The Zoological Society of London

Founded in 1826, ZSL is an international science, conservation and education charity (no. 208728), whose mission is to promote and achieve the worldwide conservation of animals and their habitats. ZSL pursues this mission through three main fields of activity:

• Conservation – ZSL’s Conservation Programmes department is actively involved in field conservation in over 50 countries worldwide. ZSL’s wide-ranging conservation work aims to build capacity and influence policy, to bring direct and sustainable conservation benefits to wild animals and their habitats, with activities typically undertaken by forming partnerships with local organisations and government departments;

• Science – the Institute of Zoology identifies, undertakes and communicates high quality biological research relevant to the conservation of animals and their habitats;

• Education and inspiration – ZSL presents and interprets outstanding living collections of animals at ZSL London Zoo and ZSL Whipsnade Zoo. The zoos receive around 1.5 million visitors a year and are supported by some 250 volunteers.

ZSL’s strategic aims are to: undertake and promote relevant high quality zoological and conservation research to help achieve our conservation objectives and to inform and influence conservation policy; encourage and motivate all our stakeholders to support and engage in conservation; and to implement and achieve effective and appropriate in-situ and ex-situ conservation programmes for priority species and habitats.


Annexed to this training manual are the (a) Guide on Mangrove Damage and Recovery Assessment and (b) Guidelines for Cleaning Typhoon-affected Mangroves.
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1. **Assisted regeneration** of mangroves through active planting of seedlings and wildings is required in areas of extensive historic deforestation with highly dependent communities vulnerable to typhoons with low food security.

2. **Target rehabilitation areas should be in an intertidal location** exposed during neap low tide (instead of spring low tide, the current practice), and reached by seawater during neap high tide. The middle and upper intertidal zones are therefore the most favorable.

3. **Small, backyard nurseries** enable communities to produce sufficient numbers of healthy mangrove seedlings such as *Avicennia marina*, for planting.

4. **Wildings** make an excellent source of plants for rehabilitation, but should be harvested sustainably so as not to affect natural recruitment.

5. **Seafront planting** is more successful using adapted seafront species, particularly *Sonneratia alba*, and by using taller, nursery reared saplings of at least 0.5-1 m height.

6. **Rhizophora (bakhaw) propagules** generally do not grow well in seafront zones and therefore cannot be relied upon for mangrove rehabilitation in greenbelts.

7. **Fixed quadrat monitoring** is the simplest, most efficient and robust form of monitoring for large scale rehabilitation initiatives.

8. **Active fishponds** should maintain or achieve a ratio of 4 ha mangroves: 1 ha pond area for ecological sustainability.

9. **Inner abandoned fishponds** more easily revert to mangrove forests than exposed seafronts, but they have more complex tenurial issues.

10. **Protective structures**, including breakwaters and barriers, may be required in highly eroded areas with strong wave action to protect young mangrove plants.
11. **Fences and signage** can help protect young mangrove plants from boat traffic, fishing and gleaning activities, and domestic and wild animals.

12. **Local government and community support** is required from the outset for successful implementation of community-based mangrove rehabilitation projects.

13. **Partnerships** with local government, schools and technical support and specialist groups enhance the scale and scope of mangrove rehabilitation.

14. **Engagement, mobilization and training** empower local communities in mangrove rehabilitation projects.

15. ‘**No Pay’ Planting should be promoted**, where communities appreciate and recognize the importance of their mangrove resources to their livelihoods and their contribution of labor is the basis for ownership.

16. **Counterpart funding** should be mobilized from communities and partner organizations, to maximize resources and underpin the collaborative approach to rehabilitation projects.

17. **Tenurial instruments**, such as the CBFMA, can be used to sustain community initiatives in the long term.

18. **Livelihoods** should only be established if they are economically, ecologically and culturally sustainable.

19. **Restoration of protective and productive greenbelts** should be seen a means of securing better livelihoods for coastal communities through increased resilience against natural disasters and higher fisheries productivity.

20. **Mangrove ecoparks** protect mangroves, provide a means of income and pride to local communities, and are a powerful educational and awareness raising tool.
INTRODUCTION

Mangroves are intertidal shrubs and trees found in the tropics and subtropics. They grow at or above mean sea level or MSL (Fig. 1) which is tidally inundated not more than 30% of the time (Kjerfve, 1990). That is, the middle to upper intertidal zone, and not the lower levels with mudflats and sometimes seagrass beds. This means that the currently popular practice of planting more in the latter habitats and the lower intertidal zone is ecologically misguided.

A. Mangrove Zonation and Species Selection

Globally, there are some 50-60 species of mangroves belonging to 16 families, more than 50 of them in the Indo-Pacific (Polidoro et al, 2010; Spalding et al, 2010) and ~35 species in the Philippines alone (Table 1; Primavera et al, 2004). Mangrove species distribution is influenced by tidal elevation and flooding regime, salinity pattern, substrate and other factors. Species may be distributed both vertically according to low, mid, and high tidal level, and horizontally from downstream, intermediate and upstream (Fig. 2).

- Low elevation species are *Avicennia marina*, *A. alba* and *Sonneratia alba* coastally and *Rhizophora mucronata*, *Sonneratia caseolaris*, *Xylocarpus granatum* and *Nypa fruticans* in intermediate to upstream brackishwater areas.
- High elevation species are *Bruguiera gymnorrhiza* and *Lumnitzera racemosa* in coastal, high salinity areas and *A. officinalis*, *B. cylindrica*, *Ceriops tagal* and *Heritiera littoralis* in estuarine sites.
- Environmental factors of hydrology, salinity, substrate, rainfall and freshwater supply also affect mangrove growth.

Therefore species selection for any mangrove restoration project will depend primarily on the species match for the physical characteristics of a given site (Table 2), and secondarily on the objectives for rehabilitation.

Fringing mangroves in the Philippines and the rest of Southeast Asia are naturally lined by a band of *A. marina* and/or *S. alba* frontliners with *Rhizophora stylosa* and *R. apiculata* immediately behind. Not many other species are able to withstand the extreme conditions of exposure and wave action. A wider species diversity can be found in the middle to landward sections of mangrove forests with a range of substrates, salinities and tidal variation, and where biodiversity concerns can be addressed.
Fig. 1. Tidal elevation of coastal habitats and location of mangroves in relation to other coastal habitats, and tidal elevation suitable (✓) for planting (mid- to upper intertidal). Lower intertidal and subtidal sites (✗) experience high mortality.
### Table 1. Mangrove species and families in the Philippines

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acanthaceae</strong></td>
<td><em>Acanthus ebracteatus</em></td>
</tr>
<tr>
<td></td>
<td><em>A. ilicifolius</em></td>
</tr>
<tr>
<td></td>
<td><em>A. volubilis</em></td>
</tr>
<tr>
<td><strong>Avicenniaceae</strong></td>
<td><em>Avicennia alba</em></td>
</tr>
<tr>
<td></td>
<td><em>A. officinalis</em></td>
</tr>
<tr>
<td></td>
<td><em>A. marina</em></td>
</tr>
<tr>
<td></td>
<td><em>A. rumphiana</em></td>
</tr>
<tr>
<td><strong>Bombacaceae</strong></td>
<td><em>Camptostemon philippinensis</em></td>
</tr>
<tr>
<td><strong>Combretaceae</strong></td>
<td><em>Lumnitzera littorea</em></td>
</tr>
<tr>
<td></td>
<td><em>L. racemosa</em></td>
</tr>
<tr>
<td></td>
<td><em>L. rosea</em></td>
</tr>
<tr>
<td><strong>Euphorbiaceae</strong></td>
<td><em>Excoecaria agallocha</em></td>
</tr>
<tr>
<td><strong>Lythraceae</strong></td>
<td><em>Pemphis acidula</em></td>
</tr>
<tr>
<td><strong>Meliaceae</strong></td>
<td><em>Xylocarpus granatum</em></td>
</tr>
<tr>
<td></td>
<td><em>X. moluccensis</em></td>
</tr>
<tr>
<td><strong>Myrsinaceae</strong></td>
<td><em>Aegiceras corniculatum</em></td>
</tr>
<tr>
<td></td>
<td><em>A. floridum</em></td>
</tr>
<tr>
<td><strong>Myrtaceae</strong></td>
<td><em>Osbornia octodonta</em></td>
</tr>
<tr>
<td><strong>Palmae</strong></td>
<td><em>Nypa fruticans</em></td>
</tr>
<tr>
<td><strong>Rhizophoraceae</strong></td>
<td><em>Bruguiera cylindrica</em></td>
</tr>
<tr>
<td></td>
<td><em>B. gymnorrhiza</em></td>
</tr>
<tr>
<td></td>
<td><em>B. parviflora</em></td>
</tr>
<tr>
<td></td>
<td><em>B. sexangula</em></td>
</tr>
<tr>
<td></td>
<td><em>Ceriops decandra</em></td>
</tr>
<tr>
<td></td>
<td><em>C. tagal</em></td>
</tr>
<tr>
<td></td>
<td><em>Kandelia candel</em></td>
</tr>
<tr>
<td></td>
<td><em>Rhizophora apiculata</em></td>
</tr>
<tr>
<td></td>
<td><em>R. lamarckii</em></td>
</tr>
<tr>
<td></td>
<td><em>R. mucronata</em></td>
</tr>
<tr>
<td></td>
<td><em>R. stylosa</em></td>
</tr>
<tr>
<td><strong>Rubiaceae</strong></td>
<td><em>Scyphiphora hydrophyllacea</em></td>
</tr>
<tr>
<td><strong>Sonneratiaceae</strong></td>
<td><em>Sonneratia alba</em></td>
</tr>
<tr>
<td></td>
<td><em>S. caseolaris</em></td>
</tr>
<tr>
<td></td>
<td><em>S. guingar</em></td>
</tr>
<tr>
<td></td>
<td><em>S. ovata</em></td>
</tr>
</tbody>
</table>

Sources: Brown & Fischer, 1920; Arroyo, 1979; Fernando & Pancho, 1980; Tomlinson, 1986; Spalding et al., 1997; Yao, 1999

*a Hybrids*
Fig. 2. Tidal zone (high, mid, and low) and estuarine zone (up-, mid-, and down-stream) location of mangroves (Duke, 2006)
### Introduction

