PROJECT

REHABILITATION AND DEVELOPMENT OF MANGROVE FOREST ECOSYSTEM IN THAI BINH PROVINCE

INSTRUCTION ON NURSERY TECHNIQUE FOR 3 MANGROVE PLANT SPECIES

- Sonneratia caseolaris (L.) Engler;

- Kandelia obovata Sheue, Liu & Yong;

- Avicennia marina (Forssk.) Vierh

CONTENTS

PART I: GUIDANCE ON NURSERY TECHNIQUE FOR *Sonneratia caseolaris (L.) Engler*

I. Introduction

Scientific name: *Sonneratia caseolaris (L.) Engler*

Local name: Bần chua

Other name: Bần sẻ

Family: Sonneratiaceae

Distribution and ecological characteristic: Distributed from the Northern region to the Southern region, where warp soil of seaports have a lot of clay and low salinity, rarely surpass 20‰. Tree, with height reaches to 15m or above, diameter at 1.3m can reach 60cm. Thinly scattered canopy; Leaf is single, opposite, elliptic, acumen, usually has red petiole and main vein. Aerial root has radial asparagus shaped, root can grow to the height of 70 cm, diameter of root close to surface can reach 2 - 3 cm.

Figure I1: Leaves and flowers of Sonneratia caseolaris

II. General regulation

1. Objective

This technical guidance focuses on produce seedlings for Sonneratia caseolaris to suit mangrove forest planting, contribute to rehabilitation and sustainable development of mangrove ecosystems in Thai Binh Province.

2. Content

This technical guidance assigns content, principle and technical requirement from nursery technique, collecting, processing, maintaining, sowing to tending, protecting and producing seedlings for Sonneratia caseolaris to suit mangrove forest planting.

3. Subject and scope of application

This technical guidance is applied for Sonneratia caseolaris seedlings production in mangrove forest planting of the project entitled Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is the basis to develop economical and technical standards and Sonneratia caseolaris seedlings production in Thai Binh, concurrently for organization, management, approval in seedling production.

4. Term explanation

Terms in this technical guidance are explained below:

- **Ground exposure time:** The average hour in day that the area is not inundated by tide.

- **Inundated time:** The average hour in day or the average day in month that the area is inundated by tide.

- **Salinity:** The total content of soluble salts (in gram) contained in 1000g seawater, denoted S (‰ or g/kg).

- **Deep tidal regime:** Ground exposure time of plantation area from 6-8 hours/day, the inundated phenomenon when tidal level is low.

- **Medium tidal regime:** Ground exposure time of plantation area from 8-10 hours/day, the inundated phenomenon only when the tidal level equals the average sea level.

- **Low tidal regime:** Ground exposure time of plantation area from 10-16 hours/day, the inundated phenomenon only when the tidal level is high.

III. Collecting, processing and maintaining seed

3.1. Seedling source

Seed must be collected from mother tree in certificated seed forest or

nursery garden, over 6 years, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect.

If haven't have certificated seedling source yet, choose seedlings at stand where the age of mother trees > 6 years old, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect.

3.2. Collecting, processing and maintaining seed

- Collecting season:

Sonneratia caseolaris flowers in April and May, the fruit ripens from August to November. The fruit has sphere shaped, height from 1.5-2.0 cm; diameter from 3-5cm, base has spreading calyx lobes, 10-20 fruits/kg, each one has 500-1200 seeds, 1-2 mm long with V-shaped. Sonneratia caseolaris when ripes, it transforms from blue to gray blue; collect seeds from ripen fruits for seedling in autumn from September to October.

- Colecting method:

Collect ripen fruits directly on mother trees by picking or shaking for fruits to fall down. Can put a net under the mother tree, or choose time when the tide has not risen yet to pick the fallen fruits.

- Processing:

+ Fruits, after being collected, must be classified, then exclude the young and pestilent fruits.

