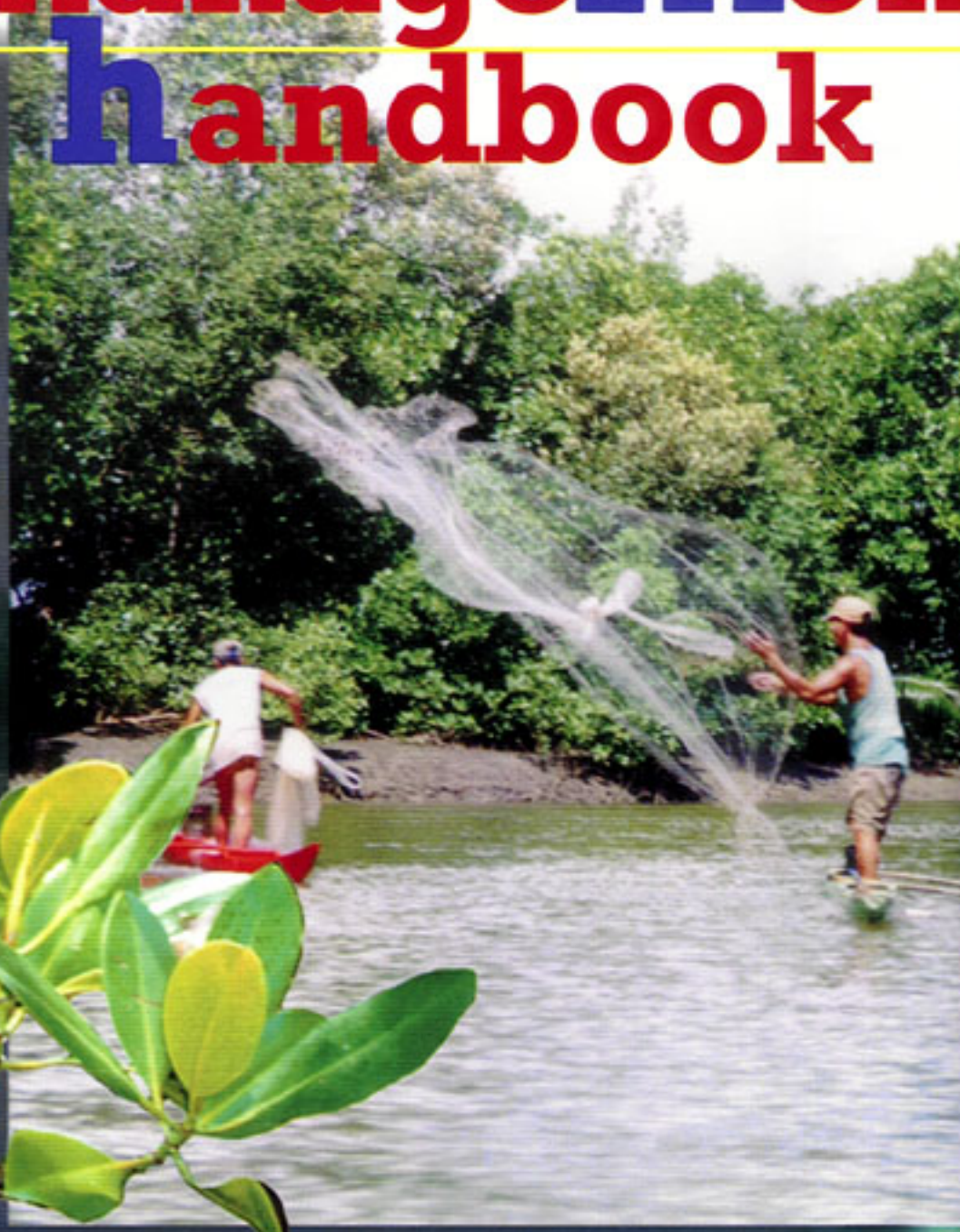


# **m**angrove **management** **h**andbook



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# Mangrove Management Handbook

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**COASTAL RESOURCE MANAGEMENT PROJECT**

**of the**



**DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES**

**supported by the**



**UNITED STATES AGENCY  
FOR INTERNATIONAL DEVELOPMENT**

# MANGROVE MANAGEMENT HANDBOOK

by

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**Front cover:** *Background:* A portion of a multi-age and multi-layered canopy of mangrove plantation in Banacon Island, Getafe, Bohol, Philippines, using *Rhizophora stylosa*. The tree is focused on the lower left corner of the cover. *Center:* Coastal community members in Tambobo Bay, Siit, Siaton, Negros Oriental – fishing on the river with intact natural mangrove vegetation. **Back cover:** *Left:* School children with mangrove propagules before planting to protect their school building from strong waves, Inabanga, Bohol, Philippines. *Right:* Participants in a mangrove trainors training during a practicum on mangrove plantation establishment in Sta. Cruz, Davao del Sur, Philippines. Photos by C.E. Yao.

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# List of acronyms

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AWP/RUP	Annual Work Plan/Resource Use Plan
ANR	Assisted Natural Regeneration
BFAR	Bureau of Fisheries and Aquatic Resources
CBFMA	Community-Based Forest Management Agreement
CDA	Cooperative Development Authority
CDF	Countryside Development Fund
CENRO	Community Environment and Natural Resources Office
CIDA	Canadian International Development Agency
CO	Community Organizer
CRMF	Community Resource Management Framework
CRMP	Coastal Resource Management Project
CSC	Certificate of Stewardship Contract
DA	Department of Agriculture
DAO	Department Administrative Order
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOLE	Department of Labor and Employment
EO	Executive Order
FLA	Fishpond Lease Agreement
GIS	Geographic Information System
GPS	Global Positioning System

HHW	Higher High Water
IRA	Internal Revenue Allotment
IRUP	Interim Resource Use Permit
ISFP	Integrated Social Forestry Program
LGU	Local Government Unit
LLW	Lower Low Water
MAO	Municipal Agricultural Officer/Municipal Agriculture Office
MC	Memorandum Circular
MFA	Mangrove-Friendly Aquaculture
MHHW	Mean Highest High Water
MLLW	Mean Lowest Low Water
MMC	Mangrove Management Component
MPDC	Municipal Planning and Development Council
MSA	Mangrove Stewardship Agreement
NAMRIA	National Mapping and Resource Information Agency
NGO	Nongovernment Organization
PCRA	Participatory Coastal Resource Assessment
PENRO	Provincial Environment and Natural Resources Office
PO	People's Organization
PPDO	Provincial Planning and Development Officer
SB	<i>Sangguniang Bayan</i>
SEAFDEC	Southeast Asian Fisheries Development Center
SEC	Securities and Exchange Commission
TWG	Technical Working Group

# Foreword

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The Department of Environment and Natural Resources (DENR) takes pride in producing this *Mangrove Management Handbook* as the accepted Philippine government information guide to assist coastal communities in the rehabilitation, management, protection and maintenance of the mangrove forests of the country and the coastal environment as a whole. This handbook will strengthen our capability to enhance the mangrove forests, thereby contributing positively in the productivity and maintenance of coastal ecosystems. It clearly identifies the roles and responsibilities of the communities, the local government units, the field personnel of the department and the other partners in mangrove management and development.

The DENR enjoins all users of this handbook to work together for the sustainable management of our mangrove forest resources.

To this end, the DENR conveys gratitude and appreciation to the Coastal Resource Management Project and the unwavering support of the United States Agency for International Development, for without them this publication would not have been possible.



**DEPARTMENT OF ENVIRONMENT AND  
NATURAL RESOURCES**  
**Diliman, Quezon City**  
**Philippines**



# Preface

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This *Mangrove Management Handbook* is comprised of six chapters packed full of useful information on how to protect and manage mangroves as a natural and productive resource. It is intended to help people anywhere who wish to become stewards of mangrove forest resources. People's organizations, nongovernment organizations and local government are the primary audience but of course others can benefit from the information presented in this volume.

The mangrove forest resources of the Philippines have deteriorated significantly during the last 50 years. The country now has less than 120,000 hectares of mangroves remaining and much of that is only secondary growth and by no means pristine. The culprits in the decline of mangroves are many but the primary one is conversion to aquaculture ponds and more recently conversion to urban land reclamation and other land uses. If this trend continues, there will be virtually no mangroves left in the Philippines after another 50 years.

The natural ecological and economic benefits lost with mangrove loss are significant and non-retrievable. One hectare of healthy mangrove forest supports fisheries alone worth at least P20,000 (US\$500) per year. In addition, there are values for wood, erosion control and waste absorption that vary from site to site but are minimally worth more than the fisheries value. This means that direct economic revenues from a healthy mangrove forest covering one hectare is conservatively P40,000 (US\$1,000). It is difficult to find a natural system that produces this kind of revenue without any investment except protection, and that has practical and economic values at the same time. As we lose these benefits, we as a society, will pay many times more than the cost of this destruction.

This volume holds many answers about how we can protect and manage our mangroves and how we can increase the area of healthy mangrove forest in the country. These are simple procedures understandable by most people. The key is finding the will power to put them into practical use. Here, political and personal support will make the difference. Let us start saving our mangrove forests now!



**COASTAL RESOURCE  
MANAGEMENT PROJECT**





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- ◆ Guide to Developing and Implementing Community-Based Forest Management Agreement (CBFMA) Monitoring
- ◆ CBFMA Application Guide

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**THE AUTHORS**



# List of scientific names, local terms and glossary of technical terms

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## LOCAL NAME

## SCIENTIFIC NAME

<i>Api-api</i>	-	<i>Avicennia officinalis</i>
<i>Bakauan babae</i>	-	<i>Rhizophora mucronata</i>
<i>Bakauan bato</i>	-	<i>Rhizophora stylosa</i>
<i>Bakauan lalaki</i>	-	<i>Rhizophora apiculata</i>
<i>Bakauan</i>	-	<i>Rhizophora</i> spp.
<i>Bungalon puti</i>	-	<i>Avicennia alba</i>
<i>Bungalon</i>	-	<i>Avicennia marina</i>
<i>Busain</i>	-	<i>Bruguiera gymnorrhiza</i>
<i>Buta-buta</i>	-	<i>Excoecaria agallocha</i>
<i>Diluario</i>	-	<i>Acanthus ebractcatus</i>
<i>Dungon-lati</i>	-	<i>Heritiera littoralis</i>
<i>Kulasi</i>	-	<i>Lumnitzera racemosa</i>
<i>Lagolo</i>	-	<i>Acrostichum aureum</i>
<i>Langarai</i>	-	<i>Bruguiera parviflora</i>
<i>Nilad</i>	-	<i>Scyphiphora hydrophyllacea</i>
<i>Nipa</i>	-	<i>Nypa fruticans</i>
<i>Pagatpat</i>	-	<i>Sonneratia alba</i> (Gedabu)
<i>Pagatpat baye</i>	-	<i>Sonneratia ovata</i>
<i>Pedada</i>	-	<i>Sonneratia caseolaris</i>
<i>Piapi</i>	-	<i>Avicennia lanata</i>
<i>Pototan lalaki</i>	-	<i>Bruguiera cylindrica</i>
<i>Pototan</i>	-	<i>Bruguiera sexangula</i>
<i>Saging-saging</i>	-	<i>Aegiceras corniculatum</i>
<i>Tabau</i>	-	<i>Lumnitzera littoria</i>
<i>Tabigi</i>	-	<i>Xylocarpus granatum</i>
<i>Tangal</i>	-	<i>Ceriops tagal</i>
<i>Tingloy</i>	-	<i>Acanthus ilicifolius</i>

## LOCAL TERMS

<i>Amatong</i>	-	Fish aggregating device made of piled logs/rocks that serve as a niche to marine life
<i>Bahalina</i>	-	Local wine made of coconut sap or juice fermented with <i>tangal</i> bark
<i>Banca</i>	-	Dugout canoe/boat
<i>Bantay-dagat</i>	-	Multisectoral team assigned to check illegal fishing

<i>Bantay-bakauan</i>	-	Multisectoral team assigned to check illegal cutting of mangroves in the coastal area
<i>Barangay</i>	-	Barrio
<i>Dagami</i>	-	Rice stalk
<i>Darak</i>	-	Rice hull
<i>Kagawad</i>	-	Representative of the municipal council ( <i>Sangguniang Bayan</i> )
<i>Sangguniang Bayan</i>	-	Municipal council

## GLOSSARY OF TECHNICAL TERMS

Aquasilviculture	-	Raising mudcrab/shrimp adjacent or under mangroves. Also known as silvofishery
Detritus	-	Mangrove leaf particles coated with microorganism in the process of decomposition
Enhancement	-	Rehabilitation by increasing the number of seedlings of planting desirable species
Hardening	-	The conditioning of seedlings through gradual exposure to sunlight and controlled watering prior to outplanting
Groundtruthing	-	Verifying map data on the ground
Propagules	-	The germinating seeds of the Family Rhizophoraceae while still attached to the mother tree. Also known as viviparous seeds
Wildlings	-	Propagules/seeds that germinate and grow naturally on the forest floor, the characteristic of which resembles that of the seedlings/propagules being raised in the nursery. These are sometimes collected using spade (earth-balled or bare-root) and potted in the nursery
Pericarp	-	The walls of ripened ovary of the fruit

# Chapter 1

## The importance of mangroves

---

### INTRODUCTION

**T**his chapter provides basic information on mangroves specifically:

- ◆ Ecological and economic benefits/functions
- ◆ Threats
- ◆ Protection and management strategies

In addition, four management alternatives for mangroves are suggested for people's organizations (POs), nongovernment organizations (NGOs), community organizers (COs) and others interested in the rehabilitation and sustainable management of the country's mangrove resources.

### What is Mangrove?

Mangrove is a type of forest growing along tidal mudflats and along shallow water coastal areas extending inland along rivers, streams and their tributaries where the water is generally brackish. The mangrove ecosystem is dominated by mangrove trees as the primary producer interacting with associated aquatic fauna, social and physical factors of the coastal environment.

The mangrove flora consists of 47 "true mangroves" and associated species belonging to 26 families (Melana and Gonzales 1996). True mangroves grow in the mangrove environment; associated species may grow on other habitat types such as the beach forest and lowland areas. A useful field guide to some Philippine mangrove species has been published by the Department of Environment and Natural Resources (DENR), Region 7 (Melana and Gonzales 1996).

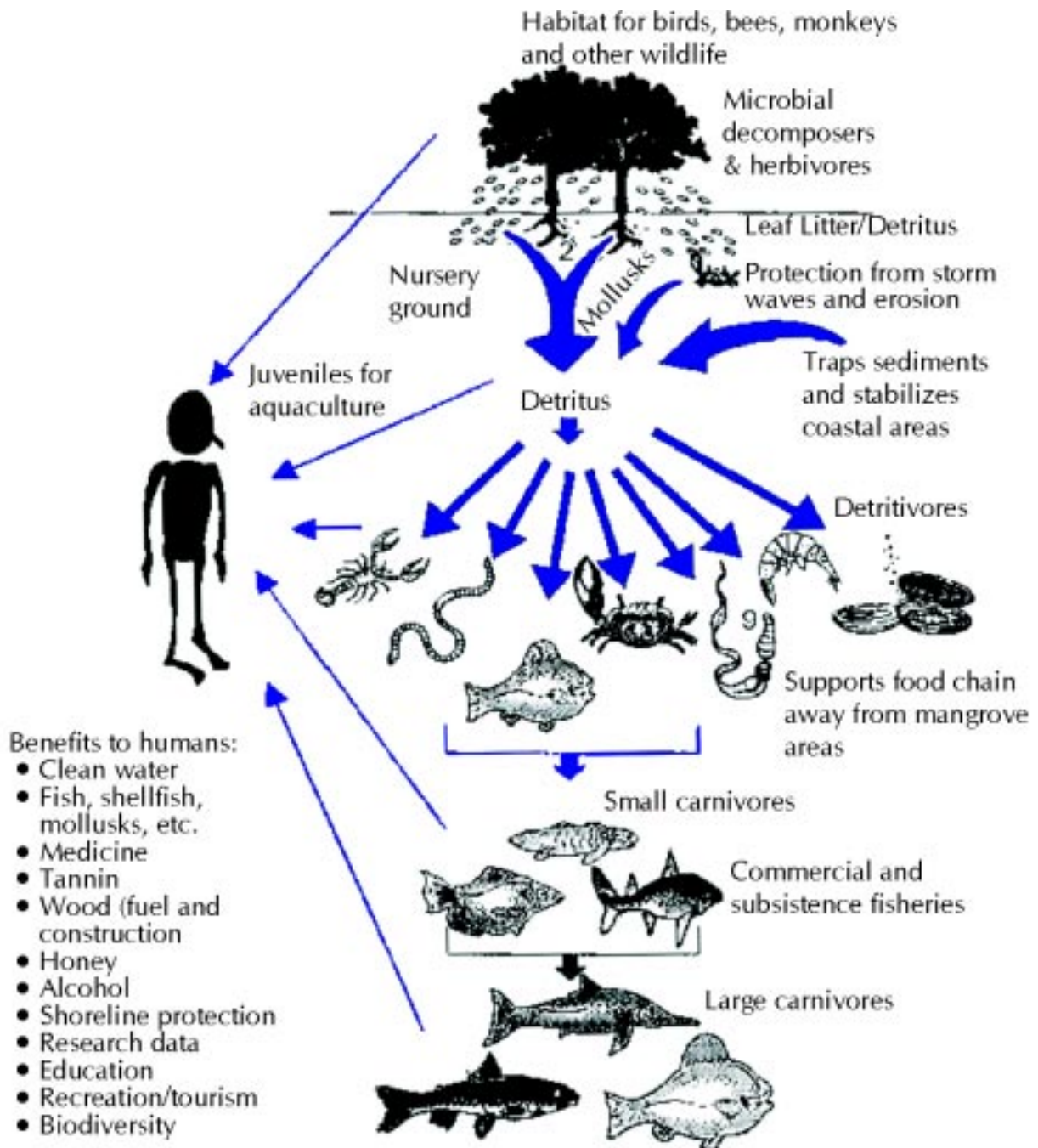
The mangrove fauna is made up of shore birds, some species of mammals (monkeys, rats, etc.), reptiles, mollusks, crustaceans, polychaetes, fishes and insects.

In 1918, some 450,000 ha of mangroves existed in the Philippines (Brown and Fischer 1918). According to DENR 1995 statistics, conversion to fishponds, prawn farms, salt ponds, reclamation and other forms of industrial development has reduced the mangrove area to 117,700 hectares.

### ECOLOGICAL AND ECONOMIC BENEFITS/FUNCTIONS

Figure 1.1 shows the primary ecological and economic benefits and functions of the mangrove ecosystem and these include the following:

- ◆ **Mangroves provide nursery grounds for fish, prawns and crabs, and support fisheries production in coastal waters.** Almost every living thing needs a safe place when it is young, small and fragile. Like human babies,



*Figure 1.1. Mangroves and their ecological and economic benefits (Berjak et al. 1977).*

young fish, shrimp, crabs and other animals in the sea need a safe place to grow, away from many predators. Only those young animals that find refuge survive to grow to full size. Smaller fish or shrimp swimming in open waters may soon be eaten by larger fish. Mangroves are good nurseries because they provide hiding places for young animals. The arched-shaped roots of the *bakauan* mangroves and the finger-like roots of the *api-api* and *piapi* mangroves are good examples. This protection, along with the abundant food supply that comes from mangrove leaves, make mangrove areas very good nurseries for many important sea animals. For every hectare of mangrove cut down, a corresponding reduction in fish catch is estimated at 1.08 tons per hectare per year.



**Figure 1.2 Fish, crabs, shrimps and shellfish are nourished by mangrove leaf detritus.**

- ♦ **Mangroves produce leaf litter and detrital matter, which are valuable sources of food for animals in estuaries and coastal waters.** The leaves that fall from a mangrove tree break up and decompose into small pieces known as detritus, some too small to be seen by the human eye (see Figure 1.2). The detritus is broken down by bacteria, fungi and other microorganisms that nourish marine animals. Mangroves contribute about 3.65 tons of litter per hectare per year.
- ♦ **Mangroves protect the environment by protecting coastal areas and communities from storm surges, waves, tidal currents and typhoons.** The crown and stem of mangroves serve as physical barriers. Their specialized roots trap and hold sediments and siltation from the uplands. Further, mangroves promote clear water and the growth of corals and seagrasses.
- ♦ **Mangroves produce organic biomass (carbon) and reduce organic pollution in nearshore areas by trapping or absorption.** Mangroves contribute 1,800-4,200 grams of carbon per square meter per year (approximating the contribution of the tropical rain forest and 10 times higher than primary production in the open ocean).
- ♦ **Mangroves serve as recreational grounds for bird watching and observation of other wildlife.** Mangroves provide shelter for local and migratory wildlife and serve as roosting and foraging grounds. They also provide access to highly diverse mangrove plants and animals and their adaptations, making them ideal ecological destinations and field laboratories for biology and ecology students and researchers.
- ♦ **Mangroves are a good source of wood and timber and *nipa* shingles for housing materials, firewood and charcoal, and of poles for fish traps. Mangrove seeds and propagules can be harvested and sold. Fish, crustaceans and mollusks can also be harvested from mangroves. Aquaculture and commercial fisheries also depend on mangroves for juvenile and mature fish species. Last but not the least, mangroves are sources of tannin, alcohol and medicine.**

Dixon (1989) estimates the value of a complete mangrove ecosystem to be in the range of US\$500 to US\$1,550 per hectare per year, the minimum valuation of a loss when mangroves are converted to other land use forms. White and Cruz-Trinidad (1998) use US\$600 per hectare per year as the acceptable economic equivalent to indicate what is lost if mangroves are converted to other uses.



## THREATS

Table 1.1 enumerates the various conditions that can cause damage to mangroves.

Some pests and diseases that destroy mangroves include: (1) barnacles which envelope stems of young *bakauan*, causing roots to rot; (2) tiny beetles (*Phoecilips fallax*) which attack propagules, thereby preventing them from germinating; the worm-like *Diopatra cuprea* which cause defoliation of leaves and seedlings; and crabs which girdle newly planted propagules and young seedlings.

From 1918 to 1970, an average of 3,100 hectares of mangrove were lost, increasing to 8,200 hectares from 1970 to 1985. These losses were mainly attributed to fishpond conversion.

**Table 1.1. Threats to mangroves.**

- ◆ **DIRECT (Human)**
  - Conversion of mangroves to fishponds and salt beds
  - Reclamation of mangrove areas for various developments (such as wharves, piers, airports, housing projects, etc.)
  - Pollution and siltation
  - Dikes and structures obstructing waterways and tidal inundation – this means that the tidal flow is prevented by these structures affecting nutrient distribution, salinity and temperature gradients, enhancing accumulation of biogas and other products of organic decomposition causing mangrove vegetation to die
  - Overexploitation/utilization
  - Disturbance due to gleaning, fish landing, etc.
- ◆ **INDIRECT (Natural phenomenon)**
  - Pests (diseases)
  - Typhoons
  - Sea level rise due to global warming causing polar ice cap to melt

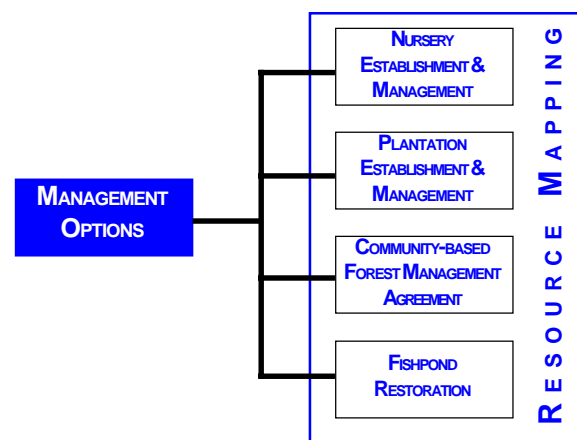
Currently, 95% of remaining mangroves are secondary growth and only 5% are old or primary mangroves mostly found in Palawan (Melana 1994). Mangrove forests remaining along Philippine coasts are of much lower quality than those found early in the century and cover less than one-third of the original area (White and Cruz-Trinidad 1998).

## PROTECTION AND MANAGEMENT STRATEGIES

Table 1.2 presents strategies for the protection and management of mangroves.

## MANAGEMENT OPTIONS

We suggest four management options for mangroves:



- ◆ **Mangrove nursery establishment and management.** Chapter 2 discusses the site selection, design, operation and management of nurseries for Philippine mangrove species. Nursery technologies ensure the availability of planting materials and the production of high quality seedlings.
- ◆ **Mangrove plantation establishment and management.** Chapter 3 provides information on developing and managing mangrove plantations and the remaining natural forest stand to maximize the benefit to the coastal ecosystem. The chapter also discusses mangrove

**Table 1.2. Mangrove protection and management strategies.****1. Assignment of users or property rights**

- ◆ Protected areas (under the Protected Area Management Board)
  - strict nature reserve
  - natural park
  - natural monument
  - wildlife sanctuary
  - protected landscapes and seascapes
  - resource reserve
  - natural biotic areas
  - other categories established by law, conventions or international agreements in which the Philippine Government is a signatory
- ◆ Contracts, permits and leases
  - Mangrove Stewardship Agreement (MSA)
  - Certificate of Stewardship Contract (CSC)
  - Community-Based Forest Management Agreement (CBFMA)
  - *Nipa* Lease Permit
  - Other Lawful Permit

**2. Regulatory techniques**

- ◆ Use of prohibitions
  - no illegal fishponds and conversion of mangroves
  - no mangrove cutting
- ◆ Utilization regulation based on affirmed resource use plan or based on use prescribed by government
- ◆ Exploitation limitations
  - close portions of mangrove areas from shell collection, boat docking, swimming, fry collection, etc.
  - compartmentalize mangrove areas to allow compatible uses in a rotation
- ◆ Enforcement of forest laws
  - needs to be coordinated and inter-/intra-participative (LGU, community, DENR and other entities)

**3. Nonregulatory techniques**

- ◆ Public education
  - seminars/workshops
  - meetings
  - video and slide shows
  - dialogues
  - publications on the importance of mangroves, alternative livelihood, sustainable development
- ◆ Training on mangrove rehabilitation and management, alternative livelihood, enterprise development, cooperatives
- ◆ Habitat enhancement/rehabilitation
  - mangrove reforestation
  - assisted natural regeneration
  - enrichment planting
  - restocking of diminishing species
- ◆ Research and monitoring
  - mangrove resource assessment
  - fishery assessment
  - growth and yield studies
  - socioeconomic profiling
  - citizen monitoring of livelihood projects
  - impact monitoring
- ◆ Community organizing
  - *bakauan* planters
  - fishers' associations
  - cooperatives
  - women's organizations
- ◆ Special and pilot projects
  - community coastal cleanup
  - waste management
  - food production
  - population control
- ◆ Alternative livelihood and other interventions
  - sea ranching/mariculture/polyculture
  - fishery
  - cottage industry
  - GO/NGO interventions (credit assistance, medical missions, etc.)

plantation objectives, plantation site identification/selection, choice of species to plant, and planning and design of the plantation. Nonregulatory techniques in Table 1.2 are especially relevant strategies in mangrove plantation planning.

- ◆ **Community-Based Forest Management Agreement (CBFMA)** is a production sharing agreement entered into between a community and the government to develop, utilize, manage and conserve a specific portion of the forestland, consistent with the principles of sustainable development pursuant to a Community Resource Management Framework (CRMF). The CRMF is a document that defines the terms and procedures for accessing, using and protecting natural resources within the CBFMA area. These terms and procedures are to be formulated by the community with the assistance of the DENR, LGU and other private entities.

Chapter 4 enumerates the benefits that the CBFMA provides to a people's organization; the steps in the CBFMA application; and the work requirements of mangrove forest stewards. It also gives information on working with *barangay* (village) councils and *Sangguniang Bayans*

(SBs) (municipal councils) for assistance in the application for a CBFMA. Details are provided on developing resolutions, ordinances and letters of support which are requisites to obtaining a CBFMA. Suggestions are put forward on obtaining financial and other support from the local municipality of the people's organization.

- ◆ **Fishpond restoration.** Chapter 5 discusses another mangrove management alternative: modifying abandoned or illegal fishponds in CBFMA areas to harvest firewood, poles, shells, fish, crabs and to provide food and shelter to crabs, shrimp, shells and fish in coastal waters. Aquasilviculture, which is the conversion of a fishpond area into a site where mangroves can grow and fish can thrive, is suggested as a fishpond restoration strategy. Steps in restoring and modifying fishponds are enumerated in the chapter.

Resource mapping (Chapter 6) can support the four management alternatives suggested. You do not have to do it all the time but in most cases it might be a good idea to resource-map your mangrove area, especially if you are doing a CBFMA.

# Aspects of Mangrove Management

*All photos by Calixto E. Yao except as indicated*



In enhancement planting, horizontal branches of old trees are pruned to create an opening to permit sunlight enough to nourish young plants.



*Bakauan bato* plantation within the Olango Bird Sanctuary, Cebu.



Traditional mudcrab traps.



Participants in a mangrove trainors training during a demonstration of bagging operation.



The Pangangan Mangrove Causeway in Bohol was planted by a student to protect the infrastructure from strong waves.

A portion of Paden's Pass, formerly Banacon Highway, Banacon Island, in Getafe, Bohol, in honor of the late Eugenio Paden, who started the most successful community-based mangrove rehabilitation in the Philippines (photo by Fer Esguerra).



Mangrove dwellers trying their luck on throw nets, Mabini, Bohol.

Dead standing *bakauan lalaki* after being enclosed with dike, an illegal fishpond, in contrast with the dense stand in the background.





*Busain (Bruguiera gymnorrhiza)* with its solitary (one per peduncle) bright red flower, Tandag, Surigao del Sur (photo by Didit Quebido).



*Pagatpat (Sonneratia alba)* and *pagatpat baye (Sonneratia ovata)*, one of the unrecorded species in the Philippines) in contrast. The former has a cup-like calyx, upturned sepals and boomerang-shaped seeds; the latter has a flat-like calyx, sepals touching the fruit and corky, granular seeds.

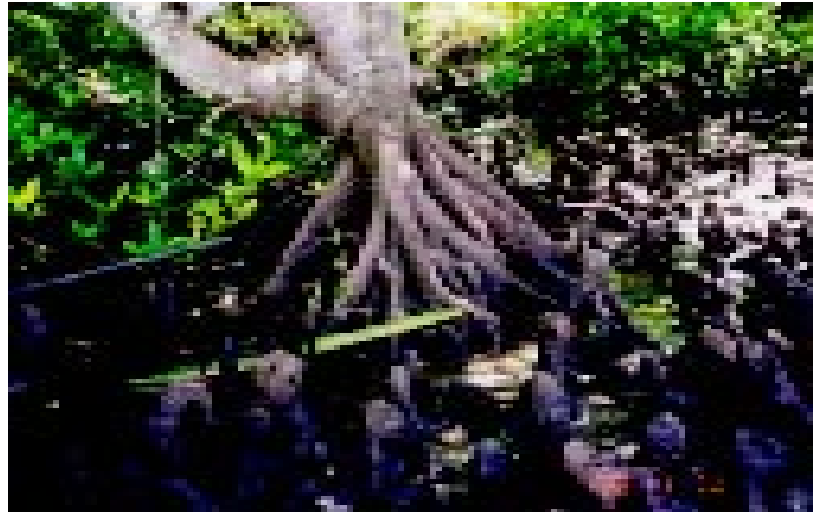


Participatory Coastal Resource Assessment mangrove site assessment, Handumon, Handayan Island, Getafe, Bohol (photo by Toni Parras).



Community in action within the CBFMA area conducting pruning before enhancement planting.

Knee roots of *pototan* (*Bruguiera sexangula*). *Busain*, *langarai*, *pototan lalaki*, *tangal* and *malatangal* are other species with the same aerial roots.



Boat load of *nipa* shingles from Cogtong Bay, Bohol for shipment to Leyte, where the cost of *nipa* is higher.

A typical mangrove nursery established by coastal barangays of Palompon, Leyte for mangrove projects, an offshoot of the training conducted by the Coastal Resource Management Project.



# Chapter 2

## Mangrove nursery establishment and management

### INTRODUCTION

**T**his chapter provides POs, COs, LGUs and NGOs with information on how to select sites, design, operate and manage mangrove nurseries. Historically, mangrove plantations have relied on natural regeneration and propagules as planting materials for their establishment. The development of nursery technologies ensures a reliable source of planting materials and helps POs minimize their reliance on the purchase of these materials from external vendors. Also, by using materials that have been started in a nursery, the PO will likely succeed. Planting mature and established plants decreases mortality at the early stages. Moreover, if a mangrove nursery is large enough it can become a source of income through the sale of mangrove planting materials to other POs and government agencies.

### What is a Mangrove Nursery?

A mangrove nursery is a place for raising and tending mangrove seedlings until they are ready for planting or for sale to other mangrove planters.

### SELECTION OF THE NURSERY SITE

Site selection is the first step in establishing a nursery. As shown in Table 2.1, poor site selection can result in a myriad of problems.

