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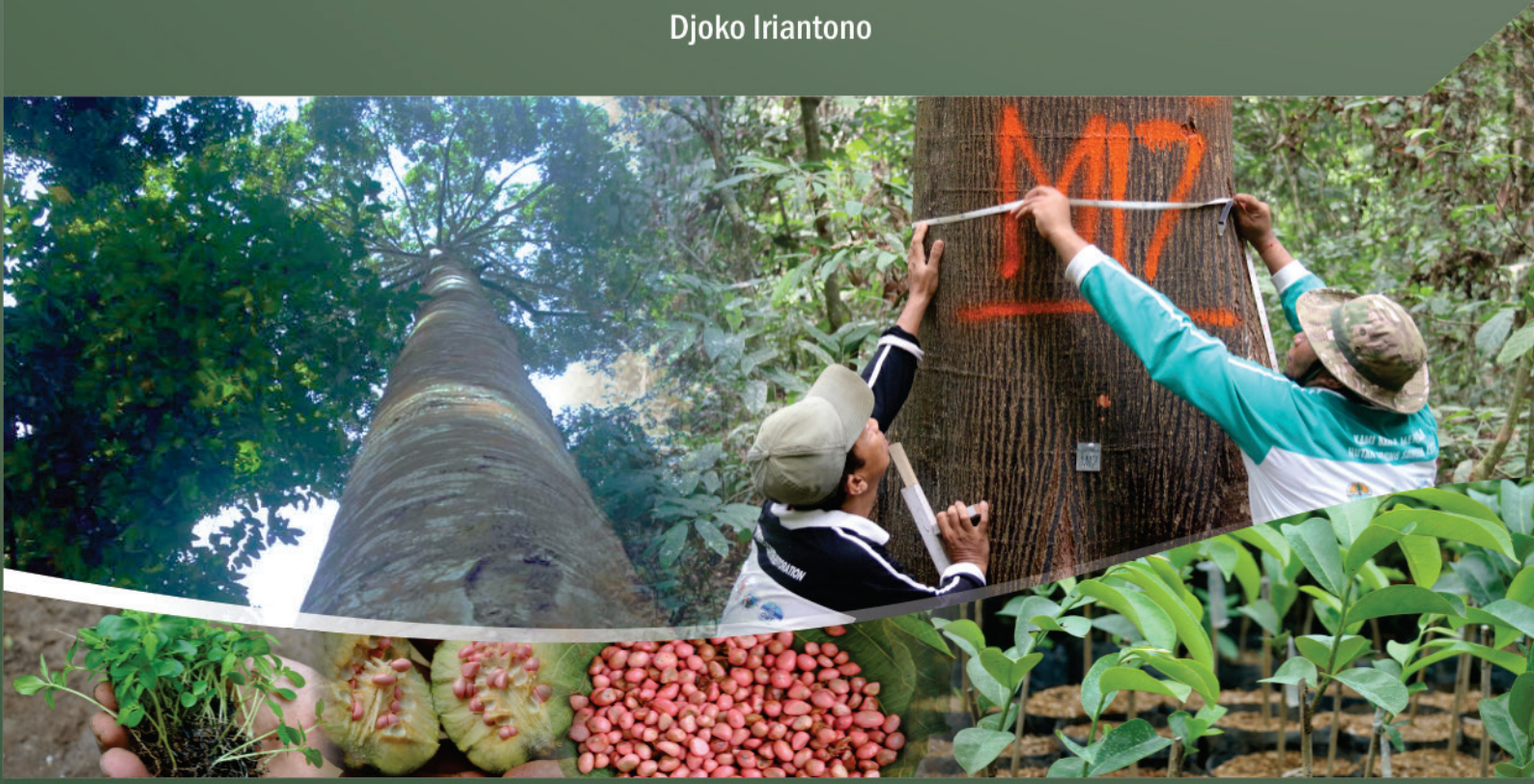

April 2017

Field Manual

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Preface

In many tropical and subtropical countries, deforestation continues at an alarming rate. Deforestation has serious consequences for the subsequent procurement (collection) of seed for afforestation and reforestation; in many cases, it also results in loss and deterioration of valuable gene resources. Lack of seed availability is a serious impediment to reforestation and provision of high quality seed for planting is a frequent problem in developing countries. In some cases, availability of seed for a whole species may be inadequate; in others, it may be difficult to procure the types of seed that have proven to be best adapted to the environmental conditions in the introducing countries. In order to resolve this problem, procurement of high quality seed has to be intensified, with a renewed focus on meeting seed demand at the local level through decentralised tree seed procurement.

The Department of Geosciences and Management of Natural Resources (IGN) under University of Copenhagen (UCPH) prepared this manual as part of a research project on decentralised tree seed supply systems in South East Sulawesi, Indonesia. Both the project and the manual were undertaken in close collaboration with World Agroforestry Center (ICRAF) in Bogor, Indonesian NGO Operasi Wallacea Terpadu Foundation (OWT), and the regional tree seed centre (BPTH) in Makassar.

The topics addressed by this manual are presented in a straightforward format so that the key points are easily implemented by farmers. The manual is divided into eight chapters:

Chapter 1. Why is this field manual needed?

Chapter 2. What is the difference between centralised and decentralised seed procurement?

Chapter 3. Why is seed so important?

Chapter 4. How to procure seed in centralised and decentralised systems.

Chapter 5. Some misconceptions about tree seed quality.

Chapter 6. Why is quality seed important?

Chapter 7. Choosing the right trees and seed collection methods.

Chapter 8. How to establish seed sources.

We hope that this manual can support farmers to improve their livelihoods through growing better quality trees from better quality seed.

Acknowledgements

This field manual was devised as part of the 'Decentralised Tree Seed Systems in South East Sulawesi, 2014-2015' project. The project was implemented by IGN/UCPH, OWT, ICRAF and the BPTH in Makassar and was financed through a contribution from the G.B. Hartmann Foundation in Denmark. The implementing partners gratefully acknowledge this support.

Special thanks are owed to the field teams of Operasi Wallacea Terpadu Foundation (OWT) for their efforts in field data collection and documentation.

Table of Contents

List of Tables

List of Figures

Chapter 1
Why is this field manual needed?

This field manual is designed to support local people operating nurseries and planting trees. It aims to help farmers make good decisions about procuring the best possible tree seed for raising seedlings in locations where there are no nearby institutions, organisations or private companies selling seed. 'Procurement' can refer to buying or collecting seed.

Most people believe planting trees is a good thing to do, as it will improve living conditions and livelihoods at the family and local level, while at the same time contributing to national and international development goals.

Indonesian villagers and small-scale farmers often plant trees close to their houses. They usually plant a mixture of tree species in small land areas. Seedlings are usually bought from small private, locally managed tree nurseries. These nurseries need seed in order to raise the seedlings required by local farmers and villagers.

People around the world plant trees for various reasons. These include maintaining water sources, upgrading soil quality, improving climate (regulation of temperature and humidity), supplying construction timber and wood-based energy, providing shelter for livestock. Trees also provide social advantages, such as protecting cultural and traditional heritage sites and promoting greener, more beautiful landscapes.

Planting trees at the homestead and along the boundaries of large fields is useful for creating strong live fences, windbreaks, wood-based energy and other complementary products, such as animal fodder.

Forest cover helps prevent erosion, and the roots of trees growing along waterways are useful for holding the soil and preventing the banks from collapsing. Waterways with no trees or plants growing on their banks suffer from high levels of soil erosion, which will eventually deplete the cultivable and residential land.

Tree planting as part of agroforestry systems involves integrating trees and agricultural crops. The aim is to create the conditions for a continual harvest that serves several purposes. Trees in agroforestry create appropriate conditions for agricultural crops through the initial control of grass, the provision of shade for crops or medicinal plants, improvement of soil fertility or prevention of soil erosion. Farmers can harvest these crops throughout the year and eventually they can also harvest forest products. Sometimes, farmers can also harvest and collect products from the planted trees for fodder, firewood or other non-timber forest products, like honey and wild fruits.

