**Why Group Consolidation?**

- Villagers as individual are very weak when considering as a stakeholder for mangrove management.
- They have little experience of mangrove management.
- They have limited opportunities of sharing experience.

**POWER OF CONSOLIDATION**

- If local people are consolidated into groups, they share their power, experience and skills and become more powerful for mangrove management.

**METHOD FOR EFFECTIVE GROUP CONSOLIDATION**

- People organize user group for mangrove management.
- FD staffs periodically communicates with villagers.
- Local network will be constructed among UsG in the Ayeyawady Delta to share the experience and information, and among UsG, FD staffs, and other concerned people/organizations.

Network of UsG and FD staffs
Why Group Consolidation?

Subject: Local people as individual are very weak when considering as a stakeholder for mangrove management.

Teaching method: Discuss with trainees (villagers) following matters and confirm.

- They are relatively poor and pressed by livelihood activities, and frequently without any help from supporters and donors.
- They have neither organized technical know-how nor management skills. They need to be informed such for better mangrove management.
- They have little experience of mangrove management. They have to share the experience of other villages and FD.
- However, they have limited opportunities of sharing experience.

POWER OF CONSOLIDATION

Subject: If local people are consolidated into groups, they become more powerful.

Teaching method: Discuss with trainees (villagers) using examples and confirm the followings.

- If they are consolidated, they enjoy mutual help. They can assist each other in a form of cooperation work.
- If people share their knowledge, experience and skills among group members, they can be more powerful than each person working individually (learning each other).
- If they help each other, they can manage mangrove rehabilitation more effectively (consolidation will create multiplier effect).
- They exchange understandings and expertise with FD staffs (interaction of stakeholders).

METHOD FOR EFFECTIVE GROUP CONSOLIDATION

Subject: Villager will be involved in multiple network of stakeholders for mangrove management.

Teaching method: make trainees (villagers) understand the role of UsG, relation with FD staffs and the network of UsG.

- People organize users group (UsG) for mangrove management.
- FD staffs periodically communicate with villagers.
- Local network will be constructed among UsG in the Ayeyawady Delta to share the experience and information, and among UsG, FD staffs, and other concerned people/organizations.
Key points

- Enable sustainable community forestry activities based on findings from periodical monitoring (such as weekly, monthly, annually progress check through site check and/or working records for the CF activities).
- Self monitoring by user groups and overall monitoring by CF task force of FD
- Developed mutual understanding of community forestry between user groups and FD through a series of monitoring activities

Why/what monitoring for management?

- To grasp the progress of community forest activities in accordance with management plans (activity areas, survival rate, achievements of each activities etc.)
- To explore needs for assistance for user groups
- To identify constraints/ issues (insufficient techniques for planting operation, livelihood problems, encroachment issues, etc.)
- To feed back next plan/ implementation of community forest activities with findings and lessons learned from step by step monitoring.

Monitoring Type

1. User group activity recording (self monitoring by user groups and basis for progress and growth monitoring)
2. Monitoring of community of forestry activities (e.g., planting, patrolling, harvesting, preparation of annual plan, monthly meeting etc.)
3. Growth monitoring for confirmation of growth condition and survival rate of plantation, identification of constraints and difficulties, and consideration of countermeasures.

<table>
<thead>
<tr>
<th>Type</th>
<th>Contents</th>
<th>frequency</th>
<th>Source of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity monitoring</td>
<td>-name of activities</td>
<td>Monthly by entire user group</td>
<td>working record of each member, minutes of meeting of periodical meeting of user group shall be prepared and kept by management committee of user group.</td>
</tr>
<tr>
<td></td>
<td>-period of activities</td>
<td>Biweekly by sub-group, FD staff</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-mandate for each activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-achievements of each activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-copy of working record etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-list of user group members and their achievements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth monitoring</td>
<td>-species of planted seedlings</td>
<td>Annually or Semiannually,</td>
<td>Management plan for plantation, field survey, interview of user group members</td>
</tr>
<tr>
<td></td>
<td>-number of survived seedlings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-survival rate by species etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Monitoring procedure

Step1: Support UsG with preparation of monitoring forms and user group activity record formats
Step2: Support UsG with preparation of a monitoring plan by user groups
Step3: Organize workshops and/ or periodical meetings for information sharing about monitoring activities to target user groups/ members
Step4: Implementation of the monitoring with stakeholders (such as MC members, subgroup leaders, related user group members as owner of target monitoring area
Step5: Recording results to monitoring forms
Step6: Report the result of monitoring with evaluation to CF task force and township office
Step7: Feed back the evaluation result to user groups
Step8: Support UsG with countermeasures toward effective and sustainable implementation of community forestry activities by user groups
1. Preparation of activity monitoring form

- Contents of the form shall be in accordance with the component of concerned management plans of user groups
- User groups should keep work/activity records as data source of progress monitoring

Activity monitoring form (sample)

<table>
<thead>
<tr>
<th>No</th>
<th>Prototype/Component</th>
<th>Location</th>
<th>Area (acre)</th>
<th>Activities</th>
<th>Duration</th>
<th>People-day</th>
<th>Work Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>Plantation group 6</td>
<td>Plantation in group 6</td>
<td>10</td>
<td>preparatory work</td>
<td>20-22 May</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>seedling transportation</td>
<td>Plantation in group 6</td>
<td>11</td>
<td>2</td>
<td>seeding/transportation</td>
<td>25-27 May</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>planting</td>
<td>Plantation in group 6</td>
<td>3</td>
<td>1</td>
<td>planting</td>
<td>1-5 Jun</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>brushing</td>
<td>Plantation in group 6</td>
<td>4</td>
<td>1</td>
<td>brushing</td>
<td>1-5 Jun</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>tending</td>
<td>Plantation in group 6</td>
<td>1</td>
<td>0</td>
<td>tending</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>replanting</td>
<td>Plantation in group 6</td>
<td>7</td>
<td>0</td>
<td>replanting</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

2. Preparation of growth monitoring form

Growth monitoring form (sample)

<table>
<thead>
<tr>
<th>UG Member</th>
<th>Prototype/Component</th>
<th>Total CF area (acre)</th>
<th>Species</th>
<th>Planted date</th>
<th>Inspection date</th>
<th>Target Area</th>
<th>Avg. diameter/height at breast height (in/cm)</th>
<th>Avg. height (ft/m)</th>
<th>Tree planted (no)</th>
<th>Tree survived (no)</th>
<th>Survival rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Uaaa</td>
<td>Plantation</td>
<td>xxx</td>
<td>aab</td>
<td>2019</td>
<td></td>
<td></td>
<td>180 (m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Daw bbb</td>
<td>NFIO patching</td>
<td>xxx</td>
<td>aab</td>
<td>2019</td>
<td></td>
<td></td>
<td>180 (m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Uccc</td>
<td>Plantation</td>
<td>xxx</td>
<td>aab</td>
<td>2019</td>
<td></td>
<td></td>
<td>180 (m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 school PTA</td>
<td>Plantation</td>
<td>xxx</td>
<td>aab</td>
<td>2019</td>
<td></td>
<td></td>
<td>180 (m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Field measurement

Example: Plantation area

1: Decide a starting corner of area for community forest activity
2: Install poles with paint all corner as landmark and record the length between poles
3: Count the planted seedlings within delineated area and record in monitoring form

If GPS is available for monitoring, confirmation of area under community forestry activities shall be located on the topographic map with higher accuracy.

In GPS survey for monitoring, necessary to:
- procure batteries for GPS receiver,
- train to operate the GPS,
- train to record GPS data, and
- establish of submission process from sites to offices which installed computer and GIS technology with experts.
Procedure of reporting of monitoring result

User group under community forestry

User group member
(sub-group)

Community forest activities

Periodical meetings
(such as monthly meeting)

User group activity record

Site inspection

Interview/data collection

Activity monitoring
Growth monitoring

Activity monitoring form
Growth monitoring form

CF Task force

Divisional office
DG office
PSD office

Township office
District office

Forest department

Feedback

Submission

Site inspection

Submission of monitoring form follows a CFC procedure
Management Concept:
Buffer Zone as “Social Fence” against encroachment from outside and “Natural Barrier” for core areas with remaining mangrove vegetations

Key points
• Buffer zones are focal areas inside reserved forests for creating public awareness of mangrove degradation and rehabilitation
• Villages and settlements inside buffer zones are the priority targets for implementing and CF and formulating UsG
• Tight collaboration between FD and CF user groups for buffer zone management and operations
• In addition to the regular patrol system, establishment of joint buffer zone patrolling system (including fire protection) between FD and user groups, in collaboration with local authorities
• Utilization of CF products by user groups
• FD to provide basic equipment, materials and technical guidance to CF UsG

Buffer Zone (BZ) Management

FD
- Overall responsibility and authority of BZ
- Preparation of management plans for buffer zones in consideration of UsG.
- Responsibility and initiative for implementing the joint buffer zone patrolling
- Supervision of CF activities
- Support CF UsG

CF User groups
- CF operations in BZ
- Patrolling against encroachment and forest protection of own CF areas
- Reporting responsibility against encroachments in non CF areas inside BZ (contribution to joint patrolling)

FD shall supervise and support CF User groups for effective BZ management!!
Management Concept: Integrated River Bank Management to protect national land and its production capacity

Current Conditions of Land of the Delta:
- Exposed land to very salty wind, wave, water flow, sunshine, etc. without protection by natural vegetation
- Erosion of river banks and coast lines are common phenomenon in the delta
- The country's land is decreasing because of a lack of proper protection/rehabilitation measures
- Moreover, the livelihood of residents and regional economy are affected by damage to settlements, paddy fields and other infrastructures

Key Points
- Introduce appropriate counter measures against erosion/degradation observed along coastal and river banks
- Countermeasures for critical areas and banks outside of reserved forests shall be conducted by local authorities and concerned ministries
- Inside reserved forests, FD needs to take the initiative for riverbank protection/rehabilitation in collaboration with local authorities
- For core zone area, riverbank protection/rehabilitation to be conducted under FD direct operations.
- For buffer and multiple-use zones, riverbank protection/rehabilitation to be conducted as one type of CF prototypes
- CF river bank management is to protect the national land resources and production/living areas of user groups.
- Integrated river bank management is to be promoted in association with public awareness for mangrove resource protection.

River bank management/rehabilitation to be under CF in the reserved forests
- CF River Bank 100 Feet Woodlot -
FD Volume III: CF Management
III-6: CF River Bank Management

**Methodology:**
- Civil engineering works are more effective, but locally appropriate technology and materials should be used for river bank stabilization
- Reforestation and surface re-vegetation are feasible methods of river bank stabilization
- Fencing and gabion work by locally procured materials (phoenix poles) can be applied in areas where immediate stabilization is required
- Organize a river bank management subgroup under the CF user group
- Avoid unnecessary conflicts with fishery activities; therefore, coordination with the fishery department is required by FD before implementation of any works.

**Water Edge (CF River Side Woodlot/CF Paddy Woodlot, CF Village):**
- Prevention of landslide & landfall
- Re-vegetation
- Coastal protection forest establishment
- Fencing
- Gabion work

**High Ground Level (CF River Side Plantation / CF Paddy woodlot / CF public Woodlot):**
- Prevention of soil erosion
- Stabilization of Slope
- Surface Re-vegetation
- Reforestation

**Mid Ground Level (CF River Side Plantation / CF Paddy woodlot):**
- Prevention of top soil erosion
- Surface re-vegetation
- Reforestation

**Low Ground Level (CF Nipa Plantation / CF River Side Woodlot):**
- Protection from waves action
- Coastal protection forest establishment
- Gabion Work
### Summary of Activities for Mangrove Forestry Operation

<table>
<thead>
<tr>
<th></th>
<th>FD Operation</th>
<th>CF Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Natural Forest Operation:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| a. Protection and Conservation | - Preservation of critical areas  
- Wildlife/ecosystem conservation  
- Patrolling to prevent illegal activities & fires  
- Monitoring & evaluation |                                                                              |
| b. Forest Regeneration Operation: | (Forest Stand Improvement: FSI) - Climber cutting & clearing  
- Thinning  
- Regeneration treatments (seed tree, coppice, assisted natural regeneration, enrichment planting)  
- NFTP extraction  
- Forest Protection |                                                                              |
| c. Forest Improvement Operation: | (Regeneration Improvement Felling: RIF) - Improvement felling (cutting, clearing, thinning, pruning)  
- Regeneration treatments (clear-felling on alternative strip, selection, seed tree, coppice, assisted natural regeneration, enrichment planting)  
- NFTP extraction  
- Forest Protection | (Natural Forest Improvement Operation: NFIO) - Improvement felling (cutting, thinning, pruning)  
- Regeneration treatments (selection, seed tree, coppice, assisted natural regeneration, enrichment planting)  
- Harvesting  
- Forest Protection |
| (Timber Stand Improvement: TSI) |                                                                              |                                                                              |
| 2. Plantation Operation: |                                                                              |                                                                              |
| a. Mangrove Species Plantation | - Potted seedling for mid/high ground  
- Bare root seedling & propagule for low/mid ground | - Bare root seedling, propagule, sowing for low/mid ground |
| b. Non-mangrove Species Plantation | - Assisted natural regeneration (nurse/shade tree at high ground)  
- Multiple-use tree establishment at high ground |                                                                              |
| 3. Riverbank stabilization |                                                                              |                                                                              |
| a. Vegetation activities | - High ground reforestation  
- Re-vegetation for surface erosion  
- Low ground/ wave action stabilization | - High ground reforestation  
- Re-vegetation for surface erosion  
- Low ground/ wave action stabilization |
| b. Bank protection work | - River embankment | - River embankment |
| 4. Forest Protection |                                                                              |                                                                              |
|                           | - Pest & disease prevention control  
- Fire protection & control  
- Patrolling & monitoring against illegal cutting & encroachment  
- Monitoring & evaluation | - Pest & disease prevention control  
- Fire protection & control  
- Patrolling & monitoring against illegal cutting & encroachment  
- Monitoring & evaluation |
| 5. Seedling Production | - Seed/propagule/wildling collection  
- Seed orchard operation  
- Seedling production (bare-root & potted seedling) | - Seed/propagule/wildling collection  
- Village nursery operation |
Desirable & Preferable Species by Ground Level for Forestry Operations

Key points

- Desirable species are based on site-species matching, suitability and profitability (financial and economic returns and environmental soundness)
- Preferable species are based on availability of abundant seed sources, ease in collection and raising seedlings, or already established planting methods, and often selected by FD/villagers
- Fast growing non-mangrove species shall be introduced in high ground and extremely high ground areas where growing of mangrove species are not favorable due to less tidal inundation

