Hesti L. Tata, Gede Wibawa and Laxman Joshi

Manual

Enrichment planting with *Dipterocarpaceae* species in rubber agroforests

World Agroforestry Centre

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Preface

Cultivation techniques for meranti (*Shorea* spp.; Dipterocarpaceae) are already known to foresters through forest rehabilitation and plantation development projects. However, because forest areas are decreasing, planting meranti on non-forest land is becoming increasingly important.

One of the potential areas for meranti development is rubber-tree gardens. Rubber gardens managed as part of an agroforest system are known as rubber agroforests. These gardens have become an attractive alternative site for meranti planting because the meranti can enrich and develop smallholder timber production. Meranti can be planted either with young rubber on open land or with mature trees, although it has different physiological characteristics from rubber. Farmers can plant meranti in their rubber garden, generating benefits both from the rubber's latex and the meranti's timber.

This manual was written to promote enrichment planting with meranti in rubber agroforests (Chapter 1); give an introduction to several species of Dipterocarpaceae, their seed physiology and habitat distribution (Chapter 2); nursery techniques for seedlings and cuttings (Chapter 3); and cultivation techniques, including land preparation, planting distance and seed maintenance (Chapter 4).

This manual was compiled based on results of research we conducted in Bungo and Tebo districts, Jambi province, Sumatra, Indonesia. It is intended to be used as a field handbook for practitioners, extension workers, farmers and anyone else who wants to plant meranti or other Dipterocarpaceae species in rubber gardens. Using this manual, rubber farmers can develop their own nursery independently or together in farmers' groups, by collecting seeds from forests or other sites.

The first author would like to thank the Netherlands Fellowship Program and the Common Fund for Commodities that funded the research. Our deep gratitude goes to colleagues at the World Agroforestry Centre's Muara Bungo office who helped the research activity, Ratna Akiefnawati and Yatni. We would also like to express the same to our colleagues at the Centre's national office in Bogor: Subekti Rahayu who edited the Indonesian text and Robert Finlayson who edited this English version; Tikah Atikah, Josef Arinto and Diah Wulandari for text layout and design. Our strongest appreciation must, however, go to the farmers who participated in the research activities: Abror, Cholic, Jamhuri, Sudiharjo, Sudirman, Sunardi, Supriyadi, Paijan and Rebiman.

We hope that this technical manual will be useful to you.

Bogor, December 2010

Contents

1. Introduction

The lowland tropical rainforests in Indonesia are dominated by Dipterocarpaceae species with various local names such as meranti, *kruing, kapur, mersawa, merawan, bangkirai* and *balau*. They produce valuable timber, known locally as 'carpenter's wood', suitable for high and light construction. Moreover, several Dipterocarpaceae species were identified as producer of non-timber forest products such as *tengkawang* (illipe nuts) and *damar mata kucing* (dammar resin from *Shorea javanica*).

Nowadays, demand for natural forest timber is increasing yearly while the rejuvenation of meranti in natural forests is limited. The demand for round wood in the decade 2000–2010 reached 37.6 million m^3 per year, yet production in, for example, 2006 was only 19.2 million m^3 (http://www.dephut.go.id/index.php?q=id/node/2643). Presently, natural forests and industrial timber plantations produce meranti timber while small-scale private forests usually produce other timbers, such as teak and mahogany.

Rubber agroforest systems already exist in several areas in Indonesia and are growing in area in Sumatra and Kalimantan. Dipterocarpaceae species can be interplanted in existing rubber agroforests. A rubber agroforest is a complex agro-ecosystem based on rubber trees. It is managed extensively with low maintenance. This creates a suitable environment for natural growth of non-rubber species (for example, herbs, lianas and other trees). Farmers deliberately allow these non-rubber species to grow and they maintain them in the garden for special purposes such as fruit production, firewood and timber.

