ restoration, blue carbon, sea level rise, mapping, funding opportunities, and partnerships, among others. These presentations provided the analyses and recommendations to help improve mangrove conservation and restoration programs.

Two workshops were conducted to serve as inputs for the formulation of a national mangrove management plan and roadmap for 2030. The first workshop was designed to consolidate regional information per major island group (i.e., Luzon, Visayas, and Mindanao) as a means to prepare for a comprehensive national mangrove status report. The outputs of the first workshop served as inputs for the second workshop. The second workshop was designed to produce a roadmap that is intended to implement priority programs (as conservation/ restoration, climate change adaptation, and policy). The results from the two workshops will definitely provide significant inputs in the formulation of a national mangrove management plan.

Opportunities, potential issues/ challenges, and recommendations

The Summit was a platform to discuss the status of mangroves and mangrove management in the Philippines. Opportunities were identified to improve mangrove research and management. However, there are also potential issues and challenges that could limit and/ or delay the realization of mangrove management programs.

International programs (e.g., IPCC, UNSDG, ASEAN 2030, etc.) as well as national development programs will provide an opportunity to align the national mangrove management agenda. These programs have distinct components where mangrove research, conservation, and policy development can be complemented. Some of the national commitments are the reduction of GHG emissions, climate-adaptive development, biodiversity conservation, and blue economy, among others. At the local level, the NGOs for Fisheries Reform in partnership with GIZ is also facilitating planning for the immediate reversion of AUU fishponds to mangroves. The group has also advocated for the reactivation of the National Mangrove Committee (currently under the DENR-ERDB), which undertook the original mandate

for mangrove management. In Congress, the National Coastal Greenbelt Program is also being considered for legislation. These developments help generate public interest on mangrove management.

One of the key challenges is to sustain the momentum gained from the Summit. There were several research and policy needs identified by the participants that were either raised from the presentations or were directly mentioned in the workshops. The concerns on generating and/ or updating mangrove information, as well as harmonization of policies and programs among NGAs were especially clear.

The Summit participants expressed modest expectations on what can be reasonably achieved within 10 years. Nevertheless, three immediate activities were identified to sustain the gains of the Summit, The first was proper documentation, which is now in the form of these Proceedings. The other two were policy and institutional improvement, and developing a roadmap to 2030.

1. **Summit documentation**

These Proceedings collect the regional state of the mangrove reports, NGA presentations, technical papers, and workshop outputs.

2. **Policy and institutional improvement**

As the Summit progressed, it became clear that a chief issue in mangrove conservation and management is overlapping and/ or conflicting mandates among NGAs. Understandably, each institution is implementing its own priority programs. Some of these programs must be reviewed for gaps, relevance, and whether they are consistent with the research and development needs of the country. A thorough policy review is recommended to mainstream the mandates of agencies engaged in mangrove research and management.

The call to reactivate the National Mangrove Committee is timely. To start, it should be able to facilitate better coordination among concerned agencies. For now, the agency or institution to lead this "re-activation" has yet to be resolved. Identifying the lead and member agencies, among other concerns, will impact identification and prioritization, and planning of mangrove programs. The 2nd National State of the Mangrove Summit, yet to be scheduled, is hoped to provide further clarity on related activities.

3. **Roadmap 2030**

A roadmapping exercise among key institutions was recommended to review and prioritize the research and management gaps and programs identified during the Summit discussions and workshops. The roadmap will aim to provide details on harmonizing policies, generating (baseline) and/ or updating mangrove information, and planning for future State of the Mangrove summits at both the subnational (i.e., local and regional) and national levels.

The process of developing the roadmap was initiated in the first quarter of 2020, but has been delayed due to the covid-19 pandemic and its impacts. A draft with vision statements for each thematic area has been prepared (Annex 3), but is still to be reviewed and confirmed by all partners. It is recommended that the roadmapping process be taken up once more, but be carried out through innovative means that are cognizant of circumstances in the new normal while ensuring that all partners are able to provide meaningful inputs and express buy-in.

Del Carmen, Siargao (Photo © Dixon T. Gevaña)