**Table 2.1. Problems resulting from poor nursery selection.**

Problem	Likely reason
High mortality due to underwatering.	No nearby water source makes watering difficult.
High mortality due to flooding.	Site placed in a floodplain, tidal range or an area subject to intense runoff from rainfall.
High mortality due to low level of care.	Site is too remote from the barangay.
Loss of plants from theft.	Site is too remote from the barangay.
High mortality due to lack of proper soil for potting.	Site is too remote from a proper source of appropriate potting soil.
High mortality due to overcrowded plants.	Site is too small for the number of plants being grown.
High mortality due to long-distance transport.	Site is not centrally located.



## General Criteria for the Selection of Nursery Site

The cost and quality of seedlings produced in a nursery depend on the efficiency of its operation. Critical to this are the nursery's water supply, its location and accessibility, the drainage and the size of its area. These are described in detail below.

**Water supply**—Locating a nursery near a brackishwater or freshwater source should be easy since mangroves are located in the coastal zone. Daily watering is a basic requirement for a nursery; thus, secure access to piped water or situate the nursery near a well. While locating the nursery close to a river is a good idea, it is necessary to keep a certain distance to avoid flooding during rainstorms or high tides.

**Central location and accessibility**—Ideally the nursery should be located close to where PO members live and close to the mangrove area. If this is not possible, find a place close to the *barangay* or one where it can be easily reached by *banca* so that seedlings can be readily transported for planting and potting soil can be brought in for seed beds and pots. The area should be open enough to ensure that the seedlings get enough light. For security reasons, it would also be wise to locate the nursery site near people's homes.

**Drainage**—Since mangroves are found in or near areas influenced by tides and subject to flooding, it is critical to select a site that drains well and is relatively flat. Proper drainage is essential because plants become waterlogged when standing water is always present and working in the area becomes difficult. Therefore, when evaluating an area as a potential nursery, the surface of the ground should be examined. If it is so moist and soft that puddles of water form, it is probably not a good site for a nursery.

**Size of area**—The size of an area is the last contributory factor in nursery efficiency. If you are forced to work in different nurseries because there is simply not enough room to have all your seedlings at one site, imagine the extra work you will have to

put in visiting each nursery on a daily basis. As a general rule of thumb, about 325 square meters is needed for seed bed. (This assumes 10,000 seedlings per hectare with about 20 percent allowance for mortality.) Add another 100 to 200 square meters for work space—potting, laying seed beds and other activities.

As a general rule, a PO needs 325 square meters of space for every hectare it intends to plant, plus another 100 to 200 square meters for work area.

## Types of Nurseries

**Permanent** nurseries are for mangrove planting over an extended period of time. They tend to have more developed working areas with small sheds to provide shelter from the sun and the rain.

**Subsidiary** nurseries are designed for areas located at a distance from the permanent nursery, or for areas separated from the permanent nursery by such natural features as large rivers, bays or rough water that make it difficult to move the seedlings (risking damage during transport). Subsidiary nurseries may operate for several years as in permanent nursery.

**Temporary** nurseries are generally set up where there is a small planting area (typically less than 5 hectares) which could be planted over a one-year period. These nurseries are not nearly as elaborate as permanent or subsidiary nurseries.

## DESIGNING AND BUILDING THE NURSERY

After selecting a nursery site, you should think about the design. There are several steps in this process:

- ◆ Identify who will work on the nursery project
- ◆ Determine the boundary and area of the nursery
- ◆ Develop a plan for the nursery
- ◆ Build the nursery

## Identifying Who Will Work on the Nursery Project

Identifying who will work on the nursery project is crucial to a community-based effort; yet, this step is often overlooked. The PO must decide who will be responsible for all the phases of the project. While it is possible for only one or two people to identify the nursery site, as many as ten or more will be needed to design and build it. The CO should remind the PO officers to meet so the group can discuss who will be responsible for these important tasks.

***PO officers should publicly acknowledge the individuals who identified the site and use that as an opportunity to request volunteers for the next step—designing and building the nursery.***

## Determining the Boundary and Area of the Nursery

Once your PO has determined the general location of the nursery area, you need to determine its boundary and area. Develop a sketch map showing the boundary of the nursery area, including the lengths of its dimensions.

The sketch map need not be a polished map. Rather, it only needs to present basic information about the shape of the area and the approximate lengths of each of its sides. (Chapter 6, *Resource Mapping of Mangroves*, provides information on how to prepare a sketch map.) As much as possible, lay out the nursery as a square or rectangle. After completing the map, determine if the area is large enough to support the nursery management activities. Since the shape of the site will not likely be a perfect square or rectangle, it may be necessary to estimate the distances with simple arithmetic to gauge the area size as illustrated in Table 2.2.

## Developing a Plan for the Nursery

Designing the nursery is vital to success. Instead of placing potting soil in one place, seed beds in another,

**Table 2.2. Formulas to determine nursery areas.**

Shape of area	Likely reason
Square	Multiply length of two equal sides.
Rectangle	Multiply length of longest side by length of shortest side.

and so on, carefully consider what goes where. The group in charge of nursery activities should do this planning exercise. Developed as part of locating the nursery, the sketch map in Figure 3.1 is a useful planning tool.

First, determine where the seedlings will be loaded for field planting. Questions that need to be resolved include:

- ♦ Will they be taken to the planting area by truck or *banca*?
- ♦ Is there a place in the nursery area which people think will be most convenient for loading seedlings?

### ***Is Our Nursery Area Big Enough?***

***The calculation to answer that question is fairly simple. First, determine how many hectares of plantation your PO expects to put in every year. Next, multiply that number by 325 and add 100 (or 200). The total is the area requirement for the nursery.***

***Example: If you intend to plant 10 hectares per year, then  $(325 \times 10) + 100 = 3,350$  square meters is the minimum area to meet the seedling requirement. A larger area is better than a smaller one. If the site is too small, then:***

- ♦ ***An area of sufficient size will have to be found;***
- ♦ ***An additional area will need to be identified and two nurseries established; or***
- ♦ ***Reduce target area for annual planting.***

The location of the loading area determines where to place the hardening beds. Figure 2.1 shows a sample diagram of a nursery which is just one of the many ways to design a site.

### ***Why is the Location of the Hardening Bed so Important?***

***In order to answer that question, ask another: Which is heavier, the tongki or the seedling? Seedlings weigh around 500 grams, considerably heavier than the seeds or tongki. Remember, in the beginning planting will involve thousands of seedlings (1,000 seedlings weigh around 500 kilograms). That is ample reason to situate the hardening beds near the seedling loading area.***

To begin planning, basic nursery components must be understood. These include:

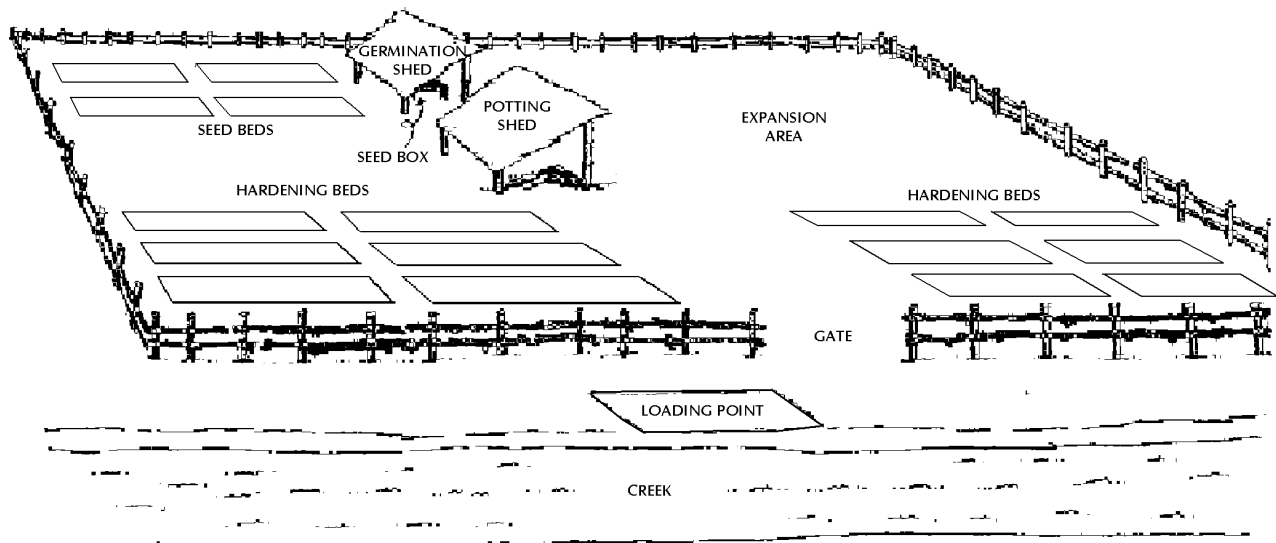
- ♦ Seed germination beds
  - ♦ Seed box
  - ♦ Germinating shed
  - ♦ Potting shed
  - ♦ Bagging and storage shed
- ♦ Potting soil and sawdust stockpiles
  - ♦ Compost beds
  - ♦ Seedling hardening beds

### **Building the Nursery**

Building the nursery will probably require more people than there are in the committee. Because everyone will benefit from the nursery, it is suggested that this be a task for the entire PO. Not everyone, however, is required to take part in the actual construction. Other important activities include:

- ♦ Buying or obtaining the necessary materials
- ♦ Transporting materials or workers to the site
- ♦ Buying or lending tools (shovels, hammers, bolos, etc.) needed to build and operate the nursery
- ♦ Preparing lunch for those working on the nursery
- ♦ Helping those working on the nursery in their full-time job

**Site preparation**—If possible, the nursery site should be an open area to avoid the cutting of trees. Should cutting be necessary, extra care should be exercised in trimming branches to let in more sunlight.



***Figure 2.1. A typical nursery layout.***

It is not essential to clear all the trees and shrubs; they can be used to shade some areas of the nursery, and leaves and twigs from removed vegetation can be used to start the compost beds. Be sure to remove all stumps and pull up all grasses including the roots to prevent regrowth.

After being cleared, the site should be leveled. This can be accomplished by cutting through the area and breaking up any lumps of dirt. After cutting, the low and high areas should be leveled by digging the high levels and putting the soil in the low spots. Excess soil can be stockpiled at the potting soil area.

Once clearing and leveling have been completed, the nursery should be laid out using the prepared map. With twine and a measuring tape or rope, determine the lengths and widths of the various parts of the nursery, stake out each of the nursery component areas and begin construction.

**Seed germination beds**—These 1 x 10 meter beds are raised slightly (5 to 10 centimeters) above the level of the surrounding area by adding potting soil to each bed or by digging out the soil from the 40-centimeter wide area immediately next to the beds. Keep the soil from spreading by lining each bed with a wood or bamboo curb. If boards are used, dig a 2- to 3-centimeter groove around the bed and slot the board in. If bamboo is used, a similar (though wider) depression should be dug. A line of concrete blocks (only one block high) makes an excellent curb, but tends to be expensive.

**Seed boxes**—A number of seed boxes will be needed if you choose to grow trees from the *pagatpat* group. Materials include:

- ◆ Boards 1 centimeter thick, 10 centimeters wide and at least 2 meters long
- ◆ Plywood (at least 1 centimeter thick) for the box base
- ◆ Nails

Assuming that the seed boxes will be 30 x 35 centimeters, the boards and plywood should be cut accordingly and nailed together. Drill a series of small holes between 0.3 and 0.7 centimeters every 5 centimeters

in the plywood base to allow water to drain. Fill the boxes with three different layers of sand and stones: fill the bottom 5 centimeters with small stones (less than 1.5 centimeters), the next 3 centimeters with coarse sand and the top 2 centimeters with fine sand mixed with compost and/or potting soil.

**Germinating shed**—The germinating shed is more like a simple roof with no walls than a shed. Roughly 3 x 5 meters in area, it is constructed by simply putting in four pieces of bamboo with a woven *cogon* grass roof. Under this roof is a simple bamboo table for the seed boxes. Place the legs of the table in cans filled with water to prevent ants and other crawling insects from reaching the seedlings.

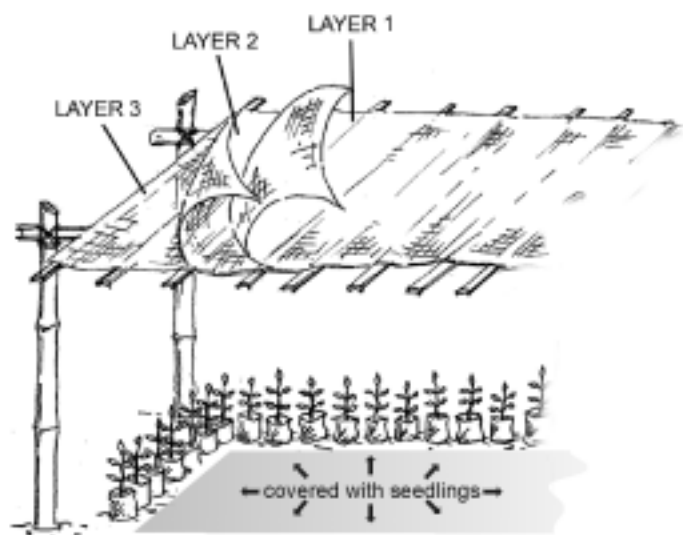
**Potting sheds**—Potting sheds can be made out of *nipa*. Typically not smaller than 3 x 4 meters in area (and maybe twice that), they are built with three walls; and instead of a door, a fourth wall is kept open. Depending on the wishes of the nursery workers, a bamboo table for potting can be built although potting is typically done on the floor.

**Bagging and storage sheds**—These sheltering and storage sheds, which are also made with *nipa*, are similarly constructed. Since they can be used to store nursery tools, these sheds could be enclosed and locked.

**Potting soil and river sand**—The potting soil pile should be at least 5 cubic meters in volume and the river sand pile at least 1 cubic meter. To protect the material from rain, stage both piles under a roof similar to that built for the germinating shed. These materials may be brought in by truck and should be staged close to the bagging shed.

**Compost piles**—Compost piles should also be placed under a roof. Be sure that they are of sufficient size to provide enough mulch for the nursery.

**Seedling/hardening beds**—Unlike germination beds, hardening beds need not be raised. Figure 2.2 is an example of a hardening bed. Hardening beds require a temporary roof with several layers of covering (coconut leaves or *nipa* shingles) but typically mesh nets gauge 14 to control the amount of light reaching the



**Figure 2.2. Hardening bed.**

seedlings. These beds are 20 to 30 meters long and 1 meter wide; bamboo poles can be used to support the roof. The roof should be at least 1.5 meters above the ground to allow easy access to the seedlings. Usually the top layer of the roof is *nipa* followed by *wagon* grass on top of a fine mesh net. This enables nursery workers to remove a single layer and allows more light to reach the plants over time.

### **Useful Nursery Tools**

**Hammer, saw, bolo, hoe, shovel, small shovel, rake, watering cans or boxes, wheel barrow, pick mattock, spading fork**

## **OPERATING AND MANAGING THE NURSERY**

Once nursery construction is completed, organize shifts to operate and manage the nursery on a daily basis. This requires PO members to assume responsibility for managing the nursery. Typically it takes 4 to 6 months to grow out seedlings to the point where they can be transplanted. This is a rather extended commitment but it need not be a full-time job if there are several people willing to work in the nursery.

The group responsible for finding a site for the nursery and for setting it up may not like the day-to-day management of the nursery. If that is the case, PO officers should call a meeting to determine who is interested in working in the nursery. Again, organizing a committee to run the nursery is the best approach. (This committee should consist of at least five people to make the management less work.)

### **What Are the Daily Activities at a Nursery?**

**Seedlings must be watered twice a day at the early stage. Later, watering can be done once daily towards the outplanting season (4 to 6 months old) to acclimatize seedlings. This activity is very important and must be done religiously. Otherwise, the seedlings may dehydrate. For a nursery with 50,000 seedlings, this requires one person watering 2 to 3 hours per day.**

**At least five hundred 4 x 6 inch bags can be filled with potting soil by a single worker every day (assuming all the potting materials are ready).**

**The transfer of seedlings from seed boxes/seed beds to plastic bags: Depending on the size of seedlings a laborer can pot 600-1,000 seedlings in an 8-hour day.**

During the meeting, explain the daily work schedule, i.e., estimate how long the work will take. The CO should work with the PO officers to decide on a schedule and activities.

Emphasize that all of the PO members are responsible for harvesting seeds and propagules, and for transporting and planting seedlings. Remember that a nursery can become a viable livelihood on its own. Potting soil is also a source of income.

While running a nursery is not commonly thought of as a typical livelihood, it can be a moneymaking proposition for those involved. As described in detail below, the typical activities that make up nursery operations are:

- ♦ Collecting and transporting seeds and propagules
- ♦ Propagation practices
- ♦ Maintenance of the seedlings
- ♦ Preparation for planting

## Collecting and Transporting Seeds and Propagules

A proper supply of mangrove seeds and propagules is one of the major obstacles to mangrove reforestation in the country, especially for less common species such as *pototan* and *bakauan babae*, *busain*, *tangal* and *tabigi*. This may be one of the main reasons why the monoculture plantation of *bakauan bato* is so common in Central Visayas. Another problem is the large numbers of seedlings needed to establish plantations. Upland forest plantations typically have 2,000 seedlings per hectare. Mangrove plantations range from 10,000 to 40,000 seedlings per hectare (assuming a spacing of 1 x 1 meter to 0.5 x 0.5 meter respectively).

**Timing of collection**—Collecting propagules and seeds at the right time is critical. While collection is possible from some mangrove species almost every month of the year, peak seasons vary by area and date. Knowing when to collect the seed or propagule also makes the operation quicker and more efficient. Table 2.3 shows the approximate time of the fruiting season for the major mangrove species on a province-wide level. The information will not be exactly the same in each area, but this should provide a good idea of the

### A Nursery as Livelihood

***Some people in the PO may challenge the idea that a mangrove nursery can become a livelihood. It certainly can. DENR is actively planting mangroves or assisting LGUs and other organizations in planting mangroves by providing them with planting material—tongki or seedlings. If a nursery has sufficient capacity to cover the needs of a plantation, it is possible to sell the excess capacity to DENR or to other POs who do not want to develop a nursery. Make certain you have a market before investing a lot in growing additional seedlings.***

general time to expect to find mature seeds and propagules.

Seeds or propagules are not always available. In those cases, wildlings (young saplings less than 30 centimeters tall) may be used as planting material. Wildlings are collected by balling with a spade. For a 10-centimeter wildling, the diameter of the excavation should be approximately 10 centimeters. For a 20-centimeter wildling, 20 centimeters; for a 30-centimeter wildling, 30 centimeters. Insert the blade of the spade into the soil at the appropriate distance from the wildling, lift up the chunk of soil containing the wildling and gently wrap mud around the root ball (this is known as mud paddling). Place the wildlings in folded banana leaf sheets (in groups of 50 or 100 for easy counting) for transportation to the nursery and immediate potting.

### Hint

***When collecting wildlings, always make certain that each one has 2 to 4 leaves (for species that grow from propagules (tongki). For other species, the seedling should be from 4 to 6 centimeters in height. This ensures the wildling is strong enough to transplant. Also, be certain that sufficient potting bags are available; wildlings will die if not potted quickly.***

The main characteristics of good quality seeds and propagules are:

- ♦ The material is of average to superior size.
- ♦ They are free from defects and insect infestation.
- ♦ They are fully mature.
- ♦ They are fresh, without developed roots.

Selecting seeds and propagules with all of these characteristics ensures a high rate of germination.

**Identifying mature seeds and propagules**—In many cases, hundreds or thousands of seeds are wasted because they are collected while still immature. This wastes the time of the collectors and nursery operators and can reduce the overall success rate of the plantation. It is important, therefore, to select seeds and propagules

**Table 2.3. Best collection times for selected mangrove species (adapted from Palis et al. 1998).**

Species	Climate Type* 1	Climate Type 2	Climate Type 3	Climate Type 4
<i>Bakauan bato</i>	Jan & May	Feb-Jul	Feb, Apr, May	Jan & Feb
<i>Bakauan babae</i>	Oct-Dec	Jan-Aug	Apr-Jun	Jan & Feb
<i>Bakauan lalaki</i>	Aug & Sep	Feb & Mar; Apr-Jun	Mar & Apr	Jan & Mar; May & Jun
<i>Tangal</i>	May	Jan & Feb; May	May; Nov & Dec	**
<i>Busain</i>	Jan; Oct-Dec	Jan & Feb; May-Jul	Feb & May	May-Aug
<i>Pototan lalaki</i>	Jan-May; Oct	May	Apr-Jun	**
<i>Api-api</i>	Jan-Feb; May & Jul	Jan & Feb; Jun-Aug	**	Aug
<i>Bungalon</i>	Apr, Jul; Nov & Dec	Jan; May-Oct	Jan & Mar	Jan-Oct
<i>Pagatpat</i>	Aug-Nov	Jan	Feb-May; Jul	Mar
<i>Tabigi</i>	Aug-Nov	Jan-Aug	Jan-Apr	Mar

\*Climate type refers to rainfall pattern. Type 1—Two pronounced seasons; dry from November to April, wet all other times. Type 2—No dry season. Very pronounced rainfall in November. Type 3—No pronounced wet or dry season, but relatively dry from November to April. Type 4—Rainfall distributed more or less evenly throughout the year.

\*\*Species not identified in this climate type.

that are ready to grow. Signs and indicators of mature fruits/propagules are as follows:

- ◆ All trees from the *bakauan* and *tangal* groups exhibit a whitish to yellowish ring-like mark on the propagule located 1 to 3 centimeters from the top of the pericarp (where it attached to the mother tree). The ring is absent or very thin in propagules that are not yet ripe. The wider the ring, which can be up to 5 centimeters, the more mature is the propagule.
- ◆ Another indicator of maturity is color. The propagules turn from green to brown as they mature.
- ◆ The *busain* and *pototan* groups do not exhibit the ring noted above, but immature green propagules turn brownish or bronze as they mature. Mature propagules drop together with the pericarp or fruit, unlike the *bakauan* and *tangal* groups whose propagules drop without the pericarp.
- ◆ In the *pagatpat* group, the fruit will turn shiny yellowish to light green and soft when ripe.
- ◆ In the *tabigi* group, the light green globular fruit turns light brown with the lines on the fruit becoming prominent.
- ◆ *Dungon* seeds turn from green to dark brown.

**Methods of sorting and transporting seeds and propagules**—Successfully collecting the material is only half the battle. Transporting the collected seeds and propagules can be very difficult when handling big volumes over long distances. Sorting of propagules is the first stage in the transport process. Carefully inspect your material to see if it is:

- ◆ Mature
- ◆ Healthy
- ◆ Free of insect infestation and physical injury

With larger fruits and propagules, inspect each one to determine if it should be included in the shipment. In the case of small seeds, it is harder but less important to do this because the small seeds are generally much larger in number.

The next stage is the packing of the seeds or propagules. Larger materials (e.g., the *tongki* or *bakauan* propagules), can be packed in bundles of 50 or 100. Bundles made out of palm or banana leaves should be kept moist. Small seeds should be transported in bags with a moist cloth placed on top of each bag. Be sure to keep the cloth moist throughout the trip and do not expose the materials to direct sunlight, as this will cause damage. Wildlings, like the propagules, should also be

**Table 2.4. Indicators of maturity for some species of mangrove fruit (adapted from Field 1996).**

Mangrove species	Seeds (S) or propagules (P)	Maturity indicator
<i>Saging-saging</i>	P	Fruits become lightly yellowish to reddish brown upon maturity
<i>Api-api, piapi, bungalon</i> and <i>bungalon puti</i>	P	Seed coat changes from green to light yellow. Seed coat becomes wrinkly and oftentimes opens
<i>Busain, pototan</i> and <i>pototan lalaki</i>	P	Tip of the hypocotyl changes from green to brown
<i>Tangal</i>	P	Ring-like mark immediately below the cap of the propagule and yellow line approximately 1 to 2 centimeters from top of propagule
<i>Nipa</i>	S	Seeds change from light brown to dark brown upon maturity and turns lustrous to dull
<i>Tabigi</i>	S	Fruit changes from light brown to dark brown upon maturity
<i>Bakauan</i> and <i>tangal</i> group	P	Presence of ring-like mark (abscission layer) below the pericarp or cap (up to 1 centimeter wide)
<i>Busain</i> group	P	No ring-like mark; green propagule turns brownish/bronze and drops without the pericarp or cap
<i>Pagatpat</i>	S	Dark green or yellowish fruits sometimes with cracks
<i>Pagatpat baye</i> and <i>pedada</i>	S	Fruits turn shiny or yellowish and soft
<i>Tabigi</i> group	S	Green fruits turn to brown with compartment becoming prominent

packed in groups of 50 or 100 in a folded banana leaf, palm sheet, or gunny sack to protect plants from the sun while in transit.

If you are transporting the materials by pump boat it is easy to keep them moist. Pour sea water over them two or three times a day (more if they are in direct sunlight). If the boat is open, protect the shipment with a tarp or some coconut fronds. Do the same if you are

### ***Protect Your Investment!***

***Remember that a lot of effort and potential earnings are tied up in these seeds, propagules and seedlings. Protect them from drying out or getting burned by the sun. Without protection, the seeds and propagules will die; this directly affects PO plantation earnings.***

transporting the material by truck. Avoid placing the propagules or seeds in direct sunlight.

Upon returning to the nursery, the seeds and propagules must be prepared for planting or storage. Allow small seeds to air-dry somewhat prior to storing. Then place the seeds in polyethylene plastic bags, seal the bags and store them at room temperature. Propagules may be kept under shade for as long as 2 weeks without adversely affecting their viability. Avoid placing them on the ground or any moist surface to inhibit root development.

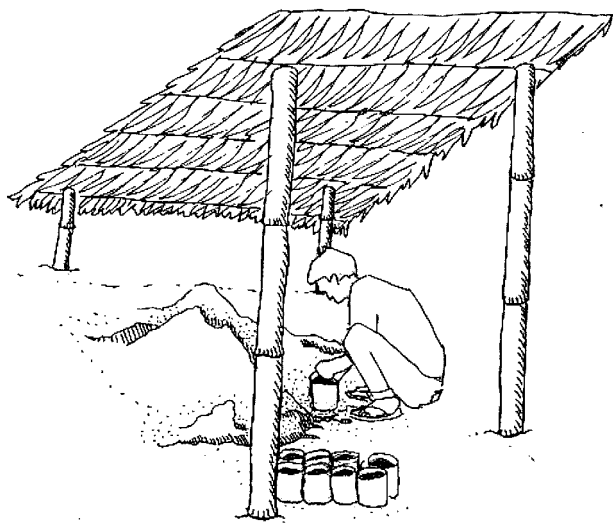
### **Propagation Practices**

Propagation practices include the following activities needed to germinate seeds and propagules and produce seedlings:



- ◆ Preparation of potting soil
- ◆ Germination techniques
- ◆ Potting
- ◆ Hardening

**Preparation of potting soil**—The growth of seedlings in the nursery significantly depends on the quality of the potting soil. Fast root development is enhanced when the potting soil is porous. If possible, use sandy-loam soil that is high in organic matter or compost mixed with cured sawdust or rice stalks (*dagam*). Pulverize and then screen these materials and thoroughly mix the soil and organic matter (a 50:50 ratio is best). Potting soil should always be prepared in advance to avoid unnecessary delays in potting which can result in high seedling mortality, especially for wildlings. Thus, it is a good idea to prepare potting soil of several cubic meters and have it on hand at all times. Figure 2.3 shows a person filling bags for potting.

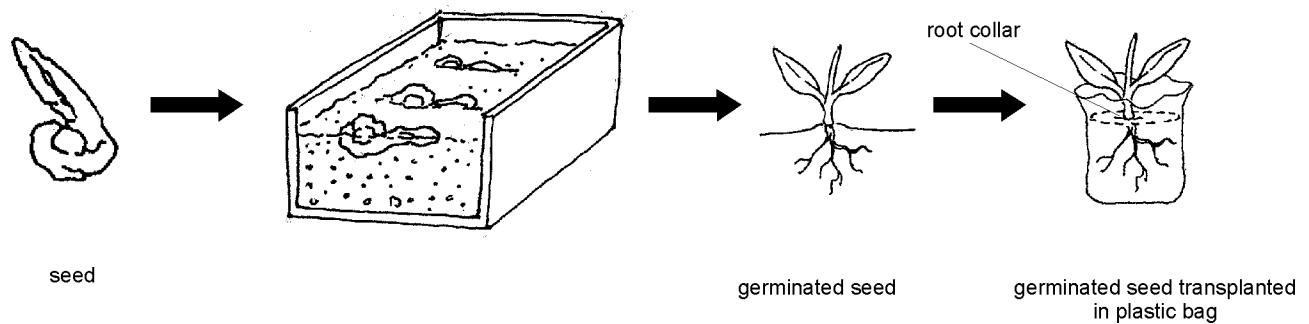


**Figure 2.3. Soil bagging under a shed.**

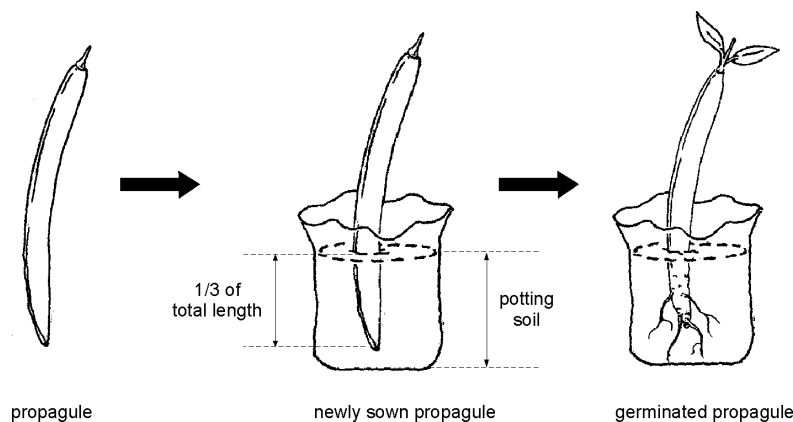
**Germination techniques**—Mangrove plantations in the Philippines have tended to be monocultures of *bakauan* not only because of the absence of germination information for other species but also because many of the areas available for planting are open mudflats (which are much better suited to the *bakauan* species). Below are brief discussions on how to germinate some of the major groups. Figures 2.4 and 2.5 provide some examples of planting depth for selected species.

- ◆ *Bakauan, tangal* and *busain* groups—These groups all have viviparous seeds or propagules that are sown or planted directly in the field and have a high survival rate in areas not exposed to strong waves. In cases where there is a need for nursery raised seedling (e.g., an area with unstable substrate), the species may be germinated in a plastic bag. Table 2.5 provides the appropriate size for bagging each species.
- ◆ *Pagatpat* group (*pagatpat* and *pedada*)—*Pagatpat* has a big potential for reforestation due to its wide range of habitat from the seaward side and high salinity to the landward portion. The boomerang-shape seeds of the *pagatpat* are planted or sown in a seed box with sandy soil. Seeds are then covered with a thin layer of soil and watered daily with brackish water. For early and uniform germination, soak the fruit in fresh water for 7 days and sow the macerated seeds in depressed seed beds.
- ◆ *Api-api* group (*api-api, piapi, bungalon* and *bungalon puti*)—This group is considered semi-viviparous because of its emerging radicle and split seed coat while still attached to the mother tree. It is the easiest to germinate, either in seed beds or directly in bags. Seeds are sown in an upright position half buried with the emerging leaf or the cracked portion of the seed at ground level. For higher germination rates, use seed beds made of sawdust. Once the seedlings develop a pair of leaves they can be handpicked for potting.
- ◆ *Tabigi* group—POs often favor *tabigi* because of its valuable wood. Its big angular seeds are germinated in seed beds or potted directly. As in the *api-api* and *saging-saging* groups, the seeds are sown halfway with the embryo eye just at the soil surface.

**Potting**—Potting is the transfer of germinants/seedlings from seed box/bed to the plastic bag or pot where it is hardened before planting in the field. Table 2.5 shows the different sizes of plastic bags for the different species. Potting is done by pricking the germinants using a flattened stake to minimize root



**Figure 2.4. Germination of small to medium-size seeds.**



**Figure 2.5. Germination of bakauan species (and other propagules) directly sown in plastic bag.**

damage. The seedling is then planted in the bag with the root collar level with the surface of the soil in the bag. Propagules are sown about 1/3 of the length of the hypocotyl deep in an appropriately sized bag (see Table 2.5 for suggested bag sizes.)

In the absence of seeds, wildlings may be used and hardened following the same potting and seedling procedure. When potting wildlings, take extra care not to damage the root system.