Based on the characteristics of rubber agroforests and the shade-tolerant characteristic of meranti, Dipterocarpaceae can be successfully planted in rubber agroforests. Our research results show that meranti seedlings (Shorea selanica and Shorea lamellata) grow well in mature rubber agroforests (more than 10 years-old) and young rubber (1 year-old) without shade trees. There are several kinds of meranti or tengkawang that can be planted in smallholder rubber agroforests: *Shorea leprosula, Shorea macrophylla (tengkawang tungkul), Shorea parvifolia, Shorea macroptera, Shorea pinanga (tengkawang), Shorea stenoptera, Shorea javanica (damar mata kucing), Shorea lamellata (damar)* and *Shorea johorensis.*

2. Morphology and distribution of meranti

2.1. Species distribution

Dipterocarpaceae are distributed widely throughout Kalimantan, Sumatra, Java, Bali, Nusa Tenggara, Sulawesi and Maluku. Kalimantan has the richest and widest endemic distribution of Dipterocarpaceae in the world, followed by Sumatra.

Dipterocarpaceae species grow naturally in lowland rainforest, from 0 to 500 metre above sea level, with A-B climate type (Schmidt and Ferguson 1951), that is, mean of annual rainfall at 2000–3000 millimetre. They grow in various soil types, for example, *latosol*, red yellow *podsolik* and yellow *podsolik*. Some species, like *Shorea seminis*, grow along rivers and in areas flooded during the rainy season. Some other species grow in swamp forests or peat swamps, such as *Shorea balangeran*.

2.2. Morphology

Meranti is a member of the Dipterocarpaceae family. 'Dipterocarpaceae' comes from Latin: *di* = two; *carpa* = carpus = wings. The name refers to the double-winged fruit, though not all members of the family have this feature. Dipterocarpaceae species (*kruing*), *Cotylelobium* (*kamper*) and *Anisoptera* (*mersawa*) generally have double wings, whereas *Hopea* (*merawan*), *Parashorea* and *Shorea* (*meranti, bangkirai* and *balau*) have various numbers of wings up to as many as 25, while *Vatica* (*resak* species) has very short wings and is even wingless (Figure 1).

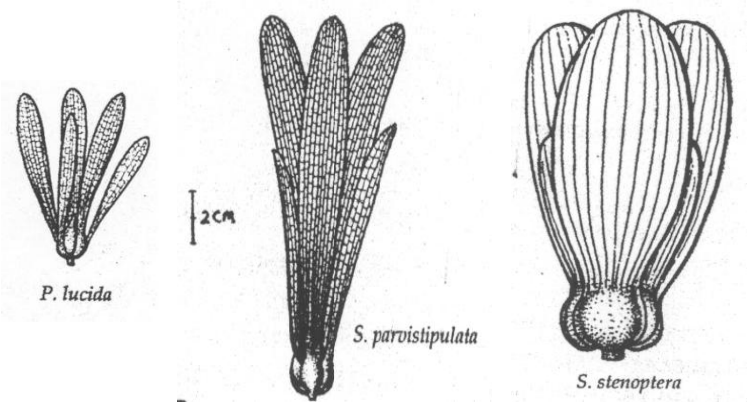

Figure 1. Fruit shape of *Parashorea lucida, S. parvistipulata* and *S. stenoptera* (Source: Yasman and Hernawan 2002)

Meranti trees have a cylindrical bole and grow to 40–50 m. They can have smooth, shallow or deeply fissured bark, greyish to brown in colour. Generally, they have high buttress roots (*banir*) to 6–7 m. Trade names are determined by the cambium colour: white, yellow and red meranti. Description of meranti habitat (*Shorea* sp.) is presented in Figure 2.

Figure 2. Habitat of *Shorea* sp. in Jorong Sigantang natural forest (Photo: Hesti Tata)

2.3. Growth

Meranti timber can be extracted when its diameter at breast height (dbh) has reached 40 cm. The diameter growth increment of each species is related to the characteristics of the site in which they grow. Diameter growth increment of *Shorea leprosula* (meranti *batu*) in East Kalimantan is 1.4 cm/year (Al Rasjid et al. 1991). It can be harvested 30 years after planting. However, if diameter growth reaches 1.8–2.0 cm/year it can be harvested in 25 years.