Annexes

Annex 1: Summit program of activities

Time	Activity	Lead/s
	**Day 0	8 October 2019**	
04:00 – 20:00	Arrival and registration	
	**Day 1	9 October 2019**	
07:30 – 08:30	Registration	
08:30 – 08:45	Opening program	Ms Rona Lallana *Master of Ceremonies*
08:45 – 09:00	Welcome/ opening remarks	ASec. Ricardo L. Calderon *DENR Biodiversity Management Bureau*
09:00 – 09:15	Message from Conservation International Philippines	Mr. Enrique A. Nuñez Jr. *Country Executive Director*
09:15 – 09:30	Message from Forest Foundation Philippines	Mr. Eric Buduan *Senior Program Officer*
09:30 – 09:45	Summit Overview and Program of Activities	Ms Ma. Josella M. Pangilinan *Director for Climate Resilience, Conservation International Philippines*
09:45 – 09:55	National Programs on Mangrove Ecosystems (CMEMP and E-NIPAS) Working Break	Ms Angelita P. Meniado *Chief, Coastal and Marine Division, DENR-BMB*
09:55 – 10:10	Mangrove Forest Based on 2010 and 2015 Land Cover Map	Engr. Raul T. Magabo *Chief, Physiography and Coastal Resource Division, NAMRIA*
10:10 – 10:40	Research and Initiatives on Mangrove Rehabilitation from the Government	Dr. Maria Lourdes Quiatchon Moreno *OIC Chief, Mangrove Research and Development, DENR Ecosystems Research and Development Bureau*
10:40 - 10:55	Status of Forestland released for FLAs	Ms Cecilia Arquilita *DENR Forest Management Bureau*
10:55 – 11:10	Abandoned, Underutilized, and Undeveloped Fishpond Lease Agreement (FLA)	Ms Mary Anne Gonzales *OIC, Fishpond Lease Section, DA-BFAR*
11:10 – 11:25	History, Lessons, and Prospects on Mangrove Research and Management in the Philippines	Dr. Miguel D. Fortes *Professor (ret) and consultant, Marine Science Institute, University of the Philippines*
11:25 – 11:55	Historical and current distribution of mangroves in the Philippines: spatio-temporal analysis	Mr. Alvin B. Baloloy *Senior Science Research Specialist, IAMBlueCECAM Project, University of the Philippines*
11:55 – 12:05	Synthesis and Lessons from the State of the Mangrove Summits	Dr. Severino G. Salmo III *Assistant Professor, Ateneo De Manila University*
12:05 – 12:20	Open forum	
12:20 – 13:20	Lunch break	
	Luzon presentations	
13:35 –13:50	Region 1: Ilocos Region	Mr. Chester O. Casil *NGP Coordinator Region 1*
13:50 –14:05	Region 2: Cagayan Valley	Mr. Nestor Lorenzo *CENRO Palanan*
14:05 –14:20	Region 3: Central Luzon	Ms Olive Ebido Gregorio *MENRO, Masinloc*
14:20 – 14:45	National Capital Region (NCR)	Mr. Carlito P. Castañeda *Chief, Conservation and Development Division*
14:45 – 15:00	Region 4-A: CALABARZON	Mr. Januel Peras *Development Management Officer V*

Time	Activity	Lead/s
15:00 – 15:15	Region 4-B: MIMAROPA	Ms Maria Elena Parañaque *Forester I*
15:15 – 15:30	Region 5: Bicol Region	Ms Emerin Dadea *Forester II*
15:30 – 15:50	Reaction from the panel of experts	Dr. Miguel D. Fortes Dr. Maria Lourdes Quiatchon Moreno Dr. Augustus Rex Montebon *Conservation International Philippines*
15:50 – 16:00	Coffee break	
	Visayas presentations	
16:00 – 16:15	Region 6: Western Visayas	Mr. Rod Reynan G. Laspiñas *Development Management Officer 1*
16:15 – 16:30	Region 7: Central Visayas	Mr. Reginaldo Bueno *Development Management Officer 1*
16:30 – 16:45	Region 8: Eastern Visayas	Ms Melecia Sumbeling *Chief, CRFMS*
16:45 – 17:05	Reaction from the panel of experts	Mr. Judah Aliposa *Wetlands International* Dr. Jurgenne H. Primavera *Chief Mangrove Scientific Advisor, Zoological Society of London* Ms Miledel Christine C. Quibilan *Marine Science Institute, University of the Philippines*
17:05 – 17:35	Lessons and Challenges in Mangrove Conservation/ Restoration in The Philippines	Dr. Jurgenne H. Primavera
17:35 – 17:50	Synthesis	
18:30 – 20:00	Welcome dinner Launch of the Blue Carbon Assessment in the Verde Island Passage	c/o DENR – BMB Mr. Enrique Nunez, Jr. Dr. Severino Salmo III
	Day 2 | 10 October 2019	
08:00 – 08:15	Day 1 synthesis and session introduction	
	Mindanao presentations	
08:15 – 08:30	Region 9: Zamboanga Peninsula	Ms Chantal S. Tiga *Forest Technician II*
08:30 – 08:45	Region 10: Northern Mindanao	Ms Mercedita Barbarona *Chief, Coastal Resources Management Section*
08:45 – 09:00	Region 11: Davao Region	Mr. Gil Bigcas *Development Management Officer II*
09:00 – 09:15	Region 12: SOCCSKSARGEN	Mr. Cirilo Lagnason Jr. *Chief, CRFMS*
09:15 – 09:30	Region 13: CARAGA	Ms Nilda G. Ebron *Development Management Office V*
09:30 – 09:45	Bangsamoro Autonomous Region in Muslim Mindanao (BARMM)	Mr. Alibsar D. Palawan