**Table 2.** Site characteristics of common mangrove species

<table>
<thead>
<tr>
<th>Species</th>
<th>Intertidal Zone</th>
<th>Estuarine Position</th>
<th>Salinity</th>
<th>Substrate</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Avicennia marina</em></td>
<td>Lower</td>
<td>Downstream</td>
<td>Wide range</td>
<td>Varied</td>
<td>Front liner</td>
</tr>
<tr>
<td>(bungalon/ apiapi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Avicennia alba</em></td>
<td>Lower</td>
<td>Mid- to downstream</td>
<td>Full salinity</td>
<td>Sandy-muddy</td>
<td>Front liner</td>
</tr>
<tr>
<td>(bungalon/ apiapi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sonneratia alba</em></td>
<td>Lower</td>
<td>Downstream</td>
<td>Full salinity</td>
<td>Sandy-muddy</td>
<td>Front liner</td>
</tr>
<tr>
<td>(pagatpat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rhizophora stylosa</em></td>
<td>Lower</td>
<td>Downstream</td>
<td>Full salinity</td>
<td>Sandy</td>
<td>Behind <em>A. marina-S. alba</em> zone, other sheltered sites</td>
</tr>
<tr>
<td>(bakhaw bato)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rhizophora apiculata</em></td>
<td>Lower</td>
<td>Downstream</td>
<td>Full to brackish</td>
<td>Sandy to muddy</td>
<td>Behind <em>A. marina-S. alba</em> zone, along riverbanks, other sheltered sites, e.g., lagoons</td>
</tr>
<tr>
<td>(bakhaw lalaki)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rhizophora mucronata</em></td>
<td>Lower to middle</td>
<td>Mid- to downstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Along tidal creeks and rivers</td>
</tr>
<tr>
<td>(bakhaw babae)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Bruguiera cylindrica</em></td>
<td>Middle to upper</td>
<td>Midstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Often found along tidal creeks</td>
</tr>
<tr>
<td><em>Ceriops decandra</em></td>
<td>Middle</td>
<td>Midstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Colonizer, invades grassland</td>
</tr>
<tr>
<td><em>Avicennia rumorhiana</em></td>
<td>Middle</td>
<td>Mid- to upstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Often landward</td>
</tr>
<tr>
<td><em>Avicennia officinalis</em></td>
<td>Middle</td>
<td>Mid- to upstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Often landward</td>
</tr>
<tr>
<td><em>Xylocarpus granatum,</em></td>
<td>Middle to upper</td>
<td>Midstream</td>
<td>Brackish</td>
<td>Muddy</td>
<td>Dioecious, leaves turn brown, orange, red then fall</td>
</tr>
<tr>
<td><em>X. moluccensis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Heritiera littoralis</em></td>
<td>Upper</td>
<td>Mid- to upstream</td>
<td>Brackish to fresh</td>
<td>Muddy-clay</td>
<td>Landward, rarely near the sea</td>
</tr>
</tbody>
</table>

Refer to Fig. 2
### B. Mangrove Functions and Valuation

Mangrove systems have contributed significantly to the well-being of coastal communities through a wide array of ecosystem services (Fig. 3) which have been classified into regulating, provisioning, cultural and supporting.

The total value of such services ranges from US$14,000 to $16,000/ha with the biggest contribution from coastal protection (Table 3).

#### Table 3. Valuation of mangrove services a

<table>
<thead>
<tr>
<th>Service</th>
<th>Examples of value (US$/ha/yr)b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials and food</td>
<td>484-585</td>
</tr>
<tr>
<td>Coastal protection</td>
<td>8,966-10,821</td>
</tr>
<tr>
<td>Erosion control</td>
<td>3,679</td>
</tr>
<tr>
<td>Maintenance of fisheries</td>
<td>708-987</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>30-50</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>12,166 – 16,142</strong></td>
</tr>
</tbody>
</table>

* a Barbier et al, 2012  
  b No estimates available for a) water purification, and b) tourism, recreation, education, and research

**Fig. 3.** The importance of mangroves is beautifully illustrated by the Vietnamese artist Ta Luu
A. Biophysical

1. The Philippines has semidiurnal tides, meaning it has 2 tidal cycles over a 24-hr period each with a Major and Minor Tide (Box 1, Fig. 4) with maximum tidal range of ~2 m. Areas exposed during neap tide will remain above water even during spring tide, a prerequisite for mangrove survival, as mangroves cannot stand flooding more than 30% of the time. Neap tide selection is a major paradigm shift from the past protocol of selecting exposed sites during spring tide – which turn out to be flooded when the neap tides follow, resulting in mortality of seedlings.

2. The above guidelines have been simplified into a short checklist of criteria for selection of outplanting sites in Box 2, which also gives criteria for nurseries and evaluation questions for LGU buy-in and PO commitment.

3. Any natural or artificial beach structures that may affect tidal flow should be considered. For example, a concrete seawall in Balaring, Ivisan, Capiz caused a backwash of incoming waves affecting planted mangrove seedlings and resulting in high mortality.

**Box 1. All about tides**

In a single tidal cycle, the sea level rises on the flood tide and falls on the ebb tide. There is no flow in the period between flood and ebb, called slack, when the lowest point (low tide) and the highest point (high tide) of sea level are attained. The Philippines has mainly semidiurnal, or two – major and minor – tides in a day (Other places have diurnal tides, or a single tidal cycle over a 24-hr period). Tidal elevation depends on the lunar phase such that spring tides (when tidal range, or difference between high and low tide, is greatest) occur during the New Moon and Full Moon, and neap tides (range least) during First Quarter and Last Quarter. Spring and neap tides occur around every two weeks.
Fig. 4 The Philippines has semidiurnal tides— with a major and minor tide— over a 24-hour cycle. Tidal fluctuation is greater (max. 2.2 m) during spring tides during the New or Full Moon, as compared to neap tides during First or Last Quarter.

B. Socio-economic-political

1. Buy-in and commitment of Local Government Units (LGUs) – the LGU, having jurisdiction over mangrove management including conservation as well as implementation of community based projects, must be open minded, collaborative, easy to work with, willing to provide counterpart funds, open to having their staff trained, and share a common vision with the project.

2. Presence of POs – as major stakeholder for community-based projects, POs provide the formal structure for decision-making and sustainability. In sites with no POs, the community must be able and willing to form one.

3. Access to technical support or specialist groups such as the Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR) and academic institutions. Such groups can converge and discuss common problems and develop appropriate strategies to facilitate pond cancellation and reversion to mangroves, recommend project sites, and intervene in major concerns.
**Box 2** Criteria for mangrove rehabilitation sites – biophysical (nursery and outplanting of seafront, abandoned ponds) and socioeconomic (LGU, PO and partners) – as applied to Lipata, Carlos P. Garcia, Bohol (2012).

<table>
<thead>
<tr>
<th>Biophysical</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flooded during spring tide (upper intertidal)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Protected from wave action</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Substrate firm</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Substrate flat</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Well-drained location</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Presence of trees for shade</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Outplanting: seafront</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed during neap tide (low tide)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Protected from wave action</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Substrate firm (foot does not sink above the ankle)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Remaining mangroves</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><em>First 3 criteria should be YES</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outplanting: outer abandoned pond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed during neap tide (low tide)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Protected from wave action</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Substrate firm (foot does not sink above the ankle)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Remaining mangroves</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><em>First 3 criteria should be YES</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outplanting: inner abandoned pond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not waterlogged</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Substrate firm (foot does not sink above the ankle)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Socio-economic</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Socio: LGU buy-in and commitment (interviews)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open minded</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Collaborative</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Easy to work with</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Willing to provide counterpart funds</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Willing to have their staff trained</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Shares a common vision with the project</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><em>5/6 criteria should be YES</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio: POs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO present on site</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Registered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With constitution and by-laws CBL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete set of officers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio: If no POs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community express willingness to form</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Socio: Partners buy-in (BFAR, DENR, academe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willing to provide technical/other support and guidance</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Nurseries can provide mangrove seedlings of the required species in the required numbers and sizes at a given time. Otherwise, planting will be highly dependent on the availability of propagules, seeds or wildings. Nurseries are essential for large-scale reforestation – they meet the need for seedlings of different heights, e.g., taller plants for sites with deeper water or faster sedimentation. Additionally, nurseries provide temporary storage for excess seeds and propagules produced in the fruiting season which otherwise would be lost (Fig. 5).

Small seeds are not suitable for direct planting as they are easily washed away by currents; they need a nursery phase.

Survival along the seafront is higher for nursery-raised seedlings (vs propagules) because their woody stems and developed roots and bigger sizes can better withstand barnacle infestation and wave action. In contrast, these biophysical stressors are absent from the inner portions of abandoned ponds, so the latter can be directly planted with propagules.

**Fig. 5** *Avicennia marina* seedling banks a, c) created by dense pneumatophores that slow down tidal flow and trap propagules; b, d) fewer wildings can withstand wave action along the beach strand.
A. Site Selection

In selecting a nursery site, the following factors should be considered:

a. **natural tidal flow/inundation** during spring tide to minimize labor for watering plants
b. **protection from waves during extreme storm events** – nurseries set up during the non-typhoon season may be destroyed when storms come
c. relatively **flat, with firm substrate and well-drained** (not waterlogged)
d. **under the shade of mangrove/other trees** – but should avoid insects (e.g., larvae from talisay leaves falling on mangrove seedlings)
e. **proximity to the planting site** (for backyard nurseries, to reduce transport costs)
f. preferably **close to a freshwater supply**
g. preferably **close to seed/propagule sources**

B. Preparation for Field Collection

- Prior to the fieldwork

  1) Consult commercial calendars (with tide levels coded in red or blue color) or a tidal calendar (Fig. 7) to select a suitable date and time.

  2) Collectors (volunteers/ PO members) should prepare the following: appropriate clothes (long-sleeved shirts, hats), rubber shoes/booties (Fig. 8).
A tidal calendar that shows the time and height of tides (for Iloilo Station, January 2011) is a must in planning mangrove activities.

Taking 19-20 Jan 2011 as examples, planting or any activity can be conducted from 6am to 11am and 2pm to 6pm.

Fig. 8
Requirements for mangrove planting activity: cap, long-sleeved shirt, long pants and booties/thick socks for wear, and digging blades.

3) Prepare logistics and materials
   ✓ transportation, snacks, certificates for volunteers
   ✓ seedling polybags
     • 8 x 12” (20 x 30.5 cm) for wildings
     • 4 x 6” (10 x 15 cm) for seeds
   ✓ shovels or digging blades (tagad).
• **On the day of field work:**

4) Give a brief orientation to the volunteers about nurseries, e.g. their importance, site requirements, and divide them into groups of seed/wilding collectors, baggers and haulers.

5) For better supervision, a ratio of one supervisor or facilitator (ZSL/project staff): 15-20 participants is recommended (Fig. 9). More than this will mean some volunteers may be unsupervised and apply wrong practices, e.g., throwing – instead of carefully carrying – the bagged seedlings, thereby causing higher mortality.

6) The above become part of the regular onsite activities after initial bagging, for PO members.

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**Fig. 9** Mangrove outplanting: a) briefing volunteers, b) marking rows of 1-1.5 m distance for staking and making holes, c-f) removing seedling from polybag, placing inside hole, levelling soil surface, and tying seedling to stake.