Trees also serve as protection from environmental threats. Strong winds, storms and floods are more devastating in open areas than in areas planted with trees. Storms and floods do not only destroy infrastructure and houses, they also destroy agricultural products. This can be prevented with the planting of trees as a physical barrier.

In short, tree planting safeguards and improves livelihoods of local people, while also maintaining biodiversity and reducing the negative effects of climate change.

It is difficult to purchase good quality seed in remote areas, far away from major cities and regional capitals that have no institutions or private companies dealing with seed. There are very few institutions and companies dealing with seed and they usually operate in or around big cities, procuring seed in large quantities for major private and public planting programmes.

As a result, most small privately operated nurseries have to procure their own seed locally. Nonetheless, nursery operators can often find support for obtaining the seed they need. There are many NGOs (non-governmental organisations) working in communities to provide support and advice on various aspects of natural resource management, agriculture and forestry. Sometimes it is also possible to make contact with government institutions that specialise in tree planting, and small private seed dealers operating in the area can also provide information and support.

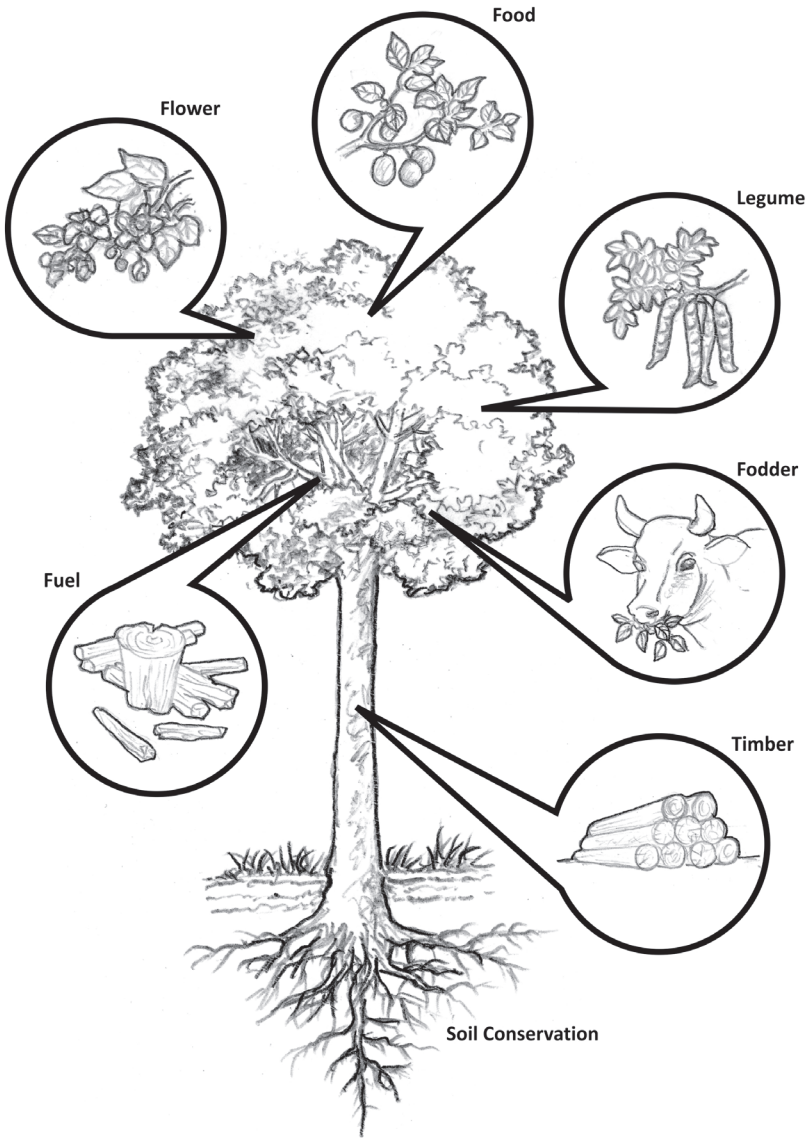

Figure 1. Planting and growing trees has many benefits

Figure 2.
Farmers can receive information about seed, seedlings and nursery management from NGOs and government institutions

Chapter 2

What is the difference between centralised and decentralised seed procurement?

A system where most nursery operators procure their own seed is referred to as a 'decentralised tree seed procurement system', meaning that most of the seed used by the nurseries is procured (collected) locally. This system contrasts with a 'centralised tree seed procurement system', where most of the seed used in the nurseries is procured (bought, in this case) from seed producing/selling organisations managed by government institutions or private companies. Usually, only large nurseries close to major cities purchase seed through the centralised system.

Seed from the centralised system is mostly sold relatively close to the seed organisations, which only sell seed of a limited number of tree species, only in large quantities and often at high prices. It is important to remember that there is no guarantee that this seed is of a higher quality than seed bought or collected locally.

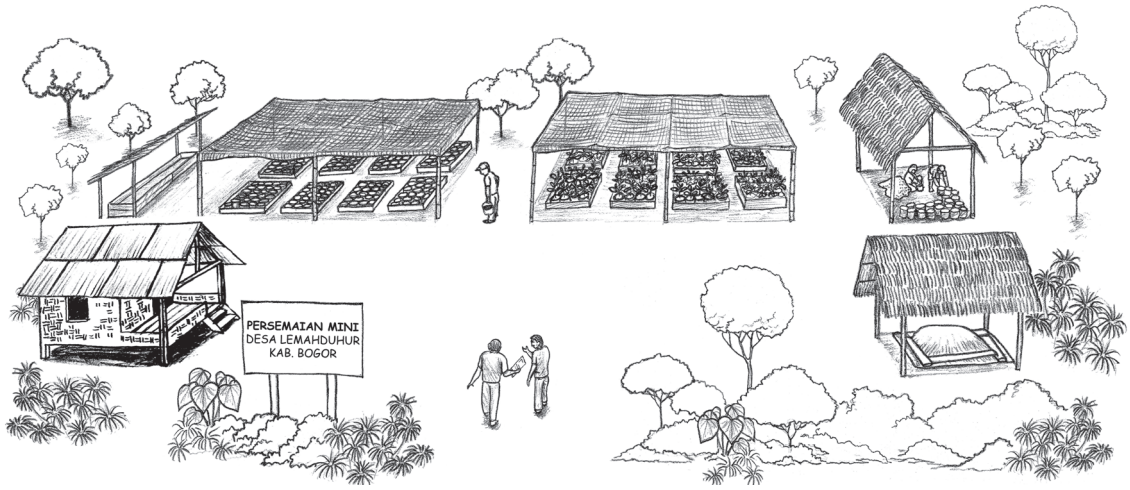

Figure 3. A village nursery

Chapter 3
Why is seed so important?

Seed is important because it is the starting point for the development of each seedling and tree. The seed holds the 'code' or information that determines whether the seedling will be able to develop into a strong and healthy plant. Farmers need to have strong and healthy plants so that they get the best possible output from growing trees. They need to gain the maximum benefit from the time and energy they have put into planting and managing the plant from the moment the seed is planted until the output is harvested-as wood, fodder, fruit, shelter or other products from growing trees. It takes long time to grow a tree and this is why it is wise to invest in the right seed-that is to say, the best quality seed.

When we refer to 'seed quality' we are talking about the inherent attributes of a seed that determine its germination potential and how well it will grow over time. High quality seeds will result in high value trees in the field. Low quality seeds will result in poor quality trees. See Chapter 6 for more information on seed quality.

However, use of good quality seed is not a guarantee that the farmer will grow high quality trees that yield high quality products. To achieve good results, trees must be planted in locations where the conditions match the requirements of that particular species of tree. It is also important that seedlings are properly planted and maintained as they grow.