Time	Activity	Lead/s
09:45 – 10:00	Reaction from the panel of experts	Mr. Alvin B. Baloloy Dr. Dixon T. Gevaña *Professor, College of Forestry, University of the Philippines Los Baños* Dr. Sitti Zayda Halun *Mindanao State University in Tawi-Tawi* Dr. Jurgenne H. Primavera
10:15 – 11:00	Carbon Sequestration in Philippine Mangroves	Dr. Dixon T. Gevaña
11:00 – 11:30	Government-CSO-Business partnerships for mangrove management: challenges, lessons, and future scenarios	Engr. Francisco A. Arellano *Senior Technical Advisor, Maynilad Water Services, Inc.*
11:30 – 12:00	Understanding the Impacts of Climate Change to Mangroves	Dr. Rodel D. Lasco *Senior Scientist, Oscar M. Lopez Center; World Agroforestry Centre (ICRAF)*
12:00 – 12:30	Experiences and Lessons in Funding Mangrove Restoration and Management in the Philippines	Mr. Eric Buduan
12:30 – 13:30	Lunch break	
13:30 – 14:00	Global Climate Change related to Mangroves: International Blue Carbon Initiative, Global Mangrove Alliance, RISCO	Ms Ma. Josella M. Pangilinan
14:00 – 14:30	Policy Review and Recommendations for Mangrove Conservation and Management	Atty. Grizelda Mayo-Anda *Executive Director, Environmental Legal Assistance Center, Inc.*
14:30 – 15:00	Workshop 1: Revisiting Lessons, Challenges and Opportunities for Mangrove Management	Designated workshop facilitators
15:00 – 16:00	Workshop 2: Roadmap to 2030 – Envisioning Philippines Mangroves	Designated workshop facilitators
14:00 – 16:15	Coffee break	
17:00 – 17:20	Synthesis	Mr. Ronald Dionnie Olavides *Conservation International Philippines*
17:20 – 17:40	Orientation on the field visit to the Las Piñas – Parañaque Critical Habitat and Ecotourism Area (LPPCHEA)	Ms Ma. Josella M. Pangilinan
17:40 – 18:00	Poster and info materials viewing	
18:15 – 20:15	Dinner	
	**Day 3	11 October 2019**	
06:30	Assembly at the hotel lobby	
06:30 – 07:30	Travel to LPPCHEA	
07:30 – 11:30	LPPCHEA field visit and demonstration of C-Stock measurements	Dr. Severino G. Salmo III
11:30 – 12:30	Return to hotel	
12:30 – 1:30	Lunch break	
13:30 – 16:30	Training/ workshop on carbon sequestration assessment in mangroves Data analysis and presentation Online Mangrove Monitoring System	Dr. Severino G. Salmo III Mr. Alvin B. Baloloy
16:30 – 16:45	Coffee break	
16:45 – 17:00	Ways forward	Dr. Severino G. Salmo III
17:00 – 17:15	Closing remarks	Ms Angelita P. Meniado

Annex 2: Summit participant directory

Name	Affiliation	Contact
Abian, Emelinda A.	Conservation International Philippines	eabian@conservation.org
Aliposa, Judah S.	Wetlands International	judahsa@yahoo.com
Arellano, Francisco	Maynilad Water Services, Inc.	kicksarellano@gmail.com
Arocena, Eden Pearl L.	SIKAT, Inc.	sikat.sikat@gmail.com
Arquilita, Cecilia	Forestry Management Bureau, Department of Environment and Natural Resources	fluasfmb2015@gmail.com
Asis, Alvidon F.	League of Cities of the Philippines	alvidon.lcp@gmail.com
Baling, Nilda S.	Biodiversity Management Bureau, Department of Environment and Natural Resources	
Baloloy, Alvin B.	Department of Geodetic Engineering and Training Center of Applied Geodesy and Photogrammetry, College of Engineering, University of the Philippines Diliman	alvinbbaloloy@gmail.com
Barbarona, Mercidita	DENR Region 10	merc_barbarona@yahoo.com.ph
Bigcas, Gil. V.	DENR Region 11	forester5811@yahoo.com.ph
Boja, Jesus S.	DENR Region 12	
Buante, Carlito	DENR Region 7	
Buduan, Eric	Forest Foundation Philippines	ebuduan@forestfoundation.ph
Bueno, Reginaldo	DENR Region 7	
Cabactulan, Dominic Jone C.	DENR Region 11	cabactulan.denr@gmail.com
Calderon, Ricardo L.	Biodiversity Management Bureau, Department of Environment and Natural Resources	
Casil, Chester O.	DENR Region 1	denr1engp@gmail.com
Castañeda, Carlito P.	DENR NCR	denrncrlppchea@gmail.com
Castillo, Buddy	Conservation International Philippines	bcastillo@conservation.org
Celino, Gemma	DENR Region 10	gbcels@yahoo.com
Cordero, Grick S.	Biodiversity Management Bureau, Department of Environment and Natural Resources	grickcordero@gmail.com
Dadea, Emerin	DENR Region 5	aedad_12@yahoo.com
Davalos, Joseph Ryan B.	Biodiversity Management Bureau, Department of Environment and Natural Resources	
De Castro, Rouenne Camille G.	Conservation International Philippines	rgdecastro@up.edu.ph
Destacamento, Mabelle	DENR Region 5	mabelle.destacamento@yahoo.com
Ebron, Nilda G.	DENR Region 8	nildaebron@yahoo.com
Evangelista, Charles Louie	Biodiversity Management Bureau, Department of Environment and Natural Resources	ctevangelista@up.edu.ph