2.4. Seed physiology

Meranti generally has a massive flowering and fruiting season every 4–7 years. However, some species planted in the arboretum of the Forest Research and Development Agency in Bogor bloom yearly, such as *Hopea odorata (merawan)* and *Anisoptera marginata (mersawa)*.

Meranti has various fruiting seasons depending on the location and species. In the research forest of Haur Bentes, Jasinga, West Java, *S. leprosula, S. pinanga, S. stenoptera* and *S. mecistopteryx* species have ripe fruit December through to March, however, *Hopea mengerawan, H. sangal* and *H. odorata* have ripe fruit July to September.

In Sumatra, *S. parvifolia* fruits in December–January but another Dipterocarpaceae species, *S. acuminata*, fruits through October–December.

The fruiting season of meranti will determine seed availability. Dipterocarpaceae seeds cannot be stored for long because they are

recalcitrant, that is, germinate rapidly. The storage process will reduce seed viability or germination capacity.

The seeds are collected directly from mother trees or collected on the ground around the mother trees. The seeds must be collected every day during the fruiting season. There are three characteristics of viable seeds:

1. Fully mature: indicated by brown-coloured fruit and brown, dry wings.
2. Perfect shape: no animal bites or insects marks or infestations.
3. Free from mould.

Figure 3. *Shorea leprosula* (meranti *batu*, meranti *tembaga*) (Source: Soerianegara and Lemmens 1994)

3. Meranti nurseries

3.1. Nursery development

Providing high-quality seedlings is one of the most important factors in growing quality meranti. Preparing the seed can be done in both temporary and permanent nurseries. For smallholders, meranti nurseries can be in the same place as rubber-tree nurseries (for root stocks), such as intercropping in rubber agroforests. An ideal nursery location needs to fulfil a number of conditions:

- Relatively flat, with no more than 5% slope
- Close to water
- Close to a road network with easy access

3.2. Nursery preparations

Meranti propagation can be carried out in seed beds or trays.

1. Preparation

a. Prepare the seed bed (1 m x 5 m) in an east–west direction. Provide 50 cm space between beds if there is more than one.

b. Erect bamboo or wooden fencing around the bed.

c. If using a seed tray, use a plastic container that is sufficiently large and robust.

d. Use a plastic cover to keep humidity high (Figure 4).

e. Ensure 50% light-penetrated shading by using netting or a roof made from leaves (such as sago palm or coconut). The height of the poles on the western and eastern sides should be 80 cm and 100 cm, respectively.

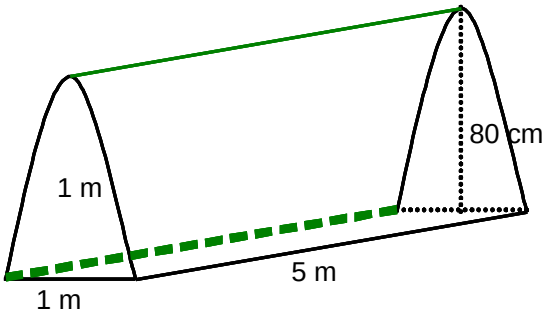

Figure 4. Seed bed covered by transparent plastic with bamboo frame

2. Seed-bed media

There are two kinds of media that can be used for meranti seed beds:

a. Mixture of soft sand or sawdust and rice husk in equal parts. If you are planning for mycorrhiza inoculation, the media should be sterilised prior to use by being steamed or fried for six hours. The sterilisation aims to reduce pathogenic fungi and other harmful substances in the media.

b. Mixture of soft sand or ground coconut husk and rice husk in equal parts.

When the media has been prepared, spread it over the bed evenly to 5–10 cm thickness and pour water thoroughly to field capacity.[1].