Always choose the best quality of seed available in the area. In remote locations, with no contacts to seed producers or seed companies, seed from a good local plantation or a large group of trees will be considered good quality. It is important to make the effort to find the best possible quality of seed.

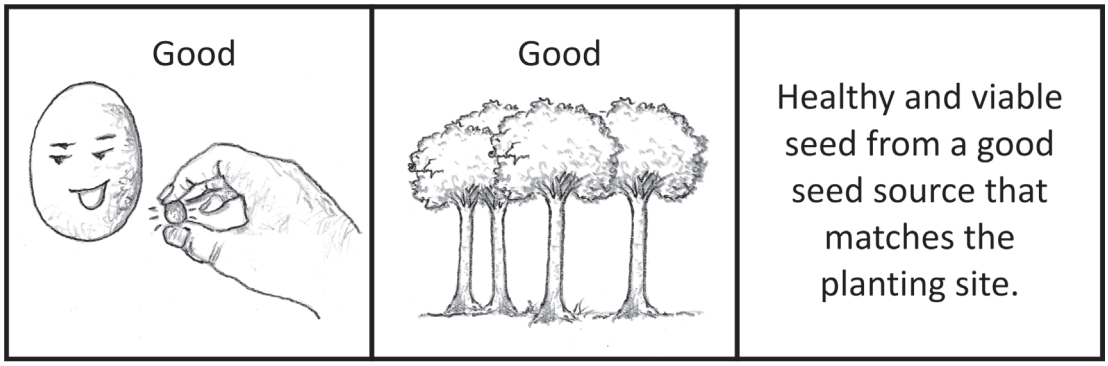

Figure 4. Choose healthy, viable seed

- **A good quality tree provides economic return faster than a poor quality tree:**
  Planting trees is a long-term investment. Improved growth rates, from good quality seed and careful maintenance, offer faster and larger economic returns.

- **A good quality tree has a higher value than a poor quality tree:**
  For timber trees, the value of the wood is closely connected to quality criteria such as straightness and branching habit (see Figure 5). A good quality fodder tree or fruit tree will produce a higher quantity and quality of leaves and fruit.

- **The labour costs the same to grow good quality trees as it does to grow poor ones:**
  Labour costs in the nursery - for planting and maintenance work - are the highest cost in tree planting. It doesn't pay to spend money on poor materials. Buying cheaper, poor quality seed is a false economy - choose good quality materials.

- **A good quality tree takes up the same space as a poor quality tree:**
  Where land resources are limited, the productivity of each unit of land is important. Choose the best quality of seed to grow the most productive trees.

- **Well run plantations with high quality seedling have lower maintenance costs because the trees grow faster and stronger:**

  The highest labour cost in plantation establishment is maintenance and weeding. The faster the plantation is established, the quicker the crowns will close and shade out the weeds. This means less weeding and reduced costs.

- **Good quality trees can make good seed sources in the future:**
  Planting good quality trees can create a new seed source. The better the quality of the planted trees, the higher the quality of the seed harvested from them.

- **Using high quality seed is part of a process of improvement and development:**
  As farmers invest in good quality seed and careful maintenance, demand grows for higher quality materials. Improving seed quality is part of a process that can make growing trees more beneficial for everyone.

Figure. 5. Different species of tree offer different benefits

Chapter 4

How to procure seed in centralised and decentralised systems

Farmers and other villagers need to procure (buy, collect or otherwise obtain) seed in order to grow trees. In a centralised system, a farmer can go to a large nursery, government organisation or seed company to directly purchase seed. Away from the major cities, seed is obtained through a decentralised system. This is a seed procurement system in a more remote location where there are no organisations that sell high quality seed.

A number of different actors are involved in both centralised and decentralised seed procurement systems. The seed procurement system is defined by way these actors function and work together in different locations and points the system. The actors involved in seed procurement typically include: i) farmers/communities; ii) NGOs; iii) forest administration units (national to district levels); iv) government seed organisations; and v) private seed companies.

- **Farmers/communities:** Farmers, farmer groups and other community members are the primary recipients of information and training in the seed procurement system. These people receive training on many different aspects of natural resource management (NRM), as well as information on choosing seed and growing seedlings. However, these people can also act as trainers, as a lot of information about seed choices, and seedling and tree planting, are shared from farmer to farmer and from farmer group to farmer group.
- **NGOs:** Many NGOs are active in remote areas. These NGOs are often important actors in NRM projects and decentralised seed systems. They provide technical help with seed and seedlings through training and extension services, they establish contact with other actors in the system, and they can often procure quality seed from institutions in other parts of the country. NGOs have the advantage of being located close to the farming communities; they have frequent contact and can provide quick and relevant support to meet local needs.
- **Forestry Administration:** The Ministry of Environment and Forestry is responsible for issuing rules and regulations relating to all aspects of tree seed (seed sources, quality norms and control, trading seed, etc.). It is the major actor in the centralised system. Occasionally, the rules and sanctions released by the ministry are so complicated or strict that they actually make it more difficult to procure good seed. Rules and regulations should widen the availability of better quality seed for all tree planting activities in the country, and sanctions that cannot be enforced are at the best useless.

Forestry administration at the district level is more relevant to farmers and communities, and officers are in a better logistical position to provide technical support to nursery operators and tree planters, and to build networks with other actors in the decentralised seed procurement system (NGOs, government seed organisations, private seed dealers). However, district forestry officers may only have limited knowledge or information about seed and seedling issues. If district officers could be trained with this information, they would be of more practical help to farmers and communities, and become more effective actors in the decentralised seed procurement system.

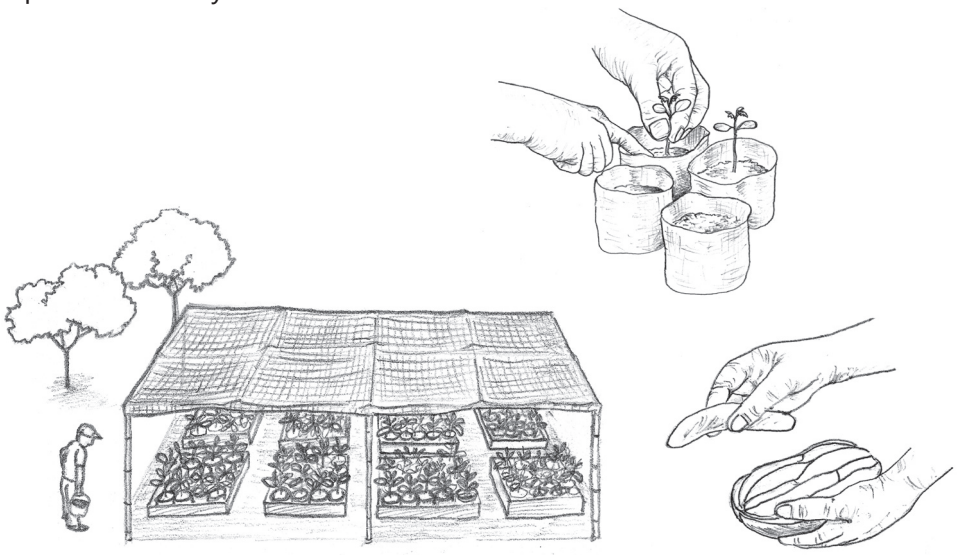

Figure 6.
NGOs are often based close to farmers and can provide valuable information about seed and seedlings

- **Government Seed Organisations:** These organisations, also known as national tree seed centres/agencies or regional tree seed offices, are part of the Ministry of Forestry. Their work includes: 1) establishment and management of seed and/or conservation stands ('stands' are clearly defined areas of trees); 2) approval and monitoring of seed sources; 3) research and development (seed procurement, tree improvement, genetic resource conservation); 4) commercial seed production and sales, and non-commercial distribution of seed; 5) seed certification, and control and monitoring of seed procurement; 6) nursery operation; and 7) training and advisory services. Their clients and customers are mostly other government institutions at the regional and district levels.