Name	Affiliation	Contact
Fortes, Miguel D.		miguelfortes@gmail.com
Gabo, Lei Esther	Biodiversity Management Bureau, Department of Environment and Natural Resources	lei20gabo@gmail.com
Galupo, Primitiva A.	DENR-ERDB	oli.ma_5@yahoo.com.ph
Garcia, Ma. Carmela	Philippine Business for the Environment	carmelagarcia@thepbe.org
Gempes, Christy	Biodiversity Management Bureau, Department of Environment and Natural Resources	
Gevaña, Dixon T.	University of the Philippines Los Baños	dtgevana@up.edu.ph
Gianan, Eunice	Marine Science Institute, University of the Philippines Diliman	eunicegianan@yahoo.com
Gonzales, Mary Anne	Bureau of Fisheries and Aquatic Resources, Department of Agriculture	
Gregorio, Olive E.	Municipal Environment and Natural Resources Office, Masinloc	olivegregorio@hotmail.com
Guab, Alfredo III B.,	WWF Philippines	aguab@wwf.org.ph
Halun, Sitti Zayda	Mindanao State University in Tawi-Tawi	
Lacandazo, Severino Jr. A.	DENR Region 8	rinolacandazo@gmail.com
Lagnason, Cirilio Jr.	DENR Region 12	
Laroco, April Cyril		polaps.laroco@gmail.com
Lasco, Rodel D.	Oscar M. Lopez Center	rlasco@omlopezcenter.org
Laspiñas, Rod Reynan G.	DENR Region 6	
Lorenzo, Nestor	DENR Region 2	
Macabuhay, Marilou G.	DENR Region 13	macmalou_05@yahoo.com/ crfscaraga@yahoo.com
Manahan, John Rommel F.	Ecosystems Research and Development Bureau, Department of Environment and Natural Resources	jrmanahan0412@gmail.com
Mancio, Alexander E.	DENR Region 4-B	
Mangubos, Mae Anne D.	Climate Change Commission	
Mayo-Anda, Grizelda	Environmental Legal Assistance Center, Inc.	gerthiem@yahoo.com
Meniado, Angelita P.	Biodiversity Management Bureau, Department of Environment and Natural Resources	
Montebon, Augustus Rex F.	Conservation International Philippines	amontebon@conservation.org
Morales, Florante F.		florantefmorales410@gmail.com
Moreno, Maria Lourdes Quiatchon	Ecosystems Research and Development Bureau, Department of Environment and Natural Resources	mqmoreno@yahoo.com
Nuñez, Enrique Jr. A.	Conservation International Philippines	enunez@conservation.org
Olavides, Ronald Dionnie D.	Conservation International Philippines	olavides.ronald@gmail.com
Olvida, Alvin F.	Ecosystems Research and Development Bureau, Department of Environment and Natural Resources	afolvida@erdb.denr.gov.ph