+ With ripen fruitd, soft pulp, put them into basin and squeeze the pulp, softly scrape for seeds to rise then sift the seeds by basket with holes smaller than the seed's size. (<0,7mm). After the seeds are detached, lay them into a thin layer, 2-3 cm thick, put in cool, dry place, avoid the sun for 1 day to dry the seeds before sowing.

+ With not really ripen fruits and soft pulp, put them into a sack soaking in brackish water from 2 to 5 days to ripe the fruits, then detach the seeds as mentioned above.

- Maintaining seed:

+ 1 kg has from 180.000 to 200.000 seeds.

+ Seeds are detached then being sowed immediately in the first 1-2 days will have germination rate above 70%-85%; if not immediately,

then soaking the seeds in seawater with salinity about 5-15‰ where the ground has daily tidal regime. The seeds will lose germination ability for 1 month.

+ In case to preserve for long time, put also ripen fruits into sack, soaking in seawater with the salinity about 5-15‰ where the ground has daily tidal regime, maintaining time reaches 2-4 months.

Figure I2: Fruits of Sonneratia caseolaris

Figure I3: Seeds arrangement in Sonneratia caseolaris fruit

Figure I4: Seeds of Sonneratia caseolaris

IV. Producing seedling

4.1. Establishment of a nursery

Sonneratia caseolaris nursery is developed to produce and to tend seedlings until they meet the planting standard, there are 2 kinds of nursery garden:

- **Fixed nursery:** the nursery is developed for long term plantation with large scale and investment; is banked around to adjust water system, have advantage for seedling protection.

- **Temporary nursery:** được is built at where plantation area is small, near the planting site and easy for seedling transportation, only use for planting activities in a few years.

Fixed nursery or temporary nursery in project site is developed in submerged nursery type: where have low terrain, flooded with tide, surface of seedling's pot and the surface of natural salt marsh are at the same height.

The submerged nursery should be developed where have few wave, with tidal regime, ground exposure time from 8 to 10 hours/day, the salinityfrom 5 to 20‰. Surroundings of the nursery must be banked and have net fence to protect the seedlings from aquatic animals, insects, cattle. Do not developed nursery near estuaries, where the tide ebb away fast or have high level of silt.

Figure I5: Making soil pot for submerged nursery

Figure I6: Floated nursery

Figure I7: Temporary submerged nursery with covering bank and opened sewer for tidal regime

4.2. Processing and sowing seed

Before sowing (seeds are just detached or being preserved in brackish water then are fished out to be dried in the shade), soak the seeds in warm water with KMnO4 with concentration of 5‰, 400C, 6-8 hours, then fish out, leave the seeds to dry and cover the seeds (put them into sack then cover it where the covering temperature about 40-600C). In covering duration, the seeds need to be washed by alum daily with warm water about 400C, then fish out and leave to dry, after that put back to the covering place. After 3-5 days, when the seeds crack about 70%, they can be sowed in 2 following ways:

- Sowing on beds:

Sowing soil has physical component is stable loamy argillaceous soil, begin to dig, make mud puree to the depth of 20 cm, pick trash, smooth surface then grow on the beds. After that, sprinkle 0.5kg/10m2 with powdered lime to tackle germs and pests. The sowing beds have width from 1 to 1.5m, length depends on the length of nursery, 2 close beds about 0.5m seperated, have drain for water to run out when ebbing tide. Sowing beds need to be added with completely decomposed muck (4-6 kg/m2) or 1 kg/m2 of microbiological organic fertilizer to provide more nutrients for seedling development. Before mix-sowing seed with sand, proportion of 1 seed : 2 sands for evenly sowing or can mix without sand, then strongly strew the seeds by hand on the bed's surface in order the seeds to stick on the mud, create good condition for seeds to contact with water and fixed on the bed surface, 1 kg of seed is sowed on 20m2 bed surface. Sowing in early morning or windless afternoon.

- Directly sowing into pot:

After the seeds have cracked, sowing 2-3 seeds each pot. In sowing process, use hand to plunge the seeds under the soil 2-3mm.