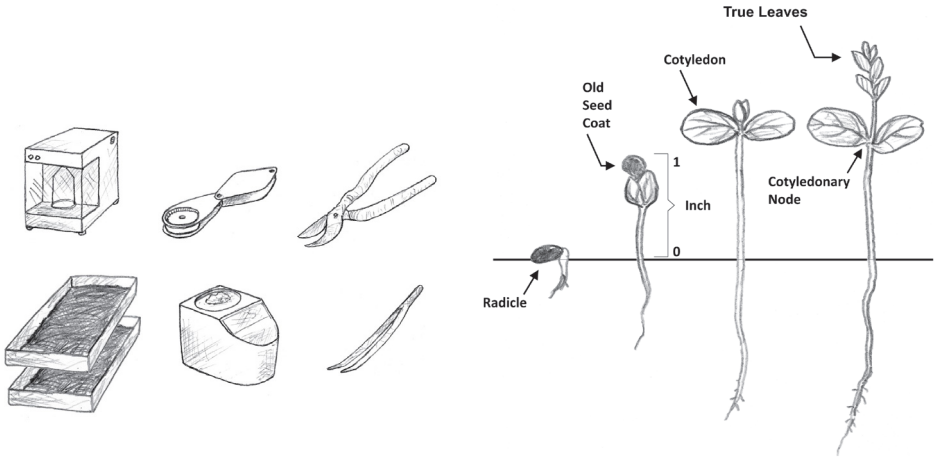

Figure 7.
Government seed organisations can provide the tools and information needed to grow healthy trees

- **Private seed companies:** These are often quite large enterprises. They tend to sell seed from those species of trees that are in the highest demand. Seed companies invest in marketing campaigns and try to sell 'best' or 'golden' quality seed at a high price. The seed is often imported and is not usually tested for suitability in other growing locations; this means that the seed may not be the best for local conditions.

- **Local seed dealers:** Local dealers tend often located close to farming communities, particularly those with a history of growing trees. They tend to be small-scale businesses that can sell smaller, more affordable quantities of seed directly to farmers and villagers. However, local seed dealers may lack technical knowledge and the quality of their seed is unregulated and variable.

Table 1. Strengths and weaknesses of different actors in seed procurement

Actor	Strengths (positive)	Weaknesses (negative)
• Farmers/communities	• Seed sources close to villages • Interest in conserving economically/culturally important tree species • Income generation through seed/seedling sales	• Lack of technical awareness and skills • Lack of seed quality control • Lack of awareness of genetic quality issues • Weak local organisational structures • Weak entrepreneurial skills
• NGOs	• Strong network at national and regional levels to support communication and information flow • Can provide intensive community training to suit local needs and conditions • Supports NRM and livelihood improvement information and training in seed/seedling and nursery operation • Flexibility in management, mentoring approach, and budget accountability • Usually have good basic field data	• Some NGO projects are short-term • Staff may not live at the project sites • Project areas are limited • Limited capacity in sustainable livelihood facilitation • Capacity and quality vary widely between NGOs • Limited capacity to improve genetic quality of seed • Limited technical skills and capacity
• Forest administration	• Responsibility for forest gene conservation and tree planting • Technical expertise • Decentralised structure • Land available to build seed sources	• Lack of financial resources to support decentralised tree seed systems • Rigid intervention design and financial administration • Lack of specialised staff at district level • Lack of transparency and accountability • Not a 'service institution' • Limited experience and capacity for working together with NGOs and communities

Actor	Strengths (positive)	Weaknesses (negative)
• Government seed organisations	• Information/training in seed/ seedling and nursery operation at provincial level • Facilitation of seed transfer between seed suppliers and buyers • Seed certification and legal procedures in place	• Very few regional centres • Restricted facilitation areas • Generic interventions with rigid financial administration • Lack of financial resources to support decentralised system • Services mainly available for government institutions rather than community groups • Limited experience and capacity for working together with NGOs and communities
• Private seed companies	• Produce sufficient quantities of seed for their own needs plus some to sell • Effective marketing	• Seed quality may not be documented • Variable seed quality • Limited range of seed for sale (mostly fast growing species or those with high market demand) • Don't sell in small, affordable quantities • Don't offer seed of indigenous tree species • High prices • Unlikely to collaborate with NGOs and communities
• Local seed dealers	• Seed stock located close to villages • Understand local needs • Income generation through seed/ seedling sales • Seed sold in quantities suitable for farmers	• Lack of technical awareness and skills • Lack of seed quality control • Weak marketing skills

Farmers and communities in remote areas will usually have to procure their seed through the decentralised system, as the centralised system cannot deliver seed for a large range of tree species in the small quantities suitable for small-scale farmers. However, farmers and communities can obtain relevant information and services from a number of the actors involved in both the centralised and decentralised seed procurement systems.

Collection: In reality, farmers procure the majority of the seed they use by collecting from any available tree. Seeds can be collected from natural stands (planted groups of trees), trees in the landscape (on common land), or farmer and community-owned seed stands or seed orchards.

The quality of the seed varies widely, depending on where and how it is collected. With care and attention, collection from local trees can be a very good way to procure seed:

- Local seeds are adapted to local environmental conditions
- Local seeds become available to harvest when the right growing conditions occur (i.e. before the rainy season)
- Dependence on foreign sources of seeds is reduced or eliminated
- Seed will not get lost or damaged during transportation from distant places
- Local collection can generate income through the sale of seed and seedlings
- Seed trees, seed stands, and seed orchards can provide products and services such as fruit, fodder, wood, shade, and soil and water conservation
- Seed trees can be part of a healthy planting mix

As farmers and villagers tend to collect seed independently and without support and advice from NGOs or government organisations, it is important to have some practical knowledge. The next chapter corrects from misconceptions about collecting seed and offers tips for success. It is equally important to know about seed quality, seed collection and handling, and establishing local seed sources; chapters 6, 7 and 8 cover these topics.

Figure 8. Seed trees can be planted with a mixture of other trees and agricultural crops that produce valuable products and generate income

Chapter 5

Some misconceptions about tree seed quality

Successful planting and growing of trees can be hindered by certain misconceptions and myths that people may share about tree seed quality. These misconceptions are mainly related to the following four issues: 1) seed source and seed quality; 2) site matching; 3) seed documentation and certification; and 4) price of seeds or seedlings.

1. Seed source and seed quality

'Seed collected from seed orchards is always good.'
Quality varies between seed orchards. To yield superior quality seed, seed orchards must be isolated from stands with poor trees. Seed orchards can be genetically upgraded by testing and genetic thinning.

'Imported seed is better than local seed.'
Imported seed can also come from poor origins. Imported seed is also more unlikely to match the conditions of local planting sites. The quality of imported seed should be verified with supporting documents (including certification).