<table>
<thead>
<tr>
<th>Ground Level</th>
<th>Desirable Sps.</th>
<th>Preferable Sps.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (equinoctial tides &amp; rainy seasons)</td>
<td>Albizia lebbek, Melaleuca spp., Acacia mangium (spp proved in trial plantation), Amoora cucullata, Excoecaria agallocha</td>
<td>Avicennia officinalis, Thame, Sonneratia apetala, Kanbala</td>
</tr>
<tr>
<td>Natural Forest</td>
<td>Phoenix paludosa, Heritiera fomes</td>
<td>Spp. existing in natural conditions, Excoecaria agallocha, Thayaw</td>
</tr>
<tr>
<td>Medium (normal high tides or spring high tides)</td>
<td>Avicennia officinalis, Ceriops spp, Sonneratia apetala</td>
<td>Bruguiera spp, Avicennia officinalis, Thame</td>
</tr>
<tr>
<td>Natural Forest</td>
<td>spp. existing in natural conditions</td>
<td>spp. existing in natural conditions</td>
</tr>
<tr>
<td>Low (all high tides)</td>
<td>Rhizophora apiculata, Sonneratia apetala, Avicennia marina</td>
<td>Avicennia alba, Thame-phyu</td>
</tr>
<tr>
<td>Natural Forest</td>
<td>spp. existing in natural conditions</td>
<td>spp. existing in natural conditions</td>
</tr>
</tbody>
</table>

Securing Seed/Propagule Sources

Key points

- Securing sufficient supply of better quality seeds/propagules are prerequisite for mangrove reforestation
- Understanding seed collection and availability situations are essential to support regeneration and planting for mangrove rehabilitation
- Consider seed/propagule availability for both FD direct operations and CF operations

Methodology

- Identify locations of seed/propagule sources
- Accumulate information of seed/propagule sources (fruiting time, seed collection time & method, available quantity)
- Establish seed production areas for desirable species as seed/propagule sources
- Accumulate information of seed/propagule (maturity, selection, storage, pretreatment)
Seed Collection

- Notice fruit bearing and ripening time because collecting seed/propagule at the right timing is critical. (refer source book for approximate period of fruiting/seed collection for major species)
- Mangrove seeds/propagules to be collected shall be 1) average to superior size, 2) free from defects and infestation, 3) matured, 4) fresh without developed roots.

- Seed/propagule collection can be done by plucking matured fruits and/or by picking up windfalls during Yethe (Low-rise) tide days.
- If required, consider and method of sorting, packaging (keep moisture and avoid direct sunlight), transportation and storage of seed/propagule:
  - When collecting propagules of Rhizophoraceae family, it is advisable to pluck them and plant at once though the matured fruits can be stored for a while.

Seedling Production

- Types of seedling for production
  1) Direct sowing species (ready for planting)
     Rhizophora apiculata, R. mucronata, Bruguiera gymnorrhiza, Kandelia candel, Ceriops decandra, Avicennia spp., (Aegiceras corniculatum, Aegialitis rotundifolia, Xylocarpus moluccensis)
  2) Bare-root seedling (need to germinate in ridge or germination bed)
     Excoecaria agallocha, Heritiera formos, Sonneratia apetala, S. caseolaris, S. griffithii, Cynometra ramiflora, Xylocarpus granatum, (Aegiceras corniculatum, Avicennia spp)
  3) Potted seedling (above two types can be produce as potted seedling)
     following species can be sown directly to pot: Avicenniaceae, Cynometra ramiflora, Heritiera formos, Xylocarpus moluccensis, Rhizophoraceae
  4) Wildering: wilderings are required when seeds/propagules and seedlings are not available. Relatively, lower survival compare to other types of seedlings therefore more care is necessary.

- Sowing and seed germination
  
  First Step: Processing seeds before nursing
  
  The seeds of mangrove species are not to be left long before sowing. It is suggestible to sow them directly at once as soon as the seeds are collected. Some species need certain pretreatment before sowing.
  
  - Sonneratia fruits are to be immersed in water for two, three days and stirred off and on to separate the flesh and the seed. Then, take out the seeds and wash them again in water. After drying under the shade, put seeds in bags and store in a cool dry place.

  Second Step: Sowing seeds

  Two ways of sowing:
  1. Sowing seeds in ridges/germination beds first and then transplanting seedlings into plastic bags or nursery beds
  2. Sowing seeds directly in the plastic bags.

  Take care that the seeds are not carried along by the tide. It is therefore advisable to sow only on Yethe (low-rise) days and seeds to get rooted before high tide.
Seed Collection and Seedling Production

Seedling Production and Maintenance

• Preparation for potting
  - For production of potted seedlings, pot filling materials (soil, manure) and plastic bags are required prior to transplanting.
  - Especially for some high ground mangrove species and non-mangrove species, should avoid clay and salt, and use sand for potting to avoid salt accumulation in soils of potted seedlings, which cause dehydration and damage seedlings.
  - Pot filling materials shall be mixed thoroughly, either by manually or by machine.
  - Plastic bags shall be filled with filling materials and filled pots shall be laid in nursery beds to be ready for transplanting and maintenance.

• Transplanting
  - Germinated seedlings to be transplanted to plastic bags or nursing beds in time for further activities.
  - Transplanting is done by pricking germinant using a flattened stake to minimize damages to root. Avoid pricking by hand.

Nursing of Seedlings (Tending activities)

watering: For non-mangrove species water daily if not exposed to rain. For mangrove species, secure daily water flows into bed, either freshwater or brackish water.

shading: Shade newly germinated/potted seedlings to avoid direct sunlight.

weeding: Conduct regularly to prevent competition with weeds.

pest & disease control: Conduct regular inspection. If any pest or disease are found conduct necessary counter measures (isolation, removal, burning, pesticide).

recording: For monitoring of growth performance and survival of seedlings in nursery and planting sites.

hardening: Preconditioning seedlings to acclimatize planting environment (sunlight increase, watering reduction, if necessary).

seedling transport: grade and sort seedlings based on seedling criteria, before packaging and transportation.

Example of Seedling Criteria

⇒ Root and stem ratio of 1:1 or 1:2;
⇒ Tough and strong collar and stem;
⇒ Proportionate growth of leaves;
⇒ Compact growth of roots;
⇒ Strong leaves with dark green color (without yellow/withered leaves)

Seedlings to be removed for planting

<table>
<thead>
<tr>
<th>Stem</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deformation</td>
<td>Having less roots</td>
</tr>
<tr>
<td>Having small stem</td>
<td>Having less lateral roots</td>
</tr>
<tr>
<td>Having less leaves</td>
<td>Having root disease</td>
</tr>
<tr>
<td>Having too many branches</td>
<td>Having wrinkled or curled up roots</td>
</tr>
<tr>
<td>Dry at the top</td>
<td>Leaves are yellowish/pale</td>
</tr>
<tr>
<td>Leaves are yellowish/pale</td>
<td>Having tiny leaves</td>
</tr>
<tr>
<td>Having tiny leaves</td>
<td>Having too big stem</td>
</tr>
<tr>
<td>Having too big stem</td>
<td>Having less hair roots</td>
</tr>
</tbody>
</table>
Mangrove Nursery Establishment

1. Site selection
Consider following items upon selection of mangrove nursery sites:

- Select the site near the river/creek, preferably in medium ground level.
- Tidal influence is needed the whole year round. However, avoid site selection where there is tidal waves.
- If tidal influence is not available, dig ditches up to the depth level where tidal influence is available.
- Embankment type nurseries require less earthwork and preferred for small scale nurseries such as for village nurseries. Excavation type nurseries require more earthworks but preferred for mass production since such nurseries are easier for quality control of seedlings.
- Choose the site where there is convenient transportation.
- Some mangrove species need the fresh water at nursing time. Others are able to live salinity water. So that, nursery site shall be at brackish water area.
- Even for a same species, consider difference of water salinity level from locations to locations and adjust bed levels which is appropriate for the concerned location.

2. Establishment of Nursery Facility
Nursery shall have enough area and facilities to fulfill annual production requirement of the said nursery. Consider following facilities for establishing mangrove nurseries:

**Water outlet:**
Outlets to control water flow in and out nursery

**Nursery beds/ridges:**
At least 3 ft. wide and fairly long beds/ridges at the site where there is tidal influence. At least 2 feet wide passage shall be constructed between two ridges for easier operation.

**Germination beds:**
Similar structure with nursery beds but smaller in size. For non-mangrove species, build a rack at a minimum of 3 ft high above to avoid tidal inundation, or establish bed floors above spring tide level. Use local products such as bamboo and Phoenix poles.

**Shed/shade:**
Erect bamboo or Phoenix poles. Tie the poles to the bamboo slats. Use bamboo screen, coconut frond, Nypa or grass for roofing. Nypa thatch can be used for shading material of nursery beds.

**Fence:**
Erect fence around nursery for protection against animal browsing and prevent washing away of seed/propagule. Bamboo or Phoenix poles can be used.

Also, based on necessity, following facilities shall be introduced in nursery

**Potting ground:** potting ground with a shed for potting activities

**Stock piles for potting materials:** stock pile grounds with shed for large-scale nursery.

**Compost bed:** Necessary if compost (manure) are used for pot filling material

**Landing points (Jetty):** for transportation of seedlings and nursery materials

**Well:** for securing fresh water

**Fresh Water Reservoir:** also for securing fresh water during dry seasons
1. Identify Plantation Objectives:

- Necessary to have well-defined management objectives reflecting objectives and intentions of implementation bodies (FD, UsG and etc.)
- For successful results, actual operation and management activities must be based on objectives of plantation
- What is Plantation Objective?
  - Production: Is it for timber, firewood/ charcoal, post/ poles, thatching materials, or other non timber forest products (NTFP)
  - Protection: Is it for re-vegetation, riverbank/ coastline stabilization, sediment trapping, habitat creation or other purposes?
- Once, a plantation objective is identified, planning and design of plantation (sites, species, planting methods), shall be determined

2. Planning and Design

   Site/ Species selection is the key factor for the successful plantation!

Site Identification and Selection

Factors to be considered for site identification/ selection:

- **Ground level & tidal inundation regime**: To understand physical site conditions, identify ground levels (low, medium, high) and tidal regimes of proposed site based on ground surveys and interviews. Determining the height of the average and highest/ lowest tides are useful to understand tidal inundation regimes.

- **Existing vegetation (species)**: To determine possible plantation species, identify common/ dominant species growing or existed at proposed sites based on ground surveys and interviews.

- **Current and past land use pattern**: Though, lands under RFs belong to FD, there are dwellers and traditional users of mangrove forest areas. Identify such land uses and users in/ adjacent to proposed sites and consider such influences in plantation operations

- **Available Areas**: Identify actual sites in terms of area, location and topography to incorporate such information in planning and design.

- **Constraints**: Identify potential disasters, pest & diseases, and other constraints which may influence plantation.

Species Selection

Based on biophysical conditions of proposed sites, and plantation objectives, planting species shall be selected. Normally species which are historically found in the area are biophysically adapted to the area, promising success of plantations

(Also refer “Volume I-2 species-site matching” and “Volume IV-1 desirable species & preferable species” for potential species for selection)
2. Planning and Design

**Planning**

**Planting Area:** Identify and determine location/ size of planting blocks, planting excluding areas, access routes, and other information necessary for implementation.

**Schedule:** Operation planning & design shall be aware of critical timing such as seed collecting, nursing, and planting periods. Also, all of activities must be arranged in time for planting.

**Planting Density:** Spacing shall be determined based on plantation objectives and species characteristics.

In delta, 1.8 x 1.8 m (6 x6 ft) is widely used, however: 1) Closer spacing, less than 1 x 1 m (3 x 3 ft), shall be introduced for the purpose of bank/ wave impact protection, straight pole production, and fuelwood production; 2) Wider spacing more than 2x 2 m shall be introduced for timber production as well as bigger trees are need.

Selection of spacing will allow to determine total amount of seedlings to be procured for planting.

**Planting Method:** Determine following factors based on objectives, species characteristics, and availability of seedlings and technologies

- planting type: direct sowing, bare-root seedling planting, potted seedling planting
- planting pattern: planting in lines, cluster planting, strip planting
- species: single spp planting, mixed spp planting
- structure: single story plantation, multi stories

3. Establishment Techniques

**Land Preparation**

- Operations to be covered depends on existing conditions of plantation sites
- Clearing/ felling of existing vegetation, dead trees and debris which inhibit further planting operations and growth of planted seedlings shall be considered
- Clear felling, partial felling (in strips or spots) shall be selected based on shade tolerance of planting species, labor intensity, and conditions of remaining vegetation need for clearing/ felling
- Felling with burning shall be avoided in mangrove areas. Especially in high ground areas, the soil becomes dry and cracked in the dry months which cause the mortality of planted seedlings.
- For site preparation in mangrove area, partial felling, remaining 40-50% shades without burning has proved to be the appropriate approach from past experiences.
3. Establishment Techniques

**Planting:**

- The planting method to be applied depend on type and availability of seedling stocks, and species introduced.

1) Direct seed/propagule sowing:
   - Easiest and the least inexpensive method
   - Not more than one-third of propagules shall be buried to hard substrate to avoid suffocation of propagules.

2) Bare-root planting
   - Suitable in areas where tides come regularly without prolonged inundation
   - Practical because it is easier for survival and lower in nursery and establishment cost
   - However, survival of bare-root seedlings are critical influenced by the timing for planting.
   - Try to plant during the beginning of rainy seasons for survival and acclimatization to planting sites

3) Potted seedling planting
   - Reliable with higher survival percentage, therefore adapted for planting on high ground level and unstable substrates where low survival of seedlings are expected.
   - Labor and cost intensive in terms of transportation when using large-size pots.
   - When planting, do not forget to remove plastic bags from seedlings.

4) Wildering planting:
   - Use wilderings when seeds/propagules and seedlings are not available by other methods.
   - Care shall be taken not to damage roots when uprooting/collection wilderings.

**Staking, hole digging, and planting**

1) Establish a baseline, and then lines perpendicular and parallel to the baseline, in accordance with planted spacing. Put stakes at intersection of lines
2) Dig planting holes at stakes: remove soil of a hole with twice to thrice the size of pot.
   - Refill cultivated and pulverized top soil to hole up to ground surface.
3) Distribute seedlings to each planting hole and dig holes with the size same as that of pot or propagule. Plant seedling without plastic bag. Root collar should be at the same level with the ground surface.
4) Remain stakes near planting holes to indicate seedlings have been planted.