4.3. Tendance after sowing

- The sowing beds must always have enough moisture. If the bed surface or pot is dried, open the drain for water to come in. At the beginning, only let the water to fill the bed surface. When the seedlings have grown stability, roots cling to the soil and able to withstand flood, then open the drain for water to come in and out follows the tidal regime.

- After sowing, make roof by net to cover 50% of light, when the seedlings

have reached the height of 5-7cm, open the roof for trees to grow.

- If sow directly into pot, need to check to supplement seeds in ungrown pot. For pots which have 2 or more seedlings, when they are stable and reach the height of 5-7cm, pull out and leave only 1 best growth seedling.

4.4. Making pot and arranging bed

- Pot cover:

+ The polyetilen (PE) pot cover, opalescent or dark color. High durability to ensure when potting can withstand being soaked in seawater and not broken during tendance and transportation.

+ Pot has carved bottom with small holes D = 0.5cm for drainage, size of 18cm x 22cm for the seedlings from 12 to18 months, the height of seedlings when being grown ≥ 1.0m, diameter of root ≥ 1.5 cm.

- Component of mixture in the pot

+ Use sludge where have daily tidal regime to pot (mud is collected at surface layer, depth of 0 - 20cm with loam and silt).

+ In case the soil has poor nutrient: Use 90% condenced mud where have daily tidal regime with super phosphate 1% and 9% of completely decomposed muck, which have already smashed to piece, or microbiological organic fertilizer by pot's weight. Mix all above components into a mixture of sludge to pot.

- Making and arranging pots on the beds

Use hand to put the mixture in the pot at about 1/3 of its height, stuff tightly to fix pot shape, then fill to pot surface by mud.

The bed's ground to place the pots is smoothed, the pots are arranged in lines closely, bed's width is 1.2m depends on the lenght of the nursery, 2 close beds are 0.6m seperated. After arranging in lines, use mud to fill around the beds to hold the pots.

4.5. Growing seedling into pot

Apply sowing on bed in 2 following ways:

- Grow the seedlings in the pot:

After sowing 20-30 days, the seedling reach the height of 2-3cm then grow

it into pot. Use hand to hold sofly the root to pull out the seedling, then put it in a clean water tray enough to submerge the root collar. Use stick to hole equal the root lenght, fill mud around to keep tree balance. Should grow on shade day, in early morning or afternoon. Pulled out seedling must be grown as soon as possible, therefore pulling-out work should be devided into many times to have time to rewind the process. Seedlings are grown into pot to make sure the root is in natural posture, good contact with the soil, tree is straight and not crushed.

- Growing on:

When the seedling reaches 5-7cm height, growing on another bed with interval space of 20x20cm, tending until before planting about 3 months, when the seedling reaches 70-80 cm (5-7 months), pull the seedling up by the roots with soil into the pot. Tending 3 more months, when tree grows stable then export out of nursery.

- During sowing process, avoid when the temperature lower than 200C, seedlings are easy to die.

4.6. Seedling tendance and pest control

- Make covering roof, water control:

Sonneratia caseolaris is photophilic species, only make covering roof after sowing, cover 50% of light until the seedlings have reached the height of 5-7cm, then open the roof. At the beginning, only regulate water to fill up the pot surface. When seedlings are stable, well growth, modify water system follows the tidal regime for tre training.

- Seedling protection:

+ Put net at drain gate and fence around the nursery to restrict aquatic species. Remove seaweeds, mosses, trash stick on the seedlings.

+ *Sonneratia caseolaris* seedlings can have some decomposed root disease. When it come out, use Fuji-One 40ND, mix 10ml medicine/4l water, spray for 100m2, or use Tobsim and Tilt 250ND mix together with proportion of 1:1, mix 12ml medicine/4l water, spray for 100m2, or other pesticide with the same effect.

- Picking grass, fertilizing and changing pot:

+ Pick grass as soon as they appear.