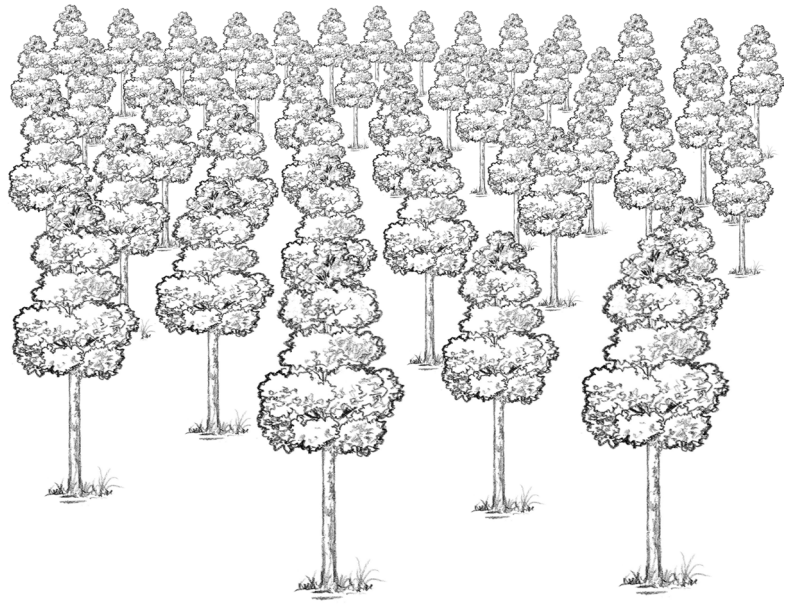

Figure 9.
A seed orchard

'Plants grown from tissue culture (TC) are better than plants from seed.'
This misconception is still held by many farmer groups, as well as the staff of some NGOs and government organisations. TC is a tree *propagation* method, not a tree *improvement* method. TC plants can never be better than the mother trees; only TC plants derived from highly improved and tested material are high quality.

Figure 10.
High technology procurement of seedlings (using tissue culture techniques)

'Seed and seedlings produced by high technology is the best.'
The technological tools used in seed procurement and nursery work do not improve the genetic quality of the resulting planting material. Locally collected seeds can be just as good or even better, if they are chosen and treated with care.

'Plants grown from vegetative material are better than plants grown from seed.'

Many farmers have had positive experiences of cultivating fruit and commodity tree species (like cacao and coffee) using vegetatively propagated trees that produce large yields in a relatively short time. This works well for certain species, but it is important to only use the highest quality of tested and improved materials.

2. Site matching

'Imported seed is better than local seed.'
It is very difficult to match imported seed with local growing conditions, so it is rarely the best choice. The quality of imported seed should be supported by reliable documentation (including certification).

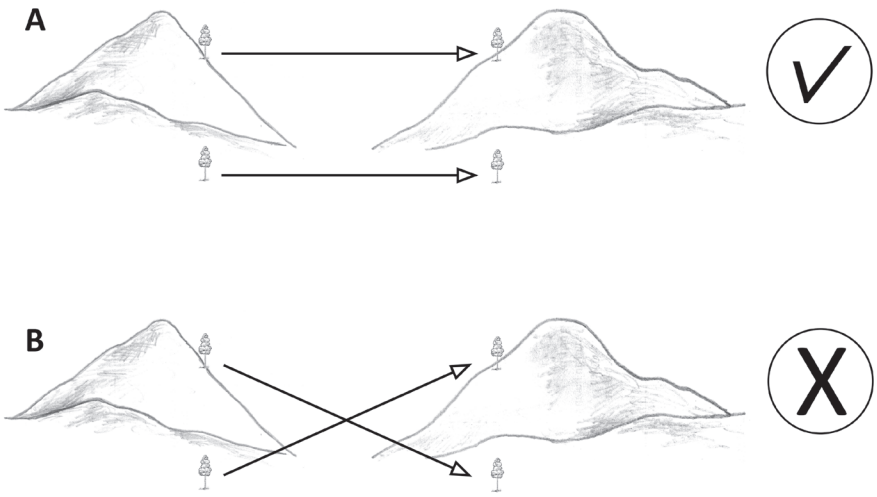

Figure 11.
Site matching - certain trees prefer certain conditions

'Local seed is better than imported seed.'
Local seed is usually a better match for local conditions. It is still important to ensure that the seed is collected from a healthy, high quality source. If local seed comes from a degraded, inbred source, this would undermine the possible advantage of local adaptation.

3. Seed documentation and certification

'Documented seed is better seed'.
This thinking is very common in Indonesia, especially among actors who are involved in tree planting activities funded by the government budget. Unfortunately the seeds or seedlings used or distributed do not match the attached documents. Therefore, having documentation does not guarantee or improve the seed. Only documentation from reliable institutions can be used to assess seed quality.

Figure 12.
Seed packages with proper documentation

4. Seed price

'Expensive seed is good quality seed.'
People often assume that if seed is expensive it must be very good quality. It is important to check the origins and official documentation (including certification) of seed. Seed produced in a well-managed orchard may be more expensive due to the high quality of the seed and the testing and improvement processes involved. However, high production and transportation also affect prices.

'***Cheap seeds/seedlings are bad seeds/seedlings.'***
On the other hand, people sometimes assume that cheap prices mean poor quality. This may be true when seed/seedlings come from unknown sources. However, if the seed/seedlings come from a good local source, the price could be low because there are low transportation and production costs, and not because the quality is low.

Chapter 6
Why is quality seed important?

What is quality seed?

Successful planting is determined by several factors. These include soil condition, environment, climate, plantation management, planting technique and, importantly, seed quality and handling. It can be difficult to confirm seed quality; in most cases, it is not easy to distinguish between high quality and poor quality seed just by looking at it. Success or failure only becomes clear after the trees have started to grow in the field, when seedlings can either thrive or fail. This chapter outlines several factors to consider when assessing the quality of seed.

Seed quality is tested according to criteria of: purity, germination capacity and health. These specifications apply to both individual seeds and to seed lots. They can also be used to calculate the number of seeds needed to produce the required number of seedlings in the nursery.

Seed quality is defined according to three criteria: physical quality, physiological quality and genetic quality.

Physical quality

- The physical condition and appearance of the seed: colour, size, shape, weight and the texture of seed's skin surface - the indicator is uniformity
- Intactness of the seed - the indicator is the level of damage
- Humidity level of the seed - the indicator is seed's water content,
- Contamination level with other materials - the indicator is seed's mechanical purity.

Physiological quality

- The physiological quality of seed is related to how well the seed germinates. This can be tested by looking at it enzyme activity, biochemical reactions and respiration. Seeds that are harvested when they are physiologically ripe have the highest germination capability. The physiological quality of seed also affects how well and how long it can be stored. The parameters to determine physiological seed quality are:
- Seed viability - the indicators are germination capacity and maximum growth potential.
- Seed vigour - the indicators are seed storability and the growth rate of seedlings.

Genetic quality

The genetic quality is determined by the genetic information contained in the seed. The genetic quality of seed is determined by the 'parent' trees of the tree from which the seed is collected.

Based on the indicators described above, quality seeds can be defined as follows:

a. Seed of superior physical, physiological and genetic quality.

b. Seed that meets both minimum and maximum standards. Minimum standards cover the seed's purity, germination capacity and growth rate, while maximum standards cover the seed's water content, freedom from pests and diseases, and freedom from contaminants (such as seed from other plants, weeds, dirt and other environmental contaminants).

c. Seed of high genetic quality is more productive and produces uniform growth.

d. Seed with good germination capacity that produces high quality seedlings with strong growth and the capacity to resist unfavourable environmental conditions.

Factors that affect the quality of seed include:

a. Seed source: quality seed comes from healthy parent trees. Good genetic quality produces good quality seedlings.

b. Level of seed maturity at harvest time: harvest or collect the seed only when it is fully ripe. Ripe seed produces healthier seedlings.

c. Post-harvest handling: (i) seed should be transported as soon as it has been collected, using a method that suits the seed type; (ii) seed needs to be properly treated before storage (seeds should be carefully dried), (iii) seed needs to be properly stored in an appropriate place (where the temperature and humidity is not too high and free from disturbance by pests and diseases).