- Planting shall be conducted during low tide (of neap tide) for easiness and prevent wash away of seedling immediately after planting
- If available, use (plastic) containers for seedling transportation. Using containers will reduce seedling damages during transportation and improve transportation efficiency
Care and Maintenance of Established Plantations

Activities in Initial stage (first 2~3 years):
- **Regular patrol**: to check and monitor any changes/problems in plantation
- **Weeding**: to avoid competition with undesirable plants and to expose more light to planted trees. Frequency varies among sites but at least twice per year is preferred
- **Removal of debris, insect, and pest and necessary countermeasure**: if detected by patrol
- **Removal of sick or dead trees**: if detected by patrol
- **Replanting**: if large extent of area has poor survival.

Activities in intermediate stage (up to first thinning):
- **Regular patrol**: to check and monitor any changes/problems in plantation
- **Removal of debris, insect, and pest and necessary countermeasure**: if detected by patrol
- **Removal/replacement of sick or dead trees**: if detected by patrol

Activities in Subsequent stage (first thinning – around 5th year):
- **Regular patrol**: to check and monitor plantation in certain intervals
- **Countermeasures against pests and damages**: same as previous stage
- **Thinning**: To reduce competition among planted trees to improve the quality of plantation. Timing and intensity of thinning depend on the expected age at harvest for the plantation. Trees with malformed shall be thinned. Avoid high intensity thinning in environmental protection forests
- **Pruning**: Cutting of unnecessary and mal-form branches/stems to: promote diameter/height growth of remained trees; improve the tree form and wood quality. Initial pruning shall be conducted a year or two after the initial thinning. Avoid pruning of more than 30% of the live crown over in 1 to 2 year period to prevent sudden decrease in growth.

Harvesting

Firewood: Firewood can be harvested from the first thinning. In plantations, removals from subsequent thinning and pruning are also utilized for firewood. In the latter stage, removals/products from thinning, topping, and harvesting can be utilized. Firewood can be also harvested from plantations for poles, posts and timber production

Poles, post, timber: thinning and pruning not only generate firewood, the operations allow to increase diameter and height growth of remaining trees. Selective harvesting of poles are possible during the thinning operation.

Non-Mangrove Species Plantation

In extreme high ground and high ground level, and where growth performance of mangrove species are not optimum due to dryness, fast growing non-mangrove species shall be introduced, *Albizia lebbeck* (Kokko), *Melaleuca spp.* (Malarluca), *Casuarina sps.* and *Acacia mangium* are considered to be adapted species.
1. Principle of Mangrove Natural Forest Management

Identify management objectives based on the principle:

- **Sustained Yield Management**: Forest resource is managed at 20 to 40 year cutting cycle to provide sustainable harvest with economic returns and at the same time poses naturally regenerating capacity or with minimal assistance.

- **Multiple-Use Management**: Management and utilization of various renewable forest resources, contributing to local and national socioeconomic development. Resource includes not only wood products but also, non timber forest products and fishery products. Furthermore, functions for environmental protection such as coastal/riverbank protection shall be considered as part of multiple-use management.

- **Ecosystem/Bio-diversity Management**: Management of mangrove forest for biodiversity and ecosystem conservation purposes. Creating various forest stands in terms of ages, structures, and species compositions to provide diversified niches and habitats.

- **Social Equity**: Opening the opportunity to local habitants to benefit and create livelihood activities, and at the same time protecting/rehabilitating mangrove forests.

The ideal multi-layer/function forest management system in the delta can be described as three tiers silvicultural management consists of the following:

1. **The Protection Tier** normally in the upper canopy to provide: forest physiognomy, seed production; and protection and partial shade for lower layers and forest floor.

2. **The Production Tier** normally in the middle layer to provide: firewood's, poles and timber and other wood products; growing space for regenerated seedlings and saplings through cutting and harvesting operations.

3. **The Regeneration Tier** normally in the lower layer and forest floor to provide: favorable regeneration of seedlings; and constant renewal of seedlings.

Protection-production-regeneration functions can be provided through protection-harvesting-regeneration operations conducted simultaneously in mangrove forests. The three tiers silvicultural management can be applied to both natural forests and plantations. Such can be attained through regular forest operations which will be conducted in the proposed mangrove management system under the IMMP. Moreover, monitoring compliance is quite easy as it only requires confirming the continued presence of the upper canopy trees and of adequate regeneration.

In natural forests, the tiered silviculture can be done in following operations: 1) selection and marking of mother trees (including potential trees); 2) assisted natural regeneration or enrichment planting if there are no sufficient regeneration; 3) intermediate harvest (selective cutting) and/or thinning of non-marked trees for domestic or commercial use; 4) final harvest of mature trees; and 5) natural regeneration or artificial regeneration by coppicing and/or planting in the area where harvest operation had been done.
Natural Forest Operation

2. Forest Regeneration Operation

Key points
• For protection and improvement of existing mangrove forests, forest regeneration operations shall be introduced.
• Natural regeneration includes activities such as
  - protection of degraded forests
  - coppice raising by cutting malformed trees for regeneration of good forests.
  - Pruning, vine cutting/clearing, thinning and planting activities

Application
Adaptable sites/locations for Forest Regeneration Operation:
• Areas where regular tide reach at least 10 to 12 days per month twice daily
• Regeneration are usually plentiful in the tidal inundated areas of mangrove forest.
• Low to medium ground level areas.
  - if lacking sufficient regeneration, assisted natural regeneration with/without enrichment planting shall be introduced

Operations
• **Climber(vine) cutting & clearing**: to release valuable/desirable species from suppression and damages from climbers and other species

• **Thinning**: To reduce competitions among existing trees to improve the quality of The stand, particularity of the valuable/desirable species. Trees with malformed and less valuable trees be thinned. Avoid high intensity thinning in environmental protection forests

• **Pruning**: Cutting of unnecessary and mal-form branches/stems to: promote diameter/height growth of valuable/desirable trees; improve the tree form and wood quality.

• **Regeneration treatments**: cutting & clearing, thinning activities are expected to release under-story regeneration. However, assisted natural regeneration including enrichment planting shall be introduced, if in case under-stocked regeneration is observed in terms of species and quantity.

• **NTFP (non timber forest products) extraction**: For protection, purpose, harvesting shall be limited to NTFP with minimum negative impacts on forest stands

Assisted Natural Regeneration
• Assisted natural regeneration is a process of rehabilitating/regenerating forest lands by taking advantages of trees already growing or planted as a nurse tree in the area.

• Operations normally include, releasing indigenous/desirable species, planting, tending, and protection activities

• Especially, gap plantings and other plantings will be applied to secure abundant regeneration
3. Forest Improvement Operation

Key Points

• For improvement of degraded mangrove forests, forest improvement operations shall be introduced.
• Forest improvement operation includes improvement cutting/felling, thinning, regeneration treatments (particularly assisted natural regeneration, enrichment planting)
• Combination of improvement cutting and regeneration operations. More known as “Regeneration Improvement Felling (RIF)”, “Natural Forest Improvement Operation (NFIO)”, or “timber stand improvement”.

Application

Adaptable sites/locations/conditions for Forest Improvement Operation:

- Majority of mangrove species can tolerate shades in early age and survive but the growth will be very slow if overhead cover is not removed.
- Effective for low ground level areas where regular tides reach intermittently to ensure sufficient moisture retention in the soil and induce natural regeneration.
- On high grounds beyond the reach of tidal inundation, it is advisable to perform RIF with planting operations for species tolerate to high ground conditions.

Operations

- Improvement Felling: Systematic cutting and felling activity of shaded trees and vines above selected tree specie where natural regeneration of small and valuable trees is highly possible. Regeneration improvement felling is considered as an improvement felling activity and should be done with heavy cutting and felling in the area.
- Thinning: To reduce competitions among existing trees to improve the quality of the stand, particularity of the valuable/desirable species. Trees with malformed and less valuable trees be thinned. Avoid high intensity thinning in environmental protection forests.
- Pruning: Cutting of unnecessary and mal-form branches/stems to: promote diameter/height growth of valuable/desirable trees; improve the tree form and wood quality.
- Regeneration treatments: cutting & clearing, thinning activities are expected to release under-story regeneration. However, assisted natural regeneration including enrichment planting shall be introduced, if in case under-stocked regeneration is observed in terms of species and quantity.
- NTFP extraction: For protection, purpose, harvesting shall be limited to non timber forest products with minimum negative impacts on forest stands.

<table>
<thead>
<tr>
<th>Regeneration Operation</th>
<th>Improvement Cutting</th>
<th>= Forest Improvement Operation</th>
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Key points

• All of forestry operations require regular forest protection and patrolling activities.
• Forest protection is necessary to monitor and maintain forest conditions in good shape.
• For forest protection activities in core zones for mangrove protection shall be directly managed and operated by FD.
• Forest protection activities buffer zones for mangrove protection shall be jointly managed and operated by FD and UsG members.
• Fire protection especially during the dry season and encroachment prevention shall be also regarded as part of forest protection in association with public awareness of mangrove resources.

Application

Operations
- Regular forest patrolling: (checking growth/ survival)
- Pest and disease prevention & control: apply countermeasures when detected
- Fire protection & control: establishment of firebreaks and regular patrol especially in dry seasons
- Patrolling & monitoring against illegal cutting/encroachment
- Monitoring & evaluation:

FD’s role
- Providing FD camps for base camp for forest protection activities
- Supervise and give legal for forest protection and patrolling activities conducted by UsG members
- Providing basic equipment/materials and technical guidance for countermeasures against fire protection, pest & disease control.
Key points

• FD should promote CF agroforestry to the lands along with creeks for protection the national land from the land erosion
• Lands along creeks should be protected through bank protection vegetation by combination of low land vegetations such as reed and low ground mangrove species i.e. nipa, Rizophora, Avicenia, etc.
• Behind lands of the bank protection vegetation, low land agroforestry can be promoted by mixed land use methods of fruits trees and vegetables
• The CF agroforestry along with creek is designed along with creeks
• FD should lead UsG for formulation of sub CF UsG agroforestry
• FD have to lead sub CF UsG agroforestry for practicing high ridge cultivation and applying composts
• High ridge must be higher than the high tide level
• Targeted to promote all CF UsG members

Methodology

• Section 1 for River Bank Vegetation with; Avicenna, nipa, reed, and staking
• Section 2 for Fruits and Legume; Coconuts Palm, Sesbania grandiphora
• Section 3 for Vegetables, legumes, Flowers; Green gram, Okra, Chile, Aster

Rule

• FD should lead the sub UsG for developing vegetation at section 1 against to land erosion
• FD should lead the sub UsG for developing fruits trees covering vegetation at section 2 and 3
• FD should support sub CF UsG for processing of products and marketing
**Agroforestry-2: Low Yield/Wasted Paddy CF Agroforestry**

**Key points**
- FD should promote CF agroforestry to the low yield paddy/bare lands for obtaining agricultural production through improvement of soil fertility
- The CF agroforestry can be promoted to low yield/wasted paddy for fruit and vegetable production
- The CF agroforestry can be designed along with creeks and foot paths
- FD should lead UsG for formulation of sub CF UsG agroforestry
- FD have to lead sub CF UsG agroforestry for practicing high ridge cultivation and applying composts
- High ridge must be higher than the high tide level
- Target sub CF UsG is farmers/land owners

**Methodology**
- Section 1 for Fruits Trees and Legume; Coconuts Palm, Banana, *Sesbania grandiphora*
- Section 2 for Paddy in accordance with improvement of soil fertility
- Use Sesbania leaves and branches for fodder and paddy composting

**Rule**
- FD should lead the sub CF UsG for developing permanent vegetation of fruits trees at section 1
- FD should support Sub CF UsG for processing of products and marketing
- FD and sub CF UsG should consider about “one village one product” to create specialized production to the village

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*Section Plan of Agroforestry at Low Yield/ Wasted Paddy*
FD Volume IV: Technical Guidance
IV-2: CF Prototype - CF Agroforestry Technical Guidance -

CF Border/ Windbreak Plantation

Key points
- Required CF border/ windbreak plantation for protecting paddy or land from dry and salty wind
- CF border/ windbreak plantation can support sustainable paddy use and maintain yield of paddy
- CF border/ windbreak plantation can support double cropping (after paddy, upland crops such as leguminous species) during summer by utilization of wind shadows
- FD should lead UsG for formulation of sub CF UsG for CF border/ wind break plantation
- Target of CF border/ windbreak plantation is whole paddy areas
- Target sub CF UsG member is farmers/ land owners

Methodology
- FD can lead UsG for promotion of the tree planting as first step, then promote whole farmers
- FD can supply seedling of Sesbania grandiflora for the planting
- FD should promote utilization of Sesbania leaves and branches for fodder and paddy composts
- Utilization of wind shadow for cultivation during summer

Rule
- FD should lead the UsG for developing border/ windbreak planting as permanent vegetation without logging
- FD should arrange technology support of Myanma Agriculture Service (MAS) for the sub CF UsG
- Bylaw of UsG have to include components for developing border/ windbreak planting
**CF Aqua-Agroforestry - 1**

**Key points**
- CF aqua-agroforestry is one of the countermeasures for illegal land use inside reserved forests
- FD promotes CF aqua-agroforestry as one of CF activities without change in land use as forest
- CF Aqua-agroforestry aims 4 benefits; 1) tree, 2) fruits, 3) vegetable and 4) aquatic resources
- CF Aqua-agroforestry is an intensive land use method by combination of; 1) forestry, 2) agriculture and 3) fish culture
- FD should lead UsG for formulation of sub CF UsG for practicing CF aqua-agroforestry
- CF aqua-agroforestry must be extensive fish culture with no purchased seed of fish/crab/shrimp supply, no chemical application, and no purchased feeding

**Methodology**
- FD should supply both mangrove and none mangrove seedlings to the sub CF UsG
- Agroforestry seedlings for the CF aqua-agroforestry shall be self supply by the sub UsG
- Section 1 is for tree production: Avicenna, nipa,
- Section 2 land area is for fruit and vegetable production
- Section 2 water body is for aquatic resource production

**Rule**
- FD has to lead the sub CF UsG for following definitions of the forest law
- Water bodies of the CF aqua-agroforestry shall be less than 1,250 square feet which is the minimum water surface area in the fishery law about fish culture ponds
- Rules and regulations of the sub CF UsG have to be developed for construction, O&M and selling and keeping consistency with the fishery law
- FD should arrange technology supports of the fishery department for the sub CF UsG
FD Volume IV: Technical Guidance

IV-2: CF Prototype - CF Agroforestry Technical Guidance -

**CF Aqua-Agroforestry - 2**

**Construction**
- **Dimension of a pond:** water surface under 1,250 square feet, depth: 4-5 feet, width: less than 10 feet
- **Layout:** CF aqua-agroforestry land shall be located under tree/fruit tree canopy
- **Drainage:** Pipes for drainage should be set at the bottom of the ponds and connect to channels to creeks or rivers.