+ If seedings grow weak or leaves turn to yellow, apply additional fertilizer by NPK (5:10:3), concentration of 2% or equivalent to water the seedlings. Before watering, smash the fertilizer to pieces, put into water, stir to dissolve the fertilizer. Use watering-can to spray 3-4l/m2 of the bed surface, then water to clean the leaves. Before fertilizing, wait until tide ebb then close the drain to prevent water to come in, wait for 3-4 days after fertilizing then re-open the drain. In case the nursery does not have bank, wait until tide ebb to carry out fertilizing. Fertilize seedlings for the last time 30 days before planting.

+ Every 2-3 months, change the pots or when the roots pierce through the pot, move the pots in order the roots not to strike deep into the soil. Change the pots when tide ebb, combine with seedlings classification to have suitable tending method.

Replanting: After growing in the pot, need to check regularly in the first month to replant dead seedlings.

4.7. Seedling standard

No.	Growing condition	Age (month)	Root diameter (cm)	Height (cm)	Quality
1	Category II	>12-18	≥ 1.5	≥ 100	Well growth, well-propotioned development, no pestilent insect, verdant leaf, soil pot is not broken

Figure I8: Sonneratia caseolaris seedlings (18 months) meet the planting standard

Note for growing condition:

Category II: Average condition;site condition: hard silt soil or soft clay soil, sink from 5-15cm, sandy (sand <50%); tidal regime: average (ground exposure time from 8-10 hours/day).

V. Guidance on implementation

This technical guidance is applied to all production units in every economical components participate in producing

Sonneratia caseolaris seedlings in the project Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is recommended to apply to all production and business units, all subjects in every economical components participate in producing Sonneratia caseolaris seedlings by other sources for mangrove forest planting in Thai Binh and other local with the same conditions.

PART II: GUIDANCE ON NURSERY TECHNIQUE FOR *Kandelia obovata Sheue, Liu & Yong*

I. Introduction

Scientific name: *Kandelia obovata* Sheue, Liu & Yong

Local name: Trang

Family: Rhizophoraceae

Distribution and ecological characteristic: Distributed mainly in the North of Vietnam, especially in the North-East and Nothern Delta. Tree height from 4 to 8m, adapt to soft muddy soil and sandy mud soil , grow mainly in high or average tidal regime area, prefer high salinity from 20 to 34‰, withstand frozen winter of Northern region and harsh amplitude of temperature. Stump has butress. Leaves grow opposite, elliptic, have acuminate apex. Flowers bloom actinomorphic with nectary. Fruit has small pear shaped when it is young, smooth fruited, fawn coloured.

Figure II1: Leaves, flowers and fruits of Kandelia obovata


Figure II2: Stump has buttress and stem of Kandelia obovata

II. General regulation

1. Objective

This technical guidance focuses on produce seedlings Kandelia obovata to suit mangrove forest planting, contribute to rehabilitation and sustainable development of mangrove ecosystems in Thai Binh Province.

2. Content

This technical guidance assigns content, principle and technical requirement from nursery technique, collecting, maintaining, sowing to tending, protecting and producing seedlings for Kandelia obovata to suit mangrove forest planting.

3. Subject and scope of application

This technical guidance is applied to produce seedlings for Kandelia obovata for mangrove forest planting in the project: Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is the basis to develop economical and technical standards and Kandelia obovata seedlings production in Thai Binh, concurrently to organize, manage, check and take over in seedlings production.

4. Term explanation

Terms in this technical guidance are explained below:

- **Ground exposure time:** The average hour in day that the area is not inundated by tide.

- **Inundated time:** The average hour in day or the average day in month that the area is inundated by tide.

- **Salinity:** The total content of soluble salts (in gram) contained in 1000g seawater, denoted S (‰ or g/kg).

- **Deep tidal regime:** Ground exposure time of plantation area from 6-8 hours/day, the inundated phenomenon when tidal level is low.

- **Medium tidal regime:** Ground exposure time of plantation area from 8-10 hours/day, the inundated phenomenon only when the tidal level equals the average sea level.

- **Low tidal regime:** Ground exposure time of plantation area from 10-16 hours/day, the inundated phenomenon only when the tidal level is high.