3.3. Nursery process

Prior to attempting to germinate seeds, choose the seeds that are healthy and viable after the wings have been removed.

a. Sowing in a seed bed

- Create a line pattern of planting holes 5 cm apart using a wooden dibble or pointed stick (10 cm long, 1 cm diameter).
- Place one seed in each hole in a horizontal position, not too deep. The cotyledons should be easy to lift up.
- Cover the seeds thoroughly with the seed bed media.
- Pour water thoroughly to field capacity.
- Cover the seed bed with a plastic sheet.

b. Sowing in a seed tray

- Place the media into the seed tray.
- Spread the seeds evenly without making a line pattern.
- Cover with seed-bed media.
- Pour water thoroughly to field capacity.
- Cover the seed tray with a plastic sheet or lid.

In general, meranti seeds will germinate within 7–12 days (Figure 5).

[1]Field capacity is moderate soil humidity; a good soil condition for tillage.

Figure 5. Sprout of meranti (*S. selanica*) in germination tray with media of sawdust and rice husk mixture in equal parts (Photo: Hesti Tata)

3.4. Potting seedlings

After seeds germinate and have a pair of leaves they are ready to be transferred from the seed bed or plastic container with a plastic bag (Figure 6).

There several steps in the seed-weaning process.

a. Prepare the seedling bed

- Make a plot 1 m x 5 m.
- Erect a bamboo or wooden fencing around it. If there is more than one seedling bed, allow space of 50 cm between them.
- Cover with a bamboo frame with plastic sheeting 70 cm high to maintain humidity.
- Erect shading sago palm, or coconut leaves or netting) that allows 50% light penetration (Figure 7).

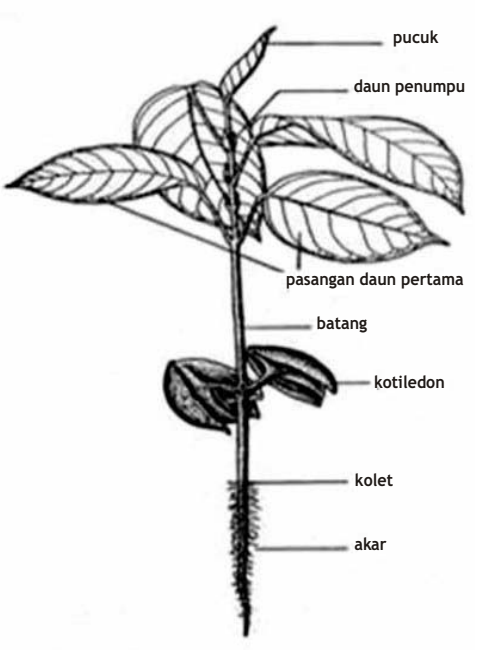

Figure 6. Complete sprout of *S. johorensis* (Source: Yasman and Hernawan 2002)

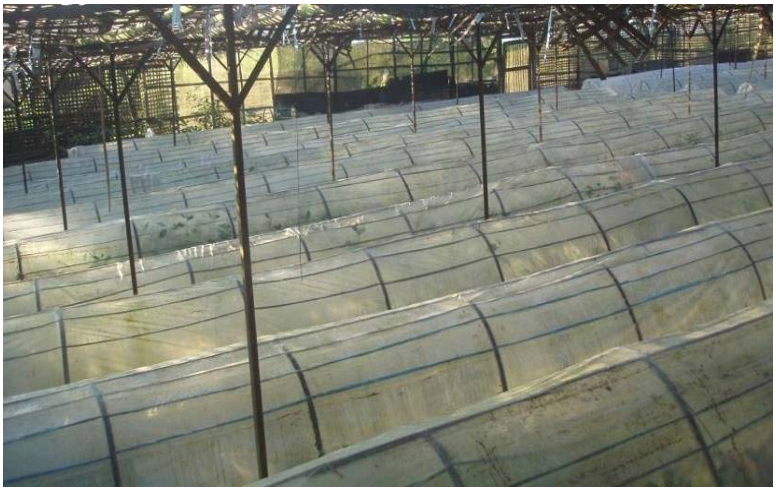

Figure 7. Seedling bed with plastic cover under bamboo roof (Photo: Hesti Tata)

b. Prepare media

- Take soil from beneath the parent trees then mix soil with rice husk in a ration of 2:1 (soil:rice husk).
- Sieve with a rough mesh to separate gravel and debris.
- Put the media into plastic containers, such as a plastic bag 12 cm x 15 cm or 15 cm x 20 cm, depending on the seedlings' size.
- Place the plastic bags into the seedling bed and cover the bed with transparent plastic.