**Utilization methods**
- **Species (Saline Area)**
  - March to December: Giant tiger shrimp (*Penaeus monodon*)
  - January to March: Barramundi (*Lates calcalifer*)
- **Freshwater Area**
  - All year round: freshwater prawn (*microbranchium rosembergii*)
- **Feeding:** Not necessary

**Maintenance**
- **Dikes and sluice gates**
  - Check the whole dike in order to avoid cracks or holes at least of once a week
  - If cracks and holes are found, then fix them as soon as possible, within a week
  - Clean fragment sticks around the mesh of sluice every day
- **Feeding** is not recommendable utilization of the water body

**Rules**
- Cannot expand the water area more than 1,250 square feet

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Survey of current situations of target areas and mangrove friendly CF Aqua-agroforestry

Arrange visiting successful CF Aqua-agroforestry practicing sites under similar condition

Formulation of sub CF UsG for Aqua-Agroforestry

Allocation of CF aqua-agroforestry sites to each sub CF UsG member

Preparation of CF management plan including production and marketing with UsG and DOF officer

Setting the rules and regulations of sub CF UsG

Construction of CF aqua-agroforestry ponds, planting mangroves, fruit trees and vegetables

Production, selling, benefit sharing

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Flow for Promotion and Practice of the CF aqua-agroforestry
CF Agroforestry Nursery

Key points
- CF agroforestry is the important CF activity in forest lands for supporting livelihood of CF user groups
- Agroforestry nursery is to be the center of the sustainable CF agroforestry activity
- CF agroforestry nurseries aim self seedling supply for CF agroforestry and selling surplus seedlings to outsiders
- The CF agroforestry aims self supply of agroforestry seedlings such as fruits, stocks, scions, vegetable stocks, vegetable seeds, etc
- FD should support for starting the agroforestry nursery as an activity of sub CF UsG for agroforestry

Methodology
- FD in collaboration with MAS should supply technology for operation and management of the agroforestry nursery
- FD should supply stocks and scions for production of agroforestry seedlings
- Grafted fruit seedling production: Mango, Jack fruit, etc
- Layering seedling production: Citrus species such as Lemon, Lime, etc
- Propagation: Banana, etc
- Sapling production: chrysanthemum, Garden Croton, etc
- Seed production: Okra (lady finger), Cucumber, etc

Rule
- FD has to lead the sub CF UsG for following definition of the forest law
- Embankment type water reservoir should be a center of the CF agroforestry nursery for a supply of freshwater for watering
- FD should arrange technology support of MAS for the sub CF UsG
Key points

- CF user groups and FD can share responsibility for management of reserved forests
- CF public woodlot is one of the CF application methods
- CF public woodlot shall promote protection of the national land and CF areas
- CF public woodlot can promote improvement of economic activities
- CF public woodlot can support weak/poverty families who cannot practice in individual CF activities
- CF public woodlot can be promoted in all village areas

Methodology

- FD shall obtain understanding about CF public woodlot of CF user groups by showing menus of CF public woodlots
- FD shall support CF user groups for application of CF public woodlot based on their intentions
- FD shall allocate CF public woodlot areas based on UsG's intentions
- FD shall support CF user groups for delineation, mapping, and planning of CF public woodlots
- FD shall support formulation of sub-CF user groups for each type of CF public woodlot
- Tree seedlings and technology for practicing CF public woodlots shall be supplied by FD
- FD shall support harvesting and utilization of production of CF public woodlots, based on rules and regulations for each type of CF public woodlot

Rule

- FD shall support CF user groups for implementation of CF activities based on the management plan
- FD shall register new members or drop out members of CF public woodlot UsGs
- FD shall lead CF public woodlot user groups for updating the management plan/map: updating of CF user group members, updating of CF areas, etc

Sample of CF Public Woodlot

- CF Village Road Woodlot
- CF Moving Sand Protection Woodlot
- CF Communal Woodlot
- CF River Bank Stabilization
- CF Water Reservoir
- CF Windbreak
- CF Homestead Woodlot
- CF Compost Woodlot
Key points
- CF school woodlots, monastery woodlots, church woodlots, VPDC woodlots, etc. shall be established based on collaboration with such groups or authorities.
- Approaches to such group activities, facilities, or authorities are important CF promotion activities.
- Those groups, facilities, or authorities are pipes for connection between FD and people.
- Those CF activities are objected to establish environmental forest that contribute to national and public benefits such as environment conservation, education, recreation, etc.
- Those CF activities are also objected to earn budgets for activities, i.e., school or monastery building renovation, bridge maintenance, etc.
- Those CF activities are promoted to all reserved forest areas where people settled.

Methodology
- FD shall obtain understanding about the CF activity of schools (PTAs), monks, nuns, village authorities as key persons of the CF activities.
- FD shall support formulation of CF user groups for those CF activities.
- FD shall allocate CF public woodlot areas based on objectives of the activity.
- FD shall support the CF user group for delineation, mapping, and planning of CF areas.
- Tree seedlings and technology for practicing those CF activities shall be supplied by FD.
- FD shall support harvesting and utilization of products of those CF activities based on rules and regulations for each CF activity.

Rule
- FD shall support the CF user group for implementation of those CF activities based on the management plan.
- FD shall register new members or drop out members of CF public woodlot UsG.

Image of CF School, Monastery, Church, Salt Pan etc.
FD Volume IV: Technical Guidance
IV-2: CF Prototype – CF Paddy -

Key points
• CF can help improving paddy fields and increasing production of paddy
• Paddy fields in the delta have low production, low benefits because of circumstance
• Paddy fields have to be protected by forest vegetation from sun ray, wave, wind, rain, etc
• Forest vegetation by CF can also supply shade for cattle & buffalos
• FD can promote CF to farmer-paddy owners and also casual labors for the paddy

Methodology
• FD shall approach paddy owners first and obtain understanding about functions of mangrove
• FD can arrange technical support of MAS for approached and interested paddy farmers
• FD shall discuss with farmers about a ratio of mangrove (forest) areas to be planted based on objectives of the CF paddy activities
• CF paddy can target various kinds of activities i.e. river bank stabilization, compost making, wind break establishment, fodder production, shade establishment, homestead garden establishment, etc
• FD shall allocate / delineate CF paddy area with the farmer
• FD shall support a formulation of CF paddy CF user group including casual labors for the paddy
• FD can allocate CF areas for the casual labor as CF communal woodlots, CF individual woodlots
• FD shall support maintenance of CF paddy woodlots

Rule
• FD shall delineate whole paddy areas in reserved forests as CF paddy areas for confirmation about land utilization and fixing ratio of mangrove areas to the paddy field
• FD shall register new members or drop out members of CF paddy UsG

Function of CF Paddy
Key points
• The CF village is the only legal measure to register villages formed inside the reserved forest, and
to change current illegal situations of existing all villages
• Delineation of CF villages serve for fixing village borders, and can be countermeasures against
current verbal delineation of village areas which has no consistency with legislation
• FD can promote CF villages to VPDC/ village authorities related to the village located inside the
reserved forest,
• User group members of CF village shall be all villagers
• Objectives of CF villages are for administration and protection of natural lands through fulfillment
of forest function through CF activities
• CF areas of CF villages shall be delineated for all types of land uses such as residential area,
paddy, etc

Methodology
• FD shall approach village/village tract authority members first for promotion about CF villages
• FD shall discuss with the authority member about the objectives of the CF village
• CF villages can target various kinds of activities i.e. village border management, river bank
stabilization, compost making, wind break establishment, fodder production, shade
establishment, homestead garden establishment, etc
• FD shall allocate / delineate CF village areas to all user group members or as community sharing
• FD shall support a formulation of CF village user group including casual labors as the member
• FD can allocate CF village areas based on coordination between adjacent villages

Rule
• FD shall support any dispute arbitrations
• FD shall keep contact about update of management plan with VPDC for change about the CF
village user member
• FD shall register new members or drop out members of CF village user groups

Image and Function of CF Village
Key points
- FD has entirely shortage of budget for CF management and support
- The FD CF camp is an emergency countermeasure for scarcity of the budget for implementing CFI
- FD CF camps shall be the best observance of each article of CFI
- FD CF camps shall be a model for ordinary CF user groups to avoid any special cases against CFI

Methodology
- FD CF camps can be promoted to FD staffs/workers/officers who can be regarded as local settlements by CFI
- FD can allocate appropriate areas for CF FD camps to the user group based on CFI
- FD can support preparation of management plans and maps based on CFI for granting CF certificates to the FD CF Camp user group
- The management plan shall cover design for demonstration and production in addition to ordinary contents
- The management plan shall employ rotational plantation and prepare value added production
- FD can support the CF FD camp user group for developing rules and regulations including benefit sharing between the CF FD camp user group and FD for CF management and support activities

Rule
- The FD CF camp shall be in accordance with CFI and no special cases shall be applied
- FD shall register new members or drop out members of CF FD camp user groups

Essences of FD CF Camp

Settled Local People: FD Staff/Worker/Officer

Each Township
Each Reserved Forest

Production and Sales based on CFI
Poles, Fuelwood, NTFPs
Value Added Production

Profits for CF FD camp user groups
and for CF Management and Support

Additional Role of CF FD Camps
Demonstration of each CF Prototype
Technical Support of CF UsG
IV-3: Buffer Zone Management Technique

Key points
- Combination of following activities: 1) fire break, 2) CF Prototypes (Plantation, agroforestry, aqua-agroforestry, river bank management), and 3) Patrolling
- Joint buffer zone patrolling system between FD and UsGs

Utilization
- Section A for fire break and patrol,
- Section B for various CF prototypes (for example B-1 as CF plantation, B-2 as CF for agroforestry
- Section C for riverbank management including river bank stabilization, and CF aqua-agroforestry

Rule
- FD staffs authorize and supervise buffer zone activities by user groups
- Joint buffer zone patrolling shall be conducted by CF User’s group in cooperation with FD staffs.
- FD to provide basic equipment, materials and technical guidance for patrol, agroforestry and other CF operations
FD Volume IV: Technical Guidance
IV-4: CF River Bank Management Technique

Key points
- Combination of reforestation and re-vegetation based on situation and ground level
- Utilization of grass species and fast growing non-mangrove species for erosion control & stabilization
- Minor construction works (fencing, gabion mats) to be introduced for important/urgent areas
- FD to cover direct operations in the core zone
- FD to provide seedlings and technical guidance to CF river bank management in the buffer zone and the multiple-use zone

High Ground Level:
- Planting by mangrove sps.
- Planting by non-mangrove sps
- Agroforestry and surface re-vegetation by grass sps

Mid Ground Level:
- Re-vegetation by grass sps
- Planting by mangrove sps

Low Ground Level:
- High density planting (1m x 1m)
- by lowland sps (Rhizophora, etc.)
- Fencing & gabion mat installation

Water Edge:
- Fencing & gabion mat by poles, gravels
- Surface re-vegetation by grass sps
- Drainages to remove excessive surface running water

CF subgroups for implementation and maintenance of river bank management
FD Volume V: Consolidation Activities of CF

V-1 FD Camp for CF Management and Support, CF Extension Center cum Mangrove Garden

**Key points**
- **Objective of the center** is for sustainable CF activities through developing close relationship among villagers/local community, local authorities and FD.
- FD should maintain FD camps for CF management and support, a CF extension center cum mangrove garden at each FD camp because of remoteness of the mangrove area.
- Role of CF Extension Center is for demonstration and training of CF activities to the CF UsG.
- Role of Forest Camp (FC) should be a front office of FD CF management and support (CF Task Force).
- **Rules**
  - Development of mangrove conservation formation by the FD, Local authorities and Villagers.
  - Information sharing about the training with CFDTC.

**Methodology (Objective and Activities)**
- **Objective:** Demonstration, training, and consolidation of CF activities.
- **Activities:**
  - Demonstration: CF activities i.e. Mangrove environment, O & M of CF UsG, technology regarding; Seedling production, plantation, NFIO, CF agroforestry, CF aqua-agroforestry, CF paddy woodlot, River bank stabilization, embankment type water reservoir, women group activity, etc.
  - Training of FD CF task force staff, villagers/community and CF UsG about the CF activities.
  - Consolidation of CF activities: Convention with local authority about Patrol, Holding CF UsG meeting, Information and technology center regarding CF activities, Monitoring of CF activities.