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**C. Collection and Bagging of Wildings**

Wildings (also spelled wildlings) are often observed near mother trees, retained by mangrove roots (seedling bank), and dikes of abandoned ponds, or caught on the beach strand (Fig. 10). The latter are short-lived because of wave exposure, in contrast to those trapped by roots or along the dikes of ponds, which remain undisturbed and grow to one meter or more.
1. Collect wildings not more than 40 cm, preferably 10-30 cm tall (with at least 6 leaves).

2. Use a shovel or digging blade (Fig. 8) to carefully remove the plant with soil still attached to the roots to ensure they are surrounded by a ball of earth (Fig. 11).

3. Wildings removed from a sandy substrate may show higher mortality compared to more compact mud because sand particles tend to fall, exposing the root hairs to air.

   • Smaller wildings (10-20 cm long) need to be conditioned in the nursery (3-4 mo up to 1 yr) until they reach a minimum 30 cm and the stems are sufficiently hardened

   • Bigger wildings (20-30 cm long) may be transplanted directly to the rehabilitation site after removal, provided enough soil remains with the roots to prevent dehydration and damage

Fig. 10 Seeds and wildings of different mangrove species

Fig. 11 Wildings are earthballed (carefully with soil) to prevent root damage, then transferred to polybag.
D. Collection and Planting of Seeds/Propagules

1. Collection should be done during peak of the fruiting season (Table 4), usually in June-August after the April-May flowering. Newly fallen fruits may also be collected from the ground, provided they have no insect and other damage.

2. When collecting fruits, check the color and texture for maturity, e.g., dark green-reddish hypocotyls of *Rhizophora* and cracked skin of *Sonneratia* and *Xylocarpus* fruits (Table 4). Exclude fruits with insect damage, e.g., the pinhead sized holes of beetle larvae, disease and malformed shapes.

3. When purchasing *Rhizophora* propagules in the hundreds or more, it is advisable to give only 30-50% down payment, and first check for viability by planting the propagules in mud. Propagules that grow roots are viable and the balance can be paid.

4. To avoid potential negative impacts on the local gene pool or possible transfer of diseases and pests, propagules should not be transported between islands.

5. Seeds and propagules can be stored in a shady, cool and dry place and should be planted within 1 week to 1 month, depending on the species, e.g., 10-20 days for *A. marina* and *A. corniculatum* and one month for *Rhizophora* during which they remain viable.

6. After seed collection, the seeds are sowed and germinated, maintained through watering, fertilization and pest protection, and hardening prior to transport and outplanting.
   ✓ Larger seeds of *Avicennia* may be germinated directly in individual containers.
   ✓ Very small seeds of *Sonneratia* are best germinated on a seedbed prior to transfer to separate bags.
   ✓ Large propagules of *Rhizophora*, *Bruguiera* and other *Rhizophoraceaeae* may be planted directly in individual polybags commensurate to their size.

7. Steps in fruit collection, seed germination, bagging of seedlings and outplanting are described in Box 3.
Table 4. Mangrove propagule/seed collection time (Panay Island) and maturity indicators

<table>
<thead>
<tr>
<th>Species</th>
<th>Seeds or propagules</th>
<th>Indicator of maturity</th>
<th>Collection time</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Avicennia spp.</em> (apiapi)</td>
<td>Propagules</td>
<td>Seed coat changes from green to light yellow; seed coat becomes wrinkly and oftentimes opens</td>
<td>May/June-Sep</td>
</tr>
<tr>
<td><em>A. marina</em> (bungalon)</td>
<td>Propagules</td>
<td>Seed coat changes from green to light yellow; seed coat becomes wrinkly and oftentimes opens</td>
<td>May-Sep</td>
</tr>
<tr>
<td><em>Bruguiera spp.</em> (busain)</td>
<td>Propagules</td>
<td>No ring-like mark; green propagules turns brownish/bronze and drops without the pericarp or cap</td>
<td>Year round</td>
</tr>
<tr>
<td><em>Bruguiera spp.</em> (pototan lalaki)</td>
<td>Propagules</td>
<td>Tip of hypocotyl changes from green to brown</td>
<td>Year round</td>
</tr>
<tr>
<td><em>Ceriops tagal</em> (tangal)</td>
<td>Propagules</td>
<td>Presence of ring-like mark (abscission layer) below pericarp or cap (up to 1 cm wide)</td>
<td>Year round</td>
</tr>
<tr>
<td><em>Rhizophora apiculata</em> (bakhaw lalaki)</td>
<td>Propagules</td>
<td>Presence of ring-like mark (abscission layer) below pericarp or cap (up to 1 cm wide)</td>
<td>Year round</td>
</tr>
<tr>
<td><em>R. mucronata</em> (bakhaw babae)</td>
<td>Propagules</td>
<td>Presence of ring-like mark (abscission layer) below pericarp or cap (up to 1 cm wide)</td>
<td>Year round</td>
</tr>
<tr>
<td><em>R. stylosa</em> (bakhaw bato)</td>
<td>Propagules</td>
<td>Presence of ring-like mark (abscission layer) below pericarp or cap (up to 1 cm wide)</td>
<td>Year round</td>
</tr>
<tr>
<td><em>S. alba</em> (pagatpat)</td>
<td>Seeds</td>
<td>Fruits turn shiny or yellowish and soft</td>
<td>Year round</td>
</tr>
<tr>
<td><em>X. granatum</em> (tabigi)</td>
<td>Seeds</td>
<td>Fruits change from light brown to dark brown</td>
<td>April, August</td>
</tr>
</tbody>
</table>

\(^{a}\) from Field, 1996. \(^{b}\) from Primavera et al., 2004
**Box 3.** Protocols for growing pagatpat *Sonneratia alba*.

*Avicennia marina* and *Sonneratia alba* are the two major colonizers of fringing coastlines but wildings are much rarer in nature for the latter, and nursery techniques relatively undeveloped (perhaps related to its small, non-viviparous seeds) compared to the first. The following protocols for pagatpat rehabilitation jointly developed by the P.O. *Kapunungan sa Gagmay’ng Mangingisda sa Concepcion* and the Philippine Tropical Forest Conservation Foundation or PTFCF (Buduan and Ballon, 2012) will greatly contribute to mangrove rehabilitation in the country and in Southeast Asia.

Collected ripe fruits are macerated to release the seeds which are then soaked in water to separate viable seeds (they sink) from nonviable floaters. These seeds are sown on a thin layer of mud lined below with canvas, germinate after 3-5 days, are removed and broadcast on a suitable substrate, e.g., abandoned ponds, at ~50 seedlings/sq m. After 4 mo, the seedlings are mudballed (removed with intact root system held in place by mud) for transplanting nearby or for transport to other rehabilitation sites.

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**E. Maintenance**

1. After wildings are bagged and seeds germinated, the nursery needs to be visited at least 2-3 times weekly to check that the plants remain upright (Fig. 12) and are healthy, and to ensure regular watering (by the tide, etc.), and protection from pests and stray animals.

2. Healthy plants have green leaves and are pest-free. Yellowing of leaves in the first month may be due to stress, but if discoloration persists, and leaf wilting and/or powdery material appears on the surface, the plant may be diseased.

   ✓ Such attacks may be caused by beetle *Coccotrypes* (formerly *Poecilips*) *fallax* larvae which bore into *Rhizophora* propagules (Fig. 13).

   ✓ To avoid this, propagules are sundried or air-dried for 1-2 weeks prior to planting in polybags to reduce moisture content, harden the covering and discourage egg-laying by beetles.
3. Remove diseased plants and bury them.

4. If nursery rearing is longer than 6 mo, polybags should be separated from the bottom of the nursery with a plastic sheet lining (e.g., recycled plastics, tarpaulins: Fig. 12) to prevent roots from reaching the ground. Otherwise, the roots could be damaged during transfer for outplanting.

5. If seedlings are stunted due to small bags, transfer to bigger bags without damaging the roots.

**Fig. 12** Regular nursery check-up is important to prevent: a) dying *Avicennia marina* (not reached by tidal water), b) fallen *Rhizophora*, and c) overgrown *Sonneratia alba* with roots reaching the ground through the plastic bag.
F. Seedling Selection and Transport

1. Regularly segregate seedlings by species and size for easy transport and hauling of required sizes for planting and/or sale.

2. Transport may be needed if planting site is far, although it is best to plant wildlings onsite. Prepare crates or modified seedling carriers, e.g., sack material attached to bamboo poles.

3. Buyers from commercial nurseries are responsible for the transportation of mangrove seedlings.

Fig. 13 Pests of *Rhizophora* propagules include the boring isopod *Sphaeroma terebrans* (Culajao, Roxas City plantation), and beetle *Coccotrypes fallax* larvae (Basyaw Cove, Nueva Valencia, Guimaras nursery).
A. Physical Interventions

Mangroves have very specific hydrological and substrate requirements. Correct elevation is marked by surviving trees in background. Potential rehabilitation sites may therefore require interventions to optimize future mangrove growth and survival. In some cases, local hydrology will have changed so dramatically that even areas that historically were mangrove forests cannot automatically be assumed to be suitable for rehabilitation. Where intensive ponds have been excavated (to maximize depth for intensive pond culture), substrate levels will need to be restored, along with the natural hydrology, to allow survival and growth of natural or planted mangrove recruits.

ZSL used the following approaches based on a philosophy of sourcing local materials that are relatively low cost and could be implemented by the POs working with LGU engineers (where necessary). Collaboration with academia helped provide technical input on the type and location, with local knowledge giving important guidance on the water and weather conditions that might influence the effectiveness of such interventions. These interventions are:

1. barriers (Fig. 14) – made of bamboo, rocks and other locally available materials. Barriers are placed in front of the plantation to reduce the energy of oncoming waves giving some protection while young seedlings become established; of secondary benefit is the increase in sediment elevation behind the structure

**Fig. 14** Barriers made of a, b, c) rocks in Ermita, Dumangas, Iloilo (2007-2008), and d) bamboo support mangrove growth by reducing wave energy and trapping sediment
2. breakwater – to mitigate shoreline erosion which had removed more than 1 meter of sediment at some points along the Pedada, Ajuy coastline, two breakwaters measuring 0.9 m high by 1–2 m wide by 70 m and 110 m long made of locally sourced rocks with a break to allow for boat traffic (Fig. 15). It was constructed in 2010 after some preliminary planting trials demonstrated that the extensive erosion and high wave action in the area meant that no other alternative was possible to reestablish the site as viable for mangrove reforestation. Since the installation of the barrier, an accreting band behind the breakwater 9 m wide has increased by 10-50 cm in elevation stabilized 2 yr after construction and supporting growth of both planted and wild recruits.

