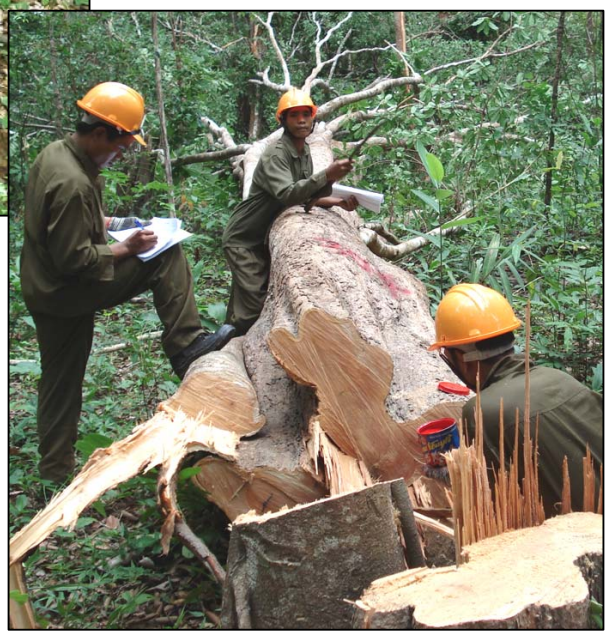
Rural Development Dak Lak - RDDL



Silviculture and Harvesting Guideline

Technical Guideline

gtz

DARD
Dak Lak

Silviculture and Harvesting Guideline

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In recognition of the kind provision to utilise these valuable experiences the authors would like to express their sincerely thanks to all respective persons who contributed to these results.

1. INTRODUCTION

1.1 Silviculture in the context of Community Forestry

This guideline is intended to be applied by local forest users such as group of households or entire village communities who have been handed over natural forest resources for sustainable long-term management and protection.

Since most of the local forest users have not received any formal forestry training nor other education in management and planning this technical guideline has been adjusted to the available capacities at grassroots level.

Consequently, conventional silvicultural and planning procedures as applied for state forest enterprises had to be simplified to ensure economic viable options for forest utilization that can be independently followed-up by local communities.

Major differences between conventional silvicultural techniques and adjustted concepts in CFM

Criteria	Conventional forestry (State Forest Enterprise)	Community Forest Management
Silvicultural system	Selective exploitation of commercial timber species based on harvest quota and minimum harvest diameter. No stand improvement through thinning in smaller diameter classes ("*harvesting and waiting*")	Selected harvesting of individual trees in all diameter classes (based on SFM* and selection criteria for individual trees). Stand improvement through removal of undesired trees for firewood consumption.
Harvesting cycle &Harvest volume	Long felling cycles with large harvest volume (based on economic criteria e.g. transport costs, sales volume, wages)	Continuous extraction of small quantities based on local demand (permanent forest management system)
Harvest volume per cut	Large (entire timber increment over 20 years extracted in one harvest)	Small to medium (mainly for self-consumption and surplus for commercial sale)
Planning units	Cubic metre of solid timber	Number of trees per diameter class
Harvesting operations	High mechanised harvesting operations; dependency on sophisticated road network	Low impact logging with motor-manual harvesting, on site-processing and low requirements on road network
Impact on remaining forest stand	High damage through intensive and mechanised logging and skidding operations. High risk of soil erosion, weed and climber infestation after canopy opening	All timber extraction oriented towards an improved forest structure following the SFM. Low risk of soil erosion and weed invasion due to selective timber extraction only

* Sustainable Forest Model

Principles for Community Forest Management

Principles	Results
Participation of local people and communities	Local forest users are involved in all planning, implementation and monitoring steps and main results are "owned" by them and lead to a commitment to implement it. All activities are within the capacity of local people for independent log-term continuation
Multi-functional forest resources	CFM meets the diversified needs of local communities in terms of timber, firewood, NTFPs, water resource etc. and at the same time ensures ecological functions of the forests. "Forest protection through sustainable utilisation"
Relevant planning procedures	Only information really needed for forest management purposes is collected and compiled
Cost- and time effectiveness	Procedures are cost and time effective to ensure that communities can comply with proposed planning, implementation and reporting
Application of local ecological knowledge and experiences	Local knowledge and experiences on the use of forest products (medicinal plants, materials, food…) are integrated into the planning procedures to maximise the tangible benefits for the communities and to satisfy their diversified demand for forest products
Technically sound forest management	Forest management planning and utilisation are following technical sound procedures and are in line with international standards for sustainable forest management
Balance of supply and demand to ensure sustainability	Forest utilisation is only allowed within the actual growth potential of the forest resources ensuring a continuous flow of products and a permanent forest cover on the entire area at any time

1.2 Objectives of harvesting regulations

- To form a basis for planning, implementation and monitoring of the approved five-year VFMP and the Annual Work Plan
- To ensure the safety of people working in the vicinity of the cutting operation
- To minimize damage to residual trees and seedlings, especially those that are expected to make up the population of future crop trees
- To minimise damage to soils and streams
- To maximise the protection of the ecological functions of the forest ecosystem
- To maximise the volume of timber that can be profitably utilized from each felled tree
- To maximise the value of the logs prepared for extraction
- To support effective implementation of extraction activities
- To support forestry and extension officers who provide training on silviculture to farmers

1.3. Concept, Goal and Legal frame of Selective cutting

Concept of Selective Cutting

Selective cutting refers to the selection and utilisation of individual trees within a forest stand. In this system trees are removed on a felling cycle that occurs more frequently than the rotation and in which an uneven-aged forest structure is maintained. The harvesting is implemented based on the approved 5-year VFMP and annual work plan of the community.