**Rules**
- Development of mangrove conservation formation by the FD, Local authorities and Villagers.
- Information sharing about the training with CFDTC.
FD Volume V: Consolidation Activities of CF  
V-2 Double Cropping (Utilization of Paddy during Summer)

**Key points**
- No utilization of paddy fields during summer causes loss of soil fertility
- No utilization of paddy fields during summer is one of reasons of the vicious circle below
- Double cropping is one of counter measures to break through the vicious circle
- So FD promotes double cropping as a part of CF paddy for supporting CF as well as improvement of livelihood

**Methodology**
- Target for promotion of double cropping is CF UsG member
- Target area for promotion of double cropping is paddy of UsG member
- FD should promote double cropping through formulation of double cropping subgroups and/or CF Paddy subgroups
- Cultivation methods: double cropping e.g. rice and green gram, cultivation under roof shade e.g. garden croton, and mix cropping green gram and cover crops e.g. sweet potato, clover

**Rules**
- FD should lead UsG to minimize inputs; introduce seed collectable crops
- FD should lead UsG to minimize cultivation period e.g. raising vegetable seedlings
- FD should lead UsG to increase double cropping cultivation area year by year in the paddy

---

**Vicious circle**

---

**Sample of Double Cropping Calendar**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
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</thead>
<tbody>
<tr>
<td>Monsoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Gram</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Sample of Planting Design**

<table>
<thead>
<tr>
<th>Unit (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>First year green gram</th>
<th>30</th>
<th>30</th>
<th>30</th>
<th>30</th>
<th>30</th>
<th>30</th>
<th>30</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>First year rice</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Second year green gram</td>
<td>35</td>
<td>20</td>
<td>35</td>
<td>20</td>
<td>35</td>
<td>20</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>Second year rice</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
Key points
- Where there is no fresh water, no production, no population. So let's construct the water reservoir, because water is critical foundation for the daily life and agri-production in the delta
- Construction of durable reservoir: Digging type of water reservoir has no durable against tide intrusion into the reservoir, so the embankment type water reservoir is the better fit for the delta
- Maintenance: CF UsG must keep maintenance of the reservoir

Key points for the Construction of the reservoir
- Through compaction of the embankment by every 10 inch at height
- Utilization of coconuts fibers instead of rice straw as of organic glue for long year durability of the embankment and bottom
- Do not dig the water reservoir-bottom level too low, it must be higher than the high tide level
- Silt, lime and coconut fiber are the major construction material of the embankment

Key points for the management of the water reservoir
- The CF UsG is a recommendable management body of the reservoir for planning, construction and maintenance inside reserved forests
- The water use fee should be collected for the maintenance of the reservoir

Planning, Management and Maintenance
- FD can allocate water reservoir site in the RF based on the condition i.e. ground level, soil, and accessibility
- FD can support the planning of construction, management and maintenance of the reservoir by CF user group
- FD can support UsG for preparation of the reservoir management and maintenance as of bylaw including collection of water fee, periodical check of reservoir condition

Rules
- Based on FD permission, the water reservoir must be constructed inside the reserved forest
- FD has to support CF UsG request regarding water reservoir

**Important Subjects for the Construction**
- Compaction of the bottom and embankment with clay, lime, and coconuts fiber by buffalo and cattle.
- Vegetation must be located outside of the embankment
- Set spillway at the highest water level for over flow
- Construct ditch for drainage of the over flowed water
- Embankment slopes must be less than 30 degrees for stability
- The reservoir configuration must be square
- The dimension of the reservoir must be consulted of experienced civil engineer of the delta
- Clay soil must be applied for bottom and embankment construction

**Standard Cross-section of Reservoir Bank**

```
<table>
<thead>
<tr>
<th>HWL 5ft depth</th>
<th>Spill Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaction of each step by one foot by buffalo &amp; cattle</td>
<td></td>
</tr>
<tr>
<td>blanket</td>
<td></td>
</tr>
<tr>
<td>Slope less than 30 degree</td>
<td></td>
</tr>
<tr>
<td>Ditch</td>
<td></td>
</tr>
<tr>
<td>Compaction of 1.5 ft bottom Layer by buffalo</td>
<td></td>
</tr>
<tr>
<td>High Tide Level</td>
<td></td>
</tr>
<tr>
<td>front impermeable banking</td>
<td></td>
</tr>
</tbody>
</table>
```

FD Volume V: Consolidation Activities of CF
V-3 Embankment Type Water Reservoir
Key points
- Applying compost to agri-land is an essential activity for sustainable use of paddy for maintaining yield by means of keeping soil fertility
- Compost can maintain yield of agri-production
- Compost woodlot can promote together with CF agroforestry, CF aqua-agroforestry, CF paddy woodlot, etc. that requires compost application

Methodology
- Target stakeholders for such compost making activity is CF UsG members
- Target area for production of compost material is all CF area such as CF plantation, CF agroforestry, CF paddy, CF village woodlot, CF school woodlot, CF monetary woodlot, CF FD camp, where need of compost exists.
- Construction of cattle houses and duck/pig cabins is good for collection of animal dung
- *Sesbania grandiflora* plantation is recommended for production of organic material for compost

Compost making
- September: Cumulate materials by layers (20% dung), add water and cover with mad
- October: turning over compost two times every 10 days
- November-January: apply compost to paddy fields and/or farmland

Applying methods
- Applying compost on surface
- Applying compost on surface and plowing into soil
- Combination with mulching and compost

Example for applying compost on and in a farmland
Key points
- Objective: Establishment of CF mangrove rehabilitation through consolidation of home economy
- Livelihood improvement is foundation of sustainable CF activities
- Utilization of SRMC;
  - not restricted rendering purpose but recommended for start small business such as agroforestry
- Self Fund: All users are investors and borrowers
- Own management by UsG based on bylaw

Role of FD
- Promotion of SRMC to CF UsG
- Lead CF UsG for development system of SRMC such as bylaw
- Support CF UsG for operation and management of SRMC
- Support CF UsG by supplying materials regarding CF activities e.g. seedlings
- Support CF UsG by supplying information about SRMC activities by other UsG

Structure of SRMC
- Organization 1: Formulation of sub UsG of SRMC who intend to participate namely: sub UsG SRMC
- Organization 2: Formulation of Bank Management Committee of sub UsG SRMC
- Organization 3: Selection of auditing committee member
- Source of loan capital: compulsory savings of all CF UsG
- Hold the assembly of sub UsG SRMC every month led by BMC of sub UsG SRMC
- Flow of rendering
  - Application for borrowing money (member of SRMC to the BMC)
  - Monthly meeting of the BMC for reviewing the application for accept or reject, if yes,
  - Preparation contract between the BMC and applicant
  - Rending
- Auditing SRMC operation and management and
- Apply penal conditions for breach

Rules
- FD supports should be limited within technical matters
- FD staff should not be a member of SRMC
- FD should support democratically operation of SRMC

Function of Self Reliance Micro Credit
Key points
- Sources of drinking water are limited to rain water, well, water reservoirs
- Qualities of water (smell, transparency, etc.) is not favorable for drinking
- There is a risk of health problems from current available drinking water
- Change current drinking water to favorable drinking water
- Getting safer drinking water during dry season without buying water

Water Filtration Function
- Gravel: preliminary filtration of solid material from raw water
- Charcoal: deodorize, purify, and removes unfavorable mineral from the raw water making favorable drinking water
- Coconuts fiber layer: secondary filtration and for dividing each layer
- Sand: final filtration for drinking

Methodology
- Prepare the tank (~50gal) by metal/plastic frame and mortar for protection from rusting by salt
- Collect and prepare material for each layer (gravel, sand, charcoal, and coconuts fiber)
- Put each material by layer one by one by the indication of the figure
- Pour raw water from top, and then wait filtered water from the tap/hole at the bottom
- Gravel and sand should be recycled by sterilizing in boiling water, and charcoal should be replaced for maintenance, when filtered water has odor, changes in taste and volume

Rules
- Avoid drinking filtered water without boiling
- CF water reservoir sub user group operates the water filtration
- Keep using the water filtration system regularly for prevention of filter clogging
FD Volume V: Consolidation Activities of CF
V-7: Value Added Products
- an Example from Boiled Phoenix Heart Trial Production -

**Key points**
- Value added production is one of essential activities for income generation
- Value added products are efficient way of utilization of existing natural resources
- Phoenix heart (shoot) for commercialization is an example of the value added product
- Other candidates value added products are medicinal plants, seasoning material, perfume material, mush room, flowers, charcoal, etc
- Villagers/ CF user groups have limited information about market, values, and technology for the production, so FD has to lead and support the production and selling including related permission

**Methodology**
- Form CF sub user group such as a women group for production and sale of value added products
- FD leads the sub CF user group for finding candidates for value added products
- FD leads the sub CF user group for establishing self-reliance micro finance
- FD leads the sub CF user group for preparation of trial production for marketing
- Based on needs of market such as production volume, quality and target price, a plan for the value added products can be finalized
- FD support sub CF user group for organizing production and selling teams
- Sub user groups start production and prepare production manuals for quality control
- In compliance with production, start selling based on promotion.
- Sell the production to whole sellers or retail merchants directly
- Share benefit based on developed rules and regulation with consideration for continuous production

**Rules**
- Be serious with quality control, secure food safety first
- Develop own products of sub CF user group “each group each products”
- No unnecessary exploitation of natural resource! Natural resource material for value added products shall be reproduced

**Road to the Commercialization of Value Added Products (VAP)**

- Establish Sub CF UsG for VAP
- Finding material for VAP
- Self Reliance Micro Credit
- Trial Production
- Marketing
- Planning for Production
- Quality Control Manual
- Production
- Selling
- Benefit Sharing

Thar Yar Kone CF UsG Women Group is producing phoenix heart
FD Volume V: Consolidation Activities of CF
V-8: Value Added Forest Products
- Charcoal Production -

Key points
- Charcoal can increase production/profits from CF activities
- Management plans of the value added production have to be prepared by same manner with CF management plan
- Charcoal production have to be operated under FD CF management and support based on permission of Ayeyawady Division
- High quality white charcoal production technology is required
- Rehabilitation of charcoal market is required such as price setting for each different quality of charcoal, for domestic consumption and for export

Methodology
- Charcoal have to be produced and harvested based on CF management plan at plantation
- FD supports UsG for formulation of CF sub user group for charcoal production and merchandizing
- FD supports charcoal production technology to the CF UsG
- FD supports the CF UsG for issuance and registration of sales voucher for charcoal

Installation of Charcoal Kiln and production
- FD can install white charcoal kilns at CF extension center for demonstration
- White charcoal kiln construction technology can be introduced by donors
- FD can prepare the white charcoal production manual and conduct its extension

Rule
- Charcoal production material shall be harvested under CF plantation
- Charcoal shall be produced based on rotational CF plantation and felling plan
- CF charcoal have to be merchandized based on the CF sales voucher

White Charcoal Kiln
Made of rock and clayey soil
Maximum Temperature ~ 1200°C
Key points
• Efficient stove saves 30 to 40% of fuelwood consumption and contribute to home economy
• For firewood, briquette, charcoal such multiple type of efficient stove should be promoted
• Efficient stove can promote to all UsG member as of their duty
Methodology
• Target for promotion of multiple type efficient stove is all CF UsG members
• Sizes of multiple type efficient stove have to be flexible by objectives such as home use, cottage industry, etc., i.e. number of fire place
• Multiple type efficient stove can be installed at indoors and also outdoors
• Multiple type efficient stove is available for boiling water, usual cooking, and grill at same time
Installation of multiple type efficient stove
• Installation and demonstration of model stove at the CF extension center, FD camp, and/or the FD mangrove nursery
• Training of UsG member for how to make efficient stove
• Promote self monitoring about installation of efficient stove on UsG Progress/report
Rule
• Fire safe first
• Multiple type efficient stove should be promoted as duty of all UsG member
FD Volume V: Consolidation Activities of CF
V-10: Living environment
- Incinerator -

Key points
• Toward clean mangrove and residential area
• Incinerator as of core of environmental education such as littering plastic rubbishes

Methodology
• FD shall start operation of garbage collection and incinerating operation at FD camp
• FD shall establish an incinerator for center of garbage collection and incineration
• In collaboration with school children environmental education, the operation can be started
• FD extension staff at FD camp should be in-charge of the operation
• Stock yard of the garbage shall be installed

Rules
• Target garbage: Plastic made materials and paper made materials (except metal)
• Target people: FD officer/staff, FD workers, villagers living near FD camps and visitors
• Collection area: Surrounding all area produce the garbage such as FD office, FD camp, FD extension center, FD worker’s village, village, etc.
• Frequency of incineration
  ✓ Dry season: Anytime when the stock yard is filled up.
  ✓ Rain season: Basically, rubbishes shall be stored in the stock yard. (If necessary, incineration with fuel wood or diesel)
Purpose of Source Book:

This source book covers the following items.

Part1: Species characteristics

Part2: Sample formats for CF map, management plan, annual/ monthly reports

The part 1 is aimed to serve as a concise field guide for major mangrove/non-mangrove species to be used for rehabilitation and production purposes in the Ayeyawady delta.

Most of information is obtained from field interviews and seedling production activities conducted in the southern Pyinalan reserved forest. Therefore, information such as fruiting time may varies in other parts of the Ayeyawady delta.

Moreover, in a long run, information on silvicultural characteristics and related technologies which serve to assist selection of appropriate forestry operations shall be incorporated to this manual. Such information has not been integrated to this manual yet, since silvicultural operations are still limited to a few species covered in the sourcebook.

The part 2 gives some ideas for users of this manual to prepare and/ support preparing necessary documents related to CF activities.
Reference:


Multiple Use Potential of Mangrove in the Ayeyarwady Delta, Feasibility Study on Mangrove Reforestation MYA/90/003, U Ohn, 1992

Report on Mangrove Forest Products and Utilization of the Ayeyarwady Delta, Feasibility Study on Mangrove Reforestation MYA/90/003, U Ohn, 1992

Handbook of Mangroves in Indonesia - Bali & Lombok -, The Development of Sustainable Mangrove Management Project, S. Kitamura et al., 1997

Mangrove Nursery Establishment Technique, Environmentally Sustainable Food Security and Micro-income Opportunities in the Ayeyarwady Delta UNDP/FAO MYA/1996/008

Establishing and Operating Tree Nurseries, Environmentally Sustainable Food Security and Micro-income Opportunities in the Ayeyarwady Delta UNDP/FAO -MYA/99/008

The Botany of Mangroves, University of Cambridge, P. B Tomlinson, 1986
FD Volume VI: Source Book
VI-1: Major Mangrove Species for Rehabilitation

Terms and Abbreviations used in this Section (1)

Tree Shape
- **tree (T):** woody perennial plant, typically large and with well-defined stem(s) and crown
- **shrub (S):** woody perennial plant usually with multiple stems without well defined main stem and height < 2m
- **vine (V):** climbing or trailing woody-stemmed plant
- **fern (F):** plant having fronds and reproduces by spores
- **palm (P):** woody plants belonging to family of Palmae
- **herb/grass (G):** non woody plants either perennial or annual

Root Type
- **stilt root (SR):** looping aerial roots exposed to the air, arising from the trunk and lower branches and extending outward and downward into soil
- **pneumatophore (PN):** conical or pencil shape aerial roots protruding upward from horizontal root
- **knee root (KR):** horizontal aerial root with bending knee shape,
- **plank root (PR):** horizontal ribbon/strip-like undulating aerial roots
- **buttress root (BR):** board like structure extending radially from the bottom of trunk
- **non aerial root (NA):** normal roots without aerial root

Fruit Type
- **cylindrical (C):** stick or pole shape mainly recognized in Rhizophoraceae
- **ball (B):** ball or flattened globe shape mainly recognized in *Xylocarpus and Sonneratia*
- **bean like (BL):** bean form with various shapes mainly recognized in *Avicennia*
- **pod (P):** elongated seed vessels mainly of leguminous plant
- **other (O):** fruits with other shapes mentioned above
Terms and Abbreviations used in this Section (2)

**Seed Type**
- **viviparous (V):** seeds germinating while attached to parent trees. Usually called propagule.
- **criptovivparous (C):** seeds germinate while attached to parent trees but are covered with their pericarp (fruit skin). Usually called propagule.
- **normal (N):** seeds not categorized as viviparous or criptovivparous

**Ground Level**
- **low (L):** flooded by all high/medium tides daily throughout the year
- **medium (M):** flooded by Yenuhta (small rise), Yehta U (beginning of the rise), and Yehta (high rise) throughout the year
- **high (H):** flooded by Gaungye (highest rise, spring tide) throughout the year