3. restored tidal and freshwater flows – dikes were built to hold water required for growing fish and shrimp in ponds. The flows of both tidal and freshwater creeks that have been subsequently altered need to be restored (by breaking the dikes at strategic points) to allow mangrove growth.

**Fig. 15** Two lengths of breakwater, 0.9 m high by 1–2 m wide by 70 m and 110 m long, have consolidated sediment and provided both substrate and protection to planted and natural mangrove recruits in Pedada, Ajuy, Iloilo.

B. Site Selection

Site selection is critical for seafront planting because the area available for mangroves along the beach is mostly lower intertidal. In contrast, abandoned ponds are generally suitable for mangrove reversion, as they are located in former mangrove areas in the middle to upper intertidal, provided pond excavation has been minimal (e.g., extensive culture ponds).
1. During neap tide, go to the potential seafront site, delineate and mark with stakes the boundaries of the suitable area (exposed during neap tide, and/or aligned with the edge of the pneumatophores or the peat layer, if present).

2. Use a Global Positioning System (GPS) if available, to take readings otherwise note the points followed in the area, based on permanent local landmarks or features.
   - Areas with many fishing boats should allow for designated navigational lanes (5-10 m wide) to facilitate traffic.
   - Fencing the planting area can help reduce boat damage and clearly identify the area to community members.

3. For seafront sites, note remarkable features such as creeks, waterlogged portions which may drown the seedlings, and in the case of ponds, dikes, gates and other structures which may affect water flow.

4. For abandoned ponds, draw a map of the area including mangrove trees and wildings, topography (mounds, excavations, waterlogged parts, dikes, gates), hydrology (seawater/freshwater channels, tidal levels) and other features. Any level portion may be planted excluding waterlogged areas and high dikes.

C. Planting Strategy

1. What
   Select species of mangroves naturally found in the area. Nearby wildings may also be directly planted in abandoned ponds, and for enrichment planting of inner seafront sites protected from wave action. Planting materials can be sourced from nurseries. Mangrove sizes for planting will depend on location and substrate:

   ✓ **bigger sizes** (minimum 50 cm to 1-1.5 m for A. marina, S. alba, R. apiculata, R. mucronata, R. stylosa) – for seafront planting, also very muddy portions of ponds
   ✓ **smaller sizes** (minimum 30 cm A. marina, S. alba to 40-60 cm R. apiculata, R. mucronata, R. stylosa) – inner abandoned ponds (no wave action)
2. When Schedule planting during the season of least wave action, e.g., northwest monsoon or amihan for southern Panay, and southwest monsoon or habagat for northern Panay. Consult a tidal calendar (Fig. 7) for daytime low tides. Because of the relatively lower elevation, seafront planting will require spring water low tides, while inner abandoned ponds can be planted during either spring or neap low tides.

3. How (density and pattern)
   ✓ Inner sites along the seafront and in abandoned ponds with little wave action can be planted at 1.5-2 m intervals.
   ✓ Seaward sites exposed to frequent wave action and debris brought by the incoming tide need to be planted at closer intervals of 0.5-1 m (Fig. 16) and/or in clusters of 2-3 seedlings each.
   ✓ Offset the planting of seedlings in consecutive rows so that the columns appear in zigzag pattern, avoiding uniformly empty rows between rows of plants. For the 1st batch in a given site, do trial planting of a few rows, then observe for the next few months. Plant additional rows only if the seedlings/ saplings show good growth and survival.

![Fig. 16 Mangroves may be sourced from a) nurseries or c) wildings, and planted b) closely spaced together along the seafront, or d) wider apart in inner abandoned ponds.](image)
Outplanting

- Whether seafront sites or abandoned ponds, plant starting from the beach or landward portion moving in a seaward direction (*pa-abante*). This is a major change from the past practice of planting from the seaward boundary in a landward direction (*pa-atras*).

- Depending on the number of planters, 2-5 rows may planted on a given day during the 2-4hr planting window allowed by the tides.

D. Outplanting Protocols

Fisherfolk and other community members with experience in mangrove planting need minimum supervision. But students, members of civil society and other volunteers need the guidance of more knowledgeable facilitators (at a ratio of 1 facilitator: 15-20 volunteers)

1. Before the activity proper, planters/volunteers should be given introductory lectures, including topics on proper field wear, species to be planted and planting methods (see below).

2. Wear a hat, long-sleeved shirt, long pants or knee-length short pants, booties or old rubber shoes (for the mud and water), apply sunblock, insect repellent and bring plenty of drinking water.

3. Prepare the following materials (in numbers proportional to area/no. of planters)
   - seedlings (from nursery or wildings for direct planting)
   - shovel, digging blades and trowels
   - meter stick
   - nylon rope, with knots tied at predetermined spacing (e.g., 10 or 20 m)
   - bamboo stakes, 1 m long
   - pre-cut strings/plastic straw, ~20 cm long
   - large plastic bags, preferably recycled
   - pen/pencil and notebook
   - camera
   - seedling carriers - plastic crates or improvised sacks with sides attached
   - along the length of two bamboo poles
   - Global Positioning System (GPS) device, if available
4. Plan the travel such that arrival in the planting site is at least 1hr before the tide becomes low enough so planting can start.

5. Divide the planters into smaller groups for the specific tasks of hauling of seedlings, marking the lines, digging holes, etc.

6. Planting steps (Fig. 9)
   - Using a meter stick, steel tape or measuring tape, mark parallel rows with distances of 1 m for seafront sites, or 1.5-2 m for abandoned ponds. For enrichment planting of sparse mangrove sites, plant seedlings in open/vacant spaces at least 2 sq m wide.
   - Within the same row, mark out 1, 1.5 or 2 m distances with bamboo stakes. Alternatively, seafront planting may use clusters of 2-3 instead of single seedlings. Plants in consecutive rows should be offset by 0.5-0.75 m to create a zigzag pattern for the columns.
   - Next to the stakes, dig holes ~30 cm (= 1 foot) deep using a trowel, shovel or digging blade (tagad).
   - Haul or transfer the bagged seedlings from the vehicle, or wildings newly collected nearby, to the planting site.
   - For bagged seedlings, remove the plant carefully from the bag to keep the soil attached, then place inside the hole. The top of the plant soil should be the same level as the ground.
   - For Rhizophora propagules, make sure to remove their caps (Fig. 17).
   - For direct planting, place the wilding together with the attached soil inside the hole.
   - Fill in with soil any remaining spaces in the hole.
   - For seafronts and on muddy substrates, place a bamboo stake securely beside the plant and tie it just loose enough (to avoid breakage) at mid-stem to the stake for support, e.g., during strong wave action. Where plants are to be monitored and need tagging, attach gina cloth tag.
Collect discarded polybags and other garbage inside the large (recycled) plastic bags for appropriate disposal when you reach home. Do not leave trash in the planting sites (Fig. 17).

E. Problems

Planting is only the first step towards restoring mangroves. During the first 1-2 yr, the plants are vulnerable to various man-made and natural stressors. Therefore monitoring (of growth and survival) and maintenance (by removing algae, other pests) are two major activities in mangrove rehabilitation.

1. Physical
   Wave action, flooding and burial in the substrate can damage young seedlings. This is a particular problem where inundation and sedimentation rates are high, as in the lower intertidal to subtidal flats. For example, seedlings in Dumangas, Iloilo planted in the lower intertidal zone died within 3 mo, mainly from inundation as evidenced by rotting stems.

2. Biological
   a. Infestation of filamentous algae (Fig. 18) peaks in the summer and disappears with the rains; it is also frequently observed near fishponds which regularly drain effluents (containing...
Fig. 18 Regular maintenance by removal of a) fishing nets, and b) algae using scissors, and c) placing inside bags for disposal outside the plantation.

excess feeds and fertilizers) to the sea. Heavy growth of filamentous algae (Enteromorpha, Cladophora and Oscillatoria) can choke and break seedlings.

b. Boring isopods identified as *Sphaeroma terebrans* attacked *Rhizophora* saplings in Culajao, Roxas City (Fig. 13); the crustaceans showed no apparent negative effects on mature *A. marina* trees.

Fig. 19 Barnacles are harmless to *Sonneratia alba* which a, d) regularly sheds its bark, but need to be removed from b) *Avicennia marina* c) by means of long-nosed pliers..
c. Barnacle infestation varies with mangrove age (declining in older >2yr-old seedlings) and species. The adhesive cement of barnacles may be deleterious to plant growth and survival. *Avicennia* and *Sonneratia* appear to tolerate barnacle infestation better than *Rhizophora*, perhaps related to their seafront dominance where barnacle incidence is higher and to the flaking bark of *S. alba* (Fig. 19).

d. Oysters may physically weigh down the plants, but do not seem to affect survival of *Avicennia* and *Sonneratia*.

3. **Anthropogenic**

Fishing gears, boat traffic, and gleaning (for shellfish and crabs) have negative impacts on mangrove plantations. Sites close to populated centers have problems with garbage and debris (fishing nets, plastic bags, etc.), and domestic animals (e.g., pigs, goats, cattle). In plantations near primary forests, wild animals such as boars and monkeys feed on newly planted *Rhizophora*.

F. **Protection and Maintenance**

Regular patrolling should be undertaken by the community (or LGU or school group), for seafront plantations. On the other hand, it is best that a caretaker (hired by the LGU or NGO) maintains plantations inside abandoned ponds with no organized communities, particularly while tenurial negotiations are ongoing.

1. Planting is recommended in the rainy season to avoid algal blooms during the summer months. Otherwise, algae should be regularly removed using a pair of scissors (Fig. 18). Collected algae should be placed in bags for disposal elsewhere.

2. The most effective way to remove barnacles is with long-nosed pliers (Fig. 19) – do not use your bare hands as the shells have sharp edges! *Rhizophora* plantations are particularly prone to barnacle infestation, so a proactive solution is to avoid planting bakhaw along the seafront (where they do not belong). Otherwise, avoid monoculture plantations that are vulnerable to pests by interplanting with *A. marina* and/or *S. alba*. Because it regularly sheds its bark (Fig. 19), pagatpat *S. alba* is unaffected by barnacles and oysters.
3. Relatively taller seedlings should be planted in seafront sites with high sediment load and in deeper water, so the higher leaves remain exposed and are less prone to gathering sediment and flooding, allowing the plants to survive.

4. For protection from wave action, install barriers made of rocks or closely spaced bamboo poles (Fig. 14). Such barriers also help to trap sediment and increase the substrate level, further enhancing plant growth. In places where erosion is a major problem, a breakwater can be constructed.

5. Alternatively, relatively sheltered portions of the plantation with a gentle slope have recruits washed up by the tide. The Balaring, Capiz P.O. NewBAMA installed a bamboo fence in July 2010 to keep out gleaners and other passersby from their plantation. After one year, the protected area has been colonized by ~500 *A. marina* wildings, now measuring ~1 m high, in an area of 0.5 ha.