Site Suitability

There are three main environmental factors to consider when choosing a site to plant trees, or choosing what kind of trees to plant in a particular site: climate, soil and elevation/topography. These three factors are important for determining where a given tree species can grow optimally. Planted areas can be categorised by geographic position and air temperature, as presented in Table 2 below:

Table 2. Area division based on geographic position and air temperature

Types of Area	Elevation (m asl)	Air Temperature (°C)	Air Condition
• Lowland	• 0 - 200	• 25 - 27	• Hot
• Moderate land	• 200 - 1000	• 19 - 24	• Warm
• Mountainous	• 1000 - 2000	• 13 - 18	• Cool
• Upland	• 2000 - 2500	• 0 - 12	• Cold

Site suitability determines which, if any, trees to plant. The designated site may be in sun or in a shaded spot; soils may be clay, sandy, saline, compacted, wet or dry, etc. Whatever the situation, it is important to determine if the site is suitable for growing a healthy tree. Trees that usually grow in lowland areas will not grow well in upland areas. However, trees that usually grow in upland areas can still show good growth when planted in the lowlands. The best results come from growing uplands trees in upland areas, and lowlands trees in the lowlands. Table 3 provides a list of examples of tree suitability, showing the ideal conditions for several species of tree.

Table 3. Examples of tree site suitability

No.	**Species**	**Site Requirements**		
		Climate	**Soil**	**Elevation**
• 1	• Clove • (*Syzygium aromaticum*)	• Temperature 22°-30°C, • Rainfall 1500-4500 mm/year	• Loamy, depth of soil minimum 2 m • pH 5,5 - 6,5.	• 300 - 600 m from sea level
• 2	• Mangosteen • (*Garcinia mangostana* L.)	• Temperature 22°-32°C, • Rainfall 1500-2500 mm/year	• Loamy, • Contain a lot of organic material • pH 5-7	• < 500-600 m from sea level
• 3	• Teak • (*Tectona grandis*)	• Temperature 13°-43°C, • Rainfall 1000-1500 mm/year	• Loamy, sandy loam, and sandy clay • pH 6	• < 700 m from sea level

Chapter 7

Choosing the right trees and seed collection methods

1. Choosing what type of tree to plant

When choosing which tree species to plant, especially on community land, the following aspects should be considered:

- Environmental aspect **(**environmentally friendly), the chosen species should match the climate, the type and quality of soil, and also the physical features of the planting site.

- Social aspect (socially acceptable), the chosen species should match the needs and expectations of the local people or communities; choose trees with products and services that fulfill local demands; in many cases easy cultivation may be important.

- Economic aspect (economically profitable), the chosen species produce marketable commodities or environmental services.

Tree species can be grouped as follows for selection purposes:

- **Firewood**
  Trees grown for firewoods: are fast growing, they produce new shoots if pruned, they have high heat calorie value. Firewood trees include: white leadtree/*lamtoro gung* (*Leucaena leucocephala*), earleaf acacia/*akasia* (*Acacia auriculiformis*), calliandra/*kaliandra* (*Calliandra calothyrsus*), gliricidia/*gamal* (*Gliricidia sepium*).

- **Construction wood**
  Trees grown for carpentry and construction: have a high economic value, have a good quality of stem and are highly productive. Trees grown for their timber include: red jabon/*jabon merah* (*Anthocephalus macrophyllus*), mahogany/*mahoni* (*Swietenia macrophylla*), white albizia/*sengon* (*Paraserianthes falcataria*), teak/*jati* (*Tectona grandis*), peronima/*sungkai* (*Peronema canescens*).

- **Industrial raw materials**
  Trees grown for industrial raw materials (paper, pulp, plywood, etc.): are fast growing, can grow in various environmental and soil conditions, grow to a large size and produce a high yield of materials. Trees grown for industrial raw materials include: eucalyptus (*Eucalyptus deglupta*), white albizia/*sengon* (*Paraserianthes falcataria*), umbrella tree/*kayu afrika* (*Maesopsis eminii*), agatis/*damar* (*Agathis loranthifolia*), white jabon/*jabon putih* (*Anthocepalus cadamba*).

- **Fruit Production**
  Trees grown for fruit production: produce good quality fruit, which are in demand in the market. Trees for fruit production include: durian (*Durio zibethinus*), mango/*mangga* (*Mangifera indica*), jackfruit/*nangka* (*Arthocarpus heterophyllus*), candlenut/*kemiri* (*Aleurites moluccana*).

- **Environmental services (e.g. reduced soil erosion)**
  Trees that can reduce soil erosion: are fast growing, have a thick crown and provide plenty of tree litter (*serasah*). They can grow in poor quality soil, having deep, widespread and strong root systems that bind the soil well; they are easy to plant and do not require maintenance; they improve soil fertility and produce new shoots with pruning. Tree species for reducing soil erosion include: rain tree/*trembesi* (*Albizia saman*), *puspa* (*Schima* sp), tamarind/*asam* (*Tamarindus indica*), agati/*turi* (*Sasbania grandiflora*), calliandra/*kaliandra* (*Caliandra calothyrsus*), ficus tree/*beringin* (*Ficus benjamina*).

2. How to identify trees or stands for seed collection

A 'seed source' is a group or 'stand' of trees that is used for seed collection. Seed sources can be divided into the following classes:

- **Seedling or clonal seed orchard:** tree stands planted specifically for seed production, with the family/clone identified (minimum 25 families). Seed orchards produce seed of superior quality and known (documented) origin.
- **Seed Production Area (SPA):** a seed collection stand, where the quality has been improved by thinning out diseased or poor quality. This technique leaves only the best trees ± 100 trees/ha. A SPA produces good quality seed, though the origin is often unclear.
- **Seed stands:** a group of trees in natural or plantation forest that has been identified to be of superior phenotype. These stands are mature and capable of producing seed. Seed from these stands often produce seed of fairly good quality, though the origin is usually unclear.
- **Seed tree:** any healthy-looking tree from which seed is collected is called a seed tree. Seeds are usually of moderate quality and their origin is unknown.
- **Farmer seed orchard:** small areas on the land of one or more farmers, or on community land, that are planted or managed for seed production (as one of many objectives). These areas may also produce fruit, wood for fuel and timber; they may contain multiple tree species (see Chapter 8).

Guidelines for seed tree selection:

- Choose a seed tree in the best, most uniform stands
- Choose the best tree in the stand by comparing the surrounding trees
- Don't choose an isolated tree (with no other trees of the same species present within 100m); isolated trees are not good seed trees
- A seed stand should contain a minimum of 30 trees, to ensure genetic diversity

Guidelines for seed stand selection:

- **Flowering and fruit setting:** the trees are mature enough to produce flower and seed, but not so old that they produce poor quality seed
- **Number of trees:** seed stands have a minimum of 30 trees (in natural forest, the minimum distance between trees should be 100m; in plantation forest there is no minimum distance requirement)
- **Quality of stands:** seed stands with good, healthy trees, at least 50% above average quality
- **Accessibility:** easy-to-reach location, near the road and with straightforward topography
- **Health:** seek out healthy trees; avoid stands attacked by pest and diseases
- **Security:** choose seed stands located in areas that are safe from encroachment, disturbance, grazing cattle, illegal logging, fire, etc.

3. How to collect seed

Criteria for seed collection:

- Collect seeds from fruits that are ripe and ready to harvest.
- Seed collected from trees in a seed stand is mixed into a seed lot representing the seed stand. Do not mix seed taken directly from the tree with seed collected from the forest floor (the ground). Where possible, avoid collecting seed from the forest floor.
- Document the seed collection process - keep a note of origin, collection method and quality.
- The fruit that ripens first will be the first to fall; the quality of seed from early fruit is often poor.

4. Methods of seed collection:

a. Collection from the forest floor

This method is cheap and easy to do. The seed of several species can be collected using this method: white teak/*gmelina*, white cedar/*mindi*, umbrella tree/*kayu afrika*, shorea or Philippine mahogany/*meranti*, teak/*jati* and candlenut/*kemiri*. Some weaknesses of this method are: i) cannot be done for trees with small seed; ii) the quality of seed can be poor (due to soil microba, if it has germinated before collection or is affected by sunlight); iii) fallen fruit may not be ripe; and iv) uncertainty about the quality of the mother tree.