**Water Salinity**
- **brackish water (B):** slightly salty water in river estuaries by mixing of fresh water and sea water,
- **fresh water (F):**
- **sea water (S):**
FD Volume VI: Source Book
VI-1: Major Mangrove Species for Rehabilitation

List of Species

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Local Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mangrove Related Species</strong></td>
<td></td>
</tr>
<tr>
<td>Aegialitis rotundifolia</td>
<td>(Sarthar)</td>
</tr>
<tr>
<td>Aegiceras corniculatum</td>
<td>(Yekaya)</td>
</tr>
<tr>
<td>Amoorra cucullata</td>
<td>(Pantha Kha)</td>
</tr>
<tr>
<td>Avicennia alba</td>
<td>(Thame Kyet Tet)</td>
</tr>
<tr>
<td>Avicennia marina</td>
<td>(Thame Phyu)</td>
</tr>
<tr>
<td>Avicennia officinalis</td>
<td>(Thame Gyi)</td>
</tr>
<tr>
<td>Bruguierea cylindrica</td>
<td>(Hnaa Byu)</td>
</tr>
<tr>
<td>Bruguierea gymnorrhiza</td>
<td>(Byu-utalon)</td>
</tr>
<tr>
<td>Bruguierea parviflora</td>
<td>(Byu War Kyaing Laing)</td>
</tr>
<tr>
<td>Bruguierea sexangula</td>
<td>(Byu Ket Tet)</td>
</tr>
<tr>
<td>Ceriops decandra</td>
<td>(Madama)</td>
</tr>
<tr>
<td>Cynometra ramiflora</td>
<td>(Myinga)</td>
</tr>
<tr>
<td>Excoecaria agallocha</td>
<td>(Thayaw)</td>
</tr>
<tr>
<td>Heritiera fomes</td>
<td>(Kanazo(Kone))</td>
</tr>
<tr>
<td>Heritiera littoralis</td>
<td>(Kanazo(Lay))</td>
</tr>
<tr>
<td>Kandelia candel</td>
<td>(Byu Baingdaung-she)</td>
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<td>Lumnitzera racemosa</td>
<td>(Pyan Shar)</td>
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<td>(Dani)</td>
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<td>Phoenix paludosa</td>
<td>(Thinbaung)</td>
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<td>(Byuchidaug (apo))</td>
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<td>Rhizophora mucronata</td>
<td>(Byuchidaug (ama))</td>
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<tr>
<td>Sonneratia alba</td>
<td>(Lame)</td>
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<tr>
<td>Sonneratia apetala</td>
<td>(Kanbala)</td>
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<td>Sonneratia caseolaris</td>
<td>(Lamu)</td>
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<tr>
<td>Sonneratia griffithii</td>
<td>(Laba)</td>
</tr>
<tr>
<td>Xylocarpus granatum</td>
<td>(Pinleon)</td>
</tr>
<tr>
<td>Xylocarpus moluccensis</td>
<td>(Kyana)</td>
</tr>
</tbody>
</table>

| **Non Mangrove Species**      |                    |
| Acacia mangium                | (Shar)             |
| Albizia lebbeck               | (Kokko)            |
| Albizia procera               | (Sit)              |
| Casuarina equisetifolia       | (Pinlaikavie)      |
| Eucalyptus spp                | (Yukals)           |
| Melaleuca spp.                | (Malarluca)        |
| Samanea saman                 | (Koko(Thin Baw))   |
| Terminalia beierica           | (Thitsein)         |
Mangrove Species

Aegialitis rotundifolia (Plumbaginaceae)

Local Name: Sarthar
Tree Shape: T/S Root Type: NA Fruit Type: C Seed Type: C
Other Description: Endemic to Myanmar, Bengal, the Andaman Island
Seed Collection Time: Jun. - Jul.
Seed Collection Method: Pluck seeds directly from trees
Seed Storage & Pre-treatment: Viable up to 2 weeks under shade. For germination improvement, remove seed cover by hand
Notes for Seedling Production: Use topsoil for potting material
Usage:

Aegiceras corniculatum (Myrsinaceae)

Local Name: Yekaya
Tree Shape: T/S Root Type: NA Fruit Type: P Seed Type: C
Other Description: fruit strongly curved
Seed Collection Time: May - mid-Jun. (High ground level), Aug. – Sept. (Low ground level)
Seed Collection Method: Pluck seeds directly from trees/collect seeds on the ground
Seed Storage & Pre-treatment: Viable up to 1-2 weeks in jute bag or bamboo basket under the shade. For germination improvement, remove seed cover
Notes for Seedling Production: Use topsoil for potting material
Usage: Firewood, construction material (pole), attractive to bees for honey, medicinal uses

Amoora cucullata (Meliaceae)

Local Name: Pantha Kha
Tree Shape: T Root Type: NA Fruit Type: B Seed Type: N
Other Description: -
Seed Collection Time: May
Seed Collection Method: Pluck cracked fruits from trees or gather undamaged fruits on ground
Seed Storage & Pre-treatment: Viable up to 1 week under the shade. Require removal of fruit cover before germination
Notes for Seedling Production: Use wider pot (4” x 8”) for better survival and growth
Usage: pole, firewood, (charcoal)
Mangrove Species

**Avicennia alba** (Avicenniaceae)

- **Local Name:** Thame Kyet Tet
- **Tree Shape:** T  
- **Root Type:** PN/SR  
- **Fruit Type:** BL  
- **Seed Type:** C  
- **Other Description:** long slender leaves than other *Avicennia* spp.
- **Ground Level:** L, M, (H)  
- **Salinity:** B/S  
- **Flowering Time:** Jun. - Jul.  
- **Fruiting Time:** Aug. - Sep.  
- **Seed Collection Time:** mid-Sep. (about 20 days)
- **Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on ground
- **Seed Storage & Pre-treatment:** Viable up to 1 week in jute bags or bamboo baskets under the shade. May require seed cover removal depend on seed maturity
- **Notes for Seedling Production:** Remove old leaves for hardening
- **Usage:** Post, pole

**Avicennia marina** (Avicenniaceae)

- **Local Name:** Thame Phyu
- **Tree Shape:** T  
- **Root Type:** PN  
- **Fruit Type:** BL  
- **Seed Type:** C  
- **Other Description:** pioneer species in high salinity areas
- **Ground Level:** L, M  
- **Salinity:** B/S  
- **Flowering Time:** Jun. - Jul.  
- **Fruiting Time:** Aug. - Sep.  
- **Seed Collection Time:** mid- Sep. (about 20 days)
- **Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on ground
- **Seed Storage & Pre-treatment:** Viable up to 1 week in jute bags or bamboo baskets under the shade. May require seed cover removal depend on seed maturity
- **Notes for Seedling Production:** Remove old leaves for hardening
- **Usage:** Post, pole, flower attractive to bees for honey, (charcoal)

**Avicennia officinalis** (Avicenniaceae)

- **Local Name:** Thame Gyi
- **Tree Shape:** T  
- **Root Type:** PN/SR  
- **Fruit Type:** BL  
- **Seed Type:** C  
- **Other Description:** leaf apex rounded, young leaves hairy, larger flower than other *Avicennia* spp.
- **Ground Level:** L, M, (H)  
- **Salinity:** B/S  
- **Flowering Time:** Jun. - Jul.  
- **Fruiting Time:** Aug. - Sep.  
- **Seed Collection Time:** mid- Sep. (about 20 days)
- **Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on ground
- **Seed Storage & Pre-treatment:** Viable up to 1 week in jute bag or bamboo basket under the shade. May require seed cover removal depend on seed maturity
- **Notes for Seedling Production:** Remove old leaves for hardening. Bare-root seedlings and direct sowing are also possible but more care is necessary
- **Usage:** Post, pole, Timber (charcoal)
Mangrove Species

*Bruguiera cylindrica* (Rhizophoraceae)

**Local Name:** Hnan Byu

**Tree Shape:** S/T  **Root Type:** KR/BR  **Fruit Type:** C  **Seed Type:** V

**Other Description:** Fruit is slightly curved compared to other *Bruguiera* spp. Less common and has smaller flowers compared to *B. gymnorrhiza*

**Ground Level:** L, M  **Salinity:** B/S  **Flowering Time:** Jan. - Feb.  **Fruiting Time:** May - Jun.

**Seed Collection Time:** Mar. - Jun.

**Seed Collection Method:** Pluck mature fruits from trees/collect undamaged fruits on the ground or floating in the river

**Seed Storage & Pre-treatment:** Viable up to 1 week (sometimes 4 weeks) in nipa house with good ventilation

**Notes for Seedling Production:** Less is known about this species due to few seedling production practices

**Usage:** Firewood, post, pole,

*Bruguiera gymnorrhiza* (Rhizophoraceae)

**Local Name:** Byu-u-talon, Byo Oask Saung

**Tree Shape:** T  **Root Type:** KR/BR  **Fruit Type:** C  **Seed Type:** V

**Other Description:** Fruit is slightly curved compared to other *Bruguiera* spp. Less common and has smaller flowers compared to *B. gymnorrhiza*

**Ground Level:** L, M  **Salinity:** B/S  **Flowering Time:** Apr. - Jul.  **Fruiting Time:** Mar. - Jun.  Aug. - Sep., Nov. - Dec.

**Seed Collection Time:** Mar. - Jun.

**Seed Collection Method:** Pluck mature fruits from trees/collect undamaged fruits on the ground or floating in the river

**Seed Storage & Pre-treatment:** Viable up to 1 week (sometimes 4 weeks) in nipa house with good ventilation

**Notes for Seedling Production:** Less is known about this species due to few seedling production practices

**Usage:** Firewood, post, pole, charcoal, medicinal uses

*Bruguiera parviflora* (Rhizophoraceae)

**Local Name:** Byu War Kyaing Laing

**Tree Shape:** T  **Root Type:** KR/BR  **Fruit Type:** C  **Seed Type:** V

**Other Description:** Less common and has smaller flowers compared to *B. gymnorrhiza*

**Ground Level:** L, M  **Salinity:** B/S  **Flowering Time:** Jan. - Feb.  **Fruiting Time:** May - Jun.

**Seed Collection Time:** Jun.

**Seed Collection Method:** Pluck mature fruits from trees/collect undamaged fruits on the ground or floating in the river

**Seed Storage & Pre-treatment:** Viable up to 1 week in nipa house with good ventilation

**Notes for Seedling Production:** Direct planting to plantation sites or direct sowing to pots. Seed collection time varies by locations. Normally 2–3 seed collection time per year.

**Usage:** Poles, post, firewood, medicinal uses
**Bruguiera sexangula** (Rhizophoraceae)

**Local Name:** Byu Kyet Tet, Byu Shwe War  
**Tree Shape:** T  
**Root Type:** KR/BR  
**Fruit Type:** C  
**Seed Type:** V  
**Other Description:** Resemble B. gymnorrhiza, but has yellowish flower (calyx) and smaller/thinner leaf. Less common compare to *B. gymnorrhiza*  
**Ground Level:** L, M  
**Salinity:** B/S  
**Flowering Time:** not clear  
**Fruiting Time:** not clear  
**Seed Collection Time:** around Jun.  
**Seed Collection Method:** Pluck fruits from parent trees/ collect undamaged fruits on the ground or floating in the river  
**Seed Storage & Pre-treatment:** Keep in Nipa house with good ventilation in one month  
**Notes for Seedling Production:** Direct planting to plantation sites or direct sowing to pots. Less is known about this species due to few seedling production practices  
**Usage:** Firewood, post, pole, medicinal uses

**Ceriops decandra** (Rhizophoraceae)

**Local Name:** Madama  
**Tree Shape:** T  
**Root Type:** BR  
**Fruit Type:** C  
**Seed Type:** V  
**Other Description:** peduncle short, cotyledonary collar dark red in mature fruit  
**Ground Level:** L, M  
**Salinity:** B  
**Flowering Time:** Sep. - Oct.  
**Fruiting Time:** Mar. - Apr.  
**Seed Collection Time:** Mar. - Apr. (mid-Jun.)  
**Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on the ground or floating in the river  
**Seed Storage & Pre-treatment:** Viable up to 2 weeks in jute bag or bamboo basket under the shade  
**Notes for Seedling Production:** Direct sowing to pots  
**Usage:** Firewood, post, pole, charcoal, flower attractive to bees for honey.

**Cynometra ramiflora** (Caesalpiniaceae)

**Local Name:** Myinga  
**Tree Shape:** T  
**Root Type:** NA  
**Fruit Type:** BL  
**Seed Type:** N  
**Other Description:** -  
**Ground Level:** M, H  
**Salinity:** F/B  
**Flowering Time:** Jan. – Feb.  
**Fruiting Time:** May- Jun.  
**Seed Collection Time:** (mid-Mar.) May - Jun.  
**Seed Collection Method:** Pluck mature seeds from trees, collect undamaged seeds on the ground  
**Seed Storage & Pre-treatment:** Viable up to 4 month in jute bag or bamboo basket under the shade  
**Notes for Seedling Production:** Direct sowing in pots  
**Usage:** Firewood, post, pole, timber, charcoal, flower attractive to bees for honey,
Mangrove Species

*Excoecaria agallocha* (Euphorbiaceae)

Local Name: Thayaw

<table>
<thead>
<tr>
<th>Tree Shape</th>
<th>Root Type</th>
<th>Fruit Type</th>
<th>Seed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>NA</td>
<td>O</td>
<td>N</td>
</tr>
</tbody>
</table>

Other Description: abundant in white latex, irritating to the eyes and skin

Ground Level: M, H  
Salinity: F/B  
Flowering Time: May - Jun.  
Fruiting Time: Jul. - Aug.

Seed Collection Time: Jul. - Aug (mid-Sep.)

Seed Collection Method: Pluck mature seeds from trees/ gather seeds caught in fishing nets with small meshes and drifted ashore of small creek

Seed Storage & Pre-treatment: Viable up to 4 weeks under the shade

Notes for Seedling Production: Potted seedlings are advantageous. Bare-roots and cuttings from twigs are also possible

Usage: Packing cases, pulping for the production of news print paper, attractive to bees for honey, and charcoal

*Heritiera littoralis* (Sterculiaceae)

Local Name: Kanazo (Kone)

<table>
<thead>
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<th>Tree Shape</th>
<th>Root Type</th>
<th>Fruit Type</th>
<th>Seed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>BR</td>
<td>O</td>
<td>N</td>
</tr>
</tbody>
</table>

Other Description: Leaf is bigger than *H. littoralis*. Distribute in sandy soil areas

Ground Level: M, H  
Salinity: F/B  

Seed Collection Time: Mar.