Name	Affiliation	Contact
Pagayao, Nashrif H.	DENR Region 9	
Palawan, Alibsar C.		
Palomar, Joseph Angelus	DENR Region 4-A	angelush_26@yahoo.com
Pangilinan, Ma. Josella M.	Conservation International Philippines	mpangilinan@conservation.org
Parañaque, Ma. Elena	DENR Region 4-B	denr_marinduque@yahoo.com.ph
Patino, Guerrero	Biodiversity Management Bureau, Department of Environment and Natural Resources	glpatino@up.edu.ph
Peñaflor, Krystel Mae J.	Climate Change Commission	
Peras, Januel	DENR Region 4-A	cenro_calaca@yahoo.com
Perey, Jake Enrico	Conservation International Philippines	jperey@conservation.org
Primavera, Jurgenne H.	Zoological Society of London	georginehp@yahoo.com
Quadra, Medelyn M.	DENR Region 6	
Quibilan, Miledel Christine C.	Marine Science Institute, University of the Philippines Diliman	mcquibilan@gmail.com
Rico, Edmund Leo B.	Center for Conservation Innovations	e.rico@conservation-innovations.org
Robles, Felix D. Jr.	DENR Region 12	felixroblesjr071966@gmail.com
Rodriguez, Mayette	NGOs for Fisheries Reform	mayettepr@gmail.com
Salmo, Severino III G.	Ateneo de Manila University	ssalmo@ateneo.edu
Sangalang, Alita D.	Biodiversity Management Bureau, Department of Environment and Natural Resources	alitasangalang@yahoo.com
Sawit, Ma. Cecilia G.	DENR Region 4-B	maricelsawit@yahoo.com
Schmitt, Klaus	GIZ Philippines	klaus.schmitt@giz.de
Sto. Domingo, Mary Angelie	Climate Change Commission	stodomingo.ccc@gmail.com
Sumbeling, Melecia B.	DENR Region 8	msumbeling@yahoo.com
Talosig, Ireneo	Conservation International Philippines	italosig@conservation.org
Tiga, Chantal	DENR Region 9	
Tuddao, Vicente, Jr.	DENR Region 4-B	vbtuddaojr590@gmail.com
Ugat, Zenaida M.	Society for the Conservation of Philippine Wetlands, Inc.	zeniugat@wetlands.ph
Ulep, Celestino B.	Society for the Conservation of Philippine Wetlands, Inc.	celes.ulep@gmail.com
Vasquez, Jonalyn	Climate Change Commission	
Ventura, Cheryl R.	Conservation International Philippines	cventura@conservation.org
Villanueva, Michael V.	Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)	mvillanueva@pemsea.org
Viray, Analyn N.	DENR Region 1	anaviray2010@gmail.com
Yap, Elenio	Zoological Society of London	elenio.yap@zsl.org

Annex 3: Roadmap with vision statements, per thematic area

The workshop outputs during the summit were synthesized to draft a roadmap. This draft was then presented to key stakeholders on 6 February 2020. Based on outputs from Workshop 2 of the Summit, major activities including key indicators for each timeline were proposed. The roadmap was originally meant to be finalized in March 2020, but has since been delayed due to the covid-19 pandemic and its impacts.

Envisioning Philippine Mangroves: Biodiversity, Conservation, and Restoration

Vision:

Guided by science, mangroves are effectively conserved and restored, biodiversity will be systematically assessed, (more) mangroves will be under Protected Areas, AUU fishponds are reverted to mangroves, and mangrove information/ datasets are updated and publicly available.

YEAR 1 (2020)

- Baseline map and biodiversity assessment
- Local legislations
- Moratorium of FLA conversion

  FLAs identified as NGP sites
- Convene/ reactivate National Mangrove Council

YEAR 2 (2021)

- Enrichment planting of NGP sites
- Capacity-building of field offices
- Fund sourcing (DENR, donors)

YEAR 5 (2026)

- Established mangrove PAs
- Ecotourism development
- Mangrove councils at provincial/ regional levels
- Awards/ recognitions
- 2nd Biodiversity Assessment
- Mangrove management manual

YEAR 10 (2030)

- Increased mangrove cover by at least 20 %
- Increased mangrove PAs
- 60,000 ha in PAs or NGP sites
- 3rd Biodiversity Assessment

On 30 April 2021, a partners' meeting was convened via video conferencing to discuss the status of these Proceedings. The draft roadmap was also presented to the group, and it was agreed that a rigorous process involving meaningful partner input and buy-in would be undertaken to finalize the document. These Proceedings are intended to inform this process.

Envisioning Philippine Mangroves: Climate Change (blue carbon and sea level rise)

Vision:

Guided by science, mangroves are conserved and restored towards climate-resilient and sustainable coastal communities.

- Science-based management plan incorporating projected rate of SLR
- Increased mangrove cover and restored in proper zone (with 4:1 mangrove: fishpond ratio)
- Engaged local communities

Year 1 (2020)

- Baseline vulnerability assessment against SLR
- Mapping of natural and restored mangrove stands:
  - Review management guidelines; Inventory of AUUs;
- Identify areas for blue carbon
- Institutionalize systematic mangrove monitoring
- Stakeholder education and involvement

Year 2 (2021)

- Mangrove management for CCAM
- Identify localized learning sites (adaptive to SLR)
- Institutionalized PES and incentive systems
- Mangrove greenbelt (2021-2025)
- Mangrove monitoring tool developed

Year 5 (2026)

- Protection of existing greenbelts
- CEPA
- Impact assessment
- Innovative monitoring of impacts of climate change
- Applied for blue carbon financing

Year 10 (2030)