**Fig. 20** Political will is important – for example, the hut (and caretaker) provided by the Leganes, Iloilo municipal government has facilitated cross visits by LGU officials, NGOs and other groups.
6. For protection from boat traffic during high tide when plants cannot be seen, NewBAMA installed floating markers made of packaging strap material attached to bamboo poles staked around the perimeter of the plantation.

7. If the mangrove site is far from road access, a rest house with toilet facilities and other amenities will provide planters rest from sun and shade. Such is the hut constructed by the Leganes, Iloilo LGU (Fig. 20), which also displays the municipal ordinance that protects the mangroves and other mangrove laws.

8. Visit the plantation regularly to repair fences and remove debris (plastics, fish nets), filamentous algae, barnacles and sediment from leaves and stems. Gather algae, debris and trash in old plastic bags and dispose of away from the plantation (Fig. 18). Do not throw these back into the water/planting site. Dead plants should be replaced with nursery-sourced seedlings or wilding transplants, especially in the 1st year.

G. Monitoring

Often overlooked in mangrove rehabilitation programmes, regular monitoring is fundamental in determining whether objectives of reforestation have been achieved. In many cases, the mere numbers of propagules or seedlings planted are considered indicators of success (especially given the propensity for photo „ops“ meaning opportunities). Yet subsequent investigation demonstrates that very few plants have survived because either the site or species selection has been inappropriate. Allocating time and resources into monitoring (Fig. 21) is a key component of a successful mangrove rehabilitation program.
Fig. 21 Plant height is the basic parameter for growth, and is measured from the base to the tip of the stem (top, right). Plants bent (by algae and other factors) must first be straightened before measuring (bottom, right). Sample monitoring sheet (below)

<table>
<thead>
<tr>
<th>M O N I T O R I N G  G R O W T H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species:</td>
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<tr>
<td>----------</td>
</tr>
<tr>
<td>Plant No. Height (cm)</td>
</tr>
<tr>
<td>1</td>
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<td>3</td>
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</table>

Community monitoring

The fixed quadrat monitoring approach is within the technical capability and resources of some trained local monitoring teams, though interpretation of results can be challenging. The primary objective of communities involved in mangrove rehabilitation projects is to conduct the most resource effective approaches to start gaining the resource benefits from recovered mangrove forests. In this case, therefore, communities need to focus on monitoring survival, identifying problems early and knowing how to solve them. The CMRP has therefore developed a simple decision tree as a troubleshooting tool which should be translated into the local dialect (Box 4).
Box 4 The Community Decision Tree

START HERE
How many plants have survived?

>50%

Do the remaining plants appear healthy?

NO

Remove excess algae

YES

Replacement plant if necessary and monitor again in one month

<50%

Is the site flooded at neap low-tide?

NO

Is substrate suitable and stable enough or are plants being eroded/waterlogged?

YES

Review site selection criteria (Section IV, B) and consider alternative planting site or whether interventions required (e.g. barriers, breakwaters; Section IV, A)

NO

Could propagules/seedlings be of poor quality

YES

Review site selection criteria (Section IV, B) and consider alternative planting site or whether interventions required (e.g. barriers, breakwaters; Section IV, A)

NO

Has the species been selected to match the site characteristics?

YES

Are there any signs of pests?

NO

Could mortality be caused by people/animals e.g. boat traffic, gleaners, goats?

YES

Install barriers e.g. fences, signs

NO

Ensure (e.g. through PO, LGU, bantay gubat) mangrove policies being followed

Monitor again in one month

NO

Replacement plant if necessary and monitor again in one month

YES

Replace dead plants with new batch

Review species selection (Table 2) and repeat planting with correct species

NO

Replacement plant if necessary and monitor again in one month

YES

Consult experts
In identifying mangrove rehabilitation sites one must have a set of criteria. The ZSL-CMRP project has identified the presence of existing POs as one of the criteria in selecting sites for Community-Based Mangrove Rehabilitation Project. The POs act as major stakeholder for community-based projects. They provide the formal structure for decision-making and sustainability. The presence of POs is a minimum requirement of the DENR for securing Community-Based Forest Management Agreement (CBFMA). In sites with no POs, the community must be able and willing to form one.

Other criteria include LGU buy-in and commitment (open minded, collaborative, easy to work with, willing to provide counterpart funds and have their staff trained, and shares a common vision with the project) and site must be in intertidal location.

The succeeding section describes the organizing process as experienced during the CMRP. It is only after the communities are organized will they have meaningful participation in mangrove rehabilitation.

A. Organizing Communities in mangrove areas

Community organizing is defined as a process by which a community identifies its needs and objectives, develops the confidence to take action, and in so doing, extends and develops cooperative and collaborative attitudes and practices in the community (Ross and Lappin, 1967).

Why is there a need to organize coastal communities?
- Increase the coastal communities awareness of the condition of their environment and resources.
- Develop a sense of ownership in communities, and help them take collective responsibility for managing and protecting the resources.
- Provide opportunities for local participation of men and women in decision-making using the participatory process of problem identification, planning, implementation and monitoring.
- Strengthen the community’s capacity to access funds for sustainable socioeconomic projects.
- Enable the community to form alliances for advocacy, information, resources and technologies sharing.
• Build and sustain organizational structures for coastal resource management.
• Provide the necessary social preparation.

The ultimate aim of community organizing is to empower the community so that they are able to manage and protect their coastal environment on their own. The process of organizing communities is best facilitated by an effective Community Organizer.

**Box 5. The Community Organizer**

COs work to develop the capacity of local leaders, to facilitate coalition building and to assist in development campaigns. They seek to build groups that adhere to the principles of democratic governance. COs must be open, accessible to community members and concerned with the general welfare of the community. The COs must have:
• A clear grasp of the different theories of development
• Familiarity with the concept and processes of community organizing
• Good social and community relationship skills
• An ability to work with other teams of professionals involved in the management of marine and coastal resources.

The CO approach should adhere to the general principles of a standard and traditional CO. Moreover, they must be able to adapt according to the focus of the project for it to be effective e.g. CO for land distribution, CO for Coastal Resource Management (CRM), or in this case, CO for mangrove communities.

One of the criteria in selecting sites for Community-Based Mangrove Rehabilitation Project is the presence of existing People’s Organization. The POs act as major stakeholder for community-based projects. They provide the formal structure for decision-making and sustainability. The presence of POs is a minimum requirement of the DENR for securing Community-Based Forest Management Agreement (CBFMA). In sites with no POs, the community must be able and willing to form one. Other criteria include LGU buy-in and commitment (open minded, collaborative, easy to work with, willing to provide counterpart funds and have their staff trained, and shares a common vision with the project) and site must be in intertidal location.

Support groups that include the agencies of the government such as the Department of Environment and Natural Resources (DENR), the Bureau of Fisheries and Aquatic Resources (BFAR) and academic institutions can be formed to regularly meet and discuss common issues on mangrove i.e. cancellation and reversion.
Steps in Organizing

Approach used is issue based. The following is the recommended steps in organizing communities.

1. **Forge agreements with partner LGUs, LGAs and academe** – This activity is designed to seal the partnership, define partners’ roles and accountability to include understanding of the duration and scope of the project. The partners must develop and sign legal agreements in the form of a Memorandum of Agreement (MOA) (Fig 22). This is the first activity during the first year of the project.

   **Box 6. Steps in forging agreements**

   1. Pay Courtesy call to the Local Government Unit/Line Government Agency Officials/Academe
   2. Present the Project
   3. Define roles and responsibilities
   4. Partners draft and review the MOA (for LGU partners only)
   5. Sangguniang Bayan authorizes the Mayor to sign MOA
   6. MOA signing

2. **Get to know the community** – This is the step where the CO enters the area and immerses in the community to become familiar with the site, ascertain the political scenario through an analysis of forces that interplay within the area, and identify potential leaders.

   The potential leaders are formed into a core group to partner with the CO until an organization is formed. Issue identification is done at this stage. The CO must be able to sense how accepting the community is of the project by way of paying courtesy calls to the village officials, conducting house-to-house visits and/or conducting formal and informal dialogues and consultations. The communities are trained by the COs to serve as Local Research Assistants (LRAs) and are tasked to examine their own problems, set their own goals, and analyze their economic situation (Fig 23). LRAs gather information using participatory techniques.
Box 7. The criteria used to identify leaders

- Well respected by members of community, and has relatively wide influence;
- Aware of community issues and concerns;
- Desirous of change and is willing to work for change;
- Believes in the participation of many people in resolving issues;
- Belongs to the targeted sector for organizing e.g. marginal fishers, shell gleaners, etc.;
- Finds time to perform the tasks of the core group; and
- Communicates effectively and listens to community members

and household surveys to establish community profile reflective of the real situation of their area. The profile serves as baseline data, a guide for project intervention, and the basis for measuring impact at the end of the project. All the activities in the second step are done in the first year of CO work.

3. Form or strengthen POs – The communities have to be organized to apply for CBFMA and to manage the mangroves for a minimum of 25 years. This step is necessary in building long-term engagement, support, and responsibility from communities towards mangrove rehabilitation. For existing POs, they need to be strengthened. Below are the steps comparing PO formation versus strengthening.

At the start of project, identify the indicators of a functional PO (Box 8). This serves as reference in conducting Organizational Diagnosis (OD) using a set of tools (Box 9). The OD result is used in identifying appropriate interventions to build strong and functional POs.
Some of the organizational strengthening activities implemented were revisiting Vision, Mission and Goal, formulating Constitution and By-Laws (CBL) (Box 6), defining organizational structure and election of officers, and registering to either the Securities and Exchange Commission (SEC) or the Department of Labor and Employment (DOLE) where requirements should be complied.

POs update their membership and seek accreditation at the municipal and provincial levels prior to CBFMA endorsement. In some cases the Provincial LGUs only affirm Municipal LGUs accreditation. POs with existing funds may require an external audit to ensure that financial records are in order. The forming and strengthening of POs are implemented at the later part of Year 1 until Year 2.