### Maintenance of the Seedlings

Seedling quality in the nursery will depend on care and maintenance. This includes:

- ◆ Watering
- ◆ Shading
- ◆ Weeding

**Table 2.5. Bag sizes for various species (Sinohin et al. 1996).**

Species	Bag size (inches)
<i>Bakauan babae</i>	8 x 12
<i>Bakauan lalaki</i> and <i>bangkau</i>	6 x 10
<i>Talisay</i>	6 x 10
<i>Dungon-lati</i>	6 x 10
<i>Api-api</i> family	6 x 10
<i>Tangal</i>	6 x 8
<i>Malatangal</i>	4 x 6
<i>Saging-saging</i>	4 x 6
<i>Pototan lalaki</i>	4 x 6
<i>Kulasi</i>	4 x 6
<i>Nilad</i>	4 x 6

**Table 2.6. Typical hardening treatment.**

Treatment	No. of weeks			
	1	2	3	4
Sunlight reduction	Removed 1st layer (about 25%)	Removed 2nd layer (about 50%)	Removed 3rd layer (about 75%)	No more shading
Reduction of watering frequency	Once a day	Once every 2 days	Once every 3 days	No more watering

- ◆ Protection from pests, diseases and stray animals
- ◆ Records management

**Watering**—Seeds and seedlings must be watered daily. Prior to placing in hardening beds, use tap water or brackish water. For hardened seedlings, brackish water must be used in order to acclimatize them to the field environment. Wells may be dug if the river is far or when no river is available.

The plants should be watered as early as possible every morning. It is important that this be done every day since failure to water even for one day can adversely affect the growth rate and survival of the plants. (Watering is not required for plants exposed to rain.)

**Shading**—The newly potted seedling should be shaded from intense sunlight. Shading material usually consists of coconut leaves and wire mesh to gradually expose the seedling in the hardening process.

**Weeding**—Weeding should be conducted regularly to keep the seedlings free from competition. At least once a week check all seed boxes, seed beds and hardening beds for other plants that might have sprouted. Anything that is not the plant you sowed should be removed from the soil and put in the compost pile. Remember, too, that since weeds are often blown by the wind, regular weeding of the nursery is a must.

**Hardening**—Hardening is the process of preconditioning seedlings in a nursery to the harsh field environment by gradually exposing the plants to

increasing amounts of sunlight. This should be continued until the seedlings are fully exposed to sunlight before planting. Watering is likewise reduced. Select only the larger hardy seedlings for planting. (Smaller seedlings may either be sorted for special care to salvage them or simply discarded.) After sorting, the seedling must be properly packaged in baskets or seedling boxes/trays. Arrange the seedlings so that there is no unnecessary movement during transport. Table 2.6 shows a typical hardening treatment.

**Protection from pests, diseases and stray animals**—Conduct daily inspections for insect pests. Table 2.7 shows insects (#1-6) and diseases (#7-8) that may harm the seedlings and the corresponding control measures. Like weeds, any insects on the plants should be removed. In areas with stray animals, fence the nursery with local materials such as bamboo poles.

A solution of detergent and hot chili pepper is suggested for pests #3-5 (aphid, scale, slug caterpillar) and or leaf spot and *bakauan* mosaic diseases.

**Records management**—Nursery activities do not end with the delivery of seedlings. Specific batches prepared by the nursery should be monitored in the field to determine growth performance and survival rate. This is especially important for a new species from a particular mother tree/seed area. Such information is necessary to establish a record of that species for future seed collection. A typical species nursery record is shown in Table 2.8.

**Table 2.7. Damage and control measures for common pests and diseases found in mangrove nurseries (Sinohin et al. 1996).**

Pest/Disease	Damage	Control measures
1. Tussock moth (All species)	Larvae or hairy caterpillar feeds on leaves of young seedlings	Manual removal of larvae
2. Seed borer (All species)	Bores propagules and breeds on seedling/hypocotyl	Exclusion of propagules with evidence of insects or holes Air-drying of propagules to reduce moisture content before germinating
3. Aphids (All species)	Sucks nutrients of <i>bakauan</i> seedlings	Spraying with chemical at company's specification
4. Scale insect (All species)	Sucks nutrients causing curling of leaves	Spraying with chemical at company's specification
5. Slug caterpillar (All species)	Defoliation	Manual removal of larvae
6. Bagworm (All species)	Defoliation	Manual removal of bagworm
7. Leaf spot ( <i>Nilad, bakauan</i> )	Brown spot interferes with photosynthesis; defoliation if severe	Removal of infected leaves and burning
8. <i>Bakauan</i> mosaic (All <i>bakauan</i> )	Defoliation; interferes with photosynthesis	Removal of infected seedlings and burning

**Table 2.8. Data that should be collected during nursery operations.**

Species	Provenance	Date collected	Date sown	Percentage germination	Date planted	Percent survival	Remarks
<i>Bakauan babae</i>	Banacon, Getafe, Bohol	July 15, 1999	July 25, 1999	98	Oct. 1997	95	As of Jan. 30, 2000
<i>Bakauan lalaki</i>	Bais City, Negros Or.	Aug. 1, 1999	Aug. 7, 1999	100	Nov. 1999	96	As of Feb. 28, 2000
<i>Pagatpat</i>	San Fernando, Cebu	Jan. 15, 2000	Jan. 21, 2000	92	Jun. 15, 2000		Percent survival shall be assessed after 3 months

Note: The sample entries on the above table are hypothetical and do not necessarily reflect actual nursery operations.

## Grading, Sorting, Packaging and Transport of Seedlings

After hardening, the seedlings should be graded using certain criteria. Normally, the criterion is height to at least 30 centimeters from the root collar for seedlings from seeds and from the ring-like marks for propagules. Those that pass the grading criterion should be sorted according to height before packaging and transport to the planting area.

When all plantable seedlings are out on the field, the remaining seedlings that do not meet the grading criteria

should be reared further in the nursery until the desired size is met. The seedling shall be subjected again to the hardening process before outplanting.

## Post Nursery Operations

When all the seedlings are already sent out, the nursery should be prepared for the next batch of seedlings. Some repair of the infrastructure and retooling of equipment may be necessary. Likewise, cleaning and sanitation of the nursery should be done to prevent infestation of the incoming seedlings.

# Chapter 3

## Mangrove plantation establishment and management

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### INTRODUCTION

Recently, interest in establishing and maintaining mangrove plantations and in managing natural mangrove forests has increased as people realize the many valuable economic benefits available from these forests. They realize that, in addition to the valuable wood, mangroves provide protection to coastlines by breaking the waves during strong storms, protect seagrass beds and coral reefs from siltation and serve as a food source and nursery for a number of important fish species. All of these can benefit the people especially the coastal dwellers.

This chapter provides POs, COs and NGOs with information on developing and managing mangrove plantations and (natural stand) forests. Historically, mangrove plantations have been relatively small and consisted of one species of *bakauan*. This toolkit advocates planting multiple species, sometimes in pure stands, sometimes in mixed stands, depending on the needs of the PO and the site. In addition, information is provided on how to manage the remaining natural forest stand to maximize the benefit to the coastal ecosystem. We strongly urge POs to consider developing several plantations as their area permits to increase wood, fodder, detritus production, and the protection of shoreline, seagrasses and corals. This chapter was developed from several publications on plantation management written in the Philippines and abroad (Watson 1928; Hamilton and Snedaker 1984; PCARRD 1991; CV-CIRRD 1993; Vande Vusse 1993; Agaloos 1994; Yao 1994, 1997; Chan 1996; ERDS 1996; Field 1996; Hong 1996; Melana and Gonzales 1996; Padron 1996; Qureshi 1996; Saenger 1996; Siddiqi and Khan 1996; Tomlinson 1996; Melana 1998). It also incorporates information from the field.

## IDENTIFYING THE PLANTATION MANAGEMENT OBJECTIVES

In establishing any plantation it is important to have well-defined management objectives. In a successful plantation, operation and management reflect the objectives of the PO. Thus, the choices the PO makes about spacing, species and specific silvicultural (tree growing) practices depend on the objectives of the plantation.

Common mangrove plantation objectives/perceived benefits include:

- Firewood/charcoal
- Posts and piles
- Tanbark
- Thatching materials production
- Shoreline protection/productivity of nearby coastal waters
- Timber production

In order for your PO to identify a site and establish, operate and manage the plantation(s), ask yourselves a series of questions:

- Is the area in question for plantation establishment or for enhancement planting?
- If the area is for plantation development, is it for production or forest protection?
- What kinds of production?
  - Firewood or charcoal?
  - Posts?
  - Piles?
  - Tanbark (for *tuba* or other uses)?
  - *Nipa* production?
  - Other uses?
- If for protection, what is the plantation “protecting”?
  - Shoreline or road stabilization?
  - Sediment trapping?
  - Natural fish production?

Depending on the answers to these questions, your PO can decide how to proceed. Next, determine: (1) where to locate the plantation, (2) which species to plant

and (3) plantation planning and design.

## PLANTATION ESTABLISHMENT

### Site Identification and Selection

One of the major reasons of plantation failure is improper siting. Some people believe that all open areas, mudflats and seagrass beds can be turned into mangrove forest plantations, especially for *bakauan*. But this is not true. A number of factors must be considered in selecting an area for plantation. Table 3.1 shows examples of the typical zonation pattern with suggestions for which species should be planted. Site selection is based primarily on these important factors:

- Type of substrate
- Current species present
- Presence or absence of seagrass
- Tidal height
- Extent of wave action
- Presence or absence of pests
- Historical users of the area

**Type of substrate**—The substrate is an important controlling factor in selecting an area for plantation development. In evaluating the substrate, it is important to realize the limitations that it sets in selecting an area for planting. (Substrates do not always fall into the distinct categories listed below; it can be a combination of two or more types.) Substrates that support mangrove species include:

1. *Mud*—This is best characterized as a soft sediment composed of a combination of organic and inorganic material. It may be as shallow as 2-3 centimeters or as deep as a few meters. A very shallow mud substrate is not recommended for a wood production plantation. In general, mud is a good substrate to plant:

- *Bakauan babae*
- *Bakauan lalaki*
- *Busain*
- *Tangal*

Some mud may have a foul smell similar to rot-

**Table 3.1. Typical zonation pattern of mangrove species and common names (after Agaloos 1994).**

Zone	Tidal regime	Soil types	Species and common names	Good species for planting
Seaward	Daily, including neap tides	Coral rubble, sandy, sandy loam	<i>Avicennia marina</i> (bungalon); <i>Sonneratia alba</i> (pagatpat); <i>Rhizophora stylosa</i> (bakauan bato); <i>R. apiculata</i> (bakauan lalaki)	<i>Rhizophora stylosa</i> (coral rubble or sand); <i>Rhizophora apiculata</i> (sandy loam, silty)
Middle	Daily, except during neap tides	Silty to silty clay	<i>Avicennia alba</i> (bungalon puti); <i>A. officinalis</i> (api-api); <i>Rhizophora apiculata</i> (bakauan lalaki); <i>R. mucronata</i> (bakauan babae); <i>Aegiceras floridum</i> (saging-saging); <i>A. corniculatum</i> (busain); <i>Bruguiera cylindrica</i> (pototan lalaki); <i>Bruguiera gymnorhiza</i> (busain)	
Landward	Inundated only during spring tides	Silty to silty-clay to clay	<i>B. sexangula</i> (pototan); <i>Ceriops tagal</i> (tagal); <i>C. decandra</i> (malatagal); <i>Excoecaria agallocha</i> (buta-buta); <i>Lumnitzera racemosa</i> (kulasi); <i>Nypa fruticans</i> (nipa)	<i>Ceriops tagal</i> (silty to silty clay)  <i>Nypa fruticans</i> (silty to silty clay, only where there is fresh water intrusion)
Riverine: (Rivermouth and upstream forebank/backbank)	Variable inundation brackish/freshwater influence	Sandy to silty clay	Rivermouth: <i>Avicennia marina</i> ; <i>A. officinalis</i> ; <i>Aegiceras floridum</i> (saging-saging); <i>A. corniculatum</i> ; <i>Rhizophora mucronata</i> ; <i>R. apiculata</i> ; <i>R. stylosa</i>  Upstream: <i>Avicennia alba</i> ; <i>A. officinalis</i> ; <i>Aegiceras floridum</i> ; <i>A. corniculatum</i> ; <i>Bruguiera cylindrica</i> ; <i>B. gymnorhiza</i> ; <i>Nypa fruticans</i> ; <i>Rhizophora mucronata</i> ; <i>R. apiculata</i>	<i>Rhizophora stylosa</i> (sandy, rivermouth)  <i>R. apiculata</i> (silty to silty clay, rivermouth and upstream backbank)  <i>R. mucronata</i> (silty to silty clay, rivermouth and upstream forebank)  <i>Nypa fruticans</i> (silty to silty clay, brackish water)



ten eggs. Avoid planting in these areas because the soil may be very acidic and the likelihood of plant diebacks is high. The consistency of mud can vary from a fairly firm substrate that easily supports the weight of a walker to very thin where a walker is quickly up to the knees. Avoid very thin areas because here the survival of plants is not high while the amount of work to plant and manage a plantation in such a location is quite high.

2. *Rocky or coralline*—This substrate may best be described as hard shelves where small or thin pockets of softer sediment are found. Rocky or coralline areas are not recommended for production forests because of relatively low soil fertility. But for protection and other ecological purposes the following species are recommended in these areas:

- *Bakauan bato*
- *Bakauan lalaki*
- *Pagatpat*

3. *Sandy substrate*—Well known to most people, sandy substrate consists of very small grains of sediment (often coral) usually less than 2 millimeters in diameter. There is no organic matter to speak of, although it may overlay mud or muck. Like mud, sand may be as shallow as 2-3 centimeters or as deep as several meters. In situations where this substrate is very shallow, it is not recommended for wood production efforts. As with rocky or coralline substrate, the following species do well in sandy substrate:

- *Bakauan bato*
- *Bakauan lalaki*
- *Pagatpat*

4. *Muck*—Similar to mud except that it contains a large amount of plant debris (its organic matter content is higher than mud). It also tends to be deeper starting at more than 10 centimeters thick up to a few meters. Like mud, muck may have the same foul, rotten egg smell; if so, planting should not be attempted. In general, muck

*The type and thickness of substrate present will help to decide which species of mangrove is best to plant in any given area. It is important to investigate an area thoroughly and to avoid blindly deciding to plant a certain species. It is important that the PO maintains flexibility about what it wants to do in particular places.*

is a good substrate to plant:

- *Bakauan babae*
- *Busain*
- *Tangal*

*Common species present*—One of the best ways to determine which mangroves will succeed in a particular area is to look at which species are currently thriving there. If the area once supported a mangrove forest, people living near may know which species were there. Not surprisingly, local people indicate that many forests now composed of *api-api* and *pagatpat* were once composed primarily of *bakauan lalaki* or some other *bakauan* species.

Think carefully about planting species that are not found in the area. It is likely that nature has already tried to establish those species and failed.

*The presence or absence of seagrass*—Many people believe that seagrass beds are very good sites for mangrove plantation, but that is not the case. It is not a

*Knowing which species were historically found in an area is a very good way of determining what species are likely to thrive there now. This information can be obtained by asking the local people or by identifying stumps in the area. If that is not possible, observe the current composition of species near or in the plantation area for a good idea of which mangrove species are likely to succeed.*

good idea to plant mangroves in seagrass beds because there are many species of coastal animals that live in these habitats; if their habitat is altered they will die. Simply replacing one habitat with another does not help to manage and enhance the coastal environment.

***Do not put mangrove plantations on top of what are now stable seagrass beds!!***

***Tidal height***—Like substrate, tidal height is an important biophysical control affecting plantation success. It is important to know if the average daily water depth of the area identified for planting will in fact support growth. In order to determine the height of the average and highest low and high tides see the detailed discussion in Chapter 6, *Resource Mapping of Mangroves*.

Planting is generally done on bare substrates during the low tide of neap tide, especially for small seedlings and propagules (such as *bungalow* and *pototan lalaki*). In some cases, big or long propagules may be planted in areas when the water depth is as high as 10 centimeters at low tide. (This is routinely done at the *bakauan bato* plantation in Banacon Island, Getafe, Bohol.)

Tidal height also affects growth and survival. In Banacon, a seedling planted at a low tide depth less than 30 centimeters has a much higher survival than those planted at 40 centimeters.

Areas constantly battered by waves especially during stormy days are critical for planting. As much as possible, avoid these areas and endeavor to plant in good sites. Table 3.2 shows suggested soils for some mangrove species.

***Presence or absence of pests***—Another major factor in plantation success is the absence of pest species such as barnacles and crabs. All of these species can cause problems to young plants. If there are large numbers of these pests in the area, look elsewhere. Another pest that people often overlook is filamentous algae. This algae can pile up against the young plants and knock them over by their sheer weight. If your PO decides that an area with these problems is the one that

must be used, then you must prepare for a significant amount of extra work to remove them periodically.

***Traditional users of the area***—All traditional users of the area should be identified and allowed an opportunity to join the PO and share the benefits of the CBFMA. If that has been done, there should be little problem with gaining their acceptance of the plantation. It is important to plan the plantation with them so their needs regarding boat traffic, shell gathering and other issues are included in the plan. (This is even more important in cases where these users did not join the PO.)

***When the historical users of an area are not consulted about a proposed new use for it, such as a plantation, they often become very unfriendly towards the promoters and can even go so far as to destroy seedlings and the new plantation area.***

There are a number of factors that contribute to identifying a successful plantation location. Good planting sites include:

- Well protected areas away from strong waves like coves, lagoons, bays and abandoned and reverted fishponds
- Open areas along rivers
- Gaps within natural stands
- Stable mudflats with barrier islands
- Barnacle free areas
- Logged-over areas

## Choice of Species

Plantation success largely depends on the choice of species. Determining which species to plant is a complex decision that is based on the plantation's purpose (whether production or protection) and the biophysical characteristics of the selected area. In the long run, it is the biophysical characteristics that will determine the

Table 3.2. Suggested soils for selected species of mangroves (after Watson 1928)

Name	Common name	Soil and location
1. <i>Acanthus ebractatus</i>	<i>Diluario</i>	Loam or clay on river banks and clearings
2. <i>Acanthus ilicifolius</i>	<i>Tingloy</i>	Loam or clay on river banks and clearings
3. <i>Acrostichum aureum</i>	<i>Lagolo</i>	Almost everywhere if light
4. <i>Avicennia alba</i>	<i>Bungalon puti</i>	Deep mud within the influence of rivers
5. <i>Avicennia lanata</i>	<i>Piapi</i>	Sandy mud not far from sea; Singapore and East Coast
6. <i>Avicennia officinalis</i>	<i>Api-api</i>	Stiff soil on river banks
7. <i>Bruguiera gymnorhiza</i>	<i>Busain</i>	Loam or sandy mud. Gregarious in drier areas
8. <i>Bruguiera parviflora</i>	<i>Langarai</i>	Will grow almost anywhere in mangrove if well drained
9. <i>Excoecaria agallocha</i>	<i>Buta-buta</i>	Clay, often behind 11
10. <i>Heritiera littoralis</i>	<i>Dungon-lati</i>	Sandy loam, river banks and inland edge of mangrove
11. <i>Lumnitzera racemosa</i>	<i>Kulasi</i>	Clay. Sometimes behind 11
12. <i>Nypa fruticans</i>	<i>Nipa</i>	River banks within the influence of fresh water
13. <i>Rhizophora mucronata</i>	<i>Bakauan babae</i>	Deep mud within the influence of rivers. Not on sea face
14. <i>Scyphiphora hydrophyllacea</i>	<i>Nilad</i>	Loam or sandy mud on river banks and open spaces
15. <i>Sonneratia alba</i> (Gedabu)	<i>Pagatpat</i>	Loam, often some distance from river banks

success of the plantation; it is up to the PO to decide which species to plant after considering all the factors discussed above.

Table 3.3 presents the major commercial mangrove species. Using these data with the information above, determine which species are best suited to your plantable area.

### Plantation Establishment Techniques

After identifying the planting site, the socio- and biophysical attributes, management objectives and choosing the mangrove species, proceed with establishment:

- **Determining what needs to be done to prepare the site**—The plantation sites often need some preparation prior to planting. The people in charge of the plantation should walk over the entire area and determine what needs to be done. This may include clearing areas of *Acrostichum* fern or other brush, removing standing dead wood that will shade out the area and removing debris. In this phase, it is important to determine both what needs to be done and when it will be completed. If a completion time is not included, the tasks are not likely to be finished in time for planting.
- **Planting organization, areas and spacing**—When people are walking through the area during site preparation they can also evaluate it for planting block size, keeping a sharp eye out for areas where people or boats commonly transit.

**Table 3.3. Commercial uses of various mangrove species.**

Species	Uses
<i>Bakauan bato, babae and lalaki</i>	Piles or poles, firewood or charcoal
<i>Busain</i> group	Piles or poles, firewood or charcoal
<i>Tangal</i>	Tanbark ( <i>tungog</i> ) for <i>tuba</i> industry, poles
<i>Pagatpat</i>	Timber and lumber, firewood or fodder
<i>Bungalon</i>	Firewood, fodder
<i>Api-api</i> and <i>piapi</i>	Timber, poles, firewood, charcoal
<i>Tabigi</i>	Timber and lumber, firewood or tanbark
<i>Piagau</i>	Timber and lumber
<i>Tabau</i>	Posts and poles
<i>Dungon-lati</i>	Timber
<i>Nipa</i>	Shingles, alcohol, wine

This information will contribute to developing a sketch map of the area.

Several organizational ideas can be used in planting:

- An inverted V shape spacing with the point of the V facing the sea to deflect wave impact. Spacing should be less than 0.5 meter.
- In Cuba, planting has been done in triangle formation with one of the corners of the triangle pointing seaward. Spacing is less than 1 meter.
- Cluster planting, as practiced in Bohol, may also be done in other areas. It is done to act as a wave break. To maximize survival, spacing is much closer (25 x 25 centimeters). After 3-5 years, when the clusters are fully established, the gaps in back of the clusters can be planted at a wider spacing, as the area will be more or less protected by the clusters.
- Strip planting—the same principle applied in strip planting. Strips (10 or 20 x 100 or 150 meters) are established 100-200 meters from the shore at very close spacing to withstand strong waves. Once established, the open areas between

the *bakauan* strips and shoreline may now be planted at a wider spacing.

• **Seedling density or spacing**—Spacing can range from 16 individuals per square meter to one individual per 1 square meter. The closer the spacing, the greater the ability of the propagules to withstand wave impact. This explains the local tradition of closer spacing (0.25 x 0.25 centimeter) in spite of DENR's recommended spacing of four individuals per square meter. Generally, wider spacing is employed when bigger trees are needed. The wider spacing reduces competition for sunlight and nutrients. Deciding on the spacing will help to determine what the total requirement for your seedlings will be.

• **Sketch map**—This map forms the backbone of the plan. While it does not have to be scaled precisely, it should be clear enough to provide users with guidance on the location of passages, blocks and seedling density. Figure 3.1 shows an example sketch map.

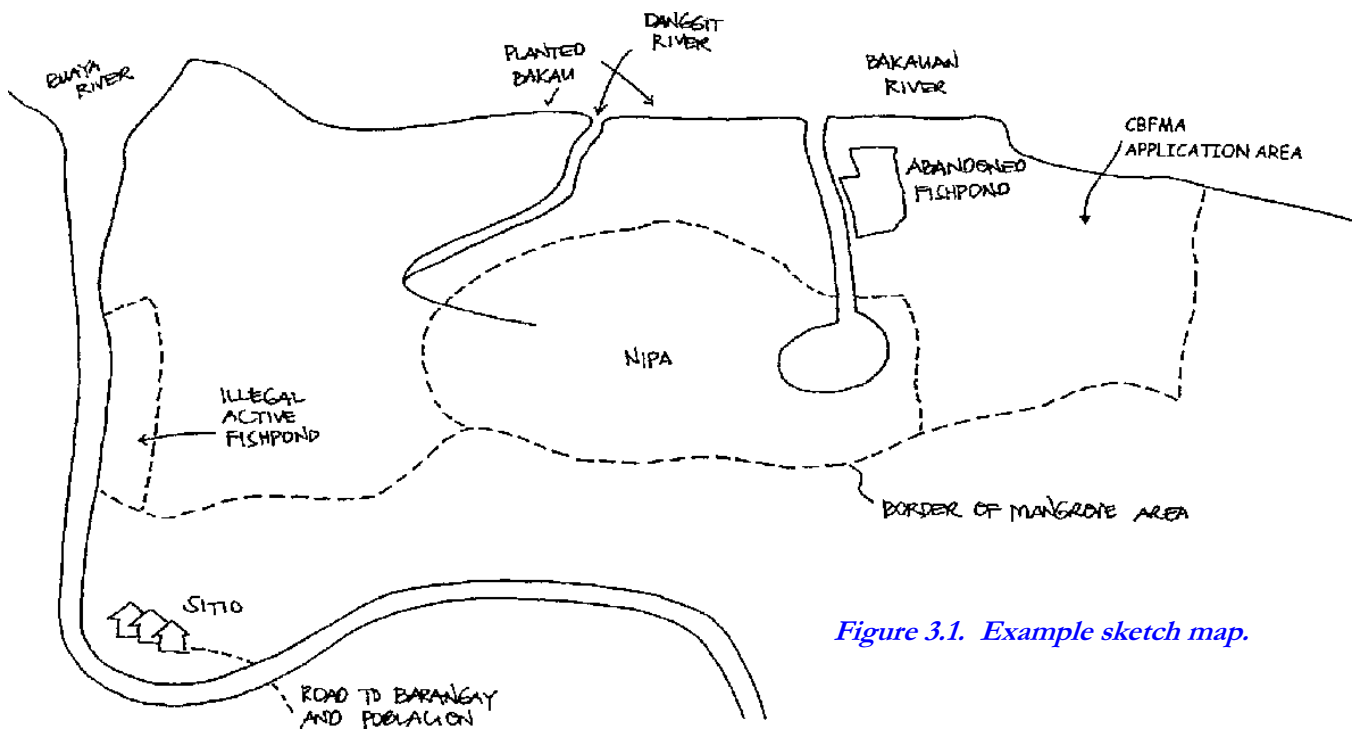


Figure 3.1. Example sketch map.



Figure 3.2. Undergrowth vegetation like the mangrove fern (lagolo), herbs and vines are removed to prepare the site for planting.

**Plan implementation**—After planning, it is time to prepare the site for planting. Examples of the work that might be needed include:

**Brushing the area**—This refers to the removal of undergrowth such as mangrove fern (*lagolo*) as in Figure 3.2 and spiny woody vine (*diluarrio*) prior to planting. Brushing can be approached in several ways:

- **Total brushing**—removes all of the undergrowth from the area. This is an extremely difficult task in areas of heavy undergrowth and is generally unnecessary.
- **Strip brushing**—removes undergrowth along pre-determined strips, generally 1 meter in width. These strips may be hundreds of meters long depending on the size of the area; they make for easier maintenance of the plantation over time.
- **Spot brushing**—removes undergrowth in a 1-meter radius around the point where plants will be placed. A stake of at least 1-meter height is necessary to be able to locate the seedlings until they become larger. Spot

brushing is the easiest of the three approaches.

- If the area is invaded by *lagolo*, use a blunt bolo or spade to uproot the ferns as if it was *cogon* grass. Cutting off the stems will not eliminate weeds, it is necessary to remove their roots. Because these areas can be so large, spot brushing is recommended to minimize effort and still provide the best environment for the seedlings.
- If it is a logged-over area, any remaining logging debris (branches, for example) will need to be taken out.
- If the area contains brush, vines or low-lying vegetation, it will be necessary to cut it down and remove it.
- With enrichment planting it may be necessary to prune branches and remove dead trees to provide light and space for the new seedlings.
- Breaking fishpond dikes and filling in internal canals. (This is discussed in more detail in Chapter 5, *Fishpond Restoration*.)
- Finally, if seedlings or wildlings are being planted, it will be necessary to dig holes in order to place the seedlings. The holes need not be deeper than the size of the rootball. Begin planting at the seaward side of the plantation at low tide.

While this list cannot cover every possible example, it does provide a number of good site preparation activities for the PO.

### Warning

***For other activities whose legal sanction is not certain, it is best to consult the local DENR office/officer.***

There are also some things a PO should *not* attempt to do as part of site preparation:

- Trying to change the depth of the area by excavating or adding soil.
- Trying to change the soil type by adding soil.
- Completely cutting down one type of tree to replace it with another. (This is particularly true

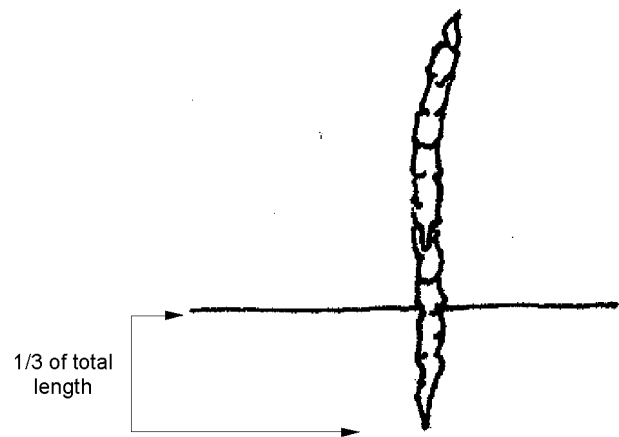
in cases where the PO wants to replace large areas of forest with *nipa* palms.)

- Removing fishing traps or mooring areas of any kind without the prior approval of those involved.

## Planting

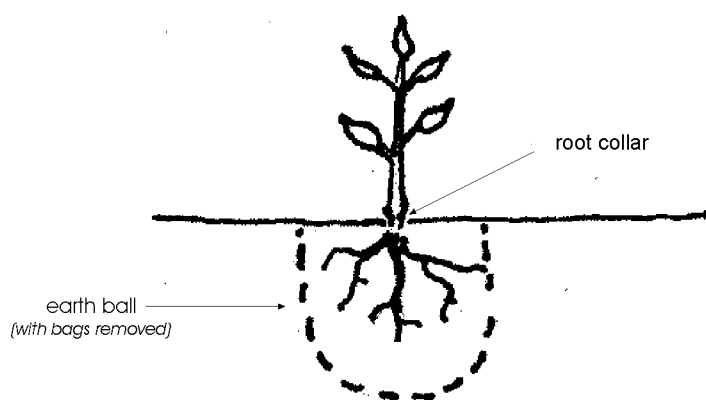
There are several planting methods. The method used depends on the type of stock and species being planted, whether seed, seedling, propagule or wildling. Common methods include:

**Direct planting**—Propagules of *bakauan*, *pototan* and *tangal* are planted directly on the ground. Other species with large seeds like *dungon-lati*, the *tabigi* group and to some extent the *bungalon* group, can also be directly seeded. (*Nipa* too is commonly sown directly in the field.) This method is economical with a high percentage of survival. Figure 3.3 shows an example of direct planting.



**Figure 3.3. Direct planting of propagules (1/3 of length buried).**

**Potted seedlings**—Used for trees with tiny seeds that are difficult to sow directly in the field, the *pagatpat* group, for example. Seedlings from the *bakauan* group also can be raised in the nursery and planted in this manner for specific sites such as open areas with unstable substrates where there is concern about the early survival of the seedlings. Potted seedlings involve considerably more cost and should only be done when it is the only option. Figure 3.4 shows an example of potted seedlings.



**Figure 3.4. Field planting of potted seedlings (root collar at ground level).**

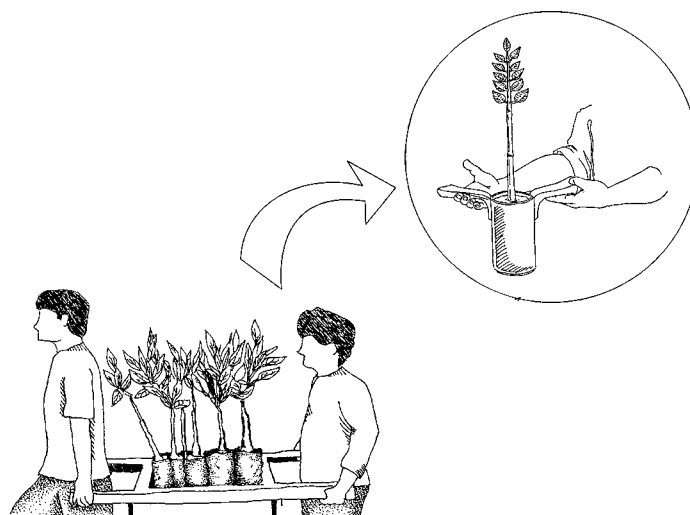
**Wildlings**—Where there are not enough seeds or propagules, wildlings may be potted and hardened in the nursery for a month. In uprooting/collecting wildlings, extra care must be taken not to damage the root system. For some species, wildlings can be directly planted provided the soil around the roots is intact. Figure 3.5 shows collected and potted *bakauan* wildlings. Planting wildlings requires extra care to protect against damage on the roots, one of the natural adaptive structures of mangrove to tolerate a saline environment.