C. Potting seedlings

- Use a plastic bag which is filled with the media.
- Lift the seedling carefully from the seedling media using a spoon, holding it by a leaf, so as not to damage its roots and stem.
- Make a planting hole in the media with dibble as deep as the roots of the seedling.
- Put the roots into the planting hole, bang the container on the ground to settle the medium and top up again if necessary.

Figure 8. Potted meranti seedlings under plastic cover (Photo: Hesti Tata)

- Pour water thoroughly to field capacity.
- Keep the seedlings inside the plastic-covered seedling bed (Figure 7) until they have adapted. Afterwards the cover can be opened.

3.5 Seedlings maintenance

Maintain the seedlings for 2–3 months until they reach 30–50 cm height. Vigorous seedlings are ready to be planted in the field.

Maintaining seedlings in the nursery includes a number of steps.

a. Fertilising. Basic fertiliser, such as NPK, is necessary if the seedlings were not treated with mycorrhiza. A dosage of 2 g NPK can be applied per pot or seedling.

b. Pest and disease control. There are several pests and diseases that commonly occur in nurseries.
   - Caterpillars, such as *Cryotothelea* sp. and *Dasychira* sp., that attack leaves.
   - *Scolytidae* larvae.
   - 'Dampening' disease.
   - A shoot tumour caused by a virus spread by spiders.
   - The stunting disease caused by mycoplasma. The symptoms are growth of stacked callus which look like small balls on the branch armpit or the young twig.
   - Die-back disease caused by fungus. The symptom is death of the shoot, spreading to the basal section.
   - 'Rotten leaves' disease (leaf blight): death of cells from the tip to the middle of leaves.

The seedlings can be treated with insecticide or fungicide if the intensity of pest and disease attack increases. Use the dosage recommended on the package (for example Benomyl®, Benlate®).

Box 1

Inoculation with ectomycorrhiza fungi

1. Media sterilisation

The media for germinating seeds and potting seedlings must be sterilised prior to mycorrhiza inoculation. Media can be sterilised by heat or fungicide (Follow the dosage recommended on the package).

Sterilisation steps

a. Prepare a sterilising bed, made with wooden planks, with the dimensions of 30 cm x 400 cm (Figure 9).

b. Place a plastic sheet at the base of the bed.

c. Mix soil and rice husk in the ratio of 2(soil):1(rice husk).

d. Pour the fungicide into the media according to recommended dosage (for example, 100 g Basamid G is used to sterilise 1 m3 of soil).

e. Stir well with hoe or shovel.

f. Cover the soil with a plastic sheet and incubate for 15 days.

g. Finally, remove the plastic sheet. The media can then be transferred to plastic containers or bags.

Figure 9. Media sterilising bed

2. Inoculation with ectomycorrhiza fungi

Fungal inoculants can be introduced two days after potting the seedlings. The fungal inoculants are available as sporocarps (fruiting body of mushrooms) and in tablet or capsule form.

a. Tablet or capsule of ectomycorrhiza spores

Several agencies in Indonesia produce tablets or capsules of ectomycorrhiza spores (Ektofer, produced by Puslitbang Hutan dan Konservasi Alam = Forest and Nature Conservation Research and Development Centre). Each kilogram package contains 1200–1300 ectomycorrhiza-spore tablets.