Figure II3: Protective mangrove forest at estuaries, coastal areas by Kandelia obovata

III. Collecting and maintaining seed

3.1. Seedling source

Seed must be collected from mother tree in certificated seed forest or nursery garden, over 6 years, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect. If haven't have certificated seedling source yet, choose seedlings at stand where the age of mother trees > 5 years old, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect.

3.2. Collecting and maintaining sprout

- Collecting season:

Kandelia obovata flowered scattered from May of the previous year,

sprout has mace shaped, ripen from April to June in the following year, yellowish, between fruit and sprout appear "a ring" from 1 to 1.5cm lenght, distended, dark brown, after that change to yellow brown, the sprout then easily seperated from the fruit. The sprout is 25- 40cm lenght, 40-60 sprouts (fruits)/kg, germination rate > 80%. If the fruit does not have the "ring" or it too short mean that the fruit is still young, can not survive if planted or seedling only can survive for a short time then die slowly.

- Colecting method:

The sprout is collected directly from mother tree or shake the tree for the sprout to fall: choose the fruits with ripen "ring", collect both fruit and sprout. Do not separate fruit from sprout in order to protect the cotyledon.

- Classification and maintainance:

To avoid sprout being crushed, use banana fiber, jute after picking to bind 20 - 30 sprouts/bunch for easy maintainance and transportation, do not let the top of sprout to be broken. Sprout after collected must carry out classification. Remove young, pestilent, broken sprout or missing cotyledon. Germination rate decrease very quick in normal condition, therefore need to grow into pot as soon as collection. For sprout which have not planted, keep in moisture, cool place and water daily (brackish or freshwater); maintainance time not exceed 10 days.

IV. Producing seedling

4.1. Establishment of a nursery

Kandelia obovata nursery is developed to produce and to tend seedlings until they meet the planting standard, there are 2 kinds of nursery garden:

- Fixed nursery: the nursery is developed for long term plantation with large scale and investment; is banked around to adjust water system, have advantage for seedling protection.

- Temporary nursery: được is built at where plantation area is small, near the planting site and easy for seedling transportation, only use for planting activities in a few years.

Fixed nursery or temporary nursery in project site is developed in submerged nursery type: where have low terrain, flooded with tide, surface of seedling's pot and the surface of natural salt marsh are at the same height.

The submerged nursery should be developed where have few wave, with tidal regime, ground exposure time from 8 to 10 hours/day, the salinityfrom 5 to 20‰. Surroundings of the nursery must be banked and have net fence to protect the seedlings from aquatic animals, insects, cattle. Do not developed nursery near estuaries, where the tide ebb away fast or have high level of silt.

4.2. Making and arranging pot

- Pot cover

+ The polyetilen (PE) pot with opalescent or dark color. High durability to ensure when potting can withstand being soaked in seawater and not broken during tendance and transportation.

+ Pot has carved bottom with small holes D = 0.5cm for drainage, size of 18cm x 22cm for the seedlings from 12 to18 months, the height of seedlings when being grown ≥ 1.0m, diameter of root ≥ 1.0 cm.

- Component of mixture in the pot

+ Use sludge where have daily tidal regime to pot (mud is collected at surface layer, depth of 0 - 20cm with loam and silt).

+ In case the soil has poor nutrient: Use 90% condenced mud where have daily tidal regime with super phosphate 1% and 9% of completely decomposed muck, which have already smashed to piece, or microbiological organic fertilizer by pot's weight. Mix all above components into a mixture of sludge to pot.

- Making and arranging pots on the beds

Use hand to put the mixture in the pot at about 1/3 of its height, stuff tightly to fix pot shape, then fill to pot surface by mud.

The bed's ground to place the pots is smoothed, the pots are arranged in lines closely, bed's width is 1.2m depends on the lenght of the nursery, 2 close beds are 0.6m seperated. After arranging in lines, use mud to fill around the beds to hold the pots.

4.3. Growing sprout into pot

After classification, grow sprout into pot:

- Plant the end of sprout into the soil, submerged 1/3 height of the sprout.

- Grow 1 sprout each pot.

- Grow on shade day.