### Care and Maintenance of Plantations

Plantations are cared for in several stages depending on their age, species and rate of growth. For example, *bakauan bato* is best harvested in its 12<sup>th</sup> year. However, if it grows well it can be harvested in 10 years (or in its 15<sup>th</sup> year if it grows poorly). Below are the major phases of care for plantations and natural forests:

- Like any newborn, the first 2 years after their establishment are probably the most intense phase of care for plantations.
- Generally, from the 3<sup>rd</sup> through the 4<sup>th</sup> years the level of care is somewhat less.
- The 5<sup>th</sup> year sees an increase in care because this is the first thinning if growth has been normal and the economic size of desired products is attained.
- The 6<sup>th</sup> through the 14<sup>th</sup> years see a period of relatively low maintenance in longer maturing

*One common practice responsible for high mortality rates in mangrove planting is the sowing of propagules more than half their length in the soil. This was done because people believed that waves would dislodge the propagules if planted too shallow. Propagules, however, are covered with lenticels that they use to exchange air while developing roots. Burying propagules too deep will render the lenticels useless, causing a slow death to plants. Generally propagules are sown one-third of their length in firm substrate and one-half of the length in soft substrate. Other types of seeds should be sown just below the substrate including the tabigi and tindung-tindukan.*



**Figure 3.5. Potted bakauan wildlings.**

species. (In *bakauan bato*, depending on growth rate, harvesting can begin anywhere from the 10<sup>th</sup> and probably should be completed by the 20<sup>th</sup> year.)

- In most other longer maturing species, the 15<sup>th</sup> year sees another round of thinning. (This thinning may occur anywhere from the 10<sup>th</sup> until the 15<sup>th</sup> year depending on growth and the needs of the PO.)

- Years 16<sup>th</sup> through 19<sup>th</sup> are typically ones of low maintenance.
- By the 20<sup>th</sup> year, possibly the 25<sup>th</sup>, the plantation is ready for harvest and replantation (if the mother tree planting method is used, the plantation will be allowed to naturally regenerate).

***Maintenance activities in the early years***—In general, maintaining a young plantation involves:

- Regular visits (daily or every other day)
- Removal of debris
- Installation or fence repair
- Removal of barnacles and other pests
- Uprooting and replacement of sick or dead plants

The purpose of regular visits is to make certain that things are all right and to perform the daily chores listed above. For example, if a large amount of green algae floats into the area, those who regularly visit will be able to remove it before it can do much damage. Other debris that might adversely affect the seedlings include pieces of driftwood, fishing nets and other heavy materials that can knock over the seedlings or damage them by tearing their bark.

Visit the plantation at least every other day, although daily visits are preferable. Develop a routine so that the entire plantation is inspected. It is best conducted at low tide since it will be easier to walk around the plantation. Because it is impossible to look at each and every seedling, the inspectors should make it a point to

### ***Do We Need a Fence Around Our Plantation?***

***This is an important question. If a fence is necessary, then quite a bit of work will go into building and maintaining it. In general, a fence is only necessary if you believe that livestock may graze on your plantation. However, if you want to build a fence to keep out people or screen out debris, one is probably not necessary. Regular patrols of the plantation are much more effective.***

look closely at a few plants in each block. Inspectors should check for:

- Encrusting organisms like barnacles
- Insects and moth larvae eating leaves
- Dead or dying plants
- Plants entangled in green algae or other debris

Where extensive problems are observed, and it is clear that more than a few hours are necessary to fix the damage, it will be necessary to involve more members of the PO (perhaps all of them).

- ***Removing encrusting barnacles***—The shells must be removed by hand (preferably using gloves) before the propagules are totally covered. Figure 3.6 shows an example of encrusting barnacles. Do not scrape the propagules with a bolo since that will result in plant damage and eventual death. Once the organism is carefully scraped off, simply throw it in the water because it cannot be able to attach again.
- ***Removing grazing organisms***—These organisms are much easier to remove than barnacles. Simply pluck them from the leaves, trunks and branches of the seedlings, place them in a bag and remove from shore for disposal; simply throwing them in the water may allow them to reach another tree.
- ***Removing dead and dying trees***—Dead or dying trees should be quickly removed from the area. If they are dying in large numbers, it may be necessary to replace them with seedlings from the nursery or other stocks. If seedlings are dying in large numbers, it is important to determine why. Bring some sample seedlings to the Community Environment and Natural Resources Office (CENRO) or ask a forester from the CENRO to visit the area to evaluate the plantation.

Without caring for the area daily, a host of problems can develop. The more problems a plantation has the less it benefits the coastal ecosystem and the less valuable it is to the CBFMA holders.



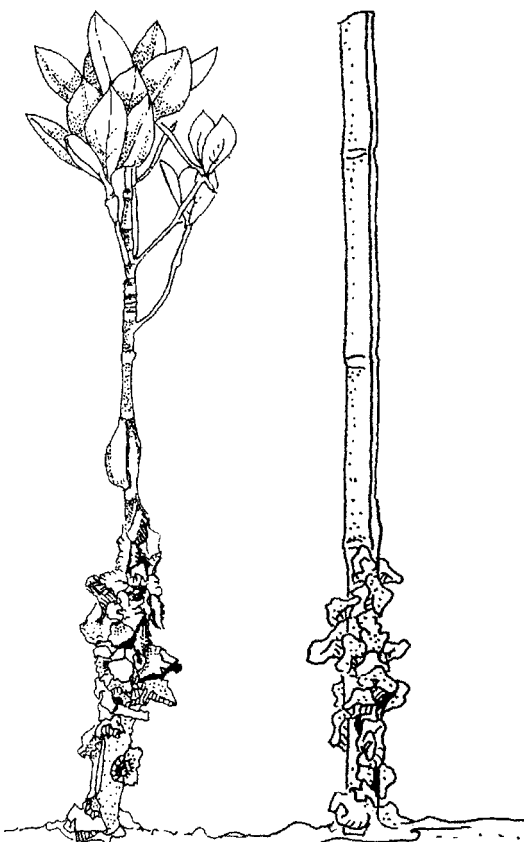


Figure 3.6. Barnacles encrusted on bakauan trunk.

## Maintenance Activities in Subsequent Years

When the trees attain economic size, thinning of the stand should be done to allow better trunk growth. Thinning is the cutting of trees to reduce competition from sunlight, nutrients and soil moisture in order to improve the quality of the stand.

Thinning is performed only two or three times during the life of the tree. The timing and number of thinnings depend on the expected age at harvest for the trees. For example, *bakauan bato* plantations can be harvested between their 7<sup>th</sup>-10<sup>th</sup> and 15<sup>th</sup>-20<sup>th</sup> years. They can be thinned in their 5<sup>th</sup> and 8<sup>th</sup> or 9<sup>th</sup> years depending on when harvesting is expected. Table 3.4 provides estimates of the number of times and spacing of thinning for the major plantation species. This information may also be used for enhancement/enrichment planting. Figure 3.7 shows how a *bakauan* forest would look at various points where it is thinned.

Thinning is best done in several stages. After each stage count how many have been cut. If the target (as calculated above) has been reached, thinning must stop. If not, go on to the next stage. First, cut only those trees that are obviously malformed, stunted or sickly. Next, cut those trees that appear to be significantly shorter than the surrounding trees. Finally, cut the trees that are not as tall as the average trees. Thinning, however, is not recommended for environmental protection.

Table 3.4. Common species and recommended thinning rates (C. Yao, pers. obs.).

Species	Initial density (no./ha)	First thinning (yr, % removed)	Second thinning (yr, % removed)	Third thinning (yr, % removed)	Harvest (yr)	Products
<i>Bakauan bato</i>	50,000	5, 50	10, 50	9, 50	15	Poles
<i>Bakauan</i> group	10,000	3, 50	8, 50	13, 50	25 - 30	Poles
<i>Tangal</i> and <i>langarai</i>	10,000	5, 50	10, 50	15, 50	15	Tanbark
<i>Tabigi</i> and <i>pagatpat</i> group	5,667	4, 50	10, 50	15, 50	25 - 30	Lumber



**Figure 3.7. Thinning operation in natural stand of bakauan.**

Pruning is another maintenance activity that takes place after the initial year or two of intensive maintenance. It is defined as the cutting of unnecessary branches and stems. Pruning is done to:

- Enhance height and trunk diameter growth rate. The nutrients that otherwise would be absorbed by the branches will now be utilized by the upper part of the tree, thus increasing growth rate.
- Improve the tree form and wood quality. Cutting the lower branches will help to define the tree trunk and reduce knots in the lumber. (As the tree increases in diameter, the uncut branches become encased in the trunk, which results in knot formation in the lumber. Cutting the branches minimizes this encasing.)

Pruning should be conducted with some restraint to avoid adverse effect on trees. The following are some pruning rules:

- Do not cut more than 30% of the live crown over a 1-2 year period. Overpruning will adversely affect plant growth because of sudden reduction of leaves that are active in photosynthesis.
- Paint stub preferably with tar to prevent fungal attack.

- Cut smaller branches close to the trunk to increase merchantable height—clear length from base of the trunk to the first branch. The branch should be 3 meters from the ground limits length of lumber if not pruned. As the branch enlarges, it creates knots that limit the tree to produce lumber more than 3 meters. This is one of the important justifications for pruning operations.
- For bigger branches, make an undercut 10 centimeters from the trunk. The upper cut should be close to the trunk to avoid bark splitting.
- Use a pruning saw (a saw attached to a long pole) to reach branches up to 5 meters in height.

One of the best things about both thinning and pruning is that the felled trees and branches are of economic benefit to the people who have done the work. For example thinning of most trees at the 5-year point and beyond results in:

- Some poles for fish pen construction
- A large amount of forage for animals feeding
- A large amount of branches for firewood production

Pruning benefits people in a similar manner. Pruning will generate both forage and firewood. Since people are in the forest pursuing these activities anyway it is likely that there will be no shortage of PO volunteers to assist.

## MANAGEMENT OF PLANTATION AND NATURAL FOREST

### Plantation Types

**Production forest**—A plantation is established to produce wood for specific purposes. Typical mangrove forest products include: poles, posts, firewood and charcoal and lumber for furniture or construction. A production forest is characterized by long, straight rows of trees. They may range in size from 2,500 square meters to hundreds of hectares. The trees grown in these forests are always meant for eventual harvest. Figure 3.8 shows

one of the most successful and oldest production forests in the country.



**Figure 3.8.** One of the most successful and oldest production forests in the country located at Banacon, Getafe, Bohol.

**Protection forest**—A plantation is developed to provide additional refuge for coastal organisms, or for keeping an area safe from damaging from wave action and sediment transport. While protection forests may be planted in the same manner as production forests, it is sometimes better to randomly plant the areas with different species that are known to survive in the area. These forests are not meant to be harvested but to maintain the ecological balance. Figure 3.9 shows an excellent example of a protection plantation along a causeway.



**Figure 3.9.** Protection plantation established to protect causeway of Pangangan, Calape, Bohol.

**Mangrovetum**—a plantation consisting of several species planted in blocks by family/genus for easy differentiation of closely similar species and comparison of growth performance. Mangrovetum is an ecological attraction while conserving biodiversity.

In addition to the above there is *enhancement planting*, but this is not, strictly speaking, used to develop a plantation. It is done in areas where some forest exists but in a much lesser density than the original forest. These areas include the following:

- Abandoned fishponds
- Heavily cut mangrove forest areas
- Gaps in naturally reforested areas

In each case, there may be some logged-over area where the PO determines that enrichment (planting additional trees of either the same or different species) would benefit the environment and the community.

As you can see, there is a variety of objectives that a PO might have in developing a plantation or in performing additional planting within an already established forest. It is important for the PO to remember that it may have all activities going on in some part of its CBFMA area. For example, a 250-hectare CBFMA may include 50 hectares where a production forest is planned, 75 hectares of protection forests, 10 hectares of an abandoned fishpond where enrichment planting is planned, 15 hectares of forest identified for enhancement and 100 hectares of forest identified as an area for no intervention at all.

## Harvesting and Regeneration Systems and Enhancement Planting

Since the intention of the CBFMA is to have a sustainable forestry system, it is important that the plantations are harvested and regenerated in that manner so that future generations can make use of the wood and the benefits to the coastal ecosystem. This section discusses appropriate harvesting and regeneration technologies for mangrove plantations and natural forests. Following these approaches will allow the PO to enjoy the benefits of their mangrove forests for generations.

**Harvesting**—This section discusses appropriate harvesting techniques for four major products:

- Firewood and charcoal
- Piles, poles, posts and lumber
- Fodder
- Tanbark

While harvesting these products is routine, it is often done in a manner that is not sustainable and leads to destruction of the forest. If a PO uses traditional techniques to harvest, it is very likely to cause significant damage to the forest. Thus, the use of sustainable harvesting techniques is critical. Luckily, practicing these techniques does not reduce the economic benefit of harvesting over the long term; in fact, benefits increase.

- *Firewood or charcoal* harvesting can begin at the time of the first thinning for plantations and all other planting strategies. As earlier, subsequent thinning and pruning can be used as a method of firewood harvesting. Later in the growth cycle, firewood will be generated from topping, thinning and harvesting trees. This is especially true when the main product of the plantation is poles or lumber. Figure 3.10 shows a firewood harvester returning with some freshly cut wood.

If a *bakauan* plantation has been established solely for firewood the tip of seedling can be split to encourage branching. Initial spacing for such plantations should be at least 1 x 1 meter (10,000 seedlings). This is done to encourage crown development and maximize the yield of branches for firewood. The plantation should be mature enough, with usual thinning and pruning, to support sustained harvesting between the 7<sup>th</sup> and 12<sup>th</sup> years after planting. At that time, firewood can be harvested exclusively from the top branches of individual trees allowing the lower branches to regenerate.

- In plantations developed for producing *piles, poles, posts and lumber* it is possible and indeed desirable to harvest firewood. By aggressively pruning side branches after the first thinning (while leaving the crown alone), energy will be



**Figure 3.10.** A firewood harvester with freshly cut wood.

directed into producing more trunk wood and therefore bigger and taller poles more quickly. As the thinning and pruning are used to produce firewood it also is possible to shift to selective cutting and remove poles on an as needed basis. This would help to move the plantation towards a seed tree form of forestry where the largest seed or mother trees are kept for seedling production and the middle story is harvested for poles or posts. (This is discussed in more detail later.)

- Traditionally, *fodder* harvesting has been done for cattle and goats. Fodder (the leaves and shoots from the cut branches) is taken from pruning and thinning activities and given to these animals. Since it is well known that cattle and goats like to eat these leaves it makes sense to extend it into a livelihood activity. Fodder can be obtained as part of firewood gathering and sold to local farmers or the PO, or its members can raise sheep or cattle on the fodder as a liveli-

hood activity making use of this product. *Avicennia* species are common for fodder purposes.

It is important to make certain that there is enough fodder to support the number of animals you want to grow. In several countries including India and Bangladesh, overgrazing by animals has caused significant loss to mangrove forests.

*Tanbark* is another mangrove product the PO can produce from several species (the one from *tangal* commands the highest price for the *babalina* industry in Samar and Leyte). Harvesting is done by cutting the trees and placing them under water for several days until the bark becomes more supple for debarking by stripping it from the trunk of the tree. Based on observations of bark in markets, the typical diameter of these trees is 20 centimeters suggesting that the trees in natural stands are harvested at about 40 to 50 years of age. Table 3.4 shows the average age at which the major mangrove species can be harvested given proper care and maintenance of the plantation.

**Regeneration systems**—This refers to cutting methodologies used to make certain that a forest remains as cutting continues. When properly pursued, regeneration systems allow for a virtually continuous harvest.

Selective cutting is a common method of harvesting in areas where there is no constant market. Trees are cut to order based on requests from customers. (Poles are cut for fishpens or posts for housing, for example.) The more the trees are cut in selective harvesting, the faster the remaining trees grow since much more sunlight reaches the ground. The new openings created by the harvest also hasten regeneration. This method can lead to a more or less naturally occurring regeneration method called the seed tree and plant method.

Strip cutting is typically done in larger planta-

### *Seed Tree and Plant Method*

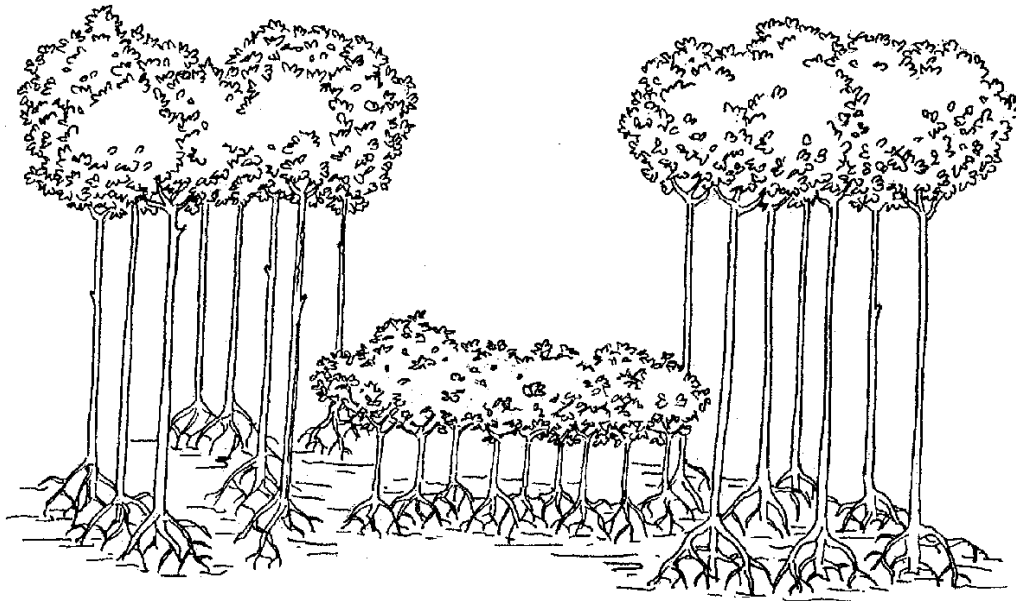
***Under this method, harvesting in natural stand is allowed provided that at least 40 healthy trees per hectare, spaced regularly over the area and representation of the species in the area, shall be retained to provide seeds/propagules for regeneration purposes. In case there are not enough surviving wildlings, the gaps will be planted with the desired species (DENR 1990).***

tions (greater than 10 hectares) (see Figure 3.11). A strip 10-20 meters wide by 50-100 meters long is cut at a 45 degree angle from the sea to lessen the impact of waves and to enhance regeneration by recruitment of wildlings or new planting. Alternating strips of forest are harvested. The harvested areas are allowed to reseed naturally or are replanted. The seed tree and plant method also can be used in strip cutting. Assuming that the area to be harvested is 10,000 square meters, a total of 40 mature trees can be left in place to act as seed trees. Over time, the forest naturally regenerates.

These major regeneration techniques can be easily incorporated in mangrove forestry, as they do not require extensive technical ability. A PO that follows this approach will enjoy a plantation and forest that can take care of itself, in a way, and thereby minimize maintenance work and maximize both profitability for the PO and benefits to the coastal resources.

**Enhancement planting**—Enhancement planting is the process of rehabilitation by increasing the number of seedlings of desirable species (Vande Vusse 1995). This is generally undertaken in denuded mangrove stands or stunted *nipa* groves to increase land productivity and conserve/increase biodiversity.

One of the common methods of enhancement is by planting *bakauan* and other desirable species with gaps of dense natural stands, or planting immediately under the canopy of less desirable species such as *api-api*



*Figure 3.11. Strip cutting of trees.*

(*Avicennia officinalis*) and *bungalon* (*Avicennia marina*) after pruning the lower horizontal branches to let in more sunlight. The cut branches may be used for posts and firewood.

Another strategy in enhancement planting is the introduction of fast growing trees in retarded/unproductive *nipa* stands. These areas may be planted with desirable species that suit the area like *bakauan babae*, *bakauan lalaki* or *pagatpat* either by strip or spot clearing, depending on the growth/density of *nipa*. The newly planted seedlings should be properly cared for and maintained until they are tall enough to overtop the palm. Eventually the palm, which demands more light, will be illuminated.

As the introduced species becomes dominant, it is expected that the original species will decrease in number and value.

Enhancement planting is more likely to succeed than standard restoration/reforestation in open areas. In enhancement planting, the existing vegetation provides an effective cover and serves as nurse tree to the introduced species that are planted right under or behind big trees. Since most planting in the country is done along the shorelines exposed to strong waves, it is important to prioritize areas with existing stands, denuded or otherwise. Once the plantation is fully established, additional planting towards the sea should be done.

Another form of enhancement is the Assisted Natural Regeneration (ANR). This is done by modifying the forest floor or the forest stand to allow fallen seeds to optimally germinate and grow as wildlings to trees. The activities may include cleaning the ground surface, pruning or thinning of trees. This strategy is by far the economical way of rehabilitation.



# Chapter 4

## Community-Based Forest Management Agreement: a land tenure instrument for mangroves

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### INTRODUCTION

**T**his chapter provides information to help POs gain a basic understanding of a Community-Based Forest Management Agreement (CBFMA), including:

- ◆ What is it?
- ◆ Is it the right thing for a PO to attempt?
- ◆ How much work is involved in the application process?
- ◆ Does the PO and its members have the necessary skills to manage a mangrove forest?
- ◆ What must the PO do to apply for a CBFMA?

The purpose of this chapter is to assist the PO in answering many, if not all, of its questions regarding CBFMAs. It is not intended to convince the organization to apply for a CBFMA and become stewards of the mangrove forest, but to help the group decide if this step is the right one to take.

### What is a Community-Based Forest Management Agreement?

A Community-Based Forest Management Agreement (CBFMA) is a production sharing agreement entered into between a community and the government to develop, utilize, manage and conserve a specific portion of forestland consistent with the principles of sustainable development and pursuant to an approved Community Resource Management Framework Plan (CRMF) (DAO 96-29, DENR). CBFMAs are used by the DENR to award tenurial rights over forestlands to organized communities. It virtually integrates all of the old tenurial instruments on forestlands prior to 1996.

The CBFMA can be issued only to POs or similar organizations. It cannot be issued to companies or to

### *Warning*

***The current policy of the government prohibits cutting of mangrove tree species per Section 4, Republic Act No. 7161, otherwise known as “An Act Incorporating Certain Sections of the National Internal Revenue Code of 1977”, as amended, otherwise known as The Revised Forestry Code of the Philippines,” and “Providing Amendments thereto by Increasing the Forest Charges on Timber and Other Forest Products” dated 22 July 1991.***

***This means that the accompanying Community Resource Management Framework (CRMF) Plan of the CBFMA in mangrove forests must not contain the Resource Use Plan (RUP) involving the cutting of mangrove trees whether planted or not or whether growing singly or in groups.***



individuals. It also must be issued to the people who actually live on the land or have made use of it historically. The CBFMA integrates the previous household-based instruments such as the Mangrove Stewardship Agreement (MSA) and the Certificate of Stewardship Contract (CSC) of the Integrated Social Forestry Program (ISFP), both of which are no longer in use.

Unlike many other centralized types of government programs that allow people tenurial control over land, the CBFMA issuance is delegated by the DENR Secretary to the regional offices for areas of forestland 15,000 hectares and below. Pursuant to this delegation of authority, the Regional Executive Director can issue a CBFMA for areas 5,000 to 15,000 hectares while the Provincial Environment and Natural Resources Officer (PENRO) can issue the document for areas 5,000 hectares and below. Because mangrove areas in the

Philippines appear in patches in coves or sheltered shores, an application for areas over 5,000 hectares is unlikely.

Table 4.1 shows the major Executive Orders (EOs), Department Administrative Orders (DAOs), Memo Circulars (MCs) and other legal instruments concerning CBFMAs. These sets of policy issuance help to protect the rights of the community as a steward of the mangrove forest. The community may want to check with its *Sangguniang Bayan* (SB) to see if it has any municipal ordinances or regulations that discuss mangrove forests.

The remainder of this chapter examines the benefits of possessing a CBFMA, the process and amount of effort involved in applying for a CBFMA, the duties and responsibilities of the CBFMA holder and the management requirements of a CBFMA area.

**Table 4.1. Legal instruments concerning Community-Based Forest Management Agreements.**

- EO 263—Adopting Community-Based Forest Management as the National Strategy to Ensure the Sustainable Development of the Country's Forestlands
- DAO 96-29—Rules and Regulations for the Implementation of EO 263, Otherwise Known as the Community-Based Forest Management Strategy
- DAO 96-30—Integration of all the Community-Based Forest Management Strategy and People-Oriented Programs and Projects into the DENR Regular Structure
- MC 97-12—Guidelines for the Formulation of CRMF and AWP for CBFMAs
- DAO 98-10—Guidelines on the Establishment and Management of Community-Based Forest Management Projects Within Mangrove Areas
- DAO 98-41—Guidelines on the Establishment and Management of Community-Based Forest Management Projects Within Watershed Reservations
- Joint MC 98-01—Manual of Procedures for DENR-DILG-LGU Partnership on Devolved and Other Forest Management Functions
- DAO 30, Series of 1992—Guidelines for the Transfer and Implementation of DENR Functions Devolved to the LGUs
- DAO 98-08, dated 24 June 1998—Guidelines on Contracting Inside Community-Based Forest Management (CBFM) Areas
- DAO 98-42, dated 24 June 1998—Production Sharing Agreement with POs in the Harvest of Forest Plantation Owned by the Government Inside CBFM Areas
- DAO 98-43, dated 24 June 1998—Exemption of CBFM Projects from the Payment of Administrative Charges
- DAO No. 3, Series of 1998—Rules of Fishpond Reversion
- DAO 98-44, dated 24 June 1998—Guidelines on the Establishment of CBFM Special Account
- DAO 98-45, dated 24 June 1998—Guidelines Governing the Issuance and Transfer of Certificate of Stewardship Within CBFM Areas
- Republic Act No. 8550, Otherwise Known as The Philippine Fisheries Code of 1998, Section 49—Reversion of all Abandoned, Undeveloped or Underutilized Fishponds

## THE BENEFITS OF THE CBFMA HOLDER

There are a number of benefits that a CBFMA brings to a PO. These include: tenurial control over the CBFMA area, the ability to use the area for a wide variety of livelihood activities, the ability to extract wood in some instances from mangroves planted in the area, and the benefits of a sustainably managed mangrove forest to the surrounding coastline.

### CBFMA as a Land Tenure Instrument

The appropriateness of the CBFMA as a land tenure instrument for those who choose to be stewards of the mangrove forest cannot be overemphasized. It represents a shift away from the traditional, regulatory-oriented forestland management, toward a development, people and service-oriented one. It creates new roles and responsibilities for the DENR, the LGUs, the private sector and the communities in mangrove management. It promotes people empowerment, extolling a firm belief in putting people first so that sustainable mangrove forest management will follow. Only when communities in and adjacent to forestlands commit themselves to stewardship will the remaining mangrove forests receive proper and profitable attention.

Upon approval of the CBFMA by the DENR, the PO is given tenure over the area for a period of 25 years (renewable for another 25 years). This tenure allows the PO to make use of the resources on the land as long as the usage is sustainable and in accordance

***The CRMF Plan is the document defining the terms and procedures for access, use and protection of natural resources within the CBFMA area. This plan shall always be consistent with the overall strategy of the entire watershed (mangrove) area where the CBFM is located, and shall be formulated by the community with assistance from its PO, LGU and/or private entities.***

with the affirmed Community Resource Management Framework (CRMF) Plan.

### Livelihood Activities

One of the major livelihood activities POs want to pursue is wood harvesting, either for firewood or construction. In CBFMA areas where plantations already exist and the trees are mature, it may be possible to begin harvesting (even while CRMF preparation is in progress as long as the PO has the Interim Resource Use Permit [IRUP] from the DENR). In cases where it is legal to harvest the wood, it would be prudent for the PO to think about a wider variety of uses than simply for firewood. For example, you could build a kiln and make charcoal or manufacture the wood into novelty items, products considerably higher in value than firewood. Alternatively, they could let the wood grow for several more years and sell it as timber or poles for building material.

Many other livelihood activities are possible, including:

- ♦ Growing *taualis* for fences and *tangal* for tannin from its bark
- ♦ Using the leaves of mangrove species such as *pagatpat* and *bungalon* as forage for goats, cattle or carabao
- ♦ Investing in the materials for beehives and selling honey, if the mangrove can support aviary
- ♦ If the area is near a tourist site, the PO can build a boardwalk through the mangroves and charge tourists entry
- ♦ Members of the PO might decide to put several *amatong* in appropriate places throughout the mangroves and use them to grow and harvest fish
- ♦ Mangrove-friendly aquaculture, such as mudcrab fattening/grow-out or shrimp culture

While this list is not exhaustive, it is easy to see that many activities are possible. The PO should decide which livelihood shall be pursued and help each other develop plans and define implementation strategies. There are a number of other incentives in applying for and possessing a CBFMA. These are listed below.

### **Additional Benefits**

- **Exempt from paying rent for use of the area**
- **Exempt from paying forest charges on timber and non-timber products harvested from plantations**
- **Consulted on all government projects to be implemented in the area**
- **Preferential access by the DENR to available assistance**
- **Receive all income and proceeds from the use of forest resources within the area**
- **Enter into agreements or contracts with private or government entities**

**From Frequently Asked Questions about CBFMA (DENR 1998a).**

### **Benefits for the Surrounding Coastline**

As mentioned in Chapter 1, mangroves provide a multitude of benefits to the surrounding coastline and nearshore waters. Mangrove forests are responsible for producing as much as 600 kilograms of fish per hectare that can be caught in the nearby coastal waters. Mangroves act as shelter for younger fish and hunting grounds for older ones, and their leaves are a source of nutrients for fish. In addition to these services, mangrove forests provide protection against waves and storms. Finally, mangrove forests trap sediment washed down from upland areas, keeping it from burying coral reefs and seagrass beds.

A CBFMA provides benefits to the nearby coastal waters through the protection and maintenance of the natural mangrove forests and the establishment of new mangrove plantations. Given these and other benefits, it is likely that a PO will consider applying for a CBFMA to be a worthwhile activity. The following section outlines how the PO can apply and how much work an application is likely to take.

## **GENERAL STEPS FOR CBFMA APPLICATION**

This section presents the general steps to take in applying for a CBFMA, as well as the level of effort

### **The CBFMA Application Process**

1. **Form a PO if one is not in existence.**
2. **Determine that you want to apply for a CBFMA.**
3. **Identify the planned CBFMA area.**
4. **Gain the support of the LGU and develop and submit a CBFMA application.**
5. **Develop a map of your proposed area.**
6. **Upon CBFMA approval, develop a Community Resource Management Framework and Annual Work/Resource Use Plan (CRMF, AWP/RUP).**
7. **Begin working as stewards of the mangrove area under your CBFMA.**

those steps involve and the approximate cost. The box outlines the application process.

There are several preconditions a PO must meet before applying for a CBFMA.

- ♦ First, the applicants must be Filipino citizens.
- ♦ Second, they must live in or near the forest they are applying to manage.
- ♦ Third, they must be part of a people's organization or be willing to form such an organization (a PO must have a minimum of ten members). Prior to applying for a CBFMA, register your PO with the Department of Labor and Employment (DOLE), the Cooperative Development Authority (CDA) or the Securities and Exchange Commission (SEC).

### **We Don't Have A People's Organization (PO)!**

**It is necessary to form a PO before applying for a CBFMA. In order to do this, the group needs to write a constitution and by-laws and elect officers. You may then approach either the LGU, an NGO or CENRO to help the registration with the Department of Labor and Employment, the Securities and Exchange Commission or the Cooperative Development Authority. PO registration and site identification can be accomplished at the same time.**

Once these preconditions have been satisfied, the PO may send a letter of interest to the local Community Environment and Natural Resources Office (CENRO) requesting for assistance. This letter should be endorsed by resolutions from both the *barangay* council (*Sangguniang Barangay*) and the municipal council (*Sangguniang Bayan*, or SB).

The PO will have to work with one or more members of the *barangay* council and SB to get them to put forward a resolution. It may take some time to effectively communicate what the PO is trying to accomplish and up to 2 weeks or even a month to obtain resolutions from each LGU.

***The DENR manual, How to Participate in the CBFM Program, has suggested language for both the application letter and the resolutions (DENR 1998b).***

It will be necessary for the PO to become more familiar with the CBFMA process. An orientation briefing may be performed by a member of the CENRO, the LGU or someone from an assisting nongovernment organization. The leaders of the PO should work with the appropriate individual to set up a meeting with the PO membership. The meeting will discuss:

- ◆ Community-Based Forest Management (CBFM) as a strategy and program
- ◆ The features, principles and scope of CBFM
- ◆ Who can participate
- ◆ The concept of the DENR, LGU, PO partnership and the roles of the partners
- ◆ The steps to follow to apply for a CBFMA
- ◆ The benefits of a CBFMA

While the orientation itself will last only a couple of hours, it may take weeks to arrange.

The next step is for the PO to determine the potential CBFMA area. While the members of the PO probably have a pretty good idea of the area it wants to apply for, it is best if everyone is able to discuss the location and boundaries. After this discussion, it will be necessary for a group from the PO to walk around and through

the area to make certain that it knows what it contains. This will constitute the required resource mapping and assessment of the area. If the PO is working with a community organizer (CO), he or she will help develop the map. Finally, the PO can contact the CENRO and request a survey of the area to check the accuracy of the map. It may take several weeks for staff from CENRO to come to the site and perform the survey.