Figure 10. Application of *ectomycorrhiza*-spore tablet to meranti seedlings

Application method:

- Make a 1 cm diameter hole 2 cm in depth near a meranti seedling.
- Put a tablet into the hole. Do not water the seedling for two days (Figure 10).

b. Sporocarps (the fruiting body of ectomycorrhiza fungus)

The fruiting body of ectomycorrhiza fungus can be found in forests under the mother trees, for example, Dipterocarpaceae and Fagaceae (Oak. Local name: *pasang* and *mempening*). Some species which have an 'umbrella'-form can be identified easily, namely *Russula, Laccaria, Boletus*, as can puffball-form fungi such as *Scleroderma* and *Pisolithus*.

Application method:

- Collect fruiting body of ectomycorrhiza in fresh condition from the forest. Choose only young mushrooms, with a semi-closed cap, of *Russula, Laccaria* and *Boletus* fungi. If puff-ball fungi are available, collect mature fruiting bodies, which are indicated by a soft ball.

- Cut the stem and remove it. Slice the cap or ball into small parts.
- Mix 100 g of sliced fungi with 1 litre of water, stir well.
- Apply 5 ml (approximately 1 tablespoon) of the mixture of fungus and water per seedling in each plastic bag. Alternatively, apply a mixture of 100 g fungus with 1 litre water to 50–100 m2 of seed bed. After inoculation, do not water the seedling for two days in order avoid mycorrhiza being washed away before it connects with the meranti roots.

3.6. Vegetative propagation

Some barriers may constrain generative propagation of meranti, such as the irregular fruiting season of Dipterocarpaceae and time limitations of seed storage. Therefore, vegetative propagation with shoot-cutting technique is an alternative for providing regular seedling stocks. This technique requires establishing seedling orchards where farmers can collect meranti shoots as cutting materials.

Some steps, such as media preparation, production of shoot cuttings, potting cuttings and maintenance, are described below.

1. Media preparation

- Prepare rooting media for shoot cuttings: (i) mixture of dust of coconut husk and rice husk in equal parts; (ii) wood sawdust (100%); or (iii) mixture of rice husk and charcoal dust at a ratio of 2:1; or (iv) river sand.
- Sterilise the media using solarisation for three days or steam for three hours to kill pathogens (bacteria and fungi).
- Prepare the cutting containers. Use plastic containers with small holes in the bottom for water regulation. Put the plastic containers on a tray or wood container which can be placed directly on the soil surface.
- Put the rooting media into the cutting containers 12–15 cm thick and water well.

2. Production of shoot cuttings

Shoot cuttings need young (juvenile) shoots as cutting material that come from nurseries or seedling orchards. A commercial plant hormone, such as Rootone F, can be applied to promote root formation. Results of previous research showed that the percentage range of viable shoot cuttings for Shorea species is wide: 19–90% (Subiakto et al. 2005), depending on the Dipterocarpaceae species. The production stages of shoot cuttings are outlined below.

- Collect cuttings, for example apical shoots, in the nursery with scissors in the morning and put them in a bucket containing water to maintain humidity. Avoid using shoots from mature trees.
- Cut a shoot 10 cm long, with two leaves. To reduce evaporation, cut half of each leaf.
- Add water to the substance for promoting root formation (for example, Rootone F) to make a paste. Rub the paste onto the base of the shoot.

Figure 11. Planting shoot cutting of meranti in a green house (Photo: Hesti Tata)

- Make planting holes in a line at distances of 6 cm x 6 cm, using bamboo or a wooden stick.
- Plant shoot cuttings into the cutting tray. Pour water carefully (Figures 11 and 12).
- Place the cutting container inside a plastic cover with shaded roof. Shoot cuttings need good aeration, optimum humidity and moderate air temperature to reduce mortality and increase root formation.

Figure 12. Shoot cutting of meranti in root container (Photo: Hesti Tata)

- Water twice a day with watering can.
- Observe the root system two months after planting. Remove dead cuttings from the container immediately.
- Open the plastic cover after three months but keep shaded.
- Potting the cuttings can be done one week later.

3. Potting cuttings

- Prepare potting media, for example, mixture of soil and rice husk or mixture of dust of coconut husk and rice husk, both at a ratio of 2:1.
- Prepare plastic bags (12 cm x 15 cm). Fill with potting media to approximately half of each bag's height.
- Dig the rooting media carefully using a bamboo stick to avoid root damage. Lift the seedlings carefully from the rooting media using a spoon, holding by a leaf, so as not to damage the roots and stem. It will be best if some root media still remains on the meranti root (Figure 13).