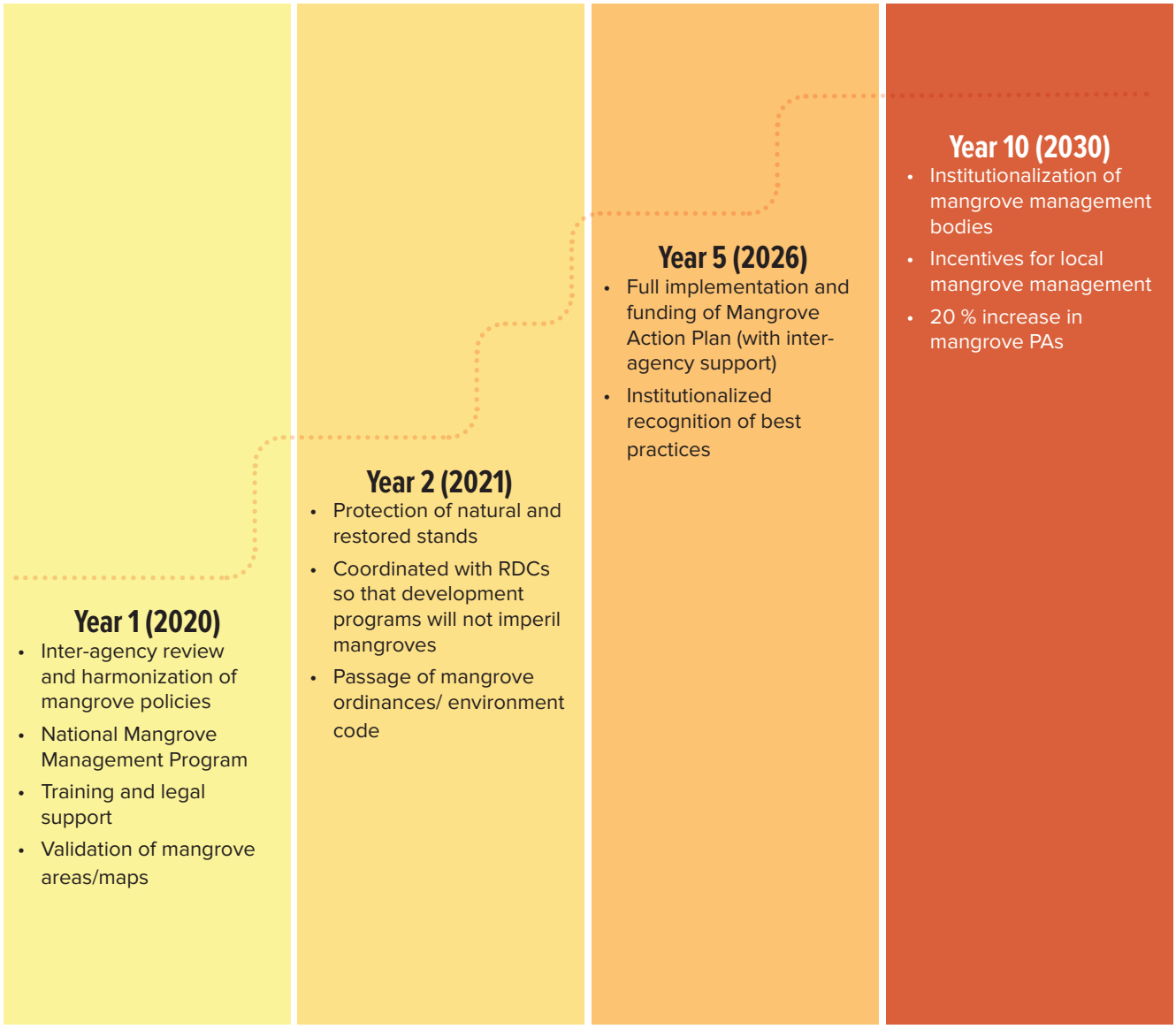
- CEPA
- Impact assessment
- Monitoring of greenbelts
- Institutionalized climate financing mechanism

Envisioning Philippine Mangroves: Policy and Governance

Vision:

Unified inter-agency mangrove action plan is developed with updated mangrove maps, clear implementation of CBFM, and with improved funding for mangrove conservation/ restoration.