Seed Collection Method: Pluck mature seeds from trees/ collect undamaged seed on ground

Seed Storage & Pre-treatment: Viable up to 4 weeks under the shade. Remove seed cover by knife

Notes for Seedling Production: Direct sowing to pots. Use sand an organic matters for potting materials

Usage: Firewood, post, poles, timber, charcoal, preferable for bee species making beehive

*Heritiera fomes* (Sterculiaceae)

Local Name: Kanazo (Lay)

<table>
<thead>
<tr>
<th>Tree Shape</th>
<th>Root Type</th>
<th>Fruit Type</th>
<th>Seed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>BR</td>
<td>O</td>
<td>N</td>
</tr>
</tbody>
</table>

Other Description: Endemic to Ayeyawady delta areas

Ground Level: M, H  
Salinity: F/B  
Flowering Time: May  

Seed Collection Time: mid-Jun. to mid-Aug.

Seed Collection Method: Usually on the ground/ sometimes from parent trees by climbing

Seed Storage & Pre-treatment: Pluck mature seeds from trees/ collect undamaged seed on ground

Notes for Seedling Production: Direct sowing to pots

Usage: Timber for construction purposes, post, poles, firewood, charcoal, preferable for bee species making beehive
Mangrove Species

*Kandelia candel* (Rhizophoraceae)

**Local Name:** Byu Baingdaung-she

**Tree Shape:** T  **Root Type:** SR  **Fruit Type:** C  **Seed Type:** V  
**Other Description:** Tree is smaller than *Rhizophora spp*. Propagule is longer than *R. apiculata*

**Ground Level:** L  **Salinity:** B  **Flowering Time:** Jan. - Feb. (Jun. - Jul.)

**Fruiting Time:** Mar. - May (Aug. - Sep.)

**Seed Collection Time:** Mar. - May (Aug. - Sep.)

**Seed Collection Method:** Pluck mature propagules from trees/ collect propagules on the ground/ floating in the river

**Seed Storage & Pre-treatment:** Viable up to 1 week under the shade inside jute bags or bamboo baskets

**Notes for Seedling Production:** Direct planting to plantation sites or direct sowing to pots.

**Usage:** Firewood, post, pole

*Lumnitzera racemosa* (Combretaceae)

**Local Name:** Pyan Shar, Eike Ma Thwe (Phyu)

**Tree Shape:** T/S  **Root Type:** NA  **Fruit Type:** O  **Seed Type:** N  
**Other Description:** Tend to grow in cluster on sandy high ground

**Ground Level:** M, H  **Salinity:** B  **Flowering Time:** Jun. - Jul.  **Fruiting Time:** Aug. - Sep.

**Seed Collection Time:** Sep

**Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on ground

**Seed Storage & Pre-treatment:** Viable up to 2 week under the shade

**Notes for Seedling Production:** Use sand and organic material for sowing and potting material

**Usage:** Firewood, post, pole

*Nypa fruticans* (Palmae)

**Local Name:** Dani

**Tree Shape:** P  **Root Type:** NA  **Fruit Type:** O  **Seed Type:** C  
**Other Description:** growing close together, often form pure communities along river side

**Ground Level:** L  **Salinity:** F/B  **Flowering Time:** Whole year  **Fruiting Time:** Whole year

**Seed Collection Time:** When fruit is mature (Preferably, Jun.)

**Seed Collection Method:** Pluck seeds from trees/ collect undamaged seeds on ground/ floating in the river

**Seed Storage & Pre-treatment:** Viable up to 2 weeks under the shade

**Notes for Seedling Production:** Less is known about this species due to few seedling production practices

**Usage:** A source of sugar, vinegar, alcohol and fermented beverage, medicines for herpes, toothache, and headache
Mangrove Species

**Phoenix paludosa** (Palmae)
Local Name: Thinbaung
Tree Shape: P Root Type: PN Fruit Type: B Seed Type: N
Other Description: thorny leaf
Ground Level: (M), H Salinity: F/B Flowering Time: Apr. Fruiting Time: Jun.
Seed Collection Time: Jun.
Seed Collection Method: Pluck mature fruits from trees/ collect undamaged fruits on the ground
Seed Storage & Pre-treatment: Viable up to 2 weeks under the shade
Notes for Seedling Production: Direct sowing to planting sites is more common
Usage: post/pole for shanties and sheds, Firewood, phoenix shoots as food

**Rhizophora apiculata** (Rhizophoraceae)
Local Name: Byuchidauk (apo)
Tree Shape: T Root Type: SR Fruit Type: C Seed Type: V
Other Description: leaf smaller than other *Rhizophora*, two flowers per shoot
Seed Collection Time: Mar. - May
Seed Collection Method: Pluck mature propagules from trees/ collect propagules on the ground/ floating in the river
Seed Storage & Pre-treatment: Viable up to 2 -4 weeks under the shade with good ventilation
Notes for Seedling Production: Direct planting is reliable and economical if planted in the beginning of rainy season. Potted seedlings are advantageous for planting in other seasons.
Usage: Firewood, post, pole, charcoal, medicinal uses

**Rhizophora mucronata** (Rhizophoraceae)
Local Name: Byuchidauk (ama)
Tree Shape: T Root Type: SR Fruit Type: C Seed Type: V
Other Description: Propagule is larger than *R apiculata*. Multiple flowers per shoot.
Seed Collection Time: Apr. - May
Seed Collection Method: Pluck mature propagules from trees/ collect propagules on the ground/ floating in the river
Seed Storage & Pre-treatment: Viable up to 2 -4 weeks under the shade with good ventilation
Notes for Seedling Production: Direct planting is reliable and economical if planted in the beginning of rainy season. Potted seedlings are advantageous for planting in other seasons.
Usage: Firewood, post, pole, charcoal, attractive to bees for honey, medicinal uses
## Mangrove Species

### Sonneratia alba (Sonneratiaceae)

| Local Name: | Lamu, Lamu Tathut |
| Tree Shape: | T |
| Root Type: | PN |
| Fruit Type: | B |
| Seed Type: | N |
| Other Description: | Distribute along coastal and high salinity areas |
| Ground Level: | L, M |
| Salinity: | B/S |
| Fruiting Time: | Aug. - Sept. |
| Seed Collection Time: | Aug. - Sept. |
| Seed Collection Method: | Pluck mature fruits using a bamboo stick with hook |
| Seed Storage & Pre-treatment: | Viable up to 2 weeks under the shade in air dry condition. |
| Notes for Seedling Production: | Less is known about this species due to few seedling production practices |
| Usage: | Firewood, pole, timber |

### Sonneratia apetala (Sonneratiaceae)

| Local Name: | Kanbala |
| Tree Shape: | T |
| Root Type: | PN |
| Fruit Type: | B |
| Seed Type: | N |
| Other Description: | has narrow and tapered leaf, and smaller flower than other Sonneratia spp. |
| Ground Level: | L, M |
| Salinity: | B/S |
| Flowering Time: | May - Jun. |
| Fruiting Time: | Jul. - Aug. |
| Seed Collection Time: | Jul. - Aug. |
| Seed Collection Method: | Pluck mature fruits from trees by climbing, using a bamboo stick with hook or shaking trees (keeping a net under the tree) |
| Seed Storage & Pre-treatment: | Viable up to 4 weeks under the shade in air dry condition |
| Notes for Seedling Production: | Susceptible to insect/fungus damages especially for bare root seedlings. Keep constant water flow to avoid such damages |
| Usage: | Firewood, construction material |

### Sonneratia caseolaris (Sonneratiaceae)

| Local Name: | Lamu |
| Tree Shape: | T |
| Root Type: | PN |
| Fruit Type: | B |
| Seed Type: | N |
| Other Description: | mature leaf short petiole with a reddish-pink base |
| Ground Level: | L |
| Salinity: | B/S |
| Flowering Time: | May - Jun. |
| Fruiting Time: | Jul. - Aug. |
| Seed Collection Time: | Jul. - Aug. |
| Seed Collection Method: | Pluck mature fruits using a bamboo stick with hook |
| Seed Storage & Pre-treatment: | Viable up to 2 weeks under the shade in air dry condition |
| Notes for Seedling Production: | Direct sowing to pots seems to be higher survival than transplanting from sowing beds or raising as bare-root seedlings |
| Usage: | Firewood, post, pole, flowers attractive to bees for honey |
**Mangrove Species**

**Sonneratia griffithii** (Sonneratiaceae)

Local Name: Laba

Tree Shape: T  Root Type: PN  Fruit Type: B  Seed Type: N

Other Description: rounder leaves compare to *S. caseolaris*


Seed Collection Time: Mar. – Apr.

Seed Collection Method: Pluck mature fruits using a bamboo stick with hook

Seed Storage & Pre-treatment: Viable up to 2 weeks under the shade in air dry condition. Removal of fruit cover by soaking/ washing in water for 1 – 2 days

Notes for Seedling Production: Direct sowing to pots seems to be higher survival than transplanting from sowing beds or raising as bare-root seedlings

Usage: Firewood, pole, timber, medicinal uses for cough and drink

**Xylocarpus granatum** (Meliaceae)

Local Name: Pinelon

Tree Shape: T  Root Type: PR/BR  Fruit Type: B  Seed Type: N

Other Description: big  hard spherical melon-like fruit in yellowish brown color

Ground Level: L, M  Salinity: B  Flowering Time: Jan. - Feb  Fruiting Time: Apr. - May

Seed Collection Time: mid-Apr. - May

Seed Collection Method: Pluck mature fruits from trees/ collect undamaged fruits on the ground

Seed Storage & Pre-treatment: Viable up to 1 week with daily watering under the shade. Removal of fruit cover by knife

Notes for Seedling Production: Direct sowing to pots. Submerge seeds to regular tide to avoid insect damages

Usage: Firewood, post, pole,

**Xylocarpus moluccensis** (Meliaceae)

Local Name: Kyana

Tree Shape: T  Root Type: PR/PN/(BR)  Fruit Type: B  Seed Type: N

Other Description: buttress sometimes absent or very short, fruit smaller than *X. granatum*


Seed Collection Time: Jul. – Aug.

Seed Collection Method: Pluck mature fruits from trees

Seed Storage & Pre-treatment: Viable up to 1 week with daily watering of seeds under the shade. Removal of fruit cover by knife

Notes for Seedling Production: Direct sowing to pots. Submerge seeds to regular tide to avoid insect damages

Usage: Firewood, post, pole, timber
**Non-Mangrove Species**

**Acacia mangium** (Leguminosae)

Local Name: Shar (for Acacia spp, in general)

Tree Shape: T  Root Type: NA  Fruit Type: P  Seed Type: N

Other Description: Inflorescences are on loose spikes up to 10 cm long with white or cream colored flowers

Ground Level: M, H  Salinity: (B), F  Flowering Time: Jan. - Feb.  Fruiting Time: Apr - May

Seed Collection Time: Apr - May (Jun.)

Seed Collection Method: Pluck mature seeds by using a bamboo stick with hook

Seed Storage & Pre-treatment: Viable up to 6 months in a plastic bag. Soak in water for 2 days

Notes for Seedling Production: Use sandy soil and organic materials for potting material

Usage: reforestation in very poor soil, timber, chip

**Albizia lebbeck** (Leguminosae)

Local Name: Koko (Myanmar)

Tree Shape: T  Root Type: NA  Fruit Type: P  Seed Type: N

Other Description: Large compound leaves with oblong leaflets


Seed Collection Time: Apr – May (Jun.)

Seed Collection Method: Pluck mature fruits using a bamboo stick with hook

Seed Storage & Pre-treatment: Viable up to 6 months in a plastic bag. Germination improved by soaking in water for 2 days or immersing seed in boiling water for 3 seconds and then allowing it to cool and dry.

Notes for Seedling Production: Use sandy soil and organic material for potting material

Usage: Wood for furniture, paneling, general construction, and carving, firewood and fodder, shade and ornamental along roads and plantations, attractive to bees for honey

**Albizia procera** (Leguminosae)

Local Name: Sit

Tree Shape: T  Root Type: NA  Fruit Type: P  Seed Type: N

Other Description: Large compound leaves with oblong leaflets


Seed Collection Time: Mar. - Apr.

Seed Collection Method: Pluck mature fruits using a bamboo stick with hook

Seed Storage & Pre-treatment: Viable up to 6 months in a plastic bag. Germination improved by soaking in water for 2 days or immersing seed in boiling water for 3 seconds and then allowing it to cool and dry.

Notes for Seedling Production: Use sandy soil and organic materials for potting material

Usage: Wood for furniture, paneling, general construction, and carving, firewood and fodder, shade and ornamental along roads and plantations
Non-Mangrove Species

**Casuarina equisetifolia** (Casuarinaceae)

- **Local Name**: Pinlaikavie
- **Tree Shape**: T
- **Root Type**: NA
- **Fruit Type**: O (woody capsule)
- **Seed Type**: O
- **Other Description**: Leaves look like pine needles
- **Ground Level**: M, H
- **Salinity**: F
- **Flowering Time**: Jan. - Feb.
- **Fruiting Time**: Apr. - May
- **Seed Collection Time**: May
- **Seed Collection Method**: Pluck mature fruits using a bamboo stick with hook
- **Seed Storage & Pre-treatment**: Viable up to 4 months in a plastic bag.
- **Notes for Seedling Production**: Transplant from sowing beds to pots. Use sand and organic material for potting material
- **Usage**: Pole, firewood and fodder, coastal sandy areas reforestation

**Eucalyptus spp.** (Myrtaceae)

- **Local Name**: Yukalys
- **Tree Shape**: T
- **Root Type**: NA
- **Fruit Type**: O
- **Seed Type**: N
- **Other Description**: -
- **Ground Level**: M, H
- **Salinity**: (B), F
- **Flowering Time**: Apr. - May
- **Fruiting Time**: Jul. - Aug.
- **Seed Collection Time**: Jul. - Aug
- **Seed Collection Method**: Pluck mature fruits using a bamboo stick with hook
- **Seed Storage & Pre-treatment**: Viable up to 6 months in a plastic bag.
- **Notes for Seedling Production**: Use sand and organic material for sowing and potting material
- **Usage**: Firewood, pole, timber, chip, leaves are distilled to yield oil

**Melaleuca spp.** (Myrtaceae)

- **Local Name**: Malarluca (for *M. leucadendron*)
- **Tree Shape**: T
- **Root Type**: NA
- **Fruit Type**: Woody capsule
- **Seed Type**: N
- **Other Description**: Spongy bark is distinctive and can be peeled off easily
- **Ground Level**: M, H
- **Salinity**: (B)
- **Flowering Time**: Jun. - Jul.
- **Fruiting Time**: Sep. - Oct.
- **Seed Collection Time**: Sept. - Oct.
- **Seed Collection Method**: Pluck mature fruits using a bamboo stick with hook
- **Seed Storage & Pre-treatment**: Viable up to 6 months in a plastic bag.
- **Notes for Seedling Production**: Transplant from sowing beds to pots. Use sand and organic material for sowing and potting material
- **Usage**: Windbreak and coastal planting, construction materials, firewood, leaves are distilled to yield oil (especially for *M. alternifolia*)
Non-Mangrove Species