4. **Build capability of POs** – Capacity building includes activities that improve effectiveness of the organizations in Years 2-3. These activities include three broad approaches to enhance the ability of POs in achieving its mission.

   a. **Conduct trainings and seminars.**

      Three types of training are provided to the POs:

      1) training aimed at enhancing awareness;
      2) training for increasing capacity in running and managing the organization; and
      3) training to increase knowledge and skills in managing and protecting the mangroves.
**Box 8. ZSL Indicators of a functional PO**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Objective Verifiable Indicators</th>
<th>Means Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milestone 1: Six POs formed and active</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizing/ strengthening of fishers/ mangrove users</td>
<td>POs organized/ strengthened; Organizational Diagnosis conducted</td>
<td>Minutes of meeting; diagnosis report; attendance sheet</td>
</tr>
<tr>
<td>Training on leadership, organizational management</td>
<td>All PO officers trained; monthly meetings conducted</td>
<td>Attendance sheet; documentation/report; minutes of meetings</td>
</tr>
<tr>
<td>Formulation of organizational structure through meetings</td>
<td>6 written/approved constitution and by-laws; set of officers elected per PO; PO registration</td>
<td>CBL document; registration and accreditation papers</td>
</tr>
<tr>
<td>Participation of members in forum/seminars on mangroves</td>
<td>At least 50% active members have attended seminars and forums</td>
<td>Attendance sheet, certificate of participation</td>
</tr>
<tr>
<td>Membership recruitment</td>
<td>At least 20 members per PO</td>
<td>Application for membership, payment of dues, list of members</td>
</tr>
<tr>
<td>Study tour</td>
<td>5-10 members participated/PO in at least 1 study tour</td>
<td>Attendance sheets; tickets; certificate of participation; pictures</td>
</tr>
<tr>
<td>Writeshop on proposal development for development projects</td>
<td>At least 1 proposal developed/approved per PO</td>
<td>Certificate of award for funding, proposals</td>
</tr>
<tr>
<td>Milestone 2: PO have catalogued and mapped resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping of resources with the DENR and LGU</td>
<td>1 CBFMA map produced per site</td>
<td>CBFMA maps</td>
</tr>
<tr>
<td>Milestone 3: CBFMA awarded to POs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation on CBFMA</td>
<td>1 seminar on CBFMA conducted per PO</td>
<td>Attendance sheet; documentation/report</td>
</tr>
<tr>
<td>Preparation of documents for CBFMA application</td>
<td>Workshop/meeting conducted; letter of intent submitted to DENR; LGU endorsement</td>
<td>Documentation; compiled CBFMA papers; CBFMA awarded</td>
</tr>
</tbody>
</table>
## Box 8. continued

<table>
<thead>
<tr>
<th>Activity</th>
<th>Objective Verifiable Indicators</th>
<th>Means Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milestone 4:</strong> CRMF and AWPs developed, endorsed by DENR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training workshop/ formulation on the theoretical and practical aspects of CRMF and AWPs</td>
<td>6 CRMF and AWPs developed/submitted to DENR</td>
<td>DENR affirmation of the documents</td>
</tr>
<tr>
<td><strong>Milestone 5:</strong> Sustainable livelihood activities are developed/agreed by POs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training on enterprise planning and development</td>
<td>Module on enterprise planning and development</td>
<td>Attendance sheets; documentation report</td>
</tr>
<tr>
<td>PO meeting</td>
<td>At least 1 skills training/ PO implementation</td>
<td>Pictures; PO records</td>
</tr>
<tr>
<td><strong>Milestone 6:</strong> POs/government provided with training in livelihood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skills training of POs and government officials</td>
<td>At least 1 skills training/ identified livelihood</td>
<td>Attendance sheet; documentation report</td>
</tr>
<tr>
<td>Preparation of training modules</td>
<td>Training module developed/livelihood</td>
<td>Training design</td>
</tr>
<tr>
<td><strong>Milestone 7:</strong> Sustainable livelihood activities implemented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation and submission of business plans and implementation</td>
<td>Business plans developed</td>
<td>Business plan</td>
</tr>
</tbody>
</table>
### Box 9. PO Organizational Diagnosis (OD) Tool

<table>
<thead>
<tr>
<th>Item</th>
<th>CMRP indicators of success</th>
<th>Present status</th>
<th>Gaps</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational formation</td>
<td>POs organized/strengthened</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational structure</td>
<td>Set of officers elected; organizational structure in place/complete; clear/defined roles and responsibilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBL</td>
<td>Written and approved CBL; understood by the majority of the members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registration</td>
<td>Registration with any registering body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accreditation at the local level</td>
<td>SB resolution of accreditation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membership to local groups/councils</td>
<td>Member in at least 1 Local Special Body / group / council</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMG</td>
<td>Formulated VMG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct of meetings</td>
<td>Monthly meetings conducted; knowledge and skill in facilitating meetings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational policies</td>
<td>Policies developed and approved by the GA; organizational policies implemented</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict management</td>
<td>Knowledge and skill in resolving organizational conflict</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trainings attended/participated</td>
<td>At least 50% of active members attended seminars and forum; all officers trained on leadership and organizational management; training on laws and rights, mangrove ecology, national policies re FLAs, greenbelts, and sustainable CRM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Box 9. continued

<table>
<thead>
<tr>
<th>Item</th>
<th>CMRP indicators of success</th>
<th>Present status</th>
<th>Gaps</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects/ programs managed</td>
<td>Knowledge and skill in program management; Training in livelihood; PO managing programs/projects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membership</td>
<td>At least 20 members/PO; membership expansion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linkage established</td>
<td>Linkage established with DENR, BFAR or the LGU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negotiations done/conducted</td>
<td>Knowledge and skills in doing negotiations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational funds</td>
<td>Payment of regular dues/fees; CBU system in place</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBFMA</td>
<td>Orientation on CBMFA done; CBFMA papers submitted and CBFMA approved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of organizational formation</td>
<td>Barangay based; primary or federation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**i. Cross visit and study tours** – One effective means of enhancing POs awareness is to take them to other areas with advanced mangrove projects where PO to PO learning is demonstrated through direct interaction.

Choose sites that demonstrate the best management practices even if they are at more distant locations. The value for such cross visits are the learnings gathered by the POs from the trip that they can bring home to start up their own mangrove project and the togetherness during the trip increased group cohesiveness (Fig 24).

**ii. Leadership training** – PO leaders are trained to equip them with the skills to improve working relationship between members and outside groups, develop the PO, and improve organizational culture.
Leadership training has four levels:
1) Basic Leadership training, where functions and roles of a leader, leadership principles, and qualities of an effective leader are illustrated and discussed,
2) Leadership Skills training, where facilitating meetings, taking minutes, making decisions, and solving problems are demonstrated through role playing,
3) Empowering Dispute Resolution Management (EDRMP) which is an advanced skills training for leaders that focuses on managing organizational conflict and conducting principled negotiation, and
4) Financial Management training with emphasis on simple bookkeeping and financial systems installation.

iii. Technical hands-on training – POs underwent technical training to equip them with the basic knowledge on the uses and importance of mangroves, identification of species, nursery establishment, outplanting, and care and maintenance (Fig 25). In the sites, Local Monitoring Teams (LMTs) are organized and trained to assist the project’s Marine Biologist. The LMTs later monitored the sites themselves, interpreted and used the data in making decisions related to mangrove rehabilitation (Fig 26). Work of the LMT is voluntary in nature.
Some PO members are trained and deputized by the DENR as mangrove forest guards (Bantay Gubat or BG) to protect the mangrove areas and enforce laws related to mangroves and environmental laws. The PO/BLGU selects among the qualified and willing leaders who will be trained.

As soon as the list of requirements (Box 10) is compiled the chronological steps below in deputation are followed:

1) Request LCE/CENRO authorized Representative to sign a Sworn Statement (stating that the applicant is willing to perform the functions of DENRO without compensation)
2) Submit papers/documents to CENRO for checking/validation
3) CENRO endorses the papers to PENRO
4) PENRO endorses the papers to RED
5) RED gets clearance from DENR Secretary to deputize BG and verifies if the applicant has undergone training through reports submitted by the DENR Regional office that conducted the training
6) RED signs paper of deputation and issues ID

The POs and LGU partners are given training on Sustainable Coastal Resource Management (SCRM) to prepare them for the eventual development of the CRM Plan. The CRM plan is the venue where the POs’ agenda on mangroves are mainstreamed in the LGU agenda and has a good chance of being implemented and budgeted in the succeeding years.
b. **Mobilize and engage communities.** Mobilization is the act of assembling the community together to prepare for a specific collective action or movement with available logistical support. When communities are engaged and have been successful in mobilization, the activity becomes empowering for the people.

Community mobilization work includes

- planting and maintaining mangroves, establishing and maintaining nurseries,
- formulating policies, reporting to LGU and the registering agency e.g. DOLE requires submission of a yearly accomplishment report,
- sourcing funds internally (monthly dues, membership fees) or externally (BFAR aquasilviculture, DENR NGP),
- participating in seminars and forum, and
- conducting advocacy and education campaigns (film showing (Fig 27), setting up signages, students ecopark tour during science month celebration (Fig 28)

C. **Implement livelihood enhancement projects.** POs implement income-generating projects using mangrove as the base resource to augment income. Such activities must be legal, environmentally sensitive, and socially and economically appropriate for the communities. The ZSL-CMRP PO livelihoods experiences include managing an ecopark (Fig 8) and the milkfish cage culture (Fig 29). The former was implemented in 2.5 economic cycles (1 cycle = 1 year operation) while the latter was implemented in 2 cycles (1 cycle = 1 culture period). To measure whether an income generating project is viable and can significantly effect increase in household income, it has to be implemented in at least three economic cycles.

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**Box 10 List of BIG requirements**

- Letter of endorsement from the organization head/ employer or Barangay Clearance signed by the Barangay Captain
- Bio-data with ID picture
- Certificate of Good Moral Character from the Barangay Chairman,
- Parish Priest or Minister where the applicant resides
- Police Clearance (2 X 2 ID required)
- Sworn Statement that the applicant is willing to perform the functions of DENRO without compensation
- ID Picture – 1.5 X 1.5
- Medical Certificate
The process of developing income-generating projects includes:

- project identification,
- proposal packaging,
- preparing and formulating business plans,
- capacity building (Box 11),
- actual implementation and monitoring (Box 12), and
- evaluating project outcomes (Box 13)
Box 11 PO Capacity-Building in operating KII
(KII is managed by two People’s Organizations from the two adjoining Barangays of Bugtongbato and Naisud, Ibajay, Aklan). Below are the Capacity-Building Activities/ Training that the PO leaders attended.

1. Project Management Orientations
2. Conduct of Mangrove Ecology Training (MET)
3. Visit Other Areas thru “Lakbay Aral”
4. Facilitate Registration
5. Process Accreditation with LGU
6. Apply CBFMA with DENR
7. Leadership Training
8. Creation of Project Management Committee (PMC)
9. Regular Monthly Meeting of PMC and POs
10. Financial On-the-Job Coaching (OJC)
11. Conduct of Interpretative Tour Guiding
12. Script Practice
13. Creation of Maintenance Committee
14. Suggestions/Visit of Tourism Experts
15. Facilitate Bureau of Internal Revenue (BIR) Registration
16. Attendance to METB Meetings
17. Training for “Bantay Gubat”
18. Assistance of Business Manager from LGU
19. Financial and Visitors Updating

Box 12 Ecopark monitoring

Visitors numbers peak in September each year as students visit KII to celebrate Science Month. Ninety eight percent (98%) of all visitors to KII were domestic tourists with a quarter visiting for educational purposes.