***If you are applying for a CBFMA without the assistance of a CO, you may refer directly to Chapter 6 for information on how to develop a community-based map.***

Once the CENRO has performed the survey, it is necessary to develop a map to include in your CBFMA application. The map will take at least 1-2 weeks to complete depending on the size of the area.

Assuming the PO is already registered, it is time to apply for a CBFMA. The application itself is fairly easy to complete. Elements include: an application letter sent to the CENRO indicating the proposed CBFMA area, a copy of the PO certificate of registration and a list of the PO officers and members (including their addresses and names of spouses for those who are married).

***Remember to include any resolutions—by the barangay or the municipality—and any other supporting documents that support the application!***

At this point, the CENRO will review the application and draft a CBFMA in consultation with the PO. This will cover discussions of the terms and conditions of the CBFMA, including PO incentives and responsibilities. Upon completion of the review, the application will be forwarded to the Provincial Environment and Natural Resources Office (PENRO) for approval by the PENR Officer, or sent back to the PO if modifications are required.

## Work Requirements of the Mangrove Forest Stewards

Once the CBFMA application goes to the CENRO, the PO can begin working on the most important part of the process: the Community Resource Management Framework (CRMF) and the Annual Work Plan/Resource Use Plan (AWP/RUP). Below are brief descriptions of these documents.

Typically, most PO members will be looking at a CBFMA as a way to *enhance* their livelihood, not as a livelihood all by itself. But as time goes by, people may find that their “secondary” livelihood is more income generating than their primary livelihood. The amount of cash or food one receives from forest activities will ultimately determine how much work they will do there (aside from their dedication and commitment to conserve the CBFMA area).

***The amount of work the member of the PO will do depends in part on the amount of work they want to put in. Some people will almost immediately begin to back off on what they said they want to do while others will forge ahead and do more work than expected. Of course the organization will also have to have meetings and the officers will have a heavy workload.***

Activities such as planting new areas or tending a nursery will take more time than others (establishing an *amatong* for example—a resemblance of a natural coral reef constructed on waterways in the mangrove forest which bottom fish use for shelter and foraging). Those who are most dedicated to establishing plantations for eventual harvest will tend to do that work. In general, the amount of work and time people spend working on the forest will correspond to what they believe they are benefiting from it.

The PO will need to find a way to equitably share the duty of guarding the area. In some cases this may not be necessary. In other cases, however, the PO may discover the area is beset by poachers, or is the target of

illegal fishpond development. In those instances, an organization must work with the municipal authorities to protect the area (much like “*bantay dagat*”)—and possibly authorize a group like “*bantay bakawan*.”

***Planning to meet work requirements***—The Community Resource Management Framework (CRMF), as defined earlier, describes the present situation in the community and the CBFMA area, presents a strategic resource management plan and outlines how the PO will manage the area (short, medium and long term). It includes an assessment of what resources are present, a discussion of how the area will be allocated, what the proposed socioeconomic and environmental indicators will be and the proposed marketing and financing strategies. The CRMF is submitted at the beginning of the CBFMA period and may be modified if significant changes are needed. Then the CENRO approves the CRMF. If the CENRO takes no action on the CRMF within 30 days of submittal, the plan is considered approved.

The Annual Work Plan/Resource Use Plan (AWP/RUP) discusses in detail how, what and when everything will happen. The plan’s focus is the following year’s activities including resource development and the forest resources that will be utilized. The PO is required to file an AWP each year with the LGU and the DENR-CENRO. The CENRO approves the AWP/RUP. If the CENRO takes no action on the AWP/RUP within 30 days of submittal, the plan is considered approved.

The document itself need not be long or complicated. It is simply intended to provide guidance and understanding for both the PO and the DENR, detailing forest activities for the following year. The AWP/RUP should include what, where and how much one intends to develop or plant for the year, and to what degree (what, where and how much) the extractable mangrove resource will be harvested. It should also discuss any other livelihoods the PO will be pursuing. In most cases, the AWP/RUP may not discuss harvesting trees and other vegetation until a plantation has been established. This typically does not occur until the 5<sup>th</sup> or 6<sup>th</sup> year of CBFMA operation.

The overall CBFMA application process, including CRMF and AWP/RUP approval, can take from 4 to 6 months.

## Gaining Support from Local Government Unit(s)

The concerned municipality may also institute administrative requirements of its own. Because these will be specifically for the CBFMA area, the PO will most likely be able to negotiate to keep these to a minimum.

Resolutions, ordinances and letters of support can be of great help in pursuing a CBFMA. While it is possible to process an application without the support of the *barangay* council and the SB, their support makes it much easier.

***A resolution is a legal instrument issued by any level of government (from the barangay to the President) indicating endorsement, or lack of endorsement, of a particular situation. An example is a resolution of a barangay council to support a PO, the first step in obtaining an ordinance.***

***An ordinance is a legal instrument issued by a municipality or city that prescribes laws or regulations. An example is an ordinance requiring all illegal fishpond developers in the proposed CBFMA area to cease developing fishponds or face fines.***

***A letter of support is submitted by a municipality to a national government (or any other) agency indicating that the municipality is supporting an activity and/or requesting assistance.***

**The barangay resolution**—It is important that the PO plans out what it wants to accomplish before presenting any requests to the *barangay* council. The PO must decide what it wants to say to the council and who will say it. To begin, the PO members should discuss and decide as a group what kind of political assistance is needed, and what a resolution can provide toward that end. For example, are there problems with squatters or illegal fishpond development? Is there a claim on the area by another *barangay* or by a person who is not a *bona fide* resident of the site?

The stronger and more complete the resolution, the better off the PO will be in the long run. Therefore, when a PO is considering what to include in the *barangay* resolution it should also consider what to include in the municipal resolutions and ordinances. Table 4.2 provides examples of what can be requested from the *barangay* council and the SB.

The PO can use this information as a checklist to determine if there are other issues affecting the CBFMA that require the attention of the council or the SB. In general, the PO will decide if it needs a resolution from the *barangay* endorsing the founding of the PO and

**Table 4.2. Examples of actions the people's organization can request from the barangay council and the Sangguniang Bayan.**

### Barangay Council Resolution

1. Endorse formation of the PO.
2. Endorse activities of the PO.
3. Endorse area the PO has proposed for the CBFMA.
4. Endorse application for the CBFMA.
5. Request assistance from the SB in all aspects of the CBFMA application process.
6. Request assistance from the SB in solving problems associated with other claimants.

### SB Resolution and Ordinance Resolution

1. Endorse formation of the PO.
2. Endorse activities of the PO.
3. Endorse area the PO has proposed for the CBFMA.
4. Endorse application for the CBFMA.
5. Request assistance from the DENR in all aspects of the CBFMA application process.
6. Request assistance from the DENR and BFAR in solving problems associated with other claimants.

### Municipal Ordinance

1. Set aside land identified in the CBFMA for member use only.
2. Forbid development other than that identified in the CBFMA and associated papers.
3. Set aside prior claims on the area identified in the CBFMA.
4. Provide for protection of forest area under the CBFMA.
5. Provide logistic support to the PO.

supporting its intent to apply for the CBFMA to manage the area. This is the simplest resolution a *barangay* council can pass and may be all that is necessary.

After the PO drafts its resolution, it must meet with the *barangay* council to inform the council that the PO has been organized. Some PO members will have spoken informally with members of the council. This now needs to be done formally with the officers of the PO attending the *barangay* council meeting, explaining in detail their proposed activities. Table 4.3 outlines the information the PO will want to provide the council.

A PO officer should talk to the *Barangay* Captain and Secretary in order to get on the meeting agenda. The officer should explain what the PO wants to present to the council and who will be attending. The PO should indicate that it will be requesting a favorable resolution that can be taken to the SB.

It is important for the main presenters to practice what they intend to say to the council. Some of PO members should act as the *barangay* council and have the presenters practice their presentation before them. Several practice sessions will allow the PO members to find areas that must be strengthened.

It may take days or weeks for the resolution to be passed. During this time, the local SB representative (*Kagawad*) should be informed that the PO will be requesting time to meet with the SB, the purpose being to request a resolution endorsing the PO and its activities. If the PO believes it will need support from ordinances, it would be wise to indicate that the PO will be asking the SB to pass specific ordinances.

***The municipal resolution, ordinance and letter of support***—Once the *barangay* council resolution is passed, it is necessary to obtain a similar resolution from the SB. The PO will have already determined what is needed from the SB and developed a draft resolution (and any ordinances) when the *barangay* council resolution was developed. In addition to the resolution, it is useful to request that the SB send a letter to the DENR transmitting the resolutions and requesting all possible help in the approval of the CBFMA. The PO may want to request from the SB specific ordinances that will strengthen their claim to the area or provide them with

**Table 4.3. Outline of the *barangay* council presentation.**

#### 1.0 Introduction

The President of the PO tells the council the name of the PO and introduces the officers. If the by-laws and other papers are complete, distribute them to the council. Explain this is the first step in applying for a CBFMA; once the resolution is endorsed by the council, the PO makes a presentation to the SB to request its support and assistance.

#### 2.0 Discussion of Purpose

The President tells the council why the PO has been formed and what the organization intends to do. Detail how many members the PO has, the total area of the application, what will be done with the area (i.e., what will be planted and harvested and other area livelihood activities) and whether there are any illegal fishponds or other activities of concern. Finally, request that the council issues an ordinance endorsing the PO and the proposed application area.

#### 3.0 Submission of Draft Resolution

Submit a draft resolution to the council for its approval or modification.

#### 4.0 Conclusion

Thank the council for its time and ask when it will be able to vote on the ordinance.

additional legal protection in the management of the CBFMA.

Before a meeting with the SB, the PO should contact the SB *Kagawad*, who can provide valuable information on contacts within the SB to assist in expediting approval of the resolution, the letter and any ordinance. In most instances, the PO asks the Municipal Secretary to schedule a meeting with the SB. Before doing so, however, the PO members should learn from the *Kagawad* who to speak with before the meeting. They should contact at least the: (1) The Municipal Agricultural Officer (MAO); and (2) the Chairman of the SB Environment (or

***It is important to discuss with the barangay council and SB Kagawad whether they will request the resolution and ordinance from the SB or whether it is the PO's responsibility. In cases where the barangay council or the SB Kagawad will be the one to request the activities, this section will not be as important. Instead, the main activity of the PO will be to attend the meeting and answer any questions.***

Agriculture/Fisheries) Committee to inform them of the PO's intentions.

Having spoken to these individuals before the meeting, the PO will have supporters during the presentation. The SB presentation is similar to the one before the *barangay* council (see Table 4.4). As in the council meeting, several practice sessions should be conducted in front of PO members, with some taking roles of particular people in the SB.

The SB resolution may take days or weeks to finalize like the *barangay* council resolution. Once finalized, the resolution and any other supporting documentation should be copied for inclusion in the CBFMA application.

### **Gaining Financial and Other Support from the Municipality**

The LGU is often in a position to assist a PO financially or to provide services depending on the kind of project proposed and the priorities of the LGU. The CO (if there is one) should be able to help the PO determine what type of assistance is needed and what level is necessary to be successful. The following section provides information on the types of support available.

For financial assistance, LGUs provide 20% of their Internal Revenue Allotment (IRA) for development projects that include both infrastructure and environment. The LGU may also facilitate access to other fund sources including the Countryside Development Funds (CDFs) provided by congressmen and senators, grants and soft loans from international funding agencies (Plan

**Table 4.4. Outline of the *Sangguniang Bayan* presentation.**

#### **1.0 Introduction**

The PO President tells the council the name of the PO and introduces the officers. If the by-laws and other papers are complete, distribute them to the council.

#### **2.0 Discussion of Purpose**

The President tells the council why the organization was formed and what it intends to do. Detail PO membership numbers, the total area of the application and what the PO intends to do with the area (i.e., what will be planted and harvested and other area livelihood activities). Emphasize how much the project will benefit members of the PO, and discuss whether there are any illegal fishponds or other activities of concern. Finally, request the council to issue a resolution approving the PO and the application area.

#### **3.0 Submission of Draft Resolution and Ordinance**

Submit a draft resolution and any ordinances to the council for their approval or modification. The President outlines what the PO is hoping for in terms of support and how the resolution and the ordinance will assist the PO.

#### **4.0 Conclusion**

Thank the council for its time and ask when it will be able to pass the resolution (and ordinance if any).

International, World Vision, Canadian International Development Agency [CIDA], etc.) and local civic organizations (Rotary, Jaycees, etc.). Further, the LGU often provides access to vehicles, the municipal hall, assistance from the Municipal Agriculture Office (MAO) and other services the PO may be able to tap.

***Internal Revenue Allotment (IRA)***—Under the Local Government Code, all LGUs are provided yearly with an IRA from the National Government for their expenses. (The amount of IRA depends on the



population and land area of the municipality.) Currently, the LGU is mandated to annually allot 20% of its IRA for development projects. However, with budget pressures this percentage may decrease. The CO must assist the PO in developing the best possible proposal.

The following steps must be accomplished for the PO proposal to be considered. (These steps are useful whenever a PO is interested in requesting for funds or other support from any organization.)

1. Decide what project to undertake, preferably in line with the priority of the LGU. To determine the priority projects of the LGU, the PO can delegate a subcommittee to meet with the Municipal Planning and Development Council (MPDC). Then the PO can best see how its project fits in the scope of LGU priorities.
2. With the subcommittee, draft a proposal that targets the major areas of MPDC interest.
3. Subcommittee officers should contact the *Barangay* Captain and the SB Chairman for Environment or Agriculture/Fisheries to discuss the proposal and to seek input. After incorporating their suggestions, ask for the Captain's and Chairman's commitment to support the project proposal.
4. From the SB Secretariat, request inclusion in the next SB meeting agenda to present the PO proposal.
5. Determine who will do the presentation at the SB session. Make sure that the presenter is articulate enough to persuade the body to support the project. The presenter must be prepared to defend the project budget and to convince the SB that the funds they invest will increase the income of the PO, improve the environment and eventually increase the municipal revenue through the harvest of forest or marine products. PO officers should attend the meeting with one or two members to lend support to the presenter. Make sure that the bud-

get is realistic and that the group provides for a counterpart in terms of labor.

6. Once SB approval is secured, submit the budget to the MPDC for further deliberation.

**Soft loans through cooperatives**—Some LGUs are now providing soft loans to cooperatives at a minimum interest of 8% per annum which the PO can avail of for viable livelihood projects. The cooperative then delivers the materials to the borrowers who pay back in cash over a given period. For a project like this, it is necessary for the PO to form a cooperative. There are other credit facilities that require cooperative credentials.

**Line agencies**—Occasionally, line agencies and NGOs have project funds that a mayor can request for a PO. For example, the DENR has reforestation funds that are contracted to farmers'/fishers' associations or individuals for the planting of mangroves. The Department of Agriculture (DA) also has livelihood component projects and some large NGOs are providing grants to qualified POs. Projects of this nature require strong LGU endorsement.

**Local and international funding sources**—LGUs may also assist a PO in obtaining funds from different local and international funding institutions known to provide grants to environmental projects, e.g., Philippine Jaycees, Rotary International, Plan International and World Vision. These organizations will almost always require a formal project proposal. The process outlined in the section on *Internal Revenue Allotment* can be followed and amended.

### ***A Success Story***

***Talibon, Bohol is using soft loans of this type with apparent success. An initial budget of P1.5 million was appropriated for 1 year from Talibon's IRA that provided materials/goods to a cooperative serving as conduit for the loans. These loans are used by fishers for equipment, supplies and working capital.***

**Logistic support**—Aside from the financial support described above, the LGU may also provide services to a PO, such as the use of heavy equipment or transportation, loan of technical staff or access to building facilities depending on needs.

For all assistance, it is vital that the PO possesses a good track record for delivering what it has promised the LGU. Requesting for support may be done informally by simply asking the *Barangay* Captain or SB member or formally through a letter requesting for assistance.



# Chapter 5

## Fishpond restoration

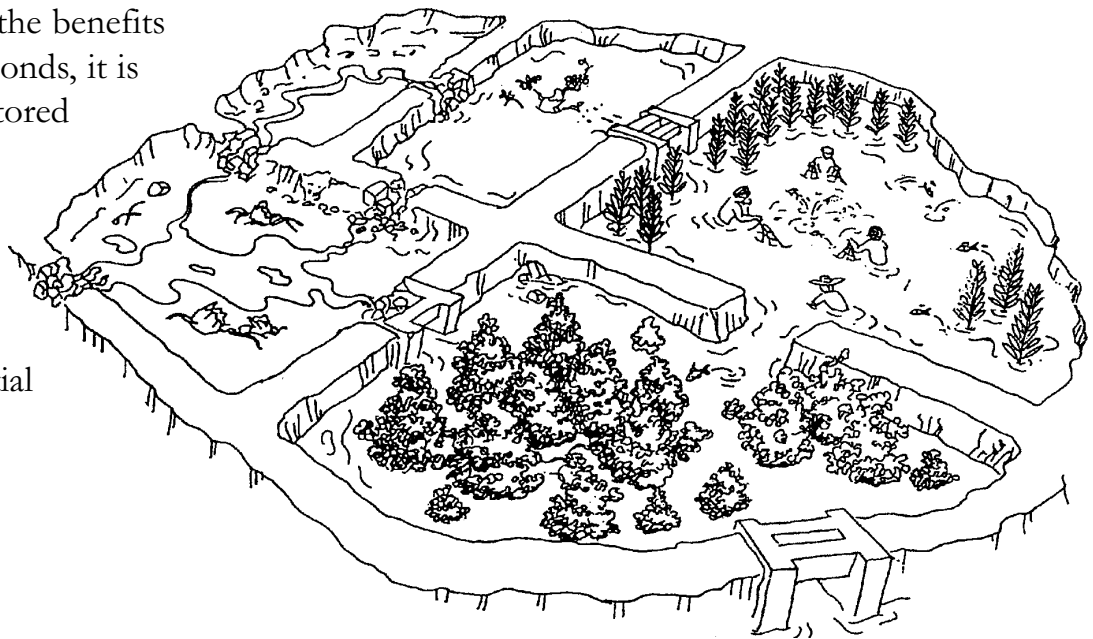
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### INTRODUCTION

**T**his chapter provides information on how POs can modify abandoned or illegal fishponds to make them more valuable to the community. Illegal and abandoned fishponds can be changed in ways that are directly and indirectly beneficial to the people who restore them and to the environment. For example, fishponds can:

- Be developed into plantations that the community can in the future harvest for firewood, poles, etc.
- Provide an area to collect shells, crabs and fish.
- Provide food and shelter to crabs, shrimp, shells and fish harvested in coastal waters.

When looking at the benefits of restoring fishponds, it is evident that a restored idle fishpond is much more beneficial than an abandoned one. (Figure 5.1 shows this potential difference.)



*Figure 5.1. Active vs. managed fishpond.*

Fishpond restoration principles and techniques are important because restoring fishponds to their former and natural state offers significant advantages to coastal systems. (Information specifically related to planting and management of mangroves is found in Chapter 3, *Mangrove Plantation Establishment and Management*.)

There is little practical experience with restoring fishponds back into mangroves. Much of the guidance in this chapter is based on sound ecological practices and an understanding of hydrology rather than on direct experience in similar situations. For example, replanting fishponds with *bakauan* or other mangrove species will eventually result in an increase in the mangrove forest area and should provide additional fish catch in the nearby coastal waters. Similarly, while still new, aquasilviculture has been proven to work in the Philippines and elsewhere on a small scale, and should work on a large scale. Suggestions are made regarding the amount of dike to remove, the placement of soil from the dikes and other construction issues. Each case will provide special challenges. The advice given here should not

### ***A Word on Reverting Fishponds***

***The reversion of abandoned fishponds under a Fishpond Lease Agreement (FLA) is currently an extremely difficult activity that takes considerable time and resources to accomplish. Although Republic Act 8550 does hold out hope for an easier process, it is not clear when that will be. At this time, the Coastal Resource Management Project-Mangrove Management Component (CRMP/MMC) suggests that POs should focus their energies on illegal and abandoned fishponds within their CBFMA application area (identify the abandoned ponds under FLA, exclude them from the application and attempt to revert these ponds at a later time).***

### ***Remember***

***Aquasilviculture does not mean that an abandoned fishpond is rebuilt and used exclusively as a fishpond. Aquasilviculture means that the fishpond area is converted into a site where mangroves can grow and fish can thrive.***

be followed if local experience has proven different.

## **STEPS IN RESTORING FISHPONDS**

As in any complicated process, it is best to break the reversion of fishponds up into several manageable bits (see Table 5.1).

The steps are designed to give the PO a general plan to approach the work necessary to identify fishponds within the CBFMA area and to determine whether to include them in the application. It is also important to establish a committee to work on this activity. Without having specific individuals assigned, it is difficult to get anything done.

Table 5.2 outlines the main situations and potential outcomes for fishpond reversion.

At a minimum, the former ponds that can be included will be useful as plantations. Simply operating them in that manner will gain some benefit for the coastal fisheries since a greater area of mangrove forest now is available to fulfill its natural functions.

### **Locate All of the Fishponds**

The purpose of this step is to make certain that all ponds have been identified and located to the satisfaction of everyone in the PO. It serves as the basis for going into the field and verifying the location and current activities at each pond. In the case of small CBFMA areas (less than 200 hectares), there may be only one or two fishponds (either active, abandoned or illegal); large

**Table 5.1. Fishpond restoration process.**

Steps	Result	Time to accomplish
1. Conduct an inventory of all the fishponds (active and inactive) in the CBFMA area.	A list of all the fishponds in the CBFMA area that includes their status and who operates them.	Less than 2 weeks
2. Visit the illegal ponds and sketch each one.	A series of sketches of each of the illegal ponds showing general location of dikes and water control structures.	Less than 2 weeks
3. Categorize the ponds.	Based on the information obtained in step one, determine which ponds may be subject to reversion (and exclude those from the CBFMA application) and which ones may be illegal.	About 1 day
4. Apply to the DENR to restore illegal and abandoned fishponds	A letter to the DENR through the LGU (copied to BFAR) requesting that the illegal and/or abandoned fishponds be turned over to them for restoration.	Less than 1 week to write and submit letter followed by follow-up visits
5. Develop a restoration plan for each of the turned-over fishponds.	After getting more information, clearance or authority over the area, a plan indicating where dikes should be breached, how much soil must be removed and where pond elevations should be changed. It shall be prepared by a Technical Working Group (TWG).	1 month (assuming two to four individual ponds)

**Table 5.2. Vegetation cover and potential** (see Figure 5.2 for mangrove coverage approximation).

Main situation	Potential outcomes
Lightly vegetated pond with dike system (<25% vegetation cover)	Plantation of bakauan or other appropriate species. Potential for enrichment planting on dikes and other areas. Aquasilviculture possible.
Moderately vegetated pond with dike system (25-50% vegetation cover)	Plantation of bakauan or other appropriate species. Potential for enhancement planting on dikes and other areas. Aquasilviculture possible.
Heavily vegetated pond with dike system (>50% vegetation cover)	Enhancement planting in pond, on dikes and other areas. Aquasilviculture possible.

CBFMA areas may have several fishponds present.

The location of each pond can be found in the prepared CBFMA by the PO's approved survey plan duly authenticated by the DENR and BFAR records on FLA reports and using it to verify the location and extent of each pond. The map will supply information on whether the fishpond is active or inactive and legal or illegal. These and other information will be used when the fishponds are categorized later. Once everyone agrees on the locations of the illegal ponds that might be used, a group must be selected to visit and sketch the ponds.

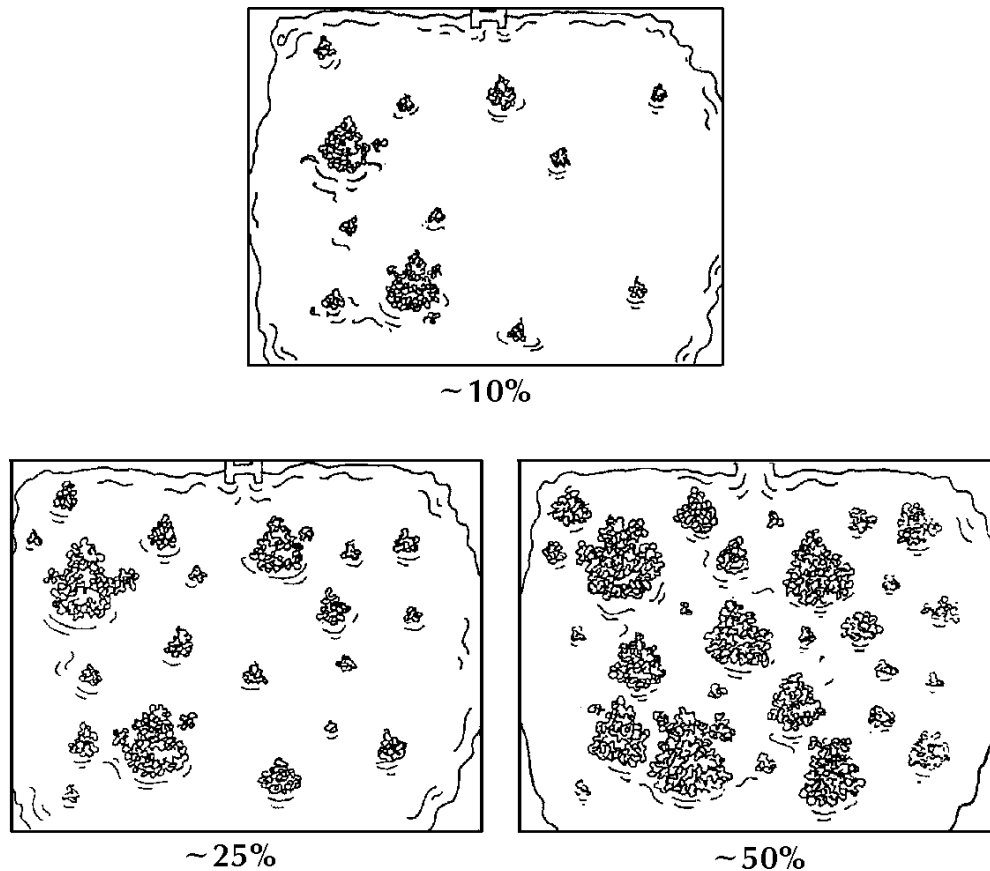
### Sketch the General Shape of Each of the Ponds

This step is important because knowing the size, amount of damage and other pond information will help

the PO determine what to do once the ponds have been reverted. The information to be gathered at this stage is:

- The size and shape of the ponds
- The state of the dikes and water control structures
- The extent of mangrove growth expressed as percentage of cover of the area (see Figure 5.2 for examples of area coverage)
- The location and approximate depth of holes, channels and high spots in the ponds
- Whether or not the ponds are operational

The group should develop a sketch map for every illegal fishpond including all of the information discussed above. (See Chapter 6, *Resource Mapping of Mangroves*, for information on how to complete a sketch map.)



**Figure 5.2. Mangrove coverage approximation.**

Whenever possible, staff from the Forest Management Service, DENR, should be asked to assist with this estimation.

## Categorize

Putting each pond in a category will help the PO decide which ponds to include in the CBFMA application. This is an extremely important step since much time and effort can be used in attempting to restore ponds possessing legitimate Fishpond Lease Agreements (FLAs).

The PO begins to categorize the ponds as part of the community mapping activities that were done during the CBFMA application process. All of the fishponds will have been identified in the area and marked with one or more of these codes:

- A11—Legal fishpond
- IS1—Abandoned fishpond
- IS26—Illegal, active fishpond
- IS26a—Illegal abandoned fishpond

These codes serve as the basis to help the PO understand whether to apply for restoration. Table 5.3 shows the other major categories and provides the codes of each. While these codes are a little confusing at first, they provide the PO with a wealth of information.

In general, the members of the PO will be able to quickly determine which ponds are legal and which are illegal. In cases of uncertainty, check with BFAR. The PO should focus efforts on including only illegal ponds in its application. The reversion process as it currently operates in the Philippines is extremely long and difficult to implement. The PO can conceivably be tied up in court cases for years over an attempt to revert a small pond.

### *Don't Forget*

1. *The PO may not begin any work on the area until the DENR or the LGU has issued the appropriate authorization.*
2. *Without a plan, the PO will waste large amounts of time and manpower on work that probably does not need to get done.*
3. *Emphasize the importance of developing a plan and following it.*

**Table 5.3. Categories of fishponds.**

Type	Category	Suggested action
Legal - Active	A11-a	Cannot be included in CBFMA application. Note location and exclude from map.
Legal - Non-working	A11, IS1	Should not be included in CBFMA application. Note location and exclude from map. Consider applying for reversion at a later date.
Legal - Unmodified	A11-u	Should not be included in CBFMA application. Note location and exclude from map. Notify DENR of the lack of activity and consider applying for reversion at a later date.
Illegal - Active	IS26	Notify LGU and request that the land be awarded to the PO for inclusion in the CBFMA.
Illegal - Abandoned	IS26a	Notify LGU and request that the land be awarded to the PO for inclusion in the CBFMA.



## Report Illegal Fishponds

After the illegal fishponds have been identified, the PO can take one of two approaches. In the first approach, members can approach the illegal operators and encourage them to join the organization. One of the requirements of joining would be the turnover of the illegal pond to the PO for inclusion in the CBFMA application. This is by far the preferred way since it does not require taking the operator to court.

If the illegal operator is unwilling to join the PO, then the members must approach the DENR or the LGU to request that the operator be notified of the operation's illegality. Joint Memorandum Circular 98-01 (signed by the Secretaries of the DENR and the Department of Interior and Local Government [DILG]) authorizes LGUs to take steps to protect forest areas, particularly mangroves, by delegating certain responsibilities from the DENR to the LGUs. It may be possible to request direct assistance from the LGU.

If it must be done formally, then the PO should write a letter to the LGU (with a copy to the DENR) outlining the problem. The PO should indicate that it:

- Has identified an illegal fishpond in an area of timberland.

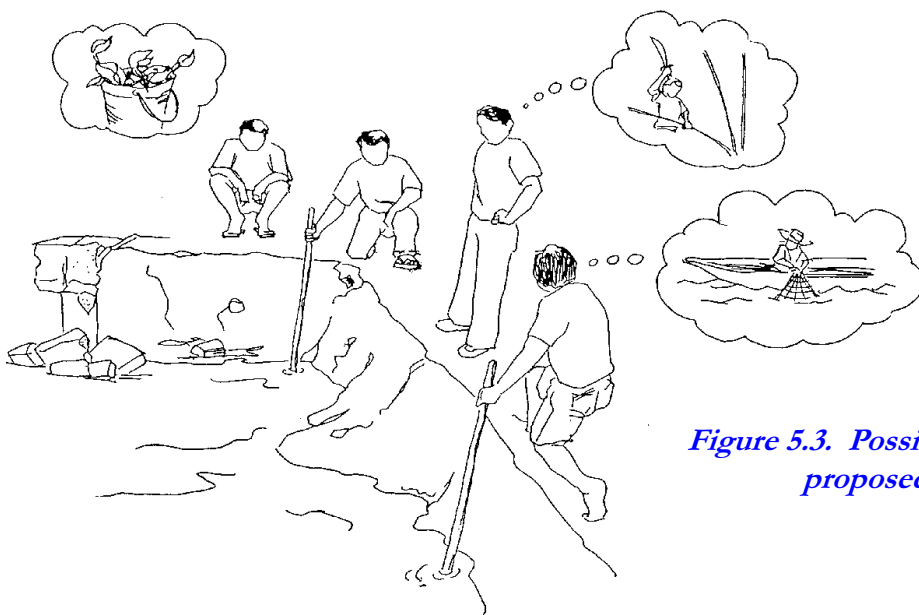
- Wants the operator of the fishpond to be required to cease operation.
- Wishes to include the area of the illegal fishpond in its CBFMA application.

Since this has not been done very much (if at all), it is impossible to determine how long it will take for the land to be turned over to the PO. At a minimum, DENR or LGU staff will have to investigate the area and make a recommendation. If it appears that the turnover will take an unreasonable amount of time, the PO should give serious thought to applying for the area without including the illegal pond(s).

## Develop a Restoration Plan

At this point it will be necessary to revisit the fishponds. The purpose is to see what can be done with each fishpond. Visit on a low tide and then on a high tide so everyone can see what areas are exposed and what areas are flooded to get an idea of the depths of the ponds and the elevations of dikes and other high areas. (See Chapter 6 for information on how to use tide tables and water levels to measure depths and elevations.) This visit is an excellent opportunity to start thinking about what might be done with the area (see Figure 5.3).

After a site visit, the team will have gathered



*Figure 5.3. Possible activities in the proposed site area.*

additional data about the flow of water near the ponds, water depth in the ponds, low and high spots at the site and existing vegetation cover. The team should also begin to think about possible approaches to modifying the flow. This information forms the basis of the reversion plan for the pond.