4.4. Tending seedling

- Make covering roof, water control: Make roof to cover 50% light when the sprouts are newly planted, after 15-20 days, remove the covering roof. After growing, regulate water so that flooded the bed surface. Once germinated, root system has developed, then regulate water regime follow the tide.

- Seedling protection: Put net at drain gate and fence around the nursery to restrict aquatic species. Remove seaweeds, mosses, trash stick on the seedlings

- Picking grass, fertilizing and changing pot:

Pick grass as soon as they appear.

If seedings grow weak or leaves turn to yellow, apply additional fertilizer by NPK (5:10:3), concentration of 2% or equivalent to water the seedlings. Before watering, smash the fertilizer to pieces, put into water, stir to dissolve the fertilizer. Use watering-can to spray 3-4l/m2 of the bed surface, then water to clean the leaves. Before fertilizing, wait until tide ebb then close the drain to prevent water to come in, wait for 3-4 days after fertilizing then re-open the drain. In case the nursery does not have bank, wait until tide ebb to carry out fertilizing. Fertilize seedlings for the last time 30 days before planting.

Every 2-3 months, change the pots or when the roots pierce through the pot, move the pots in order the roots not to strike deep into the soil. Change the pots when tide ebb, combine with seedlings classification to have suitable tending method.

Replanting: Dead sprout need to be replanted until run out of stored sprout or sprout has too long root can not be growed.

4.5. Seedling standard

No.	Growing condition	Age (month)	Root diameter (cm)	Height (cm)	Quality
1	Category II	>12-18	≥ 1.0	≥ 80	Well growth, well-propotioned development, no pestilent insect, no shortened top of seedling, verdant leaf, soil pot is not broken

Note for growing condition:

Category II: Average condition;site condition: hard silt soil or soft clay soil, sink from 5-15cm, sandy (sand <50%); tidal regime: average (ground exposure time from 8-10 hours/day).

V. Guidance on implementation

This technical guidance is applied to all production units in every economical components participate in producing Kandelia obovata seedlings in the project Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is recommended to apply to all production and business units, all subjects in every economical components participate in producing Kandelia obovata seedlings by other sources for mangrove forest planting in Thai Binh and other local with the same conditions.

PART III: GUIDANCE ON NURSERY TECHNIQUE
Avicennia marina (Forssk.) Vierh

I. Introduction

- Scientific name: *Avicennia marina (Forssk.) Vierh*

- Local name: Mắm biển, Mấm biển

- Family: Avicenniaceae

- Distribution and ecological characteristic: Distributed from the North region to the South region; mainly in the North East, North Central and West South. Tree has average height from 4 to 6m, can reach to 10m, trunk diameter up to 40cm. There are many pneumatophores with small spike shaped like fingers, high from 10 to 15cm, diameter of 6mm. Avicennia marina is pioneer tree, grows primarily in medium or high tide, suitable with salinity from 20 to 35‰. Leaves opposite, ovate, pale green on the upper surface, the underside is gray white and has fuzz, with salt glands on 2 sides. Petiole 5 to 10mm long, hairless. Flowers small, sessile, 6mm diameter, orange, with 4 petals. Fruits are heart shaped, 1.5-2 x 1.5-2.5cm sized, many pale green woolly when young, pale yellow when ripe. Sprouts are in fruits.

Figure III1: Leaves, flowers, and fruits of Avicennia marina

II. General regulation

1. Objective

This technical guidance focuses on produce seedlings *Avicennia marina* to suit mangrove forest planting, contribute to rehabilitation and sustainable development of mangrove ecosystems in Thai Binh Province.

2. Content

This technical guidance assigns content, principle and technical requirement from nursery technique, collecting, maintaining seed fruit, sowing to tendind, protecting and producing seedlings for *Avicennia marina* to suit mangrove forest planting.

3. Object and scope of application

This technical guidance is applied to produce seedlings for *Avicennia marina* for mangrove forest planting in the project: Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is the basis to develop economical and technical standards and *Avicennia marina* seedlings production in Thai Binh, concurrently to organize, manage, check and take over in seedlings production.