The trend in ecopark income is increasing every year starting in 2010 indicating the potential of KII as an alternative tour destination.
Box 13 Evaluating project outcome

The KII ecopark is on its 2.5 years of operation since launching in January 2010 and an initial assessment on the effect of income to 39 households in Bugtongbato and Naisud who are directly involved in managing the ecopark was conducted. The study showed a 17-20% increase in income from both sites.

Household income increased for Bugtongbato Fisherfolk Association (BFA) from P8,855.00 (2009) to P10,600.00 (2011). Naisud Mangrove Aquatic Organization (NAMAO) members income of P6,061.00 (2009) increased to P7,076.00 (2011).

5. Secure tenure and sustain community initiatives. Mangroves need long-term management, hence, a tenurial instrument for a minimum of 25 years has to be in place to sustain community activities. Mangrove areas are classified as public lands, therefore, these are open access and vulnerable to human abuse.

At the end of the mangrove project, the communities have invested long term stewardship on their local environment. Thus, the CBFMA complements the years of POs’ existence while allowing mangroves to full maturity. It is by sustaining mangroves that food security, coastal erosion protection, and other benefits are assured for communities. This organizing step is implemented from Year 2-4.

a. Award CBFMA to POs. The process of awarding CBFMA to the POs follows an arduous path (Box 14). The POs formulate the 25 years Community Resource Management Framework (CRMF) and the Annual Work Plan (AWP) as required by CBFMA. The CBFMA timeline established during the ZSL-CMRP was more or less 3 years on average. Linkage with the DENR - the agency responsible for awarding the CBFMA - should be intensified for the former to provide the necessary mentoring to the POs until the yearly review of CRMF and AWP are institutionalized at the PO level.
a. **Mainstream mangrove agenda with the LGU.** A mechanism to mainstream the PO mangrove agenda is to find its way into the LGU development plan like the 3-5 years short to medium-term Coastal and Resource Management (CRM) Plan. The CRM Plan guides the LGU in identifying the appropriate interventions based on community situation from data gathered (Fig. 31), prioritizing project implementation corresponding to the limited budget allocation, passing policies regulating the use of fisheries and coastal/marine resources including mangroves and guiding key stakeholders for conducting capacity building needs. A multi-stakeholder participation was ensured during CRM Planning with the BFAR, DENR, academe, Philippine National Police (PNP), Philippine Coast Guard (PCG), NGOs, Fisheries and Aquatic Resource Management Council (FARMC) members, LGUs (village and municipal) and the coastal communities represented. The local legislative council members are present during the planning. Policies can be in the form of Municipal Fisheries Ordinance (MFO) or Municipal Fisheries Code (MFC). Developing the MFC starts with the coastal communities’ consultation until it is passed by the local legislative council. The MFC highlights zoning the coastal and marine areas and define the activities allowed and not allowed in the zones.
Village policies are passed to protect the birds and wildlife that exist in the area, to enhance communities’ roles and responsibilities by requiring residents to plant mangrove prior to issuance of village licenses, to regulate the harvest of fish and shellfish in mangroves and to conduct intensive study on the areas potential before mangrove planting. These village policies were submitted to the Municipal LGU for adoption.

Fig. 31 Community resource mapping in preparation for the comprehensive CRM Plan, Balaring, Ivisan, 6 Apr. 2011.  

Fig. 32 Policy development workshop with BFAR, DENR, NIPSC and LGU partners, Ajuy, Iloilo, 27 Jan. 2011.

c. **Maintain partnerships and linkage with LGUs and schools.**  
Maintaining the partnerships forged with LGUs and schools at the start of the project was a challenge. Devise a mechanism to ensure that LGUs and schools continue mentoring and assisting the POs after the project’s life. The LGUs should be given more responsibilities in the last year in engaging the communities for project sustainability.

The Municipal Agriculture Officer (MAO) or the Municipal Environment and Natural Resources Officer (MENRO) representing the partner LGUs were present during the strategic planning session designed for the POs. The LGU partners were generous in terms of budgeting and providing financial counterpart as a result of the partnership arrangements and strong linkages (Box11). Likewise, hierarchies of LGU governance and phasing were considered in partnering with them to maximize contribution.

The engagement with the schools was equally fulfilling in terms of planting and maintaining mangroves (Fig 33), establishing nurseries, campaigning and raising awareness and in conducting participatory research with communities (Box 16). To maintain long-term partnerships, formal agreements complementing obligations and roles between the POs and the schools needs to be executed.
### Box 15 Summary of LGUs, LGAs, and NGO counterparts to CMRP

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount of Counterparts</th>
<th>Activity/Items Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>PhP 141,428</td>
<td>Venue; plastic bags, labour, refreshments, and transportation for planting; boat fare to/from Cebu City, per diems and other incidental expenses for Bohol Study Tour; food/hotel accommodation for Panay Study Tour</td>
</tr>
<tr>
<td>2010</td>
<td>PhP 2,017,700</td>
<td>Construction of footwalk in KII, counterpart for trainings, launching of KII, METB Meetings, planting activities, cost of seedlings, truck used to transport students, snacks for outplanting activities</td>
</tr>
<tr>
<td>2011</td>
<td>PhP 1,635,400</td>
<td>Food for participants in CRM Planning Workshop, boat rental in conduct of PCRA among coastal and island barangays, establishment of nursery, rest house, signage, salary of 2 caretakers, cost of material counterpart for bamboo for barriers to protect newly planted mangrove seedlings, cost of material counterpart in signages, construction of eco-park facilities and road rehabilitation for Pedada, Ajuy</td>
</tr>
<tr>
<td>2012</td>
<td>PhP 575,000</td>
<td>Food and accommodation for participants to the National Mangrove Conference</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>PhP 4,369,528.00</td>
</tr>
</tbody>
</table>

d. **Promote non-pay planting.** In the past, mangrove rehabilitation projects contracted out and paid communities with money for establishing nurseries and outplanting. Contracting is initially coursed through the BLGU, then through the PO and lastly through the MLGU. In some areas, engaging the communities to outplant and establish nurseries proved to be very difficult because of their previous experience: People were lured with money and promises of income-generating projects which in the end turned out to benefit only a few and thus disappointed the majority. Moreover plant survival was very poor. It was a major challenge for the CO to start issue-based organizing and to promote no payment scheme for the mangrove activities.

**Fig. 33** NIPSC students planting in Brgy. Pedada, Ajuy, Iloilo, 25 Sep. 2010
Box 16 Schools contribution to CMRP targets

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Planted</th>
<th>Planted by students</th>
<th>% students contribution</th>
<th>Number of student participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outplanting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>13,121</td>
<td>1,483</td>
<td>11%</td>
<td>129</td>
</tr>
<tr>
<td>2010</td>
<td>33,340</td>
<td>9,018</td>
<td>27%</td>
<td>584</td>
</tr>
<tr>
<td>2011</td>
<td>39,585</td>
<td>8,727</td>
<td>22%</td>
<td>362</td>
</tr>
<tr>
<td>Total</td>
<td>86,046</td>
<td>19,228</td>
<td>22%</td>
<td>1,075</td>
</tr>
<tr>
<td>Nursery / Bagging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>12,538</td>
<td>2,416</td>
<td>19%</td>
<td>204</td>
</tr>
<tr>
<td>2010</td>
<td>21,452</td>
<td>5,045</td>
<td>24%</td>
<td>1,077</td>
</tr>
<tr>
<td>2011</td>
<td>9,800</td>
<td>4,679</td>
<td>48%</td>
<td>495</td>
</tr>
<tr>
<td>Total</td>
<td>43,790</td>
<td>12,140</td>
<td>28%</td>
<td>1,776</td>
</tr>
</tbody>
</table>

Planted mixed species of *Avicennia marina*, *Rhizophora mucronata*, *Rhizophora apiculata*, *Sonneratia alba*, and *Nypa fruticans*

Continuing education, raising level of awareness and mobilizing communities resulted to a paradigm shift wherein communities recognize the importance of mangrove to their livelihoods.

e. **Formulate PO strategic plan.** The conduct of a strategic planning session for the POs will prepare them for the eventual exit of projects from the sites. The plan included enhancing the cohesiveness and capacity of the POs giving equal opportunities to both men and women, and recognizing their peculiar contribution to mangrove management and monitoring, coordinating closely with the DENR in reviewing and formulating AWPs and CRMFs, sourcing funds for alternative livelihoods project support, developing direct linkages between POs and institutions and LGUs among others. In summary, the PO strategic plan is the document that will give them direction over the next 5-10 years. The first part of the strategic planning process is revisiting the organizational Vision, Mission and Goals, as well as governance and policies.
B. Mangrove Rehabilitation Planning

What is a mangrove rehab plan?
• is preparing a sequence of action steps to achieve the goal of
  restoring mangroves to good condition, operation, or capacity
• it explains in detail what needs to be done, when, how, and by
  whom

With careful planning you often can see if at some point you are likely to
face a problem, hence easier to adjust the plan.

A Plan is like a map
• when following a plan, you can always see how much you have
  progressed towards your project goal and how far you are from your
  destination
• knowing where you are is essential for making good decisions on
  where to go or what to do next

Unplanned or unstructured activities
• 80 percent of the effort give less than 20 percent of the valuable
  outcome
• spending much time on deciding what to do next, or taking many
  unnecessary, unfocused, and inefficient steps

Why do we need a rehab plan?
• To serve as guide in the day to day activities
• To ensure that the target is achieved at a given timeframe e.g.
  planting area is fully planted in 3 years time
• To be able to ensure that resources are enough and maximized
• To distribute tasks among members
• To be able to quantify the number of seedlings needed taking into
  consideration spacing and species appropriate for planting
• To serve as basis for evaluation, decision-making
**Parts of a mangrove rehab plan**

1. Brief description of the area - basic demographics
2. Assessment – total mangrove area, if damaged how many percent, species and number, initiatives undertaken
3. What is the name/ type of project to be done
4. Objectives
5. Defined area/ location – draw map of area showing the mangroves, where to establish nurseries, outplanting areas, areas for protection/ existing mangroves
6. Technical considerations – spacing, seedling/ wilding requirement, species for planting
7. Budget (seedlings, planting activities, nursery, equipment and materials)
8. Schedule

Participants must bring spot maps and socio/ demographic data of the barangays where the target mangrove rehabilitation sites are located during the mangrove rehabilitation planning.

**Box 17. Template for a Rehabilitation Plan**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Timeframe</th>
<th>Responsible group/person</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Preliminaries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site selection (nursery and outplanting)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursery establishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outplanting activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring and Maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Fringing mangroves (along a coastline) are first to suffer damage when a typhoon makes landfall. In the Philippines, fringing mangroves vary in width from <20 meters to >100 meters.