### *Hint*

*It would be a good idea to invite BFAR and DENR extension agents on these visits. They can provide the PO with valuable information on fisheries and silviculture.*

One of the most important things the group must think about is how to make the water flow more useful to both the activities they want to perform in the pond and in the plantation areas surrounding the pond. Consider the following when thinking about water flow:

- Carefully map out (including direction of flow) natural water flow (adjacent rivers, creeks, sources of freshwater runoff from uplands, etc.), water supply channels, gates, low spots in dikes, gaps in dikes and other features.
- Try to make the water flow and movement more like it was before the ponds were built (by making openings in dikes, unblocking creeks or channels, etc.).
- Look for anything that has greatly changed the water flow. For example, a dike might have been built across a major creek. Breaking the dike at that point will allow the water to flow through the creek once again.

Be sure to consider the effects of the pond dikes on the non-enclosed areas of mangroves adjacent to or near the pond. For example, a pond might have a large supply channel built from a nearby creek to the pond. The pond might already be experiencing a good supply of water on every tide because the control structure has been washed away and the dike breached. In such a situation,

### *A Word About Tides*

*Knowing the average level of the tides in the pond area is important. To aid drainage, most fishponds were designed so that their bottoms are slightly higher than the low tide point. Knowing the average high tide will let you determine how much of the dike needs to be removed for proper water flow.*

it might be tempting to conclude that everything is all right with the water flow to the pond. However, when the pond is evaluated more carefully, one often finds a stretch of the old dike blocking the flow to many hectares of mangroves that are behind, but outside, the pond. If so, do whatever can be done to get better flow back to that area behind the pond.

The restoration plan need not be long or complex, but it should incorporate a minimum amount of information including:

- Proposed activities for the fishpond area. (Will it simply be a wood production plantation? Will there be a mixture of tree species planted? Is aquasilviculture going to take place?)
- Extent to which the water flow will be helpful to other parts of the plantation. (Are there areas in back of the pond that will now be reached by tidal water again? Are there areas where there may be a change in species because of a change in water depth resulting from pond modifications?)
- Proposed work to be done. (This will include a discussion of how much dike will be leveled, where soil will be placed, whether any additional excavations in the pond are necessary and any other construction activities required to accomplish the proposed activities.)
- Two sketch maps. The first showing the area as

it is now and the second indicating the areas where work will be done.

- A timetable for accomplishing the work, an estimate of the number of people and workdays it will take to accomplish and a budget.
- Putting this information together takes time. At the end of this stage, however, the group will have a good idea of what it needs to do and should be energized to do it.

***Some specific examples***—This section provides specific examples of the kinds of things that can be done to restore ponds. The list is not exhaustive; each pond has more than one solution that will be adequate to meet the needs of the PO. Therefore, do not feel that these are the only things that can be done.

- *Ponds with few trees*—If the proposed restoration pond has no trees at all (or less than 25% of the area has mangroves), there are a number of options to consider.

Large bare ponds are ideal locations for planting *bakauan* species. When *bakauan* is planted in these kinds of areas, it is done so as described in Chapter 3, *Mangrove Plantation Establishment and Management*. However, there are a few things to do differently when creating a plantation in a pond:

- r Plant along dikes and canals—Ponds offer special planting opportunities because their dikes have steep slopes and offer a range of elevations to plant a variety of species. It is good to plant the edges (both sides, in many cases) of the dikes with *bakauan* species. Not only is this a place where *bakauan* will thrive if planted at the right elevations, it will help stabilize the banks. *Bakauan* also provides places for fish, shrimp and crabs to shelter, to mature and to be caught.
- r Completed ponds often have a slightly

deeper channel along the pond side of the dike where material was dug out to make the dike higher. This deeper water can be the home of many valuable animals. This is particularly true if the edge of the dike is planted with *bakauan* and the prop roots and trees hang over and provide shade along the deeper water. The same thing holds for most water supply canals, because when they are dug a dike is built alongside them from the soil dug to make the canal. Planting the edges of these canals is a very good idea.

By planting the edges of pond and canal dikes, you are increasing the numbers of fish, crabs and shrimp in the area. After the *bakauan* matures, it becomes an accessible source of trees that can be sustainably thinned and harvested for poles, firewood and all the other uses for *bakauan*.

- *Enhancement planting of other mangrove species*—Even if most of a pond is to be replanted with *bakauan*, there are some places where other mangroves (*tabigi*, *tangal*, etc.) are a better choice, especially high spots. High spots are higher elevated areas sometimes left in the middle of a pond during its original construction or the higher parts of the dikes along the pond and canals. (Again, see Chapter 3 for information on where species should be planted.)
- *Aquasilviculture*—This is the combination of aquaculture (growing of water animals like fish, shrimp or crabs) and silviculture (growing of trees). Old fishponds can be converted to aquasilviculture allowing trees to be grown in them while providing shelter for some fish, shrimp and crabs.
- *Ponds with 25% to 50% mangrove coverage*—Natural regeneration of mangroves is a distinct possibility in these areas. If the PO wishes to pursue this option, very little must be done other than letting nature take its course.

In ponds where some trees have grown back or are still present after some fishpond construction activities, the opportunities for actively intervening are just slightly different from those described for open ponds. Plantation in open areas of the ponds is a definite possibility. Since cutting or removing the existing mangroves is not allowed, planting will have to be done in whatever open areas are remaining. It still is important to look for areas that have the right elevations and conditions for planting the selected species. The PO may find many smaller areas instead of one or two big areas to be planted. In many ponds the smaller areas add up to a substantial amount of area that can be planted with *bakauan* or some other suitable species (refer to Chapter 3 for a detailed discussion on mangrove planting). Again, the options include:

- r Plant along dikes and canals. The discussion above for open ponds applies here, too.
- r Even where there has been some regrowth of mangroves in an old fishpond there is often little or no *bakauan* growing there. This is due to one of two things: (1) a source of propagules does not exist nearby; or (2) *bakauan* is not as easily dispersed by the tides (compared with the small seeds of *api-api*, *bungalon* or *piapi*). It may be a good idea to enrich the area by planting *bakauan* propagules among the other mangrove trees that are already growing there.
- r Enhancement planting of other mangrove species (*tabigi* or *tangal*, for example).
- r Aquasilviculture: If the pond has the right depth and enough potential open water, it may be turned into an aquasilviculture pond as described above.

Ponds with more than 50% mangrove coverage—

Extensive natural regeneration has already occurred in these areas. If it has been a very long time since the pond was cleared or if the trees inside the pond have never been cut, the options are fewer because of the current prohibition on cutting non-plantation mangrove trees. The limited options include:

- r Plant in gaps
- r Plant along dikes and canals
- r Enhancement planting of *bakauan*
- r Enhancement planting of other mangrove species (*tabigi* and *tangal*, for example)
- r Low intensity aquasilviculture if there are sufficient deep areas in the former ponds

## WHAT NEEDS TO BE DONE TO MODIFY PONDS

Accomplishing the various activities discussed above requires changes to dike height, water control structures and sometimes the floor of the ponds. This section discusses how to go about making those changes including the tools needed, the approximate level of effort and assessing the success of the work performed.

### Modifying Dikes

Probably the most important part of fishpond reversion is the modification of the dikes. If done properly, the outcome will be an area that allows for the complete exchange of water. This will provide havens for fish and other organisms, and may allow other mangrove areas to be influenced by the tide. If done improperly, large areas of the pond can turn stagnant, resulting in fewer areas for fish to thrive and no increase in tidal flushing to the mangrove area.

As part of the planning process discussed above,

#### *Reminder*

***Pond modification involving significant earth movement is subject to the Environmental Impact Assessment System (EIAS) Law***

the PO will already:

- Know the level of high and low tide at the dikes. If the dikes are already breached or if the water control structures are open, the PO should have a good idea of water depths inside the area.
- Know where the dike blocked former creeks, streams or channels.
- Know the location of mangrove areas blocked by the fishpond dikes.
- Know the relative locations and depths of holes and channels inside the pond.
- Most importantly, have a plan about how they wish to modify the pond.

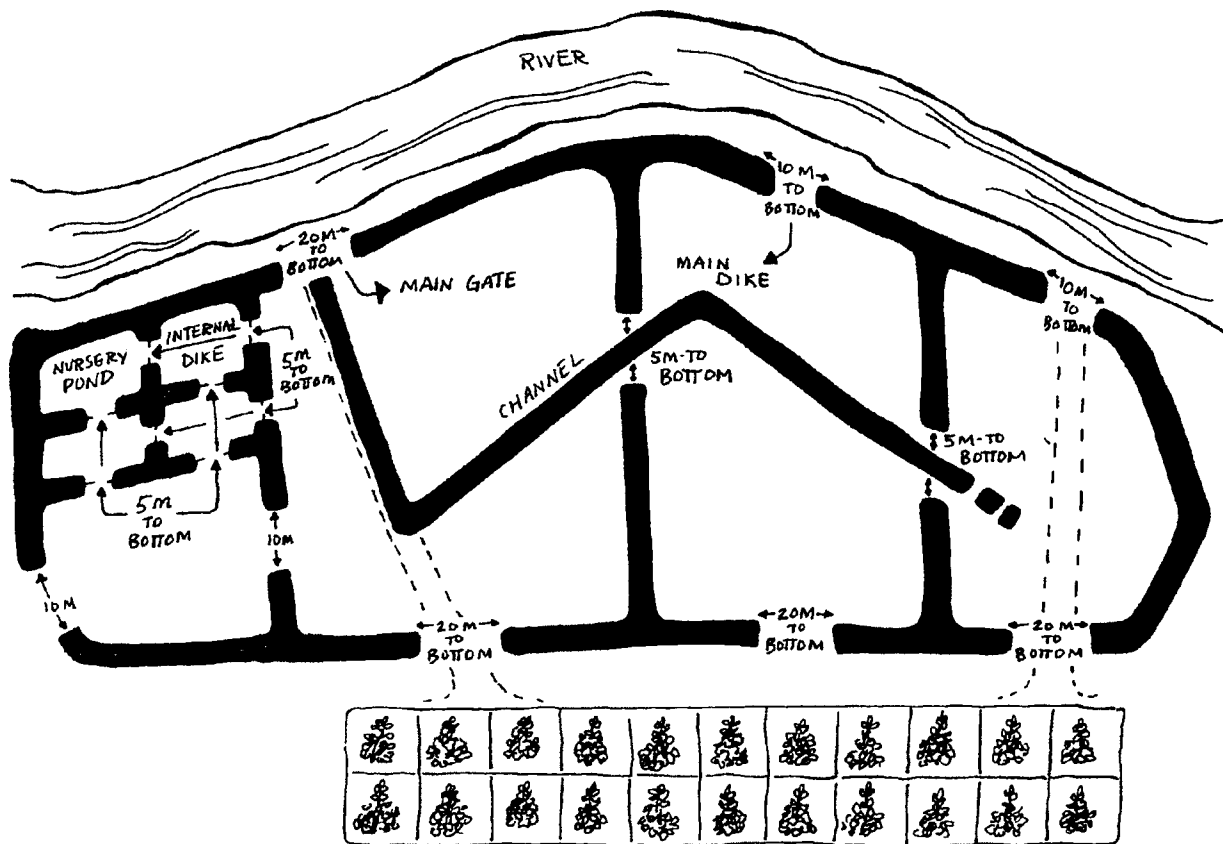
This information answers these questions:

- Where will dikes be broken?
- How much height and how long a section of dike will have to be modified?

These answers represent the two key determinants in planning how much work will have to be done to modify the dikes. These in turn will help the PO avoid the problems that go with creating areas of stagnant water.

### *Remember*

*It is important not to create any areas of stagnant water when you break open the dikes. You will need to watch the pond for several weeks to make certain that this does not happen.*



*Figure 5.4. Sketch map of fishpond, complete with dike modification directions.*

water in the pond. Figure 5.4 shows a sketch map that provides all the information needed for a crew to go about modifying dikes.

It is not necessary (at least in most cases) to excavate the entire dike area. In Figure 5.4, only about 150 linear meters of dike need to be excavated. Assuming there are 6.5 cubic meters of soil for every linear meter of dike, only 975 cubic meters of dike soil need to be dug to allow for adequate tidal flow.

In the above situation, a crew of eight men should be able to remove that amount of soil in approximately 25 days. The tools required include picks, shovels and mattocks (long spikes). While this is a significant amount

### ***What Do We Do With All of This Soil?***

***The soil that is excavated out of the pond and its dikes can be a valuable resource. The PO can use it to change the pond elevation in other areas to make it shallower and therefore easier to plant.***

of work, it is not necessary that it be done all at one time. It can be done over 1 or 2 months as time permits. There are a few “rules” that should be followed when preparing to dig and when digging.

## **Modifying the Pond Floor**

The bottoms of fishponds are seldom smooth and featureless. They often have channels left over from old streams, canals engineered for water control purposes and deeper and shallower parts because of the original pond topography. It is generally unnecessary to modify these features if all the PO wishes to do is create a mangrove plantation.

However, in cases where mangrove-friendly aquaculture is desired, it is often necessary to perform some level of modification. There are cases where the pond bottom is so deep or shallow that it is virtually impossible to modify to the extent needed for successful mangrove-friendly aquaculture. In these cases, the PO should content itself with a plantation only.

As detailed below, mangrove-friendly aquaculture does not require extensive modification of the pond bottom; the intent is not to perform full-scale aquaculture but to provide havens for fish and other organisms. Figure 5.5 shows a completed sketch map indicating where the dikes should be breached and where the pond bottom should be excavated and filled in. The soil should be placed at the back (landward) edge of the pond. This will help to modify the average depth in this area and allow a different species of tree to be planted.

Since full-scale aquaculture is not allowed, the PO should take full advantage of the unevenness of the pond bottom and such features as old stream beds and water control canals when designing their deeper areas. This may involve:

### ***Rules for Excavating Dikes***

#### ***During Planning***

- ***It is crucial to ask your DENR and BFAR extension agents to evaluate your plans.***
- ***Make certain to excavate on either side of any gates. This will lessen the amount of digging you need to do. (Note: if you intend to keep the gates operational do not excavate in this manner.)***
- ***Make certain that you have approximately the same length of excavation on the landward and seaward sides of the ponds.***
- ***Whenever possible, stagger the openings so that the landward and seaward openings do not directly face each other.***
- ***Whenever possible, try to reopen creeks or streams that passed through the pond.***

#### ***During Implementation***

- ***Excavate from the top of the dike to the bottom.***
- ***Place the soil along the inside margin of the dike to help form a shelf for future planting area.***
- ***Alternatively, if you know that there are low points in the pond, stockpile the soil and move it to the low points to fill them.***

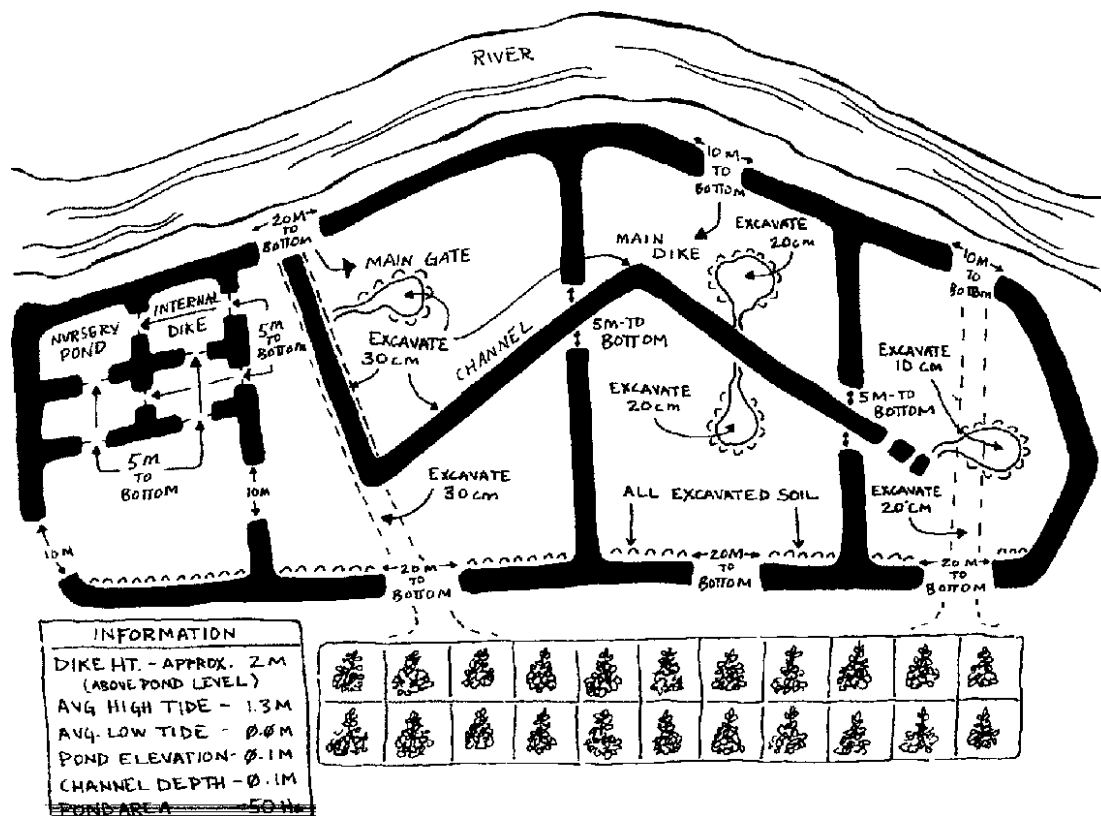


Figure 5.5. Sketch map as shown in Figure 5.4, but with further information.

- Deepening water control canals or former stream beds
- Deepening and widening depressions into holes that are several meters in diameter
- Excavating small feeder canals to parts of the pond to extend water flow

Take an area of approximately 1.5 hectares, for example, with an average excavation depth of 20 centimeters. This means 3,000 cubic meters of soil will be excavated. Place the soil at strategic points around the pond to change the elevations as desired. Moving this much soil will take an 8-man crew about 75 workdays. However, as in the case of the dikes, this task can be spread out over a long period of time, even a year or more. As parts of the area are excavated, they can be used immediately for mangrove-friendly aquaculture.

*Hint*

*The excavated soil can be used to modify areas that are judged to be too deep to support planting or to change the relative depth of the water to allow another species to be planted.*

## MANGROVE-FRIENDLY AQUACULTURE AS MANAGEMENT OPTION

Mangrove-friendly aquaculture (MFA) or aquasilviculture/silvofishery is the raising of mudcrab/shrimp within or under the mangroves. It can be a good

management option when fishponds in CBFMA areas are already restored. In the Philippines, MFA is relatively new; two types appear promising:

### Mudcrab Fattening

Mudcrab fattening involves the collection of adult crabs that are large enough to sell in the market. However, the crabs demand a much higher price per kilogram if they are held for several weeks and fed until the crabs become “fat”. When well fed, a crab will have much more meat and will have fat-rich deposits that are in big demand. Thin crabs of 100-170 grams can be fattened to 250-350 grams in 15-20 days if fed 2-3 times/day with trash fish equivalent to 5% of their body weight. The challenge is to find ways that the crabs can be maintained, fed and harvested. Pilot projects using plastic mesh cages are underway but the cost may prove prohibitive. Other approaches, perhaps without cages, might be more profitable. Finding suitable food for the crabs can also be difficult.

### Mudcrab Pen Culture

The second approach to crab aquasilviculture involves buying small, young crabs and placing them in a pond/canal or on a central platform where they are allowed to grow for months until they are big enough to be harvested and sold. (Stocking density is 3 crabs per square meter for 70-gram crabs.) A study in Indonesia by Fitzgerald (1997) shows a layout of a pond (see Figures 5.6 and 5.7). The trials have a stocking density of juvenile crab (7-11 or 16-20 grams), 1.5 per square meter for the pond grow-out culture and 2.0 per square meter for pen

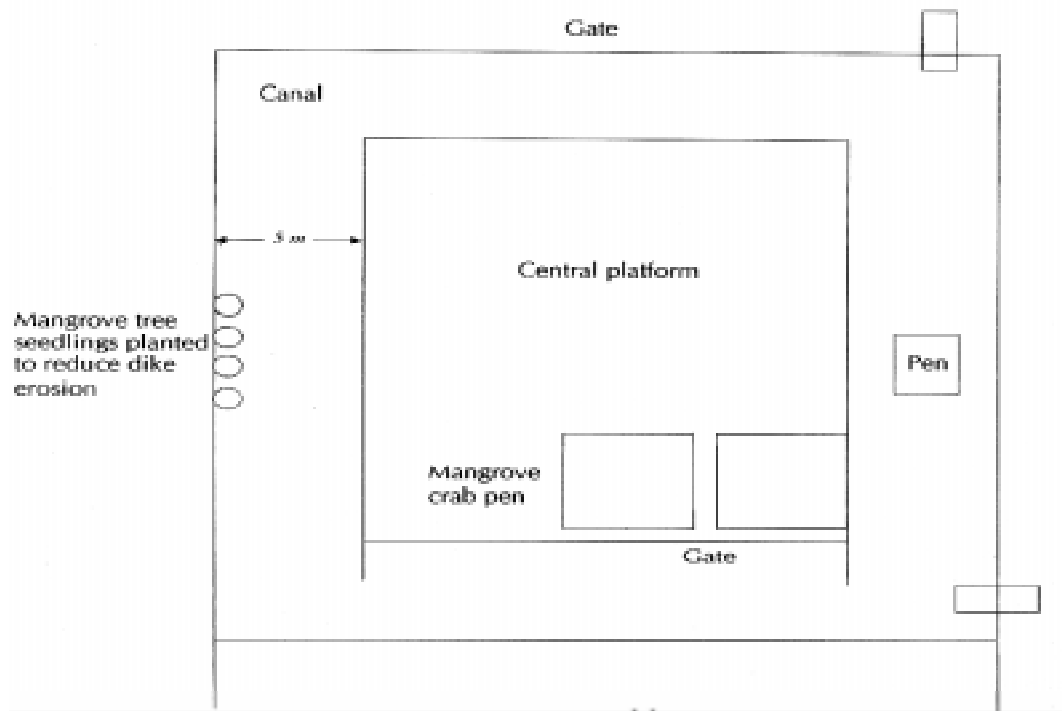
culture, with males and females grown separately (SEAFDEC, n.d.). Another recommendation includes 3 clays, soil, water temperature of 23-32°C, 15-30 ppt salinity, a minimum of 4 ppm dissolved oxygen, pH of 8 to 8.5 and water depth of 80-100 centimeters or more.

Mudcrab culture is becoming popular in Bohol where big mangrove areas with sufficient freshwater input are available. The CRMP has started a 3-day training on mudcrab culture to CBFMA holders to augment the income of the POs and be able to concentrate on forest production activities.

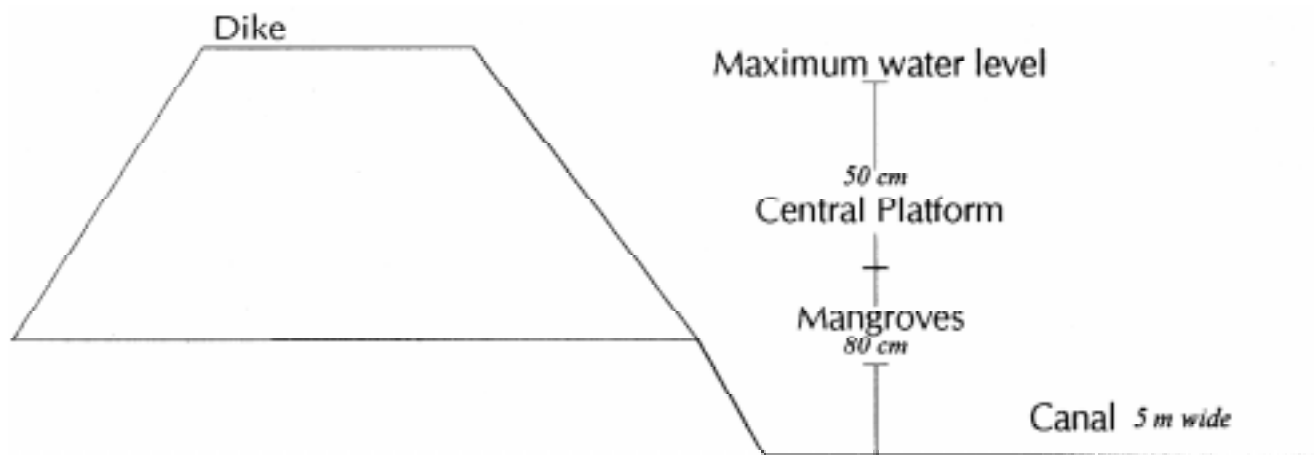
The central platform is planted in *bakauan babae* (*Rhizophora mucronata*) at a spacing of 0.5 meter; one crab pen is located on the platform and one in the bottom of the canal. The PO can also raise shrimp and fish from natural stocking that enters with the tides. In Kalibo, Aklan, the Southeast Asian Fisheries Development Center (SEAFDEC) has also proven the viability of mudcrab pen culture with a 10 x 20-meter enclosure (bamboo and nets) in a 6-year old *bakauan* plantation. But mudcrab culture is a new technology; the PO should be very cautious before adopting it. Talk with the BFAR extension agent and find places to do cross-visits before investing any significant amount of time and effort in this approach.

As we have tried to indicate throughout this chapter, aquasilviculture is a new technique in the Philippines (and elsewhere in the world). While it holds promise, no PO should “put all its eggs in one basket” and go full-scale in adopting the techniques described here. A low intensity approach is best.





*Figure 5.6. Empang Parit pond layout in Sinjai.*  
 (Source: Fitzgerald 1997)



*Figure 5.7. Cross section of Empang Parit pond at Sinjai.*

(Source: Fitzgerald 1997)

# Chapter 6

## Resource mapping of mangroves

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### INTRODUCTION

**T**his chapter provides COs, NGOs and other interested groups or individuals with information to assist POs in developing maps that can be used in applying for Community-Based Forest Management Agreements (CBFMAs) and in managing CBFMA activities.

The process used is based on the mapping methods in the Coastal Resource Management Project's Participatory Coastal Resource Assessment (PCRA). The PCRA method broadly maps a variety of resource uses and issues that are important on the *barangay* and municipal-levels. This book focuses that method on developing maps useful for managing CBFMAs. Most of the text was adapted from Walters et al. (1998).

Maps are among the most important tools used in planning and implementing CBFMA projects. Without maps, it would be difficult to understand the many variables involved in planning. With maps, the extent and condition of resources can be represented and analyzed, areas for various uses can be plotted out, infrastructure and other interventions can be spatially enhanced and the localities can be identified for possible problems, issues and conflicts.

This chapter explains how to develop maps by working with POs to transfer their knowledge onto a map by identifying the issues that are important and need to be depicted on the map, and by gathering the necessary technical information for a useful map. The next section explores why we need maps. The final section discusses what types of maps can be produced and how to produce them.

## WHY DO WE NEED MAPS?

Maps are important visual information for the POs, allowing more effective communication between the stakeholders involved in developing and managing the CBFMA. Maps can help when verbal communication is constrained by differences in background, education and world view. Indeed, mapping is one of the most appreciated and successful strategies for eliciting information from local resource users. The members of the PO, therefore, must understand maps and their spatial value to best manage their CBFMA resources.

Maps are useful in the CBFMA process at a number of points. First, a map is needed to complete the Community Resource Management Framework and Annual Work Plan. Second, maps provide the PO with a tremendous capability to manage the resources under their control. For example, this chapter gives the PO a basis for planning resource use including lumber, fishing, fodder production and other activities, a baseline against which to judge progress and make changes as needed.

## WHAT TYPES OF MAPS CAN WE PREPARE AND HOW DO WE PREPARE THEM?

Maps developed through the PCRA process can be divided into three basic types: sketch maps, base maps and field maps. Each has its own use. Typically, as a first step, a CO may ask a group of mappers to quickly draw a sketch map to help get an idea of the resources in a given area. Drawing over a base map that has been prepared will provide greater detail of familiar landmarks in the area and allow the group to develop a map that is already to scale. Field mapping is done to check the quality of the base map and to make certain that all the important information is captured. The box provides more discussion on each of these mapping activities.

The standardized mapping format shown in Table 6.1 can be used in all three map types. The approach divides the elements to be mapped (on one map) into

*Sketch maps are freehand drawings that can reveal much about the coastal areas in the maps and the people who draw them. They can be particularly useful in the early stages of developing the CBFMA map. Since sketch maps start as a blank piece of paper they provide the least biased view of how mappers perceive their surroundings, a glimpse of the mappers' "mental maps" of the coastal environment. Typically, these maps are only done when no base map is available.*

*Base maps are maps that show features such as coastlines, rivers, roads and villages. They orient the cartographer to the area and provide a consistent scale to draw in additional features such as mangroves, seagrass beds, fishponds, wood cutting areas, nipa plantations and channels. Base maps are often produced by government geological or navigation agencies or may be barangay cadastral maps. If the precision and the scale are adequate, these maps serve as the best vehicle for accurately representing the CBFMA area.*

*Field map verification is also known as groundtruthing. This method is used by individuals or small groups after at least some drawing over base maps has been accomplished. The basic idea of field mapping is to move around in the management area, either on foot or in vehicles, to verify and further refine maps from earlier exercises.*

several basic categories:

- .. Tree zones
- .. Average density and height of trees per hectare in the zone
- .. Resource uses
- .. Problems, issues and conflicts
- .. Other features

Tree zones are shown as shaded areas. *Resource uses* and *Problems, issues and conflicts* are depicted on maps where they are known to occur as numbers, letters and letter-number combinations. In preparing the map for presentation and distribution, letters and numerals can be replaced by symbols if that will make the map clearer. Table 6.2 shows tables of codes that should be used when identifying resource uses or issues. The last category, other features, can be depicted as shapes or lines depending on the nature of the feature to be

**Table 6.1. Map format for Community-Based Forest Management Agreement map development.**

Map element	Type of information	Presentation format
Tree zones	Identify the top three species of trees in major zones within the area.	Various colors to represent the major tree zones.
Average density and height of trees in the zone	Determine the average density and height of each species per hectare in each of the zones.	Two numbers within each zone representing the approximate number of trees and their average height for each of the three top species on a per hectare basis.
Resource uses	Determine the area's resource uses. Examples include fishpond, saltpond, nipa cutting, firewood cutting, woodcutting of other types, shell gathering, fry gathering, amatong and fishing.	Two-letter codes representing the identified resource uses in specific areas in the forest.
Problems, issues and conflicts	Determine issues of concern in the area. Examples include abandoned fishponds, illegal fishponds and illegal development of housing or other areas.	Two-letter codes representing the identified issues. A number from one to five can be added to indicate the severity of the issue.
Other features	Determine the location of channels, abandoned and operating fishponds, neap high and low tides, freshwater sources, etc.	Other features are typically drawn on the map using defined line styles.