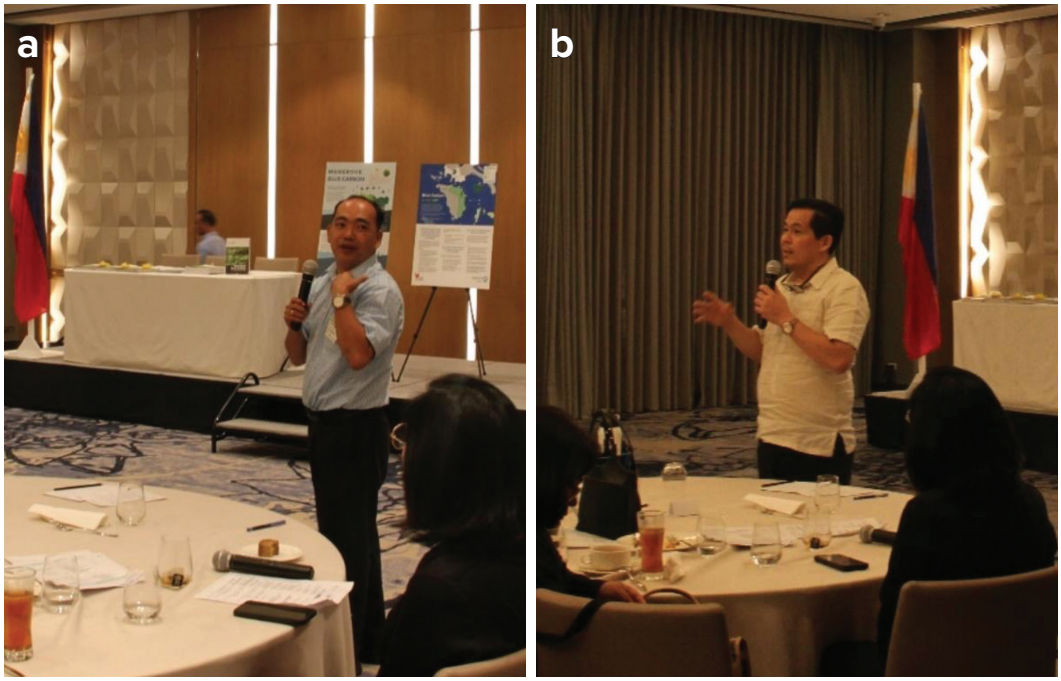
- Developed/ updated mangrove maps
- Enhanced implementation of CBFM with management sharing scheme
- Established mangrove PA at local levels
- Funding of mangrove PAs outside NIPAS



Annex 4: Launch of the publication "Mangrove Blue Carbon in the Verde Island Passage"

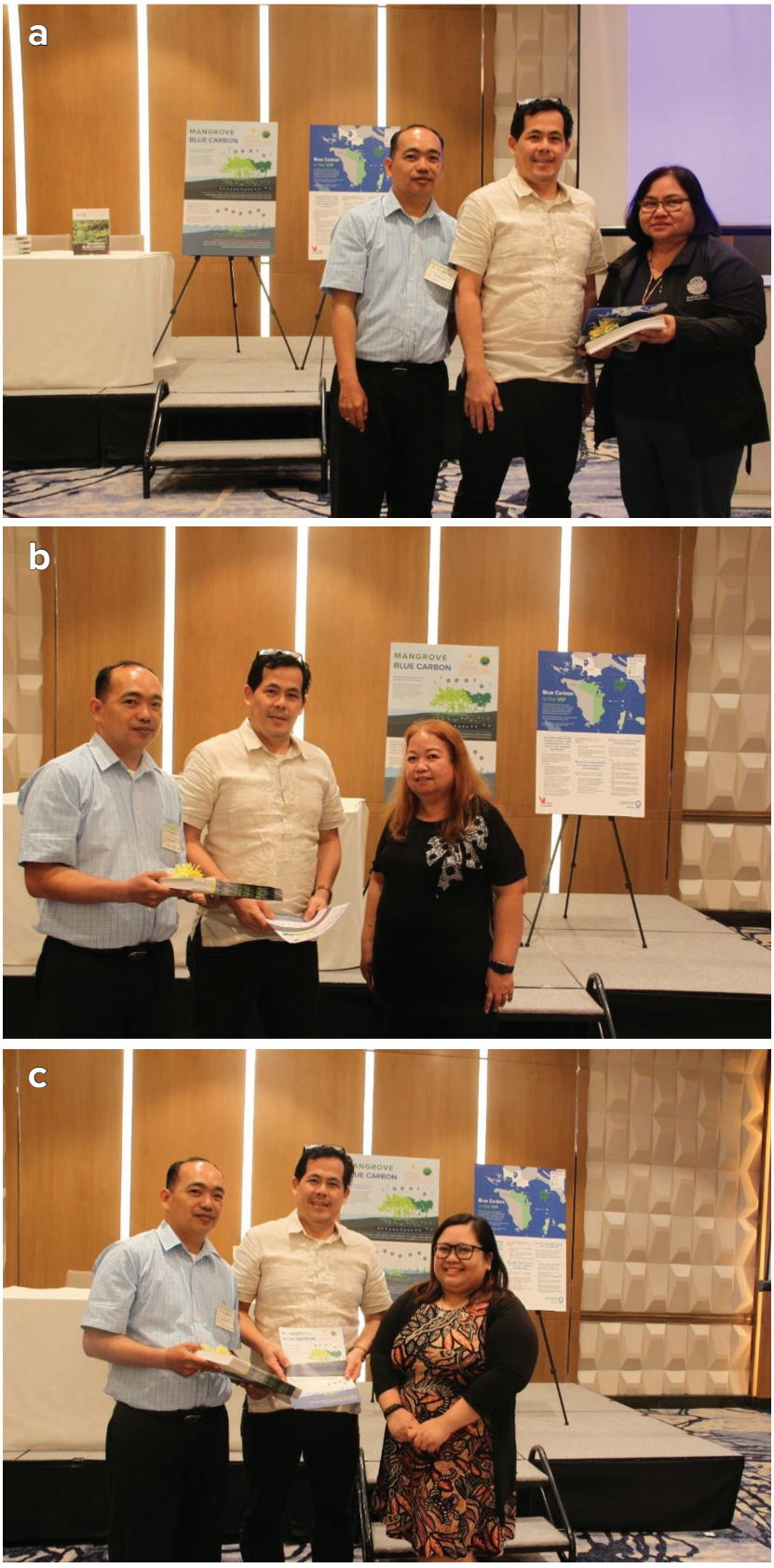
"Mangrove Blue Carbon in the Verde Island Passage" is a monograph summarizing the results of the study "Blue carbon assessment in the Verde Island Passage," which was conducted from August 2017 to January 2018, and led by Dr. Severino G. Salmo III. During the welcome dinner on Day 1 (9 October 2019) of the 1st National State of the Mangrove Summit, Dr. Salmo, with Conservation International Philippines Country Executive Director Enrique Nuñez, Jr., launched the monograph and spoke more on the blue carbon work in the Verde Island Passage. Copies of the monograph were presented to the Biodiversity Management Bureau and Ecosystems Research and Development Bureau of the Department of Environment and Natural Resources, and the Climate Change Commission.