**Samanea saman** (Leguminosae)

Local Name: Koko (Thin Baw)
Tree Shape: T  Root Type: NA  Fruit Type: P  Seed Type: N
Other Description: large compound leaves with oblong leaflets
Seed Collection Time: Apr. - May
Seed Collection Method: Pluck mature fruits using a bamboo stick with hook
Seed Storage & Pre-treatment: Viable up to 6 months in plastic bag. Germination improved by soaking seeds in water for 2 days or immersing seeds in boiling water for 3 seconds and then allowing it to cool and dry.
Notes for Seedling Production: Transplant from sowing beds to pots. Use sand and organic material for sowing and potting material
Usage: Firewood, construction material

**Terminalia belerica spp.** (Combretaceae)

Local Name: Thitseit
Tree Shape: T  Root Type: NA  Fruit Type: B  Seed Type: N
Other Description: Deciduous
Ground Level: M, H  Salinity: (B)  Flowering Time: Jan. - Feb.  Fruiting Time: Jun. – Jul..
Seed Collection Time: Jun. - Jul.
Seed Collection Method: Pluck mature fruits using a bamboo stick with hook
Seed Storage & Pre-treatment: Viable up to 4 months in plastic bag. Germination improved by soaking seeds in water for 5 days
Notes for Seedling Production: Direct sowing to pots. Use sand and organic material for sowing and potting material
Usage: Firewood, Timber, fruit for oil/medicine
Key points
The document below is the example of the management plan in the southern Pyinlanal reserved forest;
• This example was prepared as the first five year plan of the thirty years management plan
• The contents of the management plan covers all the activities of community forestry activities, such as CF plantation, CF NFIO, CF agroforestry, the each of steps of these CF activities and so on.
• After the first five year plan is completed, the management plan will be updated based on the achievement
• CF agroforestry will be continuously implemented every year in the same area
• The updated management plan will be submitted to the forest department, and the forest department needs to authorise the update
• The individual CF management plan is completed with two maps, namely the stock map and the management planning map

Community Forestry
Management Plan (Individual)

1. Name: Man Hu Bet
2. National Registration Card No. -
3. Father Name: U Jam
4. Village-
5. CF propose area: 20 (acre)
6. [Plantation Area: 10 (acre), NFIO area: 10 (acre), Species: Ao, Ea,]

<table>
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<th>Sr</th>
<th>CF activity</th>
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7.1 Plantation Activities

<table>
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<tr>
<th>Sr</th>
<th>Activity</th>
<th>Period (month to month)</th>
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<tbody>
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<td>7.1.1</td>
<td>Site preparation</td>
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<tr>
<td>7.1.2</td>
<td>Staking</td>
<td>June to Sep</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Plantation</td>
<td>July, August</td>
</tr>
<tr>
<td>7.1.4</td>
<td>Weeding</td>
<td>September Nov</td>
</tr>
<tr>
<td>7.1.5</td>
<td>Fire protection</td>
<td>Nov to Sep</td>
</tr>
<tr>
<td>7.1.6</td>
<td>Harvesting</td>
<td>Nov to Aug</td>
</tr>
<tr>
<td>7.1.7</td>
<td>Planting</td>
<td>Jan, March</td>
</tr>
<tr>
<td>7.1.8</td>
<td>Site preparation</td>
<td>March, April</td>
</tr>
<tr>
<td>7.1.9</td>
<td>Site preparation</td>
<td>March, April</td>
</tr>
<tr>
<td>7.1.10</td>
<td>Site preparation</td>
<td>March, April</td>
</tr>
</tbody>
</table>

7.2 NFIO Activity

<table>
<thead>
<tr>
<th>Sr</th>
<th>Activity</th>
<th>Period (month to month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.1</td>
<td>Site preparation</td>
<td>March to Apr</td>
</tr>
<tr>
<td>7.2.2</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.3</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.4</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.5</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.6</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.7</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.8</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.9</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
<tr>
<td>7.2.10</td>
<td>Site preparation</td>
<td>Mar to Apr</td>
</tr>
</tbody>
</table>

7.3 Agroforestry Activities

<table>
<thead>
<tr>
<th>Sr</th>
<th>Activity</th>
<th>Period (month to month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3.1</td>
<td>Site preparation</td>
<td>Apr to May</td>
</tr>
<tr>
<td>7.3.2</td>
<td>Plantation of fruit trees</td>
<td>May</td>
</tr>
<tr>
<td>7.3.3</td>
<td>Harvesting</td>
<td>June</td>
</tr>
<tr>
<td>7.3.4</td>
<td>Harvesting</td>
<td>June</td>
</tr>
</tbody>
</table>

8. I hereby admit accomplishing the community forestry activities in accordance with the working schedule mentioned above.
9. This five-year CF management plan is part of the thirty year CF management plan, which will be updated after 3 years in 2008 based on the achievement.

Members: [Signatures]

FD Volume VI: Source Book
VI-2: Sample Formats for CF Management Plan
Key points
Four key points for drawing community forest management map
• New topographical map was supplied as a base map for drawing CF map by the forest department.
• CF area was allocated by the forest department based on discussion with the CF user group.
• Accuracy of the CF map was gained to employ the GPS/GIS.
• The CF map is utilized for implementation of CF activities such as patrolling and CF boundary management.

Procedure
1. FD allocated the CF area based on:
   • land availability such as current vegetation, location/accessibility, ground level
   • availability of labor by each CF user group member
   • even benefit for each CF user group member
2. CF user group member who allocated the CF area, did staking and border line clearing with FD staff.
3. Based on allocation and staking of the CF area, the border of CF area was drawn on the base map by FD staff and CF user group.
4. Then the CF management plan such as area and name of CF UsG member were added on the map.
5. The completed CF map was submitted to FD CF Task Force together with CF management plan.
6. Example of CF map is shown below.

Recommendation: preparation of CF Map by utilization of GIS/GPS on the topographic map
• Can secure minimum requirement of accuracy of the CF map,
• Can secure minimum accuracy by less input of labor,
• Can clarify a scale, direction and area by employing the topographic map, and
• Can estimate precise CF area.

Sample management map

- a) digital topographic map
- b) Symbol of compass
- c) coordination
- d) Rich legend
- e) GPS data
- f) Name of land owner
Key points
GPS survey team for recording CF area have to be formed by GIS section, CF task force and CF user group.
GPS recorded data for delineation of CF area have to be summarized in the form.
GPS record format have to be provided by the survey team led by GIS section.
The GPS record have to be submitted to GIS section through FD Township and FD District.
Format of GPS record consists of following four contents;
- “GPS code ” means automatic name given by GPS
- “Point name” shows specific name of staking pole like “Area name & Number ”
- “Latitude/ Longitude” will be filled out by Degree/ minute/ second
- “Remarks” describes necessary various information for delineation such as big tree as a landmark, existence of creek, distance from previous point etc.

Sample GPS Record Format

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Code.No</th>
<th>Reading</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>N</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>E</strong></td>
<td></td>
</tr>
</tbody>
</table>

Name of the village  Date-  /   /
Team No( )  Compartment No-

Recorded by-
Key points

- the example of the individual CF management map in southern Pyinalan reserved forest:
  - The stock map and the management planning map was prepared by CF UsG with the support of FD
  - The stock map was prepared based on the present land condition (land utilization) such as the forest land, bush, and gap
  - Management planning map shows the yearly operation area

- the user group members used colored pencils to draw these CF management maps, using following colors
  - Natural regeneration area (NFIO area) Light green
  - Area appropriate to establish plantation Yellow
  - Area for CF agroforestry Dark green
  - Individual boundary line Red
  - Annual boundary line Blue line
  - River / creek Black line

Key points

- the example of the individual CF management map in southern Pyinalan reserved forest:
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  - Individual boundary line Red
  - Annual boundary line Blue line
  - River / creek Black line
VI-6: Example of the Annual Progress Reports

Key points:

Procedure:
- The example was prepared by Nyaung Ta Pin village CF user group by support of the forest department Laputta Township based on the definition of the CFI;
- The user group prepared the report based on monthly record of the CF activities by each CF user group member;
- The each CF user group member recorded monthly progress based on extension activity of the forest department together with the extension worker of the CF user group and sub group leader of the CF user group;
- The management committee of the CF user group compiled sub group monthly record as the monthly progress at the monthly meeting of the user group, and then summarized each month activity to whole year progress as annual report.
- The annual report was submitted to the forest department Laputta Township;

Contents:
- Summarized seedling requirement for succeeding year CF activities;
- Summarized harvesting plan as the CF production plan of succeeding year;
- New CF prototypes applied such as CF school woodlots, CF community woodlot, etc were reported.

<table>
<thead>
<tr>
<th>Community Forestry (CF) Annual Progress Report for YEAR of</th>
<th>p.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Number of UG members: 64 persons (Member name list should be attached)</td>
<td></td>
</tr>
<tr>
<td>3) Year of CF certificate grant 2003 July</td>
<td></td>
</tr>
<tr>
<td>4) Certified Areas as is in Management Plan: 287.9 acre (for year 2003 &amp; 2004)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total CF Area</th>
<th>287.9 acre (for year 2003 &amp; 2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td></td>
</tr>
<tr>
<td>- CF NFIO</td>
<td>128.6 acre</td>
</tr>
<tr>
<td>- CF Plantation</td>
<td>51.0 acre</td>
</tr>
<tr>
<td>- CF Aquaculture</td>
<td>21.9 acre</td>
</tr>
<tr>
<td>- CF Agriculture</td>
<td>44.9 acre</td>
</tr>
<tr>
<td>- CF Communal Woodlot</td>
<td>46.0 acre</td>
</tr>
<tr>
<td>- CF church woodlot</td>
<td>16.5 acre</td>
</tr>
<tr>
<td>- CF paddy woodlot</td>
<td>12.8 acre</td>
</tr>
</tbody>
</table>

5) Current Vegetation of the Natural Forest (Existing Species):
- Ga Py, Bo, Bo, Hc, Xa, Kg, sarpin, Hu, Sg, Ao, Ac, Nf.

2) Objective:
- For the household consumption for fuel wood, pole, post, timber
- To get more income for selling surplus CF forest products.
- For mangrove environmental conservation


4.1. CF Natural Forest Improvement Operation (NFIO)

<table>
<thead>
<tr>
<th>Species</th>
<th>Target acre</th>
<th>progress</th>
<th>survival rate</th>
<th>average height</th>
<th>average girth</th>
<th>the number of trees</th>
<th>estimated volume cubic feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ao</td>
<td>1.00</td>
<td>54.3%</td>
<td></td>
<td>16.0</td>
<td>1.00</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Sa</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Bg</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Ra</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Hf</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Xm</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Ea</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Xg</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Pp</td>
<td>1.00</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

4.2. CF Plantation:

<table>
<thead>
<tr>
<th>Species</th>
<th>Target acre</th>
<th>progress</th>
<th>survival rate</th>
<th>average height</th>
<th>average girth</th>
<th>the number of trees</th>
<th>estimated volume cubic feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thaemae</td>
<td>0.43</td>
<td>54.3%</td>
<td></td>
<td>16.0</td>
<td>1.00</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Kamalar</td>
<td>0.50</td>
<td>65.2%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Buyoaksaung</td>
<td>0.66</td>
<td>53.0%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Buy chidauk</td>
<td>0.50</td>
<td>53.0%</td>
<td></td>
<td>20.0</td>
<td>1.50</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Madam</td>
<td>0.90</td>
<td>90.0%</td>
<td></td>
<td>26.0</td>
<td>2.50</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Pinlaeown</td>
<td>1.00</td>
<td>100.0%</td>
<td></td>
<td>26.0</td>
<td>2.50</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Kanazo (sapling)</td>
<td>0.03</td>
<td>3 %</td>
<td></td>
<td>4.00</td>
<td>0.50</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Source: December 2003 individual CF area monitoring in the field.
FD Volume VI: Source Book
VI-6: Example of the Annual Progress Reports

Key points:

Way of submission
The CFI prescribes that the CF user group should submit the progress report for management and support of the CF activities, thus the CF task force of the forest department township office supported the CF user group for the recording and the reporting.

The CF user group member has been changed (seven member withdrew and seven new member joined), since the annual progress report was attached updated the CF management plan with updated member list and also updated CF management map, based on support of the forest department Laputta.

The annual report is planned to be submitted from the forest Department Township to the district office, and the district office forward the copies to the divisional office, PSD and director-general office.

The forest department district office will send the original report back to CF UsG with approved signature of AD of district forest department office.

The forest department district office and township office will keep the annual report in order to continue the CF management and support.

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Miscellaneous:
1. Encroachment:
   A. illegal cutting: 3 times in NTP CF area
   B. action taken for illegal cutting case by CF MC & 100hh head: 2 times
   C. Action taken for illegal cutting by FD: 1 times (annual NTP report)
   D. There was no occur in other such as salt pan, paddy cultivation, shrimp pond, etc.

2. Other Difficulties Encountered:
   Most of CF UsG temporarily move to other villages as the lowest price of crab & smaller amount of crab catching during February, March, April. So they cannot finish CF activities. Some members pass up CF.

3. Miscellaneous: One of the CF members, U Ma Thein, passed away due to heart attack. CF members of Sub village, Mwe Sein & Arma village, are now still for participation in the workshop held in Nyaung Tapin main village.

Next Year Plan

Activities | Target | Harvesting Plan | Harvesting Plan
---|---|---|---
CF school woodlot | 1.8 acre | | |
Community woodlot | 5 acre | | |
CF church woodlot | 2 acre | | |
CF AA | 0.12 acre | | |
CF NFIO | 34.25 | | |
CF plantation | 0.05 | | |

Conclusion:
CF activities are delayed as no boat for patrolling & seedlings carrying. Planted seedlings were died in illegal cutting, late planting, irrelevant with the ground level. NFIO activities are not implemented completely as the one reason of thorny bushes. CF members face illegal cutting as member had not been in their CF area. Sub group leaders are weak in participating.

U SAN
Name and Signature
Chairman of the CF UG

Name and Signature
Forester / Deputy Ranger assigned for this area

Name and Signature
District FD AD

This Annual Progress Report should be prepared by:
One will be submitted to district FD office through the beat office and township office.
One will be kept by User Group until the district FD will send one copy back with the signature of AD.