**Table 6.2. Map codes and colors.**

**Table 6.2a. Color codes used in Participatory Coastal Resource Assessment maps of Coastal Resource Management Project learning areas.**

**Habitats - color codes (12)**

Mangrove	-	dark green
Seagrass	-	light green
Beach	-	yellow
Rocky shoreline	-	brown
Mudflats	-	black
Inshore flats	-	orange
Coral reef	-	red
Estuary	-	blue
Marine waters	-	light blue
Passes/channels/deep ocean	-	dark blue
Offshore sandbar	-	yellow green
Terrestrial area	-	light yellow

**Table 6.2b. Suggested codes for traditional fishing methods, illegal activities, other traditional and subsistence fishing methods (T1-T100).**

T1	Bagnets	T17	Fish corrals	T30	Purse seines
T2	Barricades	T18	Fish pots and crab pots	T31	Push nets
T3	Beach seines	T19	Fish shelters	T32	Rakes and dredges
T4	Blanket nets	T20	Hand instruments with curved blades, forks, hooks, etc.	T33	Reef seines
T5	Bottom set gill nets	T21	Harpoons	T34	Ring nets
T6	Cast nets	T22	Hook & lines/handlines/droplines	T35	Round haul seines
T7	Cover nets	T23	Hoop nets	T36	Scoop seines
T8	Cover pots	T24	Jiggers	T37	Scoops
T9	Crab lift nets	T25	Lever nets	T38	Set longlines
T10	Dip nets	T26	Lights	T39	Skimming nets
T11	Dredge nets	T27	Multiple hook and line	T40	Snares
T12	Drift gill nets	T28	Pole and lines	T41	Spears
T13	Drift longlines	T29	Pull nets	T42	Stop seines
T14	Drive-in nets			T43	Trammel nets
T15	Encircling gill nets			T44	Trap nets
T16	Filter nets			T45	Troll lines

**Table 6.2c. Illegal fishing/uses (IF1-IF50).**

F1	Drive-in net with bamboo/tree trunk scare devices ( <i>kayakas</i> )	IF12	Harvest of manta rays
IF2	Drive-in net with weighted scarelines ( <i>muro-ami</i> )	IF13	Harvest of marine turtles and eggs
IF3	Electrofishing	IF14	Harvest of milkfish (60 cm and over)
IF4	Explosives	IF15	Harvest of triton shells ( <i>tambuli</i> )
IF5	Fine mesh nets (less than 3 cm) for unexempted species	IF16	Harvest of whale sharks
IF6	Fishing in closed areas (e.g., fish sanctuaries, limitation on baby trawls, etc.)	IF17	Not honoring closed seasons
IF7	Fishing without license	IF18	Other gears (banned by local legislation, like baby trawls, modified Danish seines, beach seines, compressors, etc.)
IF8	Harvest of dolphins	IF19	<i>Pantukos</i> (tuckseine) with torch and/or flammable substance
IF9	Harvest of giant clams ( <i>taklobo</i> )	IF20	Poisons/obnoxious substances
IF10	Harvest of helmet shells ( <i>budyong</i> )	IF21	Superlights within municipal waters
IF11	Harvest of <i>kapis</i> ( <i>Placuna placenta</i> ) <80 mm using mechanical rakes, dredges and motorized boats	IF22	Unauthorized commercial fishing within municipal waters

**Table 6.2d. Legal but controversial fishing methods (perceived as destructive/depletive) (C1-C10).**

C1	Beach seines	C4	Modified Danish seines
C2	Compressors	C5	Other drag nets
C3	Drive-in nets with various scaring devices	C6	Trawls

**Table 6.2e. Other uses and activities (A1-A50).**

A1	Airports	A15	Lighthouses/beacons	A30	Public parks/plazas
A2	Anchorage	A16	Limestone quarries	A31	Research stations
A3	Banana plantations	A17	Mangrove plantations	A32	Resorts
A4	Breakwaters	A18	Mangrove timber cutting	A33	Rice paddies
A5	Coconut farms	A19	Military station/bases	A34	Roads, bridges
A6	Drainage canals	A20	Mineral extraction	A35	Salt beds
A7	Education reservations	A21	Navigation channels	A36	Sand and gravel extraction
A8	Fish cages	A22	<i>Nipa</i> harvesting	A37	Seawalls
A9	Fish landings	A23	<i>Nipa</i> plantations	A38	Seaweed culture
A10	Fish pens	A24	Oil refinery/depots	A39	Shellfish culture
A11	Fish ponds / Shrimp ponds	A25	Orchards	A40	Waste dumps/outfalls/effluent discharges
A12	Historical sites	A26	Port/pier/wharf/marina	A41	Watchtowers/observation platforms
A13	Human settlements/built-up areas	A27	Power stations		
A14	Industrial estates	A28	Protected areas (formal and informal)		
		A29	Public laundry areas		

**Table 6.2f. Common coastal resource management issues and suggested codes (IS1-IS100).**

IS1	Abandoned/unproductive fishponds	IS30	Lack of legislation
IS2	Beach/shoreline erosion	IS31	Lack of organization
IS3	Breakage of corals	IS32	Lack of security of tenure of land and/or home lot
IS4	Closed access to sea	IS33	Lack of social services
IS5	Coliform pollution	IS34	Landslide
IS6	Coral bleaching	IS35	Loss of rare/endangered species
IS7	Coral extraction	IS36	Low awareness
IS8	Crown-of-thorns epidemic	IS37	Low prices of fishery products
IS9	Declining fish catch	IS38	Mangrove conversion
IS10	Decreased estuary circulation	IS39	Mangrove overharvesting
IS11	Defoliation/loss of vegetation	IS40	<i>Nipa</i> overharvesting
IS12	Destructive fishing	IS41	Oil spills
IS13	Deterioration of aesthetic quality	IS42	Overfishing
IS14	Diversion of fresh water	IS43	Pesticide pollution
IS15	Dredging	IS44	Piracy
IS16	Encroachment on the fishing ground by outsiders	IS45	Reclamation
IS17	Eutrophication	IS46	Red tide
IS18	Fish diseases	IS47	Salt water intrusion
IS19	Fish kills	IS48	Shellfish contamination
IS20	Fishing gear conflict	IS49	Siltation
IS21	Flooding	IS50	Smuggling
IS22	Heavy metal pollution	IS51	Theft of fishing gears and accessories
IS23	High cost of fishing inputs	IS52	Upland erosion
IS24	Hunting	IS53	Use conflicts
IS25	Illegal fishing	IS54	Use right conflicts
IS26	Illegal fishponds	IS55	Waste dumping
IS27	Increased estuary salinity	IS56	Water turbidity
IS28	Lack of alternative livelihood activities	IS57	Weak organization
IS29	Lack of law enforcement	IS58	Wildlife trade

Source of all tables: Walters et al. (1998)

mapped.

COs can conduct mapping activities with an individual or a group. (The group size usually ranges from three to twenty people.) The basic procedures are the same with individuals as with groups, except that group activities have group dynamics that can work either for or against (or both for *and* against) the success of the activities. At this stage, the local ways of referring to resources, places and habitats should be known to COs. The classification system in Table 6.1 can be used in all mapping exercises to minimize confusion and maximize local input.

## WORKING WITH THE PO—THE MAP DEVELOPMENT PROCESS

Developing the map with the PO takes at least several days. It is important to brief the PO on the length of time it will take so that the members will not get discouraged.

The process involves four phases:

- Introductory
- Map development
- Field verification or groundtruthing
- Map finalization

**Introductory phase**—The introductory phase need not start at the very beginning. If the PO is already interested in a CBFMA and has a basic understanding of what is involved, discuss the importance of the map to the CBFMA and the PO planning activities as a starting point. In cases where the concept of CBFMA is introduced, however, it will be necessary to begin earlier in the organization process.

Spend some time with the group to determine what the members think of maps. Start by asking what they know about maps. Take a copy of the *barangay* cadastral map, or if one is not available, a provincial map, land classification map or nautical chart of the area, and ask them to identify some of its features.

**Remember to link the need for a map to concrete things so that the PO can see the usefulness of mapping. Emphasize that a map is required by the DENR as part of the CBFMA application and that the information gathered from the mapping exercise will help the PO manage the forest better.**

Depending on how well they do, discuss how to use and read a map. For example, if they can quickly point out the major landmarks of their *barangay*, then they are ready to move on to a discussion of map making. But if the map confuses the PO members, work with them until they can recognize major features of their *barangay*, and talk about making their own map. Explain what the scale is and ask them to point out how far it is between familiar places. Once they comprehend how to use a map, emphasize the importance of a map to the CBFMA application.

First, explain that without a map of the area, their application for the CBFMA will never be approved. Second, discuss that developing a map will help to understand what they have in terms of resources, where they might establish new mangrove plantations and what issues they might face within the community.

Inform the group that when the map is completed, they will know what types of trees are located in what areas. This information is useful in developing livelihood options and in determining where to establish new plantations. Issues can include people from another *barangay* who use the area for shell gathering or woodcutting, fishers who set nets just outside the area, illegal woodcutters and abandoned or illegal fishponds.

This phase usually takes 1 to 2 hours depending on the sophistication of the group. After the PO accepts the need to do a map, move on to the map development phase.

**Map development phase**—This phase is where the initial map is developed. The type of map made, sketch or base, depends on whether you have a map of appropriate scale. Borrow such a map from the Municipal Planning and Development Office and make copies to work from (blueprints are probably best).

Learn the historical use patterns of the mangrove

forest by asking the PO members how far back they can remember people working (e.g., cutting wood) in the forest. Have the group determine (1) what were the top three mangrove species harvested in the past; and (2) what was the average volume of wood removed per day (or week or month). Inquire if they have the same information for each subsequent ten years. Write their answers on a white board or flip chart so all the people can see the trend of the resource. (This is known as trend diagramming.) This information will be useful

***Remember, a sketch map is drawn freehand without any model to copy from; it typically contains exaggerations of various features and an inaccurate scale.***

***A base map is traced from another map and left blank. It shows the outline of the coast, rivers and other natural geographic features, and sometimes roads. Because it is traced directly from another map, it has no exaggerations or problems with scale.***

when deciding which species to plant in particular areas.

While members of the PO are collaborating on the map, see if everyone is participating. Often one person in the group will take over and tell the others what to draw. Should this happen, ask other members of the group if they agree with what is being said; if

***It is best to do the actual drawing of the map in a stepwise fashion. For example, after the area's boundary is agreed on, move on to what tree zones are present and what species are found in each zone. Next, determine the tree density (the number of trees per unit area) and estimate the average height for each of the top three species. Then focus on resource uses, issues and other features.***

disagreement surfaces, it is important to control it. Plan on spending up to one day developing this initial map.

***Field verification or groundtruthing phase—***Field mapping should take place as soon after the development phase as possible. A subgroup of those

who developed the sketch or base map should go into the field to verify the data on the map. Check facts as they are presented on the map and obtain additional data that the mappers did not know about. The amount of time this takes depends on the size of the area, how many people can work on it, and how many samples need to be taken. Plan on a minimum of one full day. (It could take as long as 5 days.)

***Map finalization phase—***Following the field verification phase, the field team presents its findings to the entire mapping group. Incorporate any changes and additions from the groundtruthing phase.

There are several ways to develop a final map. If geographic information systems (GIS) are available, submit the map to the GIS group and to develop a draft final map for PO review and validation. This copy should be done on a sheet at least 12 x 12 inches. If the map is drafted by hand, try to find a local artist or draftsman to render the map (the municipality may have such a resource).

## Developing a Sketch Map

When a base map is unavailable, a sketch map is an adequate substitute and relatively easy to make. All that is required is a large, blank piece of tabloid (28 x 43 centimeters) or larger size paper, marking pens or pencils (with erasers and sharpeners) and a comfortable place to draw. Many people tend to start drawing at a scale that is too large for the size of the paper provided and quickly run out of room. To avoid this, draw a box on the paper with a light-colored pencil, leaving wide margins on all sides. Instruct the mapper to keep the drawing inside the box and use the margins only when necessary.

People drawing maps often find it easiest to draw first those features of the coastal area that are most familiar to them, e.g., the way from their home to the market or to their fishing grounds. Distinct geographical features such as bays, river mouths and islands are also good starting points. When prompted to draw these features, the mappers will usually draw the coastline first, then add other features like mangroves, rivers, seagrass beds, roads and settlements. To avoid confusion, use the local ways of referring to resources, places and habitats. Coastlines are best drawn in black ink using other colors



(e.g., red, green, brown) to represent other aspects of the map. Figure 6.1 is an example sketch map for a mangrove area.

Sketch maps are most useful in locations or cases where base maps and aerial photos are unavailable and where there is a lack of knowledge or understanding of the local perspective on habitats and resource uses. Sketch maps also offer an insight on those elements that are most important to the local communities participating in the sketch mapping exercise. Once the sketch map is complete, the PO can use it as a planning tool for managing its resources.

## Developing a Map Using Base Maps

The best way to produce a base map is to use a GIS to draw a large-scale map that reflects the CBFMA area. See if such maps are available from the DENR or the Provincial Planning and Development Office (PPDO). Alternatively, you can use a *barangay* cadastral map or a map produced by the National Mapping and Resource Information Agency (NAMRIA) as a guide. Prepare the base map in advance of the mapping activity, ideally on tracing paper the same size as the base map. It is

extremely important that you identify a minimum of two latitudes and longitudes from the map. If you use a GIS system to produce your map, this information is needed to accurately depict your map. The basic goal is to produce a spatial guide to the area, leaving out those features that can be easily filled in by the mappers. A base map with pre-drawn black lines representing coastlines, rivers and roads and general bathymetry (water depth) is generally sufficient to orient the mapper.

The size of the area to be mapped determines the most appropriate map scale. For mapping areas for CBFMA, the best maps to trace have scales that range from 1:2,000 to 1:10,000. If a GIS-produced map is not available, the best source for a CBFMA base map is the *barangay* cadastral map on file in the municipality. If one is not available, it may be necessary to use a navigation chart of the area. These charts are produced by NAMRIA. Every effort should be made to locate a chart with a scale lower than 1:20,000 since this allows a good level of detail for the maps, allowing the community to relate more easily to the map's depictions.

Most maps (including the cadastral maps), from which base maps can be traced, show more detail than those required by the CBFMA. Details such as locations

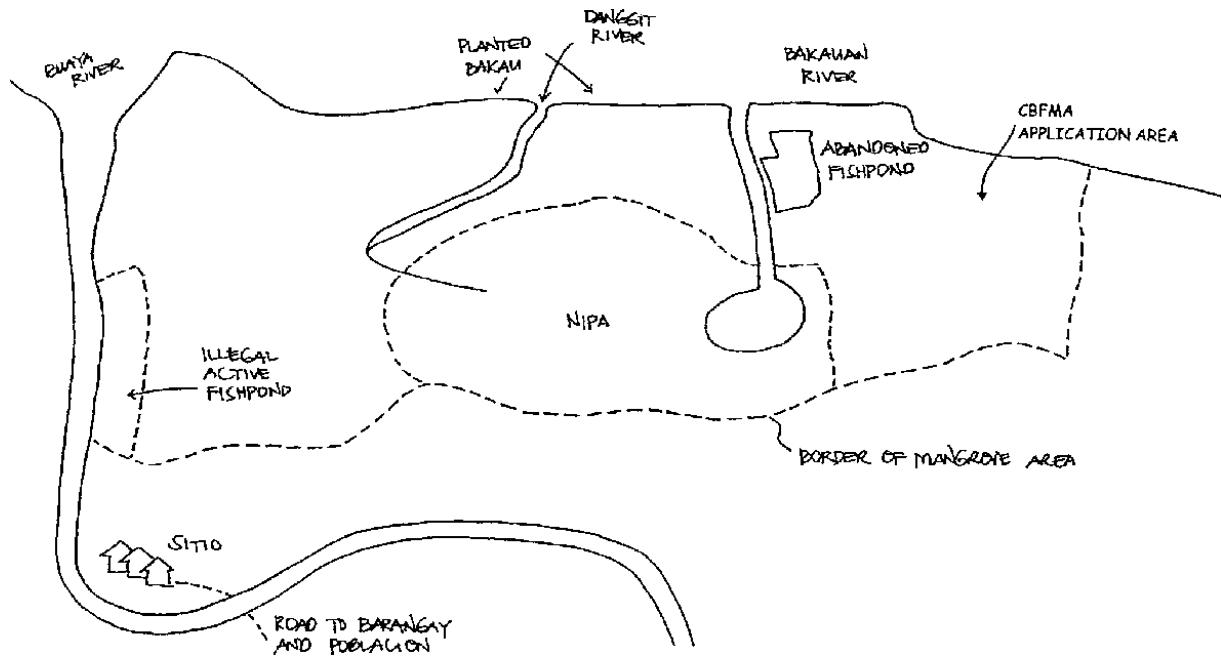


Figure 6.1. A sketch map.

### *Hint*

*It is wise to agree on a set color scheme and codes that all participants will use for all the features mapped. Recall the necessity of choosing features to be mapped that arise from previously determined classification systems for tree zones, resources and other factors (see Table 6.1). When drawing the maps, use colors to differentiate the zones. Using colors can help differentiate mangroves with significant remaining old growth from those having mostly secondary growth. Following the standardized mapping format previously discussed, numbers, letters and symbols can be used to indicate locations associated with various resources, uses and issues.*

of mangroves and seagrass beds, for example, should not be traced onto the base map, since that will defeat the purpose of the mapping activity. The goal is to record what local mappers know about the area, not what is reported by professional mapping agencies. The maps drawn by the mappers can be compared later with those done by professional cartographers. After completing the base map, make several photocopies (or blueprints) that can be drawn over by participating fishers.

Next, introduce the mapping process to the PO members developing the map (Figure 6.2). Orient the participants before the mapping begins, explaining that they are now going to improve on their sketch map. The map you are showing them was traced from another map of the *barangay* (or from whatever source you used). Point out some of the landmarks you copied on the map, then ask the group to identify some. Most mappers quickly understand the exercise, but mapping the coastline, especially mangroves, can be confusing.

After discussing the map, tape it to a table and cover it with mylar tracing paper in preparation for mapping the elements in Table 6.1. Begin with mapping the boundary of the total extent of the mangroves in the CBFMA application area. There may be several different opinions about parts of the country. It is important for two reasons. One, every person's opinion must be shown to have value to ensure the exercise is not perceived as under the control of a small elite. Two, an agreement begins to shape the ethic of people working together

### *A Word About the Mapping Process*

*Mapping is best handled as a group exercise. Peer consultation leads to better understanding of the terminology and more accurate location of map elements.*

*To begin, place the base map on a table. Take away all chairs to provide as much open space as possible. This allows the mappers to move freely around the map as they perform the mapping exercise. Before mapping each category, review the list of all elements within the category. For example, for habitats, list all types of habitats and assign a color code to each type. Be sure that no two types have the same color code and that colors are distinct to avoid confusion later. When the list is completed, map the elements one at a time, preferably in the order they appear in the list. In cases where few resource users are involved, mapping by smaller groups (one-on-one, for example) may be appropriate.*

toward a common goal. It will prove very important to the effective development and completion of the map.

Once agreement on the boundary has been reached, it is necessary to determine how many tree zones are in the area.

- Explain to the group that we need to know what types of trees are located in what areas.
- Tell them this is likely to be the most difficult part of the mapping process.
- Ask them to think about the areas within the forest where they know specific types of trees are found. For example, ask if anyone knows where there is a lot of *tangal*, *malatangal* and *busain*.

Table 6.3 gives some examples of what the group might produce in terms of zones of trees; Figure 6.3 shows how it might be depicted on a map.

At this stage, it will probably be impossible to determine the exact boundaries of these zones. Explain that the last step of the process, groundtruthing, will help to finalize the boundaries. Ask the mappers to

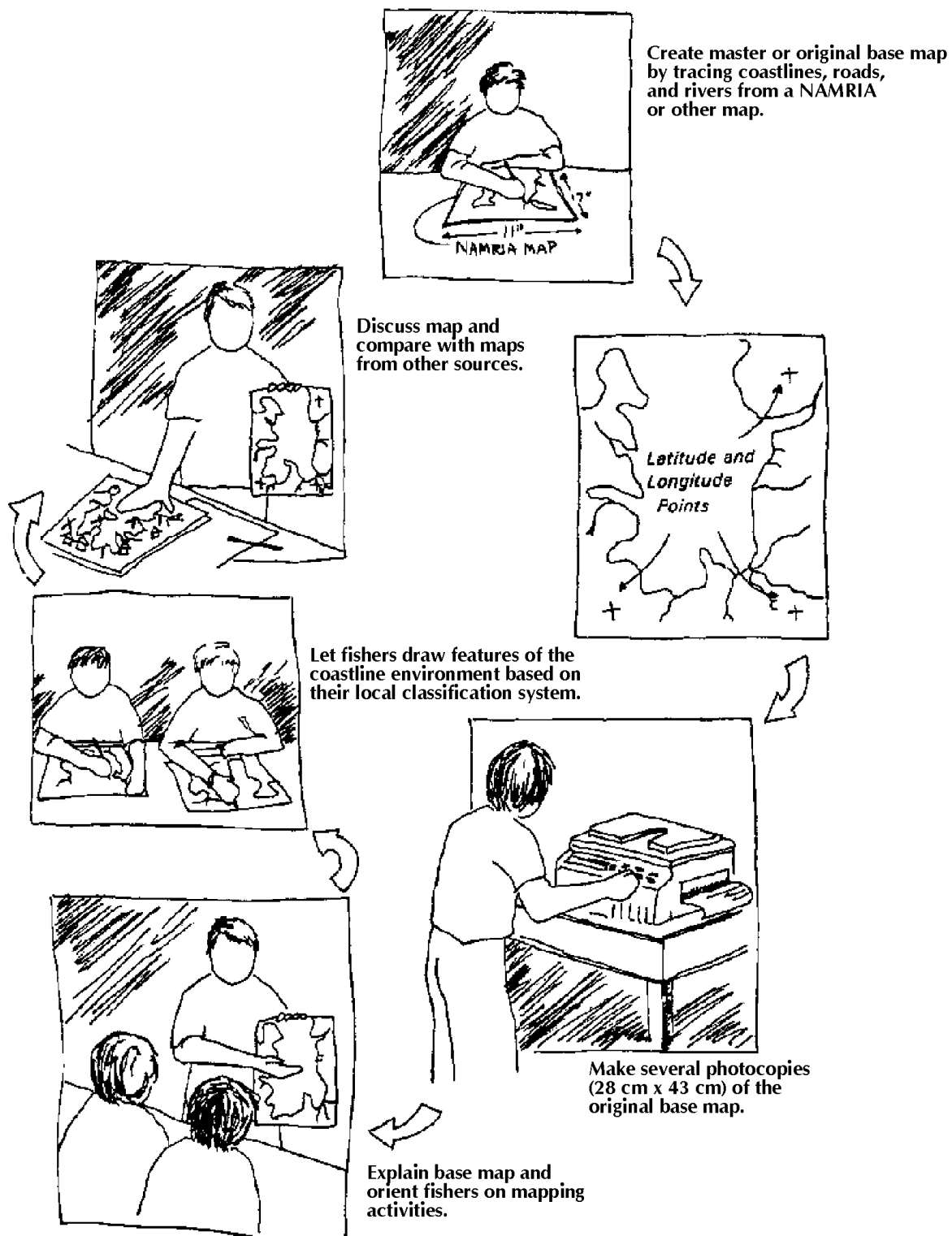


Figure 6.2. Base map procedures.

Table 6.3. Examples of tree zones.

Zone	Description
<i>Api-api, piapi, pagatpat</i>	In all cases, the first species represents the species that is most often found in the area.
<i>Bakauan lalaki, bakauan babae, piapi</i>	
<i>Tangkal, malatangal, busain</i>	There may be several more than the species listed but they make up more than 75% of the total.
<i>Tabigi, busain</i>	
<i>Nipa, api-api, pagatpat</i>	The last category should be seldom used.
Mixed	

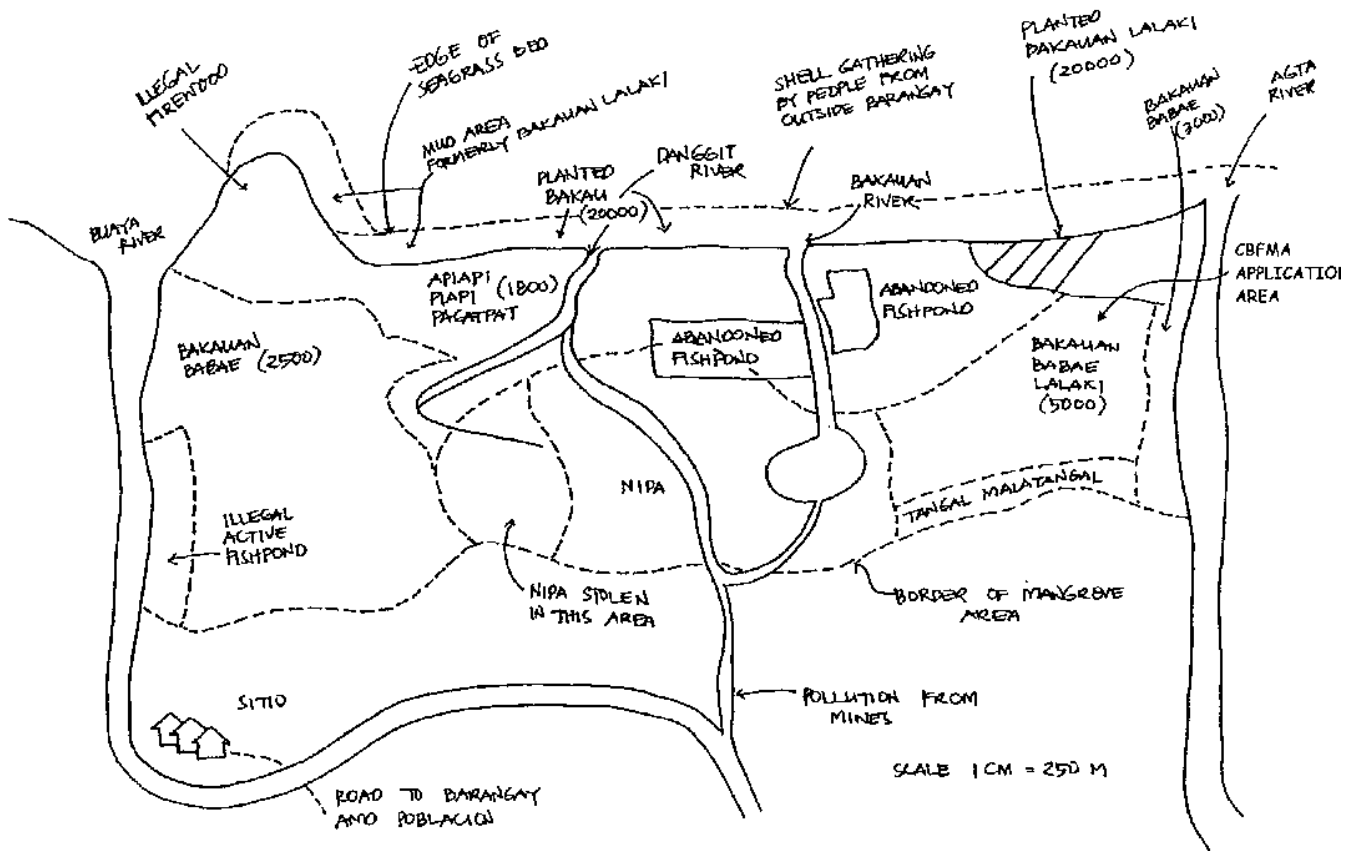


Figure 6.3. Land use map.

estimate the total number of trees per 100 square meters (show them what an area of 10 x 10 meters looks like).

Next, ask them to estimate the average height of each species.

Tree zone information should also be transferred to the map. For each species, create a small box with the name of the tree, estimated number and average height;

<i>Bakauan bato</i>	40	7	meters
<i>Bakauan lalaki</i>	25	4.5	meters
<i>Piapi</i>	5	6	meters

draw the box within the zone or next to it with an arrow pointing to the zone. It should look like the following box:

The first column is the name of the tree; the second, the number in the area; and the third, the estimated average height.

The group should now have a map that looks similar to Figure 6.3. While this is a good start, it is not complete. Ask the group to identify all of the current uses, resources and issues within the forest. Uses include not only the cutting of trees or harvesting of *nipa* but also such CBFMA area activities as fry gathering, shell gathering, fishing, fishponds (legal, illegal and abandoned), etc.

***Part of the mapping exercise is to make certain that the PO has identified all the legitimate resource users. This includes part-time users from within the barangay and outside it. All have a right to a livelihood.***

Be sure to ask the participants if the people practicing these livelihoods are members of the PO. If they are not, it is extremely important that the PO attempts to include them. Even people who are outside of the current organization have a right to continue their livelihoods.

Problems, issues and conflicts are mapped next because they logically follow the mapping of resources and uses, and because they are the most abstract of the

mapping elements. The capital letters “IS” followed by a number may be used to represent the issues as shown in Table 6.2f. The reason that the codes are not sequential is that the table is based on one from the *PCRA Handbook* and unnecessary issues (such as dynamite fishing) have been removed.

The “other features” may be entered as people determine what they are. Once again, the majority of the group must agree on these features and their location. Other features can be extremely important to the overall success of the CBFMA. For example, it is important to be able to locate any channels (large or small) in the forest since they may allow for several forms of mariculture. Also, the location of the average and highest high tides and low tides is crucial to planning additional planting activities. Other types of features may be more or less important depending on the area in question. Sometimes it will be necessary to locate other features in the field. The section on *Field Mapping/ Groundtruthing* gives details on how this is done. Figure 6.3 also shows a finished map showing all of the information discussed above.

Once the mappers incorporate all features on the base maps, show participants the details from existing printed information sources (such as the NAMRIA maps) and compare them to the maps just drawn. Comparing the maps developed by the PO to the NAMRIA maps is usually a positive experience as the group sees the strong similarity between their maps and the maps produced by experts.

While these similarities are often striking, much can be gained from examining the differences between the local and expert maps. As with PCRA results, look for new or different information on spatial details (e.g., small fishponds), details on features that vary over space (e.g., old growth vs. previously logged mangrove), and features that vary over time (e.g., locations of seasonal fishing activities in the mangrove forest).

After group members examine expert maps in comparison to their own, they often wish to amend their maps based on those features more accurately depicted on the expert maps. This should be encouraged provided the original maps are retained for reference. What usually results from the verification and correction process is a composite map of expert and local perceptions, often

more accurate and useful than either map considered separately. Expert maps can provide exact scales, overall distributions and consistent locations. Locally drawn maps can add critical details and locally significant and relevant features that make them useful for CBFMA planning purposes.

### Developing a Field Map— Groundtruthing the Base or Sketch Map

Field mapping, also known as groundtruthing, is used to check the accuracy of the PO map. This involves walking through the area to compare the reality of what is seen in the walk to what is on the map. This is usually accomplished with only a few of the people who worked on the base map. Figure 6.4 is an example of a completed field verification map.

Signboard maps can be prepared after the base map. Box 6.1 presents information on how to prepare signboard maps.

Groundtruthing involves determining if the PO’s map reflects what is actually in the forest. There are varying levels of effort the PO can use to perform this. The activity with the least effort is a walk-through of each of the forest areas identified in the map to see if they possess the characteristics of the map. The activity with the most effort involves sampling anywhere from 1% to 5% of the total forest area to identify tree species, size and height.

For a CBFMA, the first approach is appropriate because the application does not require any details about the composition or characteristics of the forest. However, in a few months when the PO begins to write the Community Resource Management Framework, the Annual Work Plan and the Resource Use Plan, a much higher level of forest characterization will be needed.

*Low-intensity groundtruthing*—This involves locating the tree zones identified in the PO map to

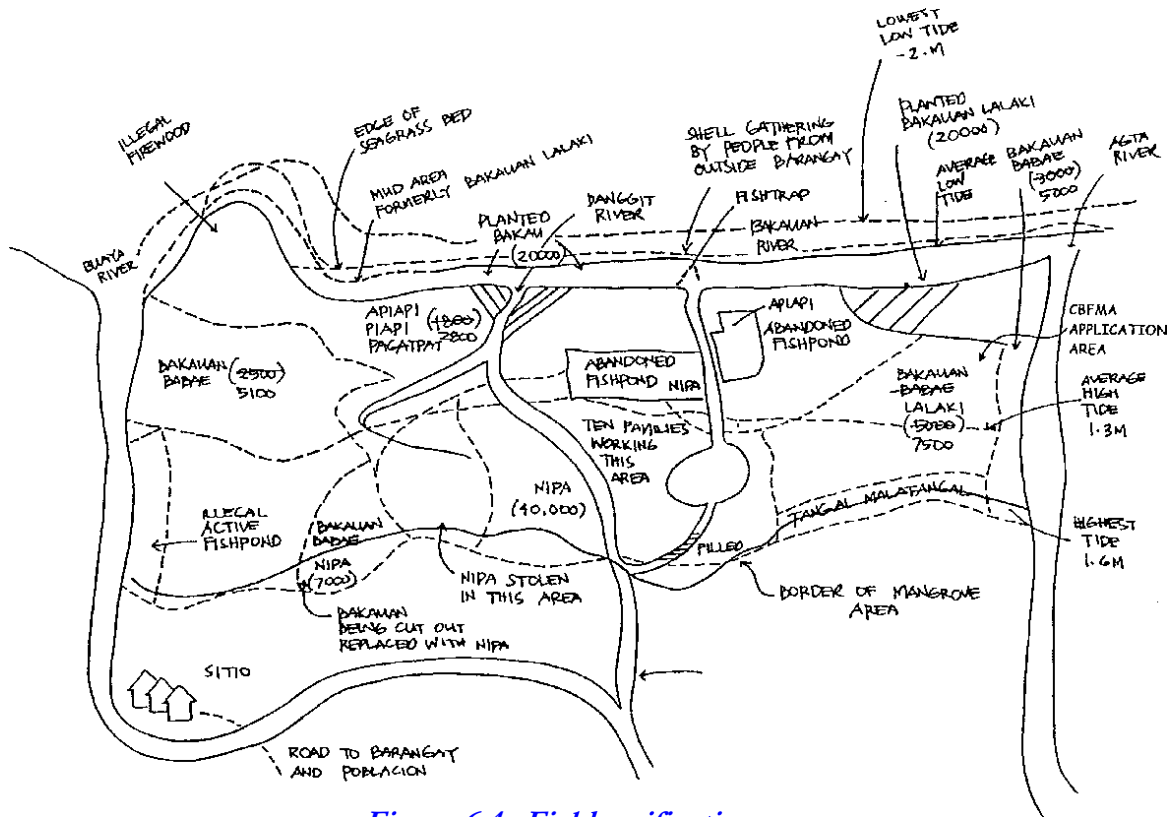


Figure 6.4. Field verification map.