4. Term explanation

Terms in this technical guidance are explained below:

- **Ground exposure time:** The average hour in day that the area is not inundated by tide.

- **Inundated time:** The average hour in day or the average day in month that the area is inundated by tide.

- **Salinity:** The total content of soluble salts (in gram) contained in 1000g seawater, denoted S (‰ or g/kg).

- **Deep tidal regime:** Ground exposure time of plantation area from 6-8 hours/day, the inundated phenomenon when tidal level is low.

- **Medium tidal regime:** Ground exposure time of plantation area from 8-10 hours/day, the inundated phenomenon only when the tidal level equals the average sea level.

- **Low tidal regime:** Ground exposure time of plantation area from 10-16 hours/day, the inundated phenomenon only when the tidal level is high.

III. Collecting and maintaining seed fruit

3.1. Seedling source

Seed fruit must be collected from mother tree in certificated seed forest or nursery garden, over 5 years, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect.

If haven't have certificated seedling source yet, choose seedlings at stand where the age of mother trees > 5 years old. Plantation area large enough to collect many seeds. Chosen mother tree are trees which the values exceed average number of forest (30 to 40 surrounding trees) at least 25% of diameter, 10% of height, well growth, leaf canopy is broad, thick, well-proportioned, no pestilent insect.

3.2. Collecting and maintaining seed fruit

- Collecting season:

Avicennia marina fruited annually, seasonal peak from August to November. Choose fruit still intact, no pests and pathogens. When ripen, Avicennia marina fruit has length from 1.5 to 2.0 cm, diameter from 1.2 to 1.5 cm. 1 kg has 300-400 fruits. Germination rate is about 90-93%. Ripen fruit turns from green to pale yellow.

- Collecting method: Collect ripen fruits directly on mother trees by picking or shaking for fruits to fall down. Can put a net under the mother tree.

- Classification and maintainance:

+ Fruits, after being collected, must be classified, then exclude the young and pestilent fruits, and those which beaten by fiddlers, small crabs and lose cotyledon. Do not choose fruits which have dark brown dots, rotten or lose peel.

+ In normal condition, Avicennia marina fruit has germination rate decrease very quick, for that, grow into pot right after collection, or maintain by scatter the fruits in shade, cover by gunnysack, water daily to keep moisture. Maintainance time not exceeds 10 days. Before sowing, soak the fruits 1-2 days and change water regularly. Best maintainance is to float the fruits in canal with net cover around.

IV. Producing seedling

4.1. Establishment of a nursery

Avicennia marina nursery is developed to produce and to tend seedlings until they meet the planting standard, there are 2 kinds of nursery garden:

Fixed nursery: the nursery is developed for long term plantation with large scale and investment; is banked around to adjust water system, have advantage for seedling protection.

Temporary nursery: is built at where plantation area is small, near the planting site and easy for seedling transportation, only use for planting activities in a few years.

Fixed nursery or temporary nursery in project site is developed in submerged nursery type: where have low terrain, flooded with tide, surface of seedling's pot and the surface of natural salt marsh are at the same height.

Figure III2: Avicennia marina submerged nursery

Seedling nursery should be established in form of land which less inundated with tide (inundated time is less) and make submerged bed with width from 1m to 1.2m, the length depends on topography of the nursery but no longer than 15m for easy tendance and sea-gauge checking. Between the submerged beds are 0.6m wide walkways to care and make bank for the beds. The depth of submerged beds depend on the height of soil pot so that the pot lower than the walkway surface at least 5cm. Submerged beds have drainage ditches when tide ebb; or use the nursery where flat and have enclosed bank around, place the beds in the direction along rising and ebbing tide.

Temporary nursery should be placed in areas with weak seawaves, lowland, regular tidal regime, ground exposure time above 8 hours/day.

4.2. Making pot and arranging bed

- Pot cover

+ The polyetilen (PE) pot with opalescent or dark color. High durability to ensure when potting can withstand being soaked in seawater and not broken during tendance and transportation.