Figure 13. Shoot cutting of *S. selanica* ready for weaning

- Put the roots into the planting hole, bang the container on the ground to settle the medium and top up with media.
- Pour with water to field capacity.

4. Maintenance

- Maintain the meranti cuttings in the seedling bed until they are being ready to be planted in the field, approximately three months after potting or 50 cm in height.

4. Planting of meranti

4.1 Land preparation

Land preparation for enrichment planting with meranti in rubber agroforests is is begun by clearing a planting row. Since Dipterocarpaceae has two characteristics of light intensity, that is, shade tolerant and light demanding, the clearing technique is divided into two parts:

1. Light-demanding species, such as *meranti batu (S. leprosula)*, *S. lamellata* and *S. selanica,* are adaptable to open areas. These species can be planted simultaneously with rubber trees. Land clearing can be carried out traditionally by cutting and slashing down or slashing and burning.
2. Shade-tolerant species, such as *S. parvistipulata, S. angustifolia*, *S. angustifolia*, *Hopea* spp. and *Vatica* spp., need moderate light for early growth. They can be planted when rubber trees are 5 years-old. Land preparation can be carried out by strip slashing in line with the planting rows (Figure 14).

Figure 14. Land preparation by slashing non-rubber species for meranti planting, which was carried out in 12 year-old rubber agroforests (Photo: Hesti Tata).

4.2 Planting distance

Based on the time of planting, there are two alternatives for planting distances in rubber agroforests:

1. Planting meranti after the rubber trees were planted: planting distance of meranti follow the rubber's planting distance. If the planting distance of rubber was 6 m x 3 m the planting distance of meranti

should be 3 m x 6 m x 12 m (Figure 15). Marker poles are installed in a rectangular format among the rubber trees in keeping with the rubber planting distance.

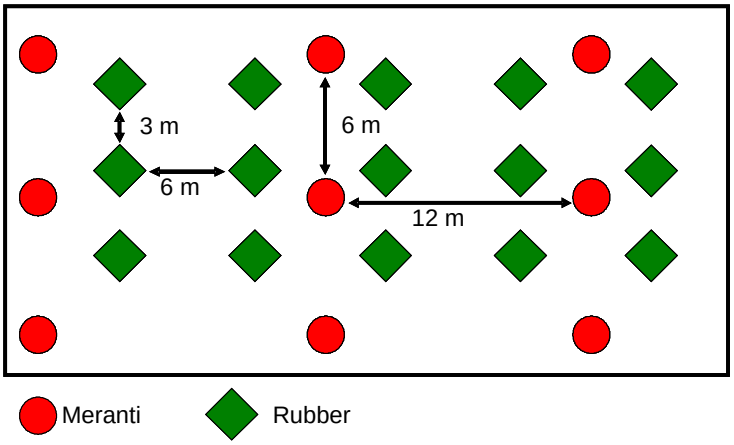

Figure 15. Layout of meranti planting in a 5-year-old (or more) rubber garden with planting distance of 3 m x 6 m x 12 m

2. Planting meranti and rubber trees simultaneously: meranti seedlings are planted in a wider row to reduce soil-nutrient competition. If the planting distance of rubber was 6 m x 2.5 m x 10 m, meranti seedlings would be planted between the 10 m rubber rows, thus the meranti planting distance would be 5 m x 7.5 m x 16 m (Figure 16). Marker poles are installed in keeping with the rubber spacing. This arrangement will put the meranti in a good configuration with the rubber trees, hence felling meranti trees at 5 years after planting is not necessary.