### Box 6.1 Making a map for display.

For planning and education it is often useful to produce a large map of the management area on a signboard or poster. Signboard maps are produced in a group setting after fishers have finished drawing over the tabloid-size base maps. The exercise is similar to that of drawing over base maps, except that the base map used is much larger and usually prepared in a different way. Signboard maps should be at least 120 cm x 120 cm and are best made of marine plywood with a 2.54 cm (1 inch) or larger border around the edges to give it strength and durability. It is best to hire a professional signboard artist to prepare the signboard base map, but a resourceful CO or community member can also handle the job. Since it is impossible to trace through a signboard, the lines of the map must be transferred from a reference map using a scaling or grid technique. Follow these steps:

1. On a tabloid-size (28 cm x 43 cm) sheet of paper, prepare a base map showing coastlines and a few other features, such as rivers and roads, to help orient the mappers.
2. Draw a grid of squares on the map so that each square measures no more than 2.54 cm x 2.54 cm (1 square inch).
3. Calculate a multiplication factor by dividing the length of the longest side of the base map into the length of the longest side of the area in which the map is to be drawn on the signboard (leave space on all the edges of the signboard for a border).
4. Multiply the size of the squares on the pa-

per base map by the multiplication factor to calculate the corresponding size of the squares to be drawn on the signboard. For transferring a tabloid-size base map onto a 120 cm x 120 cm signboard, one can draw a grid of 2.54 cm x 2.54 cm squares on the base map and a corresponding grid of 6.4 cm x 6.4 cm squares on the signboard. (120 cm divided by 43 cm is 2.8, which can be rounded down to 2.5 to leave room for a border; 2.5 multiplied by 2.54 cm equals 6.4 cm).

5. Draw the square grid on the signboard using the size of the squares just calculated (e.g. 6.4 cm x 6.4 cm).
6. Going square by square, copy the lines on the base map into the squares on the signboard using the lines of the squares as guides to the placement of the map features.

After the basic lines have been drawn on the signboard, paint of various colors can be used to fill in the map (for example, light green for seagrass and green for mangroves).

Fishers can then begin painting the features they mapped on their paper base maps. (The job is easier if the fishers tape their maps on a corner of the signboard base map, so they can glance from one map to the other as they paint.) Fishers are typically good painters and should have little trouble transferring the features of one map to another. Enamel paints, available from most hardware stores, are best for the job.

determine how close the composition of the zone reflects the information on the map. To do this, a small group from the PO goes to the forest and visits each of the zones identified on the map.

A single group of three to four people should be identified for this task (in case it cannot be accomplished in a single day those with experience can return to the task later). It should be composed of the people who frequent the forest on a regular basis. Good candidates include firewood gatherers, *nipa* harvesters and shell gatherers.

Once a group is assembled, develop a plan on how

to do the work. As a group, determine:

- When to begin (day and time)
- The number of areas to visit
- The order of visitation
- How long it will take to complete the activity
- The need for a *banca* or pumpboat
- Who will record the information
- Who will check the information against the map
- Who will present the findings to the PO group

Next, decide how to record the groundtruthing information. A helpful form is provided in Table 6.4.

**Table 6.4 Data record form.**

Example data sheet (adapted from IIRR 1998).

**MANGROVE ASSESSMENT DATA**

**SITE/PO NAME** \_\_\_\_\_

**DATE** \_\_\_\_\_ **TEAM MEMBERS** \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

ZONE NUMBER	SUBSTRATE TYPE	MATURE TREE DENSITY	AVERAGE HEIGHT	OBSERVATIONS
		S1/DENSITY	S1/HEIGHT	
		S2/DENSITY	S2/HEIGHT	
		S3/DENSITY	S3/HEIGHT	

Upon completion of the groundtruthing process, compare the group’s findings to those placed on the map. Any necessary changes should be discussed with the PO in a general meeting. Then the map can be redrafted for submission in the CBFMA application package.

***Determining the average and highest high and low tides and their depths***—Knowing the range of the tide in your CBFMA area is important because:

- It helps to determine if there are additional areas for plantation.
- It helps to determine which species might succeed in a particular area.

To determine where tides reach in your CBFMA area, observe the heights of the tides over several tidal cycles. Box 6.2 provides a detailed discussion of how to measure tides.

It will be necessary to perform these activities more than once to get accurate tidal information for the map.

*Using tidal information from calendars*—To determine the approximate height of the tide and when the average low tide will be reached, use a calendar that lists tides. These are commonly available in fishing supply stores and it is likely that someone in the PO will have one.



## Box 6.2. How to determine tides.

### Using Tide Tables

#### What are tide tables?

Tide tables are written predictions of when high and low tides will occur each day, along with a prediction of how high or how low the water will be at the time. In the Philippines, most people are familiar with and can get calendars that have the time of high tides and time of low tides listed by date. There are many things you need to understand before you can properly use these tide tables to map your area.

#### Kinds of tides

*Daily and semidaily:* At most places and at most times there are two high and two low tides each day. The time of high tide and low tide is determined by the position of the sun and moon; their gravitational attraction causes tides. In some locations, there may be several days each month when there is only one high tide and one low tide. In other places, this occurs every day. However, most of the Philippines experiences two high tides and two low tides every day.

*Unequal tides:* Usually when there are two high and two low tides, they will not be the same. For example, it is normal for one high tide to be higher than the other high tide. The higher of the two is known as the Higher High Water, or HHW; the lower low tide is called Lower Low Water, or LLW.

#### Daily tides

On average, the low and high tides occur about 50 minutes later from one day to the next. (The moon rises about 50 minutes later each day as well.) However, this is just a rule of thumb and tides are very complicated. Use this estimate to determine when the tides will occur next day, but do not count on an exact 50-minute change. Instead, look at the tide tables carefully when using the tides to map.

#### Monthly tides

Each month there will be one or two periods of several days during which the HHW is very high, and the LLW is very low. These periods usually fall around full moon and new moon periods because at those times the sun and moon are working together to pull the tide higher. Most people who

live along the coast know this from watching the tides and moon every day.

#### Seasonal tides

Tides also change during the course of a year due to the ever-shifting angle of the sun. There are usually two periods when the tides are higher than the rest of the year. In the Philippines, the period of highest tides occurs around the end of June or early July. The annual highest high tides are called spring tides. The opposite, a low tidal period, are known as neap tides. Spring tides and neap tides occur in different months.

#### What do the numbers on the tide tables mean?

The number next to the time in tide tables is the expected height of the tide in meters (level is often used in place of height). If the table reads +2.4 (or just 2.4), for example, the water will be 2.4 meters higher than it will be on a low tide that is 0.0 meter. The 0.0 level is defined as the Mean Lowest Low Water (MLLW), or the average LLW as defined above. In other words, 0.0 is a standard level that corresponds to a typical lowest low tide of a typical day during the year. If people go out to the seashore on the day that a 0.0 tide is where the tide is at its lowest point on the shore, they would be standing at a level of 0.0. If they stood there as the tide came in, the tide would rise on them to the level predicted on the tide table. For example, if the tide table predicted that the high tide would be +2.5, the depth of the water would be very close to 2.5 meters.

#### Tide table locations

In the Philippines, exact tide tables are available only for areas near major cities like Cebu or Manila. Tides vary from location to location; even the shoreline can affect the tide. To say the tides vary means that the times may be different (the high and low tides may be earlier or later than at Cebu or Manila, and the levels the tides rise to or fall to also might be slightly different). However, using the tide tables for the city nearest to you should be good enough for CBFMA mapping purposes.

#### Estimating differences from tide tables

To estimate the difference between the tide tables and a specific location, go out and observe  
continued

**Box 6.2. continued.**

high tides or low tides by watching the water rise or fall on the shoreline or on a piling or stake. When the tide reaches high or low, note the time and see how much earlier or later the tide is than the tide table predicts. Then add or subtract the difference to determine high or low tide for the area. Often the time differences will vary slightly for high and low tides. For example, in a certain place the high tide might be 40 minutes later than the table predicts, but the low tide only 10 minutes later. People who live and work along the coast or shore are generally aware of the time difference. To actually learn the differences, measure several times for the high and low tides when it is not windy or stormy.

Weather

Be advised that weather can greatly change the times predicted on the tide tables. Storms and winds can push water against or blow it away from the shoreline. The same kinds of winds and storms can also delay the tide from coming in or going out, thus change the time when the tide is highest or lowest. When using tide tables to map or to adjust the tables locally, do so only during calm, clear weather.

Currents and time lags in rivers/streams/bays

Incoming and outgoing tides are very different from high or low tides. This is because some rivers, streams or bays are not filled up to the level of the sea when the tide starts to recede at the river mouth and sea. The sea can still be higher than the river for many minutes after the tide has started to fall. Because the sea is higher, the water continues to flow into the river and move inland, even though the time of high tide has passed. In that kind of situation, the high tide in the river, stream or bay is later than the time listed in the table. Similarly, the low tide will be different. For areas quite a distance from the sea, it is important to determine the correct tidal time for better mapping.

**Mapping Mangrove Areas**

One of the most important things to know and to map in a mangrove area is the elevation or the depth of water at high tide. Both mean the same thing when they are measured accurately. By understanding tides as described above, you can use them to accurately map an area.

Tide lines

Simple and useful map features are the lines indicating where the water is at low tide and high tide. Since one low tide can be lower or higher than another and one high tide can be higher or lower than others, standards are needed.

Standards

The standard for low tide is Mean Lowest Low Water (MLLW), the place the tide falls to when the low tide is 0.0. Mean Highest High Water (MHHW) elevation determination is not as easy. Because mangroves can grow even in places where the tide reaches only on the highest tides of the year, it is important to know where that line is on the map. At the same time, some mangrove species cannot grow well unless the tide reaches them almost every day; at least two standards are needed for high tide. Look at the tide tables and see what high levels are reached each month. Select a high tide number like 3.0 or 2.8 (about the highest tide that occurs every month). This is the high tide. It is important to record what elevation that refers to high tide.

Determining the MLLW line

*Low tide, ideal case:* The simplest way to determine the MLLW line is for several participants to go out on a day when the low tide is predicted to fall to 0.0. If the weather is calm, watch the water fall and record the low tide for mapping. For example, along a shallow shoreline the tide might fall until the water is 100 meters away from the mangroves at low tide (0.0). Along another stretch of shoreline where the water is deeper closer to shore the tide might only be 10 meters out from the mangroves at 0.0 low tide. It is important to have many people doing this at the same time because if you try to do it alone, the tide would come up before you could walk to other areas. Be sure to mark where the water's edge was for any land that was exposed during low tide, including sand or mud bars.

*Low tide, practical case:* There are very few low tides that fall to exactly 0.0. Those that do may be during the night or stormy weather (remember not to measure tide levels on windy days). Use the following technique to map the MLLW (0.0) line when the tide falls below (less than) 0.0. Go out at low tide

continued

**Box 6.2. continued.**

when the tide is predicted to fall to -0.5, for example. Watch the water recede and at its lowest put a stake into the mud at the water's edge. Use a ruler or measuring stick to make a mark on the stake exactly 0.5 meter up from the mud. Wait and watch the tide come in until it reaches the 0.5 mark; now the water's edge is back up to 0.0. Then do the same things as above, as if the low tide had only fallen to 0.0 meter. Record where the water is on the shoreline at 0.0 (when the ruler is covered up to the 0.5-meter mark).

Highest tide detailed map

The only way to accurately map the highest high tide line in detail is to actually be there when the tide is high. Again, many individuals will have to help, because so much area is involved. In fact, this may require a larger number of people and more days if there is an "island" within the area that the tide never covers. It is especially important to know where the high tide line is along all rivers and tributaries. This is a difficult task, and it may take several years to complete accurately because the highest tides only occur a few days each year.

The technique is simple. Place participants in select areas with some overlap. For example, if mapping how far the tide moves into a stretch of mangroves along a shore, walk through the mangroves, following the water's edge for about 15 minutes before and after high tide. When one person finishes at 15 minutes after high tide, he/she should reach about where someone else started 15 minutes before the high tide. This ensures that all of the shoreline is mapped without any gaps. Similarly, different people will have to walk along each side of any river, tributary or other areas where water extends into the forest.

Highest tide, approximation

Measuring the highest tide line takes a lot of work and time. It is something that should be done, but in the mean time, this information can be approximated. In most cases, there are people who spend a lot of time in the mangrove areas and know from memory where the highest tide line is. They can transfer this memory onto the community-based map. This could and should be incorporated into the process from the outset. Where there are gaps in knowledge/memory, it is possible to estimate the HHW line by walking through the forest along the interior of shorelines and observing the soil and floating debris that indicates where tides have

reached.

High tide, approximation

There is no apparent way to determine a high tide line without detailed measurements. Careful examination of mangrove forests on Bohol did not reveal any indicators, as sometimes occur in other wetlands (e.g., waterlines or periphyton lines on trunks). Therefore, the high tide line must be determined using the technique used to determine the low tide (MLLW) line.

High tide measurement and mapping

Once the standard high tide elevation (e.g., 3.0) has been selected (see above), the high tide line for this standard can be measured any time when the tide is at or above this level. Just like for the low tide measurement, things would be simplest if the tide was exactly equal to the standard (3.0, in this example) on the day the measurements are made. However, as in the case of low tide, the tide will not be exactly 3.0 on many days. Therefore, measurements can be made on any day the tide is 3.0 or higher, using a reference stake(s) as for the MLLW measurements.

In this case, go to the mangrove areas to be mapped a little before the time of predicted high tide and wait until the tide reaches its highest point. (The predicted level for that tide is already known; we'll use 3.5 in this example.) When the tide is at its highest, walk into water that is more than 0.5 meter deep and insert a stake. Measure down 0.5 meter with a measuring stick and make a mark on the stake at that point (one method is to use a *bolo* to cut a line into the stake 0.5 meter down from the water surface). Then watch the stake as the water falls. When the water level goes down until it is level with the mark, the water is now at 3.0, because it is 0.5 meter lower than what it was (3.5 meters in this example). However, if the person at that site waits until the water has fallen to the mark, he or she will be able to note where the water line is but will only see where the water is at 3.0 (or a little lower as the tide continues to fall). Therefore, the observer should not wait until the water falls to the exact mark on the stake. Instead, start the survey when the water is still about 0.2 meter (2 centimeters) above the mark. This gives the observer about 15 minutes to walk while the water is still within a few centimeters of

continued

**Box 6.2. continued.**

being at an elevation of 3.0.

Other tidal level mapping

The procedure described above can be used to map other critical elevations. For example, the optimal elevation for planting *apiculata* may be between 0.5 and 1.0 meter. The techniques described above can be used to map out areas between these elevations. Mark a stake at a known low tide, such that marks at 0.5 meter and 1.0 meter are placed on the stake. The marks would be located relative to the predicted low tide. For example, if the tide is predicted to be -0.1 meter, then a stake would be placed at a location slightly below the low tide line. The mapper measures up 0.6 meter from the water line at low tide, and makes one mark at 0.5 meter ( $-0.1 + 0.6 = 0.5$ ). A second mark would be made at 1.1 meters, and when the tide reaches that mark, the tide would be at an elevation of 1.0 meter. Then, when the water reaches the lower mark, the area is surveyed and possibly marked out with stakes. When the water reaches the second mark, the area is similarly surveyed and marked to indicate the upper extent of the area between 0.5 and 1.0 meter.

Reverse tidal mapping

Another important way that tides and water level can be used to map areas involves determining the elevations at which certain mangrove species grow. For example, certain species grow well in a specific elevation range. If that species is to be planted in the CBFMA area, it is best to plant at elevations where it is known to grow well. To determine the elevation, the same elevation mapping techniques described above can be used. When the location is far from the low tide line (e.g., a clump of mangroves several hundred meters in from the open water), a reference point is established at high tide by marking a stake located in the middle of the clump. Then mappers measure the distance from the water surface to the sediments next to selected trees. Do

this by attaching a measuring tape to a piece of bamboo or some other stick.

The following example demonstrates this technique. At high tide predicted to be 3.1 meters, a mark is made at the water surface on a stake. Using a measuring stick (marked in 0.1 increments or having a measuring tape attached to it) the distance from the water surface to the soil next to a tree is measured to be 1.6 meters. Thus, the elevation of the sediments by that tree is 1.5 meters ( $3.1 - 1.6 = 1.5$ ). This can be repeated at other trees in the clump. After a few minutes, the tide will have fallen. The distance from the mark on the stake to the water can now be measured. For example, the distance from the mark is 0.3 meter, because the tide has fallen. This means that the water surface is now at an elevation of about 2.8 meters ( $3.1 - 0.3 = 2.8$ ). If the depth of water next to a tree is measured at 1.1 meters, then the elevation of the soil surface there is 1.7 meters. In other words, the sediment had been at 0.0 and the tide was at 2.8, then the measuring stick would show 2.8 meters of water over the soil. Since the measuring stick showed only 1.1 m of water over the soil, the soil surface had to be at 1.7 meters to make up for the difference between 0.0 and 2.8. This method can be confusing; be sure you understand it completely before using it.

***Knowing the range of the average tidal height and the points where the lowest and highest tides reach allows your group to determine if there are potential plantation areas outside the mangrove forest. Be sure to include these areas in the CBFMA application.***

These calendars generally predict the tides for nearby large cities and will not tell you the precise time or exact range of local tides. But they will provide a good understanding of the general trend of tides in your area. The box shows typical tidal information found on a calendar.

Above the date are the day's expected high tides;

below, the day's low tides. The numbers after each time are the expected height of the tide. For example, reading the information in the box tells us that on the 1<sup>st</sup> day of the month the first high tide will be at 7:30 a.m. and will

7:30 a.m. 1.0 m	6:37 p.m. 0.9 m
<b>1</b>	
12:20 p.m. 0.3 m	1:24 a.m. 0.0 m

be 1 meter above the average low tide for the area. Note the day's second low tide height is 0.0 meters, or average low tide.

*Determining the height of the water and extent of low tide—*

This activity is done during the neap tide period. Since every place has a slightly different tide time and height it will not be possible to use the exact times and heights to predict tides. Use the calendar to determine the approximate time and height of local tides. Simply look at the heights of the low tides during the first and last quarter of the moon. These are the neap tides.

Go out to the CBFMA area with several people about an hour before the neap low tide is predicted on the calendar. Watch the level of the water fall until it falls no longer. Note the time this happens so you know how far off the calendar is from your location. Put

***The average low tide is also known as Mean Lowest Low Water (MLLW). As the tide goes out, the shore is uncovered. The average low tide represents the typical point at which the low tide exposes the tidal flat. This point is the reference for all other tide heights. Low tide can be a positive number, negative or zero. Experience in the Philippines suggests that it is safest to extend plantations only to the lowest tide lines of the year, or neap tide line, because the survival of trees planted below the neap tide line decreases significantly (due to the long amount of time spent wet).***

bamboo or *bakauan* poles along the edge of the water at approximately every 50 to 100 meters. The poles should be about 3 meters long. Push each stake into the bottom approximately 0.5 to 1 meter. This line of stakes will mark the neap low tide for your area.

Return to the site the following day to compare the height of the low tide on the stake with the calendar information. For example, if the calendar says low tide is 0.1 meter and the stake is covered by 30 centimeters (0.3 meter) of water, local tides are slightly higher than the place where the calendar was printed. You can safely add this difference to the calendar tides and predict low tides for your area.

*Determining the tide line and depth of high tide—*This too should be done during a neap tide period. Use the established low tide information to determine the high tide by observing when high tide goes back to the poles that were placed on the low tide line and recording how much of the stake is covered at high tide. If, at high tide, the pole is in 1.2 meters of water, that is the high tide. Notice the time difference between the calendar and the tide for your area to predict future high tides.

It takes a group of people to obtain this information. About one-half hour before high tide, put one person at the poles and then have people form a landward line at a spacing of about every 100 meters to the far edge of the CBFMA area. When the tide reaches its highest point, the person at the low tide line calls out that fact, then each person in the line determines the depth of water at their location. The individual farthest away may be on dry land. He or she should walk back to the point where the water ends and note the location. This represents the furthest point landward that mangroves should be planted.

*How do we use this information?—*The information gathered on tides helps to better plan the development of plantations; for example, determining which species can be planted in a particular area. This is discussed in more detail in Chapter 3. For a complete discussion on tides, see Box 6.2.

***Identifying other important physical features such as fishponds, streams, depressions—***As part of their activities, the sampling team should observe the general surroundings. Does there appear to be recent

woodcutting to indicate illegal cutting or the beginning of clearing for a fishpond? Is *amatong* present? If so, does the group know to whom they belong? If *nipa* is present, does the group know who harvests it; and are they in the PO? Are there any streams, or active illegal or abandoned fishponds (evidenced by old dikes or water control structures)? All this information should be noted as the team walks along the transect. Reference the location of each feature so they can be added to the map. For fishponds, streams, etc., make sure to include size and shape.

***How to use a global positioning system (GPS) as part of sampling activities***—GPS is rapidly becoming more common in the Philippines as an important development tool. One may be available from the municipality, the CENRO, or the PPDO. If so, make every effort to use it as part of the PO's mapping activities.

Using satellite technology, a GPS can pinpoint exact locations in the CBFMA area, providing several advantages for the field team. First, it easily identifies latitude and longitude for each sampling point and each feature. Second, it acts as a compass. Third, it informs the group how far it has moved from one point to the next, e.g., the distance traveled along the transect. All these features are valuable, especially the ability to note latitude and longitude (generally referred to as lat. and long.), a vital component when developing a high-quality map.

There are different types of GPS available in the Philippines so it is impossible to explain how to operate a GPS. The best chance for the PO is to either get help from the group from whom the GPS is being borrowed or for the PO to read the directions and get instructions from the users.

GPS systems are not difficult to operate; simply turning it on activates the system. Soon it acquires (finds) the satellites and tells the user where he or she is located by displaying the latitude and longitude. Every time a sample is taken or a feature noted, the GPS operator must tell the group the latitude and longitude, and someone must record the information.

The GPS can also be used to help develop the

boundaries of an area. This is done in a fairly straightforward manner. After turning on the GPS and letting it determine the current location, simply walk or take a *banca* along the edge of the area the PO intends to claim. Every 100 meters or so write down the latitude and longitude, as well as every time there is a distinct change in direction.

Figure 6.5 shows examples of the points to note the latitudes and longitudes. Circles represent every 100 meters; squares represent distinct locations that would not have been recorded otherwise, e.g., a distinct change in border direction that does not occur at a 100-meter point.

After collecting a list of latitudes and longitudes, see if there is access to a GIS group who can prepare the area boundary map from the list. Alternatively, give the data to a draftsman and he or she can transfer it to a map by hand. This will increase the quality of the map and make it less open to challenge.

Figure 6.6 shows what a final map drawn using GIS looks like. It provides all the information captured during both the community-based mapping and field verification activities.

A finished map is useful for a number of purposes, including:

- Preparing the map for submission with the CBFMA application.
- Understanding the resources available within the area.
- Planning how to manage the area.

Each is important in the quest to obtain a CBFMA for a mangrove forest. By following the map development process in this guidebook, a beneficial, thorough map can be created with little trouble.



# Chapter 7

## Summary of management options and when to use them

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### **MANGROVE NURSERY ESTABLISHMENT AND MANAGEMENT**

**A** mangrove nursery is a place for raising and tending mangrove seedlings until they are ready for field planting. This ensures good quality seedlings at the right quantity by the time they are needed. It involves physical selection and preparation of the site and the application of nursery technology and operations (Figure 7.1). The former requires a nursery area and the construction of infrastructure necessary to produce seedlings such as storage/bunk house, potting and germination sheds, seed/transplant beds and hardening beds. The latter involves the application of technology needed for the selection of mother trees; seedling/propagule collection; sorting and packaging for transport to the nursery; sowing/germination techniques; proper care and maintenance; preparation of seedlings for field planting which includes but is not limited to hardening, packaging and transport to the planting site.

A mangrove nursery is needed in raising planting materials from mangroves with small seeds thereby enhancing biodiversity; raising seedlings intended for replanting dead plants (approximately 20% of the total planting stock requirement) and in raising bigger-sized seedlings needed for planting in sites which are difficult to reforest. Difficult areas can be mudflats less sheltered from wind and waves; areas with shallow water at low tide but need to be planted; and areas infested with barnacles and other pests.



*Figure 7.1. A typical mangrove nursery operation.*



## **MANGROVE PLANTATION ESTABLISHMENT AND MANAGEMENT**

Mangrove plantation is necessary to avert the declining mangrove forest of the country from 4,500 hectares (Brown and Fischer 1918) to just 117,700 hectares in 1995 based on DENR statistics. Figure 7.2 shows a typical mangrove plantation. Mangrove plantation establishment and management involve a number of stages ranging from site selection and preparation, outplanting, care and maintenance and monitoring and evaluation. In all of these stages, appropriate technologies have to be religiously applied to ensure success. A number of site factors have to be

considered such as technical, political and social factors. Mangrove forest establishment, being mostly governed by edaphic or soil factors have to seriously consider the following: type of substrate (sandy, muddy or coralline); species indicator(s); tidal height/inundation; wave and wind exposure; pests; and the community being the traditional users of the mangrove resources present in the area. Community participation and empowerment are best obtained through their inclusion (if qualified) to the Community-Based Forest Management (CBFM) Program of the government which issues a tenure instrument to organized communities composed of tenured migrants.

Plantation should be conducted in areas where natural regeneration is deemed difficult to perpetuate; when the area is open tidal flat and is practically devoid of mother trees; and when regeneration potential is nil. In all of these situations, tree establishment and growth



*Figure 7.2. A typical mangrove plantation.*

have to be accelerated through plantation development.

## COMMUNITY-BASED FOREST MANAGEMENT AGREEMENT

A Community-Based Forest Management Agreement (CBFMA) is a land tenure instrument for mangrove habitats to be given to qualified and organized coastal communities under the CBFM Program of the government implemented by the DENR (see Figure 7.3). A CBFMA is a production sharing agreement entered into between an organized community and the government to develop, utilize, manage and conserve a specific portion of forestland and or allowable portion in protected areas consistent with the principle of sustainable management and development and pursuant to an approved Community Resource Management Framework (CRMF) Plan. A CRMF Plan defines the terms and procedures for access, use and protection of natural resources within the CBFMA area. This plan emanates from the concerned PO that was issued the tenurial instrument.

The CBFMA provides a multitude of benefits to the holder ranging from management control over the area and exemption to pay taxes or rent normally levied by the government to natural resource users aside from being bankable. Besides, the holder is given preferential access by the DENR to available assistance.

The CBFMA can be issued to organized coastal communities living in or adjacent to mangrove forestlands and in allowable zones in mangrove protected areas or to those who traditionally make use of it. However, the community has to undergo the CBFMA application process as outlined in Chapter 4.

## FISHPOND RESTORATION

Fishpond restoration is a management option that provides information on how POs can modify



*Figure 7.3. A CBFMA awarding ceremony.*

abandoned fishponds reverted to the category of forestlands or fishponds not covered by the Fishpond Lease Agreement (FLA) or permit and are thus illegal. These areas can be restored and developed to plantation for benefits to the community in terms of firewood, lumber or poles; an area for collecting shells, crabs and fish; or providing shelter and food for mangrove fauna such as crabs, shells, shrimps and fish harvested in coastal waters. Figure 7.4 shows a typical abandoned fishpond that can be reverted.

Fishpond restoration involves a number of steps as outlined in Chapter 5. Some reminders are also given to provide legal guidance and the required knowledge to POs in conducting the development and management process. These may include adherence to the Anti-Pollution and the Environmental Impact Assessment System Laws and what and what not to do in conducting restoration.

Fishpond restoration shall only be conducted after the fishponds shall have been reverted to the category of forestlands and shall have been granted to the CBFMA holder by the DENR.



*Figure 7.4. A typical abandoned fishpond for reversion.*

# References

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- Agaloos, B.D. 1994. Reforestation of mangrove forests in the Republic of the Philippines. *In* Proceedings of the International Tropical Timber Organization: Development and Dissemination of Reforestation Technique of Mangrove Forest, Japan.
- Berjak, P., G.K. Campbell, B.I. Hockett and N.W. Pammenter. 1977. *In* The mangroves of Southern Africa. NOAA Technical Memorandum NMFS-SEFC-261, 40 p.
- Brown, W.H. and A.F. Fischer. 1918. Philippine mangrove swamps. Department of Agriculture and Natural Resources. Bureau of Fishery Bulletin No. 7.
- Chan, H.T. 1996. Mangrove reforestation in Peninsular Malaysia: a case study in restoration of mangrove ecosystem. *In* C. Field (ed.) Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- CV-CIRRD (Central Visayas Consortium for Integrated Regional Research and Development). 1993. Mangrove production and management. Central Visayas Technology Transfer Guide, CV-CIRRD, Cebu City, Philippines.
- DENR (Department of Environment and Natural Resources). 1998a. How to participate in the Community-Based Forest Management Program. Forest Resource Management Project, DENR, Philippines. 22 p.
- DENR (Department of Environment and Natural Resources). 1998b. Frequently asked questions about CBFM. Forest Resource Management Project, DENR, Philippines. 12 p.
- DENR. 1990. DAO No. 15, Series of 1990. Regulations Governing the Utilization, Development and Management of Mangrove Resources. Section 4. Silviculture.
- DENR Statistics. 1995. Environment and Natural Resources Atlas of the Philippines. Published by the Environment Center of the Philippines Foundation. 1998. Manila, Philippines.
- Dixon, J.A. 1989. Valuation of mangroves. *Trop. Coastal Area Manage.* 4(3): 1-6.
- ERDS (Ecosystems Research and Development Service). 1996. How to raise and plant *pagatpat* and *tangal*. Techno-Transfer Series Bulletin # 24. ERDS, Department of Environment and Natural Resources, Region 11, Davao City, Philippines.
- Field, C., Editor. 1996. Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- Fitzgerald, W. 1999. Integrated mangrove forest and aquaculture systems: Indonesia. Paper presented at the Workshop on Mangrove-Friendly Aquaculture. Southeast Asian Fisheries Development Center, January 1999.
- Hamilton, L.S. and S. Snedaker. 1984. Handbook for mangrove area management. United Nations Environment Programme, East-West Center and Environment Policy Institute.
- Hong, P.N. 1996. Restoration of mangrove ecosystem in Vietnam. *In* C. Field (ed.) Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- IIRR (International Institute of Rural Reconstruction). 1998. Participatory methods in community-based coastal resource

- management. Vol. 3. p. 10-22. IIRR, Silang, Cavite, Philippines.
- Melana, E.E. 1994. Mangrove ecosystem: concept and some implications to rehabilitation and management. Paper presented at the Fishery Sector Program-Department of Natural Resources Component Trainers' Training for Community-Based Forest Management, 21 November-2 December 1994, Lucena City, Philippines.
- Melana, E.E. 1998. Effect of thinning on 10-15 year old *bakauan bangkayo* in Banacon, Bohol. Ecosystem Research Digest. Ecosystems Research and Development Service, Department of Environment and Natural Resources, Region 7, Cebu City, Philippines.
- Melana, E.E. and H.I. Gonzales. 1996. Field guide to the identification of some mangrove plant species in the Philippines. Ecosystems Research and Development Service, Department of Environment and Natural Resources, Region 7, Baniad, Mandaue, Cebu City, Philippines. 29 p. + 8 p. appendices.
- Odum, E.P. 1971. Fundamentals of ecology. 3<sup>rd</sup> ed. W.B. Saunders Co., Philadelphia, USA.
- Padron, C.M. 1996. Mangrove ecosystem restoration in Cuba: a case study in Havana Province. *In* C. Field (ed.) Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- Palis, H.G., C.A. Lat and B.S. Alcantara. 1998. Guidebook on the phenology and identification of Philippine mangrove species. Ecosystems Research and Development Bureau, DENR, Philippines. 108 p.
- PCARRD (Philippine Council for Agriculture Resources Research and Development). 1991. Mangrove production and harvesting. The Philippines Recommends Series. PCARRD, Los Baños, Laguna, Philippines.
- Qureshi, M.T. 1996. Restoration of mangroves in Pakistan. *In* C. Field (ed.) Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- Saenger, P. 1996. Mangrove restoration in Australia. *In* C. Field (ed.) Restoration of mangrove ecosystem. ITTO-ISME, Japan.
- SEAFDEC. n.d. Mudcrab culture. Leaflets. Aquaculture Department. Tigbauan, Iloilo, Philippines.
- Sinohin, V.O., C. Garcia and S. Bacanguis. 1996. Manual on mangrove nursery establishment and development. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources, College, Laguna.
- Vande Vusse, F. 1993. Fishery Sector Project (FSP) Report.
- Vande Vusse, F. 1995. Reversion, restoration and enhancement of mangrove habitats. Mimeograph.
- Walters, J.S., J. Maragos, S. Siar and A.T. White. 1998. Participatory coastal resource assessment: a handbook for community workers and coastal resource managers. Coastal Resource Management Project and Silliman University, Cebu City, Philippines. 113 p.
- Watson, J.G. 1928. Mangrove forests of the Malay Peninsula. Malayan Forest Records No. 6, Fraser and Naeve, Ltd., Singapore. 276 p.
- White, A.T. and A. Cruz-Trinidad. 1998. The values of Philippine coastal resources: why protection and management are critical. Coastal Resource Management Project, Cebu City, Philippines. 96 p.
- Yao, C. 1994. Mangroves for seed production and botanical attraction. Philippine Lumberman (May 1994).
- Yao, C. 1997. *Bakauan* backyard. Canopy International (November 1997), Forest Research Institute, College, Los Baños, Laguna, Philippines.



COASTAL RESOURCE  
MANAGEMENT PROJECT



DEPARTMENT OF  
ENVIRONMENT AND  
NATURAL RESOURCES



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