+ Pot has carved bottom with small holes D = 0.5cm for drainage, size of 18cm x 22cm for forest category II planting, the seedlings from 8 to 10 months, the height of seedlings when being grown ≥ 40cm, diameter of root ≥ 0.6cm.

- Component of mixture in the pot

+ Use top soil of mangrove forest with the maturity in form of Ic, Id (tight mud, soft clay) at a depth of 0-20 cm or fresh mud to make pot.

+ In case the soil has poor nutrient, use 90% soil with 9% of completely decomposed muck or microbiological organic fertilizer and 1% of super phosphate 1% by weight, smash to pieces, mix together to pot.

- Making and arranging pots on the beds

Put the mixture in the pot at about 1/3 of its height, stuff tightly to fix pot shape, then fill to pot surface by mud.

The bed's ground to place the pots is smoothed, the pots are arranged in lines closely, bed's width is 1.2m depends on the lenght of the nursery, 2 close beds are 0.6m seperated. After arranging in lines, use mud to fill around the beds to hold the pots. Arrange pots into beds 7-10 days before growing in order for the soil in the pot to stable and fertilizer to decompose.

4.3. Growing seed fruit into pot

- Before growing seed fruit into pot, add water from 2 to 3 days to fill the pot surface. Then grow by pressing the root of the seed fruit into the pot that the depth equal ½ diameter of the fruit or submerge the fruit into the pot. For each pot only grow 1-2 fruits. Grow in shade day.

- Replanting: After growing 7 days, the fruit begin to germinate, check the germination rate and replant which did not germinate. After 20 days, pull out 1 seedling in pots which have 2 seedlings, leave the good one.

4.4. Tending seedling

- Water control: For nursery where inundated with tide, use water to fill the pot surface and release water when tide ebbing. In unflooded days, inundate pot surface then release water like when flooded.

- **Picking grass:** Pick grass regularly. Always keep the ground clear, increase water infiltration, reduces surface evaporation.

- **Changing pot:** Avicennia marina has developed root system, need to check and supervise regularly to change pot. Once every 2-3 months, to avoid roots strike deep into the soil, cut the root when it sticks out. It is obligatory to change pot before 1 month. Changing pot combine with plant classification (good or bad) to get the appropriate caring system.

- **Protecting:** Build net fence to prevent fiddlers and small crabs from damaging the seedlings. Remove objects stick on fruits and seedlings.

4.5. Seedling standard

Avicennia marina seedlings standard is regulated in following table:

No.	Growing condition	Age (month)	Root diameter (cm)	Height (cm)	Quality
1	Category II	8-10	≥ 0.6	≥ 40	Well growth, well-propotioned development, no pestilent insect, shortened top of seedling, verdant leaf, soil pot is not broken

Note for growing condition:

Category II: Average condition;site condition: hard silt soil or soft clay soil, sink from 5-15cm, sandy (sand <50%); tidal regime: average from 10-19 days/month (ground exposure time from 9-14 hours/day).

V. Guidance on implementation

This technical guidance is applied to all production units in every economical components participate in producing Avicennia marina seedlings in the project Rehabilitation and Sustainable Development of Mangrove Forest Ecosystem in Thai Binh Province.

This technical guidance is recommended to apply to all production and business units, all subjects in every economical components participate in producing Avicennia marina seedlings by other sources for mangrove forest planting in Thai Binh and other local with the same conditions.

DỰ ÁN
PHỤC HỒI VÀ PHÁT TRIỂN BỀN VỮNG HỆ SINH THÁI RỪNG NGẬP MẶN Ở TỈNH THÁI BÌNH

BAN QUẢN LÝ DỰ ÁN TRUNG ƯƠNG
Phòng 211 nhà A2, số 21A Ngọc Hà,
Ba Đình, Hà Nội

BAN QUẢN LÝ DỰ ÁN THÁI BÌNH
Số 1 Lê Lợi, thành phố Thái Bình

TỔNG CỤC LÂM NGHIỆP
VNFOREST

AFoCO