Figure 13.
Seed collection from the forest floor

b. Collection by shaking the tree

Seed from relatively low-growing trees with large, ripe seed/fruit can be separated from a branch by shaking. To collect the fallen seed, a reservoir tool, such as a tarpaulin or plastic sheet can be placed under the tree.

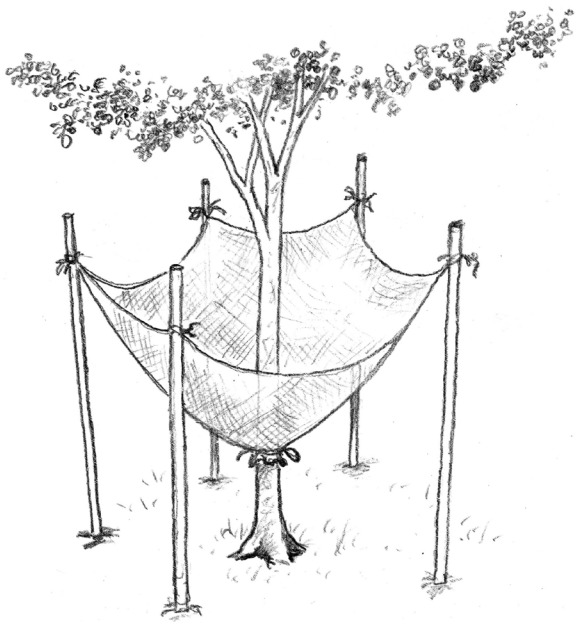

Figure 14.
Seed collection by shaking the tree

c. Collection directly from the tree

This can be done if the tree is not too high and where the ripe fruits can be reached directly from the ground using a pole, ladder or extendable collection tools. Seed quality is good because one can select only the fully ripe fruits, the seed doesn't touch the ground and the fruit/seed collected from the outer part of the crown have a high chance of pollination.

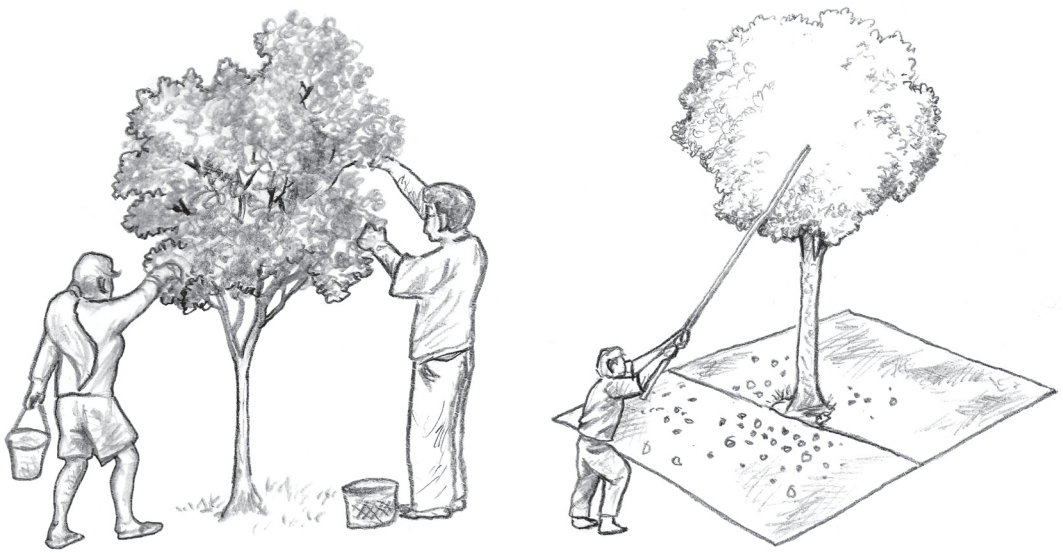

Figure 15. Seed collection directly from the tree

d. Collection by climbing the tree

This method is used for tall trees, using spurs, ropes, ladders and other climbing gear. Special attention has to be paid to safety precautions due to the danger of falling.

Figure 16. Seed collection by climbing

4. How to document seed collection

It is important to write down all the details of when and how seed is collected. All seed should have clear information about origin, collection method and quality. This kind of information should be attached to the seed lot from the time of collection through extraction, testing, storing and distribution to the user. Please note the specific information required:

- **Seed source document:** species name and local name, name of seed source location, elevation, type of seed source, number of tree, age of seed tree.
- **Seed collection document:** species name and local name, date of collection, number of seed trees (or tree number, if the collection is from one single trees), distance between seed trees, number of containers, weight of fruit in each container, name of the collector.
- **Seed quality document:** seed purity, 1000 seed weight, seed water content, seed germination capacity.

5. How to handle seed

Fruit and seed are vulnerable to damage right after collection because of their high water content. Proper seed handling is required in order to protect and maintain the quality of the seed. Seed handling activities include: fruit sorting, seed extraction, seed cleaning and sorting, seed drying, seed storage and distribution.

- **Fruit sorting:** fruit should be sorted into ripe and unripe piles; seed should only be extracted from ripe fruit. For some species, the unripe fruit can be ripened during storage for later extraction.
- **Seed extraction:** extraction is the process of removing the seed from the fruit. Methods of extraction include (i) if the seed is completely dry, it comes out by itself (for calliandra/*kaliandra*); (ii) the fruit has to be dried and then smitten or beaten to release the seed (for gliricidia/*gamal*); (iii) seed is rubbed with ashes to remove the wings (for mahogany/*mahoni*), (iv) seed is rubbed and then washed to clean the seed (for white teak/*gmelina*); (v) the fruit is split apart to get access to the seed (for mahogany/*mahoni*), etc.

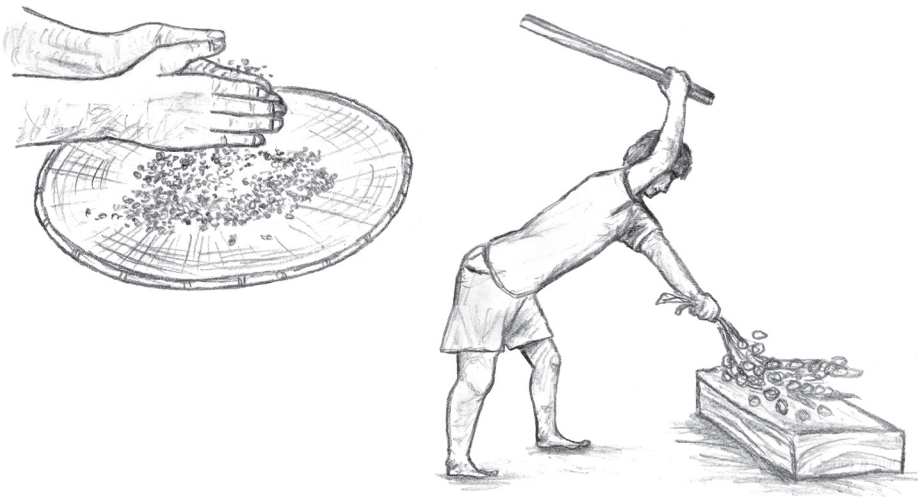

Figure 17.
Seed extraction: beating and rubbing

- **Seed cleaning and sorting:** extracted seed usually contains dirt (husk, remains of the seedpod, pieces of the twig or branch, fruit flesh, soil and damaged seed). It can be cleaned by winnowing, which also sorts the seed according to size/weight.

Figure 18. Cleaning seed using winnowing technique

- **Seed drying:** the best way to preserve and store most seed is through careful drying to reduce water content. There are two main groups of seed, according to water content: i) orthodox seed (such as teak, acacia, eucalyptus etc.) can be dried until the water content is very low (5%) and ii) recalcitrant seed (such as cocoa, durian, shorea/*meranti*, jackfruit/*nangka*, etc.), which cannot be successfully dried. These seed can only be stored for a short time (1-4 weeks) and should ideally be sown just after collection.