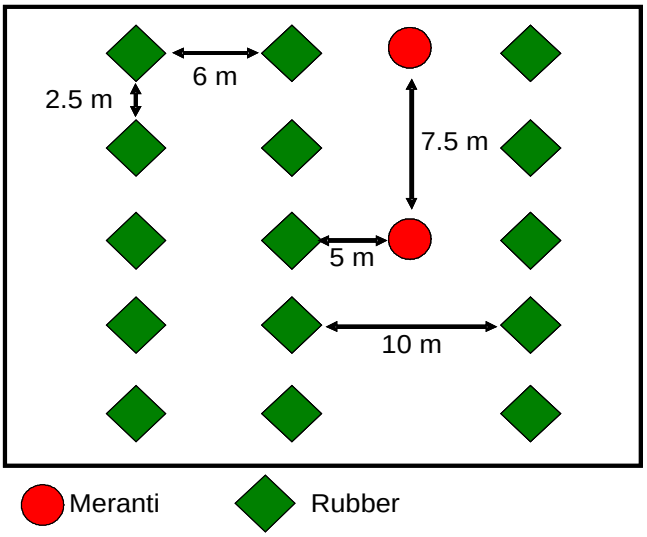

Figure 16. Layout of meranti planting in a 5-year-old rubber garden with planting distance of 5 m x 7.5 m x 16 m

4.3 Planting process

Meranti seedlings should be planted during the rainy season:

- Make planting holes of 30 cm x 30 cm x 20 cm, following the marker poles.
- Remove the plastic bags carefully so as not to damage the roots.
- Plant a seedling into a planting hole and top up with soil. One planting hole should only contain one meranti seedling (Figure 17).

Figure 17. Meranti planted in 1-year-old rubber agroforest (Photo: Hesti Tata)

4.4 Plant maintenance

The maintenance of meranti consists of weeding, replanting, fertilising and control of pests and/or diseases.

1. Weeding

The first weeding is conducted 2–3 months after planting. Weeding is repeated every 3 months during the first 2 years. Weeding is an important activity that increases seedlings' survival rates and helps meranti to grow well. Use a curette or machete for weeding around the meranti seedlings. Weeding can also be done along the planting row.

2. Replanting

If the survival of seedlings at 2–3 months after planting is less than 90% they should be replanted with the same species. Intensity of replanting depends on percentage of seedling survival. Replant dead or withered seedlings with vigorous seedlings.

3. Fertilising

Fertiliser can be applied once a year. Use a basic fertiliser such as NPK with a dosage of 100 g per tree in the first year. Fertilising is carried out for 3 years.

4. Control of pests, diseases and weeds

During the growing period meranti is usually attacked by pests, diseases and other plants (as competitors of light and nutrient), that is, weeds.

a. Pests and diseases

- Pocket caterpillars (*Cryotothelea* sp. and *Dasychira* sp.) and grasshoppers that attack leaves.
- The stick-drill pest from the larva of the *Scolytidae* beetle.
- The shoot tumour caused by a virus spread by spiders.
- The stunting disease caused by mycoplasma. The symptoms are growth of stacked callus, which look like small balls on the branch armpit of the young twig.
- Wild pigs (*Sus scrofa*) attack rubber and meranti trees by digging up the soil around the seedlings. We can eliminate pig attacks by using fencing around the tree gardens.
- Pests and diseases can be controlled mechanically and chemically by using pesticide and fungicide.

b. Weeds

In young rubber gardens under an open canopy, weeds such as *Kirinyuh* (*Euphatorium palescens*), *Mikania micrantha* and *Imperata cylindrica* reduce the growth rate of meranti. The weeds can be eliminated mechanically by slashing and weeding. *I. cylindrica* can be eliminated by herbicide (for example, Round Up).

Conclusion

This practical manual is not restricted to certain species, that is, Dipterocarpaceae, rather it can be applied to other tree species as well. Technically, the implementation of meranti planting mentioned in this book is flexible and adaptive. It can be modified according to the conditions and situation in the field.

Other challenges that may have to be faced are species and site matching, maintenance and harvesting techniques for meranti timber.

Please note that *S. leprosula* (*meranti batu*), *S. selanica* and *S. lamellata* are recommended to be planted in young rubber gardens (1–5 years of age).

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