2. Mangrove damage and recovery assessment is best done during low tide (so roots are visible to aid in species identification, seedlings/saplings also need to be counted). Check local tide calendar to determine appropriate time.

3. To survey mangrove damage, sampling plots are marked along a transect line perpendicular to the shoreline (landward margin) stretching to the seaward margin of the mangrove forest. The number of plots will depend on the width of the mangrove band (Fig. 34):
   - less than 20 m wide: make 2 plots X m wide (= width of mangrove) by 10 m long covering the narrowest and widest areas
   - 20-50 m wide: 2 plots of 10 m x 10 m located seaward and landward
   - more than 50 m wide: 3 plots of 10 m x 10 m located seaward, middle, landward

   If the plots are 2 or more, distribute them evenly/equally along the transect. If the length of the fringing mangrove is more than 1 kilometer, 2 sets of plots can be sampled.

4. The plot size should preferably be 100 square meters in area (10 m x 10 m or 5 m x 20 m) and enclosed using wood/bamboo stakes and nylon string or straw. Note that the width of the plot is along the width of the mangrove band, and the length is parallel to the coastline.

5. The recommended number of persons per plot is:
   - 1 person - to measure and enclose the plot (and take GPS readings, if available), then mark trees already classified and documented using masking tape.
   - 1 person - to identify species and classify the damage.
   - 1 person - to record data on slate board or notebook (maybe same as person b).
6. Conduct two assessments: initial at 1st month, and final at 4th - 6th month, after the storm event. Classify the recorded plants within the plot as to — —

- seedlings: < 1 meter height, stem < 4 centimeters circumference or pencil size
- saplings: > 1 meter height, stem < 4 centimeters circumference or pencil size
- trees: > 1 meter height, stem or trunk > 4 cm circumference

Use a meter stick (or pre-marked stick) for measuring height, and tape measure (or pre-marked rope) for tree circumference or diameter.
7. Materials and equipment needed:
   • Global Positioning System or GPS (optional)
   • transect tape or pre-measured rope (40+ m, marked every 10 m)
   • meter stick or premeasured/marked stick
   • tape measure or premeasured/marked rope
   • masking tape
   • improvised white slates (PVC board of 20 cm x 30 cm)
   • pencils
   • camera (optional)
   • tablet with camera and/or GPS (alternative to camera and GPS)

A. Damage

a) **Seedlings and saplings** – count no. of dead and alive, total number, and compute percent, and density (no/hectare).

b) **Trees** – classify by species as to the following, count total no. of trees, and compute percent for each:
   - **No Damage** – intact, alive
   - **Partial Damage** - some broken twigs, partial/total defoliation (at 1-5 months), assumed alive
   - **Total Damage** - tree uprooted, no leaves at 6 months

Proportion (%) of live vs dead trees can be estimated only in untouched, non-cleared areas.

B. Recovery

a) **Trees** - After 6 months to 1 year, trees that remain defoliated (no new leaves) can be considered dead (Fig. 34).

b) **Shoots (young leaves)**
   - may first appear as late as 4 months after the storm, for pagatpat (*Sonneratia alba*) (Fig. 34)
   - first appear on topmost branches, for bakhaw Rhizophora species
c) Seedlings and Saplings (from fruits/propagules released by trees before the storm;
   • Wait up to 6 months for germination period before making final counts of seedlings and saplings.
   • Sites with seedlings below 1,000/hectare may not recover (e.g., plantations in Maliwaliw) and will need replanting (see CMRP Mangrove Manual No. 1 by Primavera et al, 2012*).
   • Those with 1,000-5,000 seedlings/hectare may need enrichment planting (see CMRP Mangrove Manual No. 1 by Primavera et al, 2012*).
   • Those with 5,000-10,000 seedlings/hectare and higher have good chances of recovery.

The assessment must be able to generate the following:

   • Mangrove species present (indicate if naturally growing or planted) to determine species composition;

   • Number of trees with shoots/new leaves vs. trees still defoliated to determine density (trees per hectare), percentage of damaged and recovering trees;

   • Number of seedlings and saplings (live and dead) to determine recovery potential of the mangrove forest;

   • Presence of waste materials that shall determine the need for cleaning.

**Fig. 34** Shoots on cut trunk of *Sonneratia alba* in Hernani and defoliated bakhaw plantation in Maliwaliw Is., Salcedo, Eastern Samar
1. Conduct Mangrove Damage and Recovery Assessment prior to any mangrove cleaning activities.

2. Workers must be oriented on the Dos and Don’ts in cleaning mangrove forests before they are fielded.

3. Go to the site on a boat during high tide to avoid trampling/stepping on seedlings and saplings or on foot during low tide.

4. Be careful not to trample on the seedlings and saplings.

5. Remove plastics and other solid wastes clinging to the trees, and other debris and garbage from the area; and sort biodegradable materials from plastics and other non-biodegradables.

6. Do not allow burning of collected garbage and debris.

7. Narrow mangrove bands (< 20 meters) sustaining minimal to partial damage with only a few fallen twigs and branches should be left untouched.

8. For wider mangroves with significant damage:
   a. Remove broken branches and cut only twisted, barely hanging branches.
   b. Do not cut fallen trees with roots still connected to the ground.
   c. Do not cut the trunks or branches of seemingly dead trees.
   d. Do not cut bare, defoliated branches that are still connected to the trunk.
   e. Do not cut bare, defoliated trunks that are still standing or fallen trunks with roots still connected to the ground or roots of fallen trees.
   f. Retain/leave some dead roots, twigs, etc. to provide protection (as tree guards) around regenerating seedlings and saplings, and even to later transplanted seedlings.

In case of bakhaw plantations, remove fallen trunks and bigger branches to prevent shellfish mortality from released tannins (ZSL Seminar-Workshop on Sustainable Imbao (*Anodonta philippiana*) Fisheries, Bantayan, Cebu, 22 Sept. 2014).
9. Branches may be fashioned into artificial reefs and installed in appropriate areas.

10. Suitable-recovered broken and twisted branches may be made into art works and sold.

11. Broken mangrove branches maybe brought home for fuel wood

12. Collection and bagging of abundant seedlings may be done simultaneously with mangrove cleaning but ensure that there is significant number of seedlings left for regeneration. More so, a nursery must be prepared prior to collection and bagging of seedlings.

*Fig. 35* Garbage clinging to mangroves in Tacloban City (photos by G. Albano)
REFERENCES


**Common Mangrove Species in the Philippines**
(Along shorelines and tidal rivers)

*Avicennia marina* (bungalow/apiapi) – varied substrate (muddy, sandy, rocky, etc.), wide salinity range; front liner

*Rhizophora stylosa* (bakhaw bato) – behind *A. marina*-*S. alba* zone, along riverbanks, or other sheltered sites, e.g. lagoons, sandy to muddy substrate, full to brackish salinity

*Rhizophora mucronata* (bakhaw babae) – along tidal creeks and rivers, muddy substrate, brackish salinity

*Rhizophora apiculata* (bakhaw lalaki) – behind *A. marina*-*S. alba* zone, other sheltered sites, sandy substrate, full seawater salinity

*Sonneratia alba* (pagatpat) – sandy-muddy substrate, full seawater salinity; front liner
PHILIPPINE MANGROVE LAWS

Protection

P.D. 705 (1975) – Revised Forestry Code: Retention of 20 m-wide mangrove strip facing oceans
P.D. 953 (1976) – Pond/mangrove leaseholders to retain or replant 20-m mangrove strip along rivers or creeks
P.D. 1067 (1976) – Water Resources Code: 3 to 20 m of riverbanks, seashore for public use (recreation, navigation, floatage, fishing and salvage), building of structures not allowed
P.P. 2151 & 2152 (1981) – Declaration of 4,326 ha of mangroves including Palawan as wilderness areas and 74,767 ha as forest reserves
DENR A.O. 76 (1987) – Establishment of buffer zone: 50 m fronting seas, oceans and 20 m along riverbanks; Fishpond Lease Agreement (FLA) holders required to plant 50 m of mangrove strip
DENR A.O. 15 (1990) – Granting/renewal of mangrove timber license/permit no longer allowed; reversion of mangroves released to BFAR for fishpond not utilized or abandoned 5 years from date of release to forest land category
DENR A.O. 31 (1991) – Guidelines for award and administration of Mangrove Stewardship Agreement
R.A. 7161 (1991) – Internal Revenue Code: Ban on cutting of all mangrove species
R.A. 8550 (1998) – Fisheries Code: Prohibits mangrove conversion to fishponds and other uses; pond lessee to reforest riverbanks, seashore, etc. fronting pond dikes

Zoning, Tenure, FLAs, Pond Conversion and Reversion to Mangroves

P.D. 704 (1975) – Fisheries Code: Policy of accelerated fishpond development; set conditions for mangrove conversion to ponds; public lands for ponds can only be leased, not owned
P.D. 705 (1975) – Revised Forestry Code: DENR jurisdiction over mangrove forests, except those released to BFAR as fishponds
– Government officer/employee misclassifying mangrove forest as A&D subject to dismissal, min. 1 year imprisonment and min. Php1,000 fine
– Government officer/employee issuing tax declaration without DENR certification re A&D status subject to 2-4 years imprisonment, disqualified from elective or appointive office
DENR A.O. 123 (1990) – Award of 25-yr Community-Based Forest Management Agreement (CBFMA) for small scale use of mangroves, establishment of Rhizophora and Nypa plantations, aquasilviculture
Joint DA-DENR General M.O. 3 (1991) – Automatic reversion to DENR of abandoned or underdeveloped fishponds 5 years after release to BFAR
E.O. 263 (1995) – Community-Based Forest Management (CBFM) adopted as national strategy for sustainable development of forests
R.A. 8550 (1998) – Reforestation of riverbanks, seashores, etc. fronting fishponds; reversion of abandoned, undeveloped or underutilized (AUU)-FLA ponds to mangroves; current FLA leases entitled to 25-yr extension, thereafter preference to fisherfolk and small/medium enterprises; DENR with DA, LGUs, etc. to determine AUU-FLA ponds for reversion
BFAR F.A.O. 197 (2000) – Annual FLA rental set at PhP500/ha starting 2000, increased by PhP100/yr up to PhP1,000/ha by 2004; AUU-FLA ponds for reversion to mangrove state
Joint DA-DENR-DILG A.O. 1 (2008) – Inter-Agency TWG to identify FLAs abandoned for 5 years and prepare guidelines for mangrove reversion

“The potential of coastal mangrove greenbelts to mitigate sea level rise and increasing storm frequency and intensity caused by climate change cannot be over-emphasised. Rehabilitate mangroves we must, but let us follow science-based guidelines.”

Jurgenne Primavera, March 2010