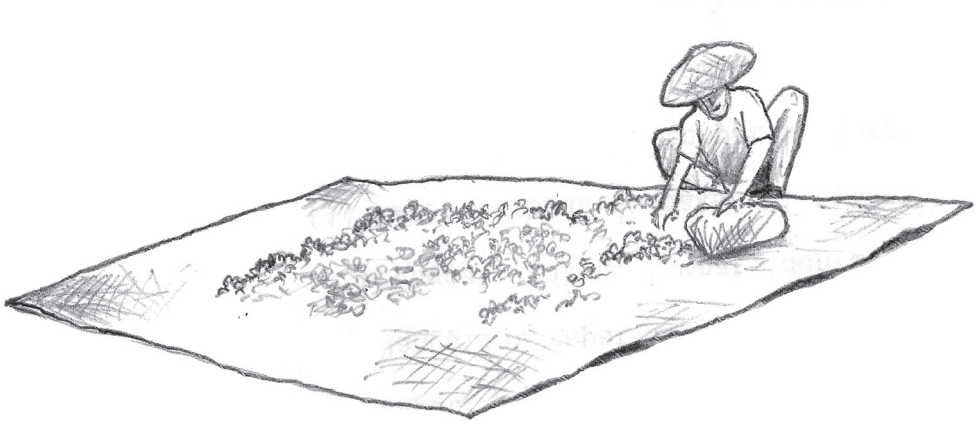

Figure 19. Drying seed under the sun

- **Seed storage:** the length of time that seed can be safely stored varies according to seed type. Orthodox seed can generally be stored for long time (up to 3.5 years), while and recalcitrant seed can usually only be stored for 1-4 weeks.

6. How to store seed

- Temperature and humidity levels are the key factors in successful seed storage. Storage needs to be carefully managed to maintain the germination capacity of the seed, to avoid attacks from pests and diseases, and to avoid germination during storage. Seed can be stored using fabric sacks, buckets, cans, and glass or plastic jars. Seed should be stored a room with good air circulation, low humidity and low ambient temperature.

Figure 20.
Seed storage options

Chapter 8
How to establish seed sources?

Seed sources (stands of trees grown to produce seed) can be established through two methods: the identification and selection of existing seed sources, or planting and tending new seed sources.

1. Where should seed sources be located?

Seed sources should be planted in locations with the appropriate environment conditions (climate, soil, elevation) for the species being grown.

If top quality seed is used for planting a seed source, then it is best to grow an isolation line of other trees (of a different species) to prevent pollen contamination, which could come in from the existing trees of the same species in the surrounding area. This isolation technique can help to protect the genetic quality of the planted seed source. In practice, this method is difficult to carry out and it is easier to select a location where no trees of the selected species are growing.

The establishment of 'farmer seed orchards' (see Chapter 7) are a good way for local communities to produce high quality seed while at the same time gaining income from other products grown on the same piece of land. Seed sources can also be planted as living fences or land boundaries around fields or houses.

2. Where to procure seed for seed source establishment

Seeds used for establishing seed sources should be of the best possible quality and of known origin. These can be collected locally from healthy, good quality tree stands or from seed obtained from government seed organisations or reliable seed companies. It is advisable to ask for support from an NGO or government seed organisation when establishing new seed sources.

3. How to plant seed sources on farm land

Many small-scale farmers may find it difficult to establish a seed source due to the limited size of their land. This problem can be overcome by combining seed trees with other trees and crops on the same piece of land. When planting a small stand of trees as a 'farmer seed orchard' it is useful to take a community approach:

- Encourage neighbouring farmers to establish their own small seed orchards to ensure cross-pollination and to avoid self-pollination and inbreeding.

- Use seed collected from a minimum of 30 good quality trees, and mix the seed into a single seed lot. When there are plenty of trees, pollinators are more attracted to the orchard and cross-pollination can take place.
- Farmers can exchange the seeds they produce. This helps to maintain the genetic variation and quality of future plantings grown from seed collected in local seed orchards.

4. How to maintain a seed source

To achieve good seed production from established seed sources, the sources or tree stands need to be carefully maintained. This involves regular fertilising, replanting, thinning and pruning, weeding, soil loosening, as well as pest and disease control.

Fertilising

Fertilising the seed source increases the nutrients available to the trees and is recommended to support flowering and enhance seed production. Organic fertiliser can be applied before planting of seedlings, and before the rainy season. It should continue until the trees are 3 years old.

Replanting

Replanting of dead or poorly-growing seedlings should be done as early as possible to ensure that the resulting seed source will consist of evenly aged trees.

Thinning and Pruning

Seedlings in seed sources are normally planted quite close together (2m x 2m) and are later thinned when the crowns start closing. Thinning reduces the total number of trees, which allows the remaining trees to develop a large crown for maximal seed production. At the same time, inferior trees can be removed and the stand opened up to make seed collection easier. The crowns can also be pruned to reduce their density, which helps to stimulate flowering and seed setting.

Weeding

Weeding should be done when the seed source is still young and the tree crowns have not yet closed. Weeding keeps the ground around the trees clear. This supports tree growth, reduces the risk of fire, and increases the effectiveness of fertilising. Weeding can be done until the trees are 2 years old (for fast growing species) or 4-5 years (for slow growing species).

Soil loosening

Soil loosening can be done to support or repair a tree's growth by improving air availability and water absorption for the roots. Soil loosening is done at the start of the rainy season, until the trees are 2 years old.

Pest and disease control

Young trees should be inspected regularly in the first year to monitor the presence of pests and diseases. If necessary, trees should be treated to prevent problems from spreading.

References

Cambodia Tree Seed Project, 2003. An Analysis of Seed Supply Options for Cambodia. Cambodia Tree Seed Project, Cambodia.

Direktorat Perbenihan Tanaman Hutan. 2004. Petunjuk Teknis Pembangunan dan Pengelolaan Sumber Benih. Departemen Kehutanan, Direktorat Jenderal Rehabilitasi Lahan dan Perhutanan Sosial, Jakarta.

Mbora A., Schmidt L., Angaine P., Meso M., Omondi W., Ahenda J., Lillesø. J-P.B, Mwanzia J.M., Mutua N. A., Mutua Wangu R., Jamnadass R. 2009. Tree Seed Quality Guide. World Agroforestry Centre, Nairobi.

Mulawarman, J.M. Roshetko, S.M.Sasongko, D. Iriantono. 2004. Tree Seed Management: Seed Source, Seed Collection, and Seed Handling. World Agroforestry Center-ICRAF, Bogor.

Nurhasybi, H.D.P. Kartiko, M. Zanzibar, D.J. Sudrajat, A.A. Pramono, Buharman, Sudrajat, Suhariyanto. 2010. Atlas Benih Tanaman Hutan Indonesia Jilid I. Balai Penelitian Teknologi Perbenihan, Badan Penelitian dan Pengembangan Kehutanan, Bogor.

Roshetko, J.M, E.L. Tolentino Jr, W.M.Carandang, M. Bertomeu, A. Tabbada, G.E.S. Manurung, C.E. Yao. 2010. Tree Nursery Source Book: Options in Support of Sustainable Development. World Agroforestry Center, Bogor.

Schmidt, Lars. 2000. Guide to Handling of Tropical and Subtropical Forest Seed. Danida Forest Seed Centre, Copenhagen.

Soerianegara, I. and R.H.M.J. Lemmens.1994. Plant Resources of South-East Asia. Timber Trees: Major Commercial Timbers. Prosea Foundation, Bogor.

Zanzibar, M., Asep R., Nanang H., Safrudin M., Enok R., Adang M. 2003. Pedoman Uji Cepat Viabilitas Benih Tanaman Hutan. Balai Litbang Teknologi Perbenihan, Bogor.

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