Enlarged versions of the one-page handout on the monograph "Mangrove Blue Carbon in the Verde Island Passage."



Study leader Dr. Severino Salmo III (a) and Conservation International Philippines Country Executive Director Enrique Nuñez, Jr. (b) speak on the blue carbon assessment in the Verde Island Passage completed in 2018.

Copies of the monograph “Mangrove Blue Carbon in the Verde Island Passage” are presented to partner agencies DENR Biodiversity Management Bureau (a), DENR Ecosystems Research and Development Bureau (b), and the Climate Change Commission (c).



Annex 5: Post-Summit field visit to LPPCHEA

On the last day of the 1st National State of the Mangrove Summit (11 October 2019), participants went for a field visit to the Las Piñas – Parañaque Critical Habitat and Ecotourism Area (LPPCHEA; also the Las Piñas – Parañaque Wetland Park) as a culminating activity. Mr. Carlito Castañeda, Chief of the Conservation and Development Division at DENR NCR, provided a brief introduction and historical background on the establishment of LPPCHEA. The park covers two land masses: Freedom Island in the northeastern part of Parañaque City, and Long Island in the southwestern portion of Las Piñas City. It has 36 ha of mangroves, and 20 ha of beach forest. There are 84 species of birds in the area including the endemic Philippine Duck (*Anas luzonica*). Although the park provides many ecosystem services, it is not spared from threats such as reclamation.

As part of the field visit, Dr. Severino Salmo III and his team of researchers provided a demonstration on mangrove assessment methods including measuring growth, survival rates, and blue carbon.

Participants of the 1st National State of the Mangrove Summit at a field visit to the Las Piñas – Parañaque Wetland Park.

Mr. Carlito Castañeda of DENR NCR gives some background on the Las Piñas – Parañaque Wetland Park.

Dr. Severino Salmo III and his team demonstrate mangrove assessment methods.

Annex 6: Suggested outline for the regional state of the mangrove reports

I. Introduction

- Regional site description, e.g., location, land area, number of provinces, municipalities/cities, and shoreline extent, among other factors
- Importance of mangroves to the community in terms of ecosystem services

II. Status of mangroves in the region

- Extent in hectares – species inventory; stand structure, e.g., natural, planted, restored (old stand), secondary growth, plantation
- Historical timeline of mangrove conservation and restoration undertaken in the region
- Location and extent of degraded mangroves
- Perceived threats to mangroves including human and natural threats (e.g., climate change, natural hazards such as typhoons, etc.)
- Maps, e.g., location and extent of existing and degraded stands, before and after management, after disturbance such as typhoons, etc.

III. Mangrove Protection and Management

- Table of rehabilitation programs including extent in hectares, process, funding sources, implementing organization, and duration (year started/ completed)
- Initiatives on mangrove conservation other than mangrove planting such as
  - Mangrove Protected Areas or Conservation Areas – profile, extent, year established, governance/ management system, and funding
  - Policy and institutional support on mangrove initiatives – local ordinances, management structure, processes
  - Monitoring and Evaluation - growth and survival rate, sampling methods and references
  - Outcomes and impacts of mangrove rehabilitation in terms of ecosystem and socio-economic contributions (e.g., food, income and livelihood)

IV. Summary and Recommendations for the Region

- Synthesized information on the status and threats to mangroves in the region; and management including biodiversity conservation and restoration initiatives
- Recommendations to address local threats, broader issues such as climate and environmental change, and management concerns
- Policy and governance opportunities, i.e., needed institutional support to improve mangrove management