Selection of trees to be harvested and those to be retained is based on a set of criteria (e.g. species, quality, density, competition…).

The operation is carried out with the aim to harvest trees that are ready for the market and trees with low-value that are competing with future crop trees while maintaining a permanent forest structure.

Under this system, the forest can provide timber on a continuous basis, with natural regeneration constantly replacing harvested trees. Timber extraction is carried out in all diameter classes based on the Sustainable Forest Model to fulfil the diversified demand of the local forest users for housing, stables for livestock, fencing, firewood and commercial timber sale.

No clearfelling at any time

Goal of Selective Cutting
The two major goals of selective cutting in the context of CFM are to: ➢ Harvest a certain volume of timber and firewood of different size, species and quality to satisfy the various needs of households and communities and partly use the surplus for trade (depending on the forest status and local market) ➢ Step by step adjust the forest structure towards the structure of the SFM in line with the long-term forest management goal for the respective forest stand.
Legal policy frame for selective cutting
In conventional forest management, selective cutting is applied in un-even aged forest blocks that have a rich forest stock with many trees of mature diameter classes for large-sized timber harvesting (as per Decision 40/2005/QDD-BNN dated 07/07/2005 on Regulations of timber and forest products harvesting of MARD). On the other hand, thinning is carried out in poor/degraded forests and forests after heavy selective cutting in order to improve the structure of the middle and lower tree layers. In CFM, all silvicultural interventions are aiming at an improved forest structure and therefore can be applied in all natural forests such as young forests, poor/degraded forests, average and rich forests as long as the two following conditions are met: ➢ The Participatory Forest Resource Assessment has revealed a surplus in a specific diameter class compared against the SFM. ➢ Local forest users or entire communities are interested in utilising the timber surplus for self-consumption or timber sale.

1.4 Expected target groups for this guideline

The guideline is intended to provide a practical guidance for local authorities, field level forestry staff and most important for local forest users during the real implementation and monitoring of Community Forest Management.

The guideline is furthermore designed as extension material for forestry staff and forestry university students, and from technical high schools dealing with social or community forestry and extension subjects.

Harvesting operations should only be carried out by people who are:

- ✓ physically fit and reasonably active;
- ✓ trained or experienced in the use and maintenance of chainsaws, felling and crosscutting;
- ✓ not under the influence of drugs or alcohol or are tired or fatigued;
- ✓ fully equipped to carry out the job;
- ✓ having a person with them who is able to assist or obtain help in an emergency;

Remember: Never work alone while felling trees or using a chainsaw!

2. SUSTAINABLE FOREST MODEL

Decision making on sustainable harvest levels has to be defined against clear and practicable benchmarks which can easily be assessed, monitored and enforced. Traditionally, stocking tables have been developed as outcome from permanent growth and yield sample plots (PSP) after decades of repeated measurements. However, the use of such stocking tables is restricted to monocultures and few defined mixed forest stands and are not applicable in the context of natural forest management under a selective harvesting regime.

In the context of community forestry in Vietnam, Sustainable Forest Models (SFM) derived from static forest inventories are utilised instead and have been recognised by the National Working Group for Community Forestry in 2004.

The SFM is an expression or picture of a well-stocked, well-managed forest which can effectively deliver economical and environmental products on a sustainable basis.

A SFM has to be developed for each specific forest type available in an ecological region based on the results of a representative forest inventory obtained in the respective forest type.

The elaboration of a SFM has to be done by a professional organisation and requires an approval by the functional authority before it can be used as guidance for sustainable forest management.

The SFM is illustrated in form of histograms showing the total number of trees per diameter classes per hectare. Main variables of the SFM are the number and width of diameter classes and the stem number per diameter class.

The SFM is forming a falling curve with the highest stem number in the lowest diameter class and the lowest stem number in the biggest diameters. Each smaller diameter class can therefore provide a sufficient number of replacements for trees that have been extracted in the respective higher diameter class. Since, when trees grow bigger they pass from the smaller to the next higher diameter class. Following this concept trees have to grow through all diameter classes before they will reach the highest diameter classes.

Any timber extraction is aiming at improving the current forest structure towards the desired SFM structure in an iterative process of repeated thinning cycles. Consequently, all silvicultural interventions will lead to an improved stand structure after utilization instead of a degradation of forest resources as often seen under large concession management.

The SFM is used as a benchmark against which the current forest structure in a respective site is compared during village forest management plan development. Imbalances between the SFM and the current forest status are defining sustainable harvest amounts or areas of strict protection for each diameter class.

If the actual stem number of one diameter class is exceeding the number as provided in the SFM, harvesting of the surplus can be permitted for the local people for the next five years period.

Providing quantifiable options for timber utilization throughout all diameter classes is crucial to reflect the divers demand of forest users which would not be possible by the use of a conventional model, e.g. minimum harvest diameter.

In Dak Lak province, SFMs have been developed for the dominant natural forest types. The models consist of eight diameter classes as shown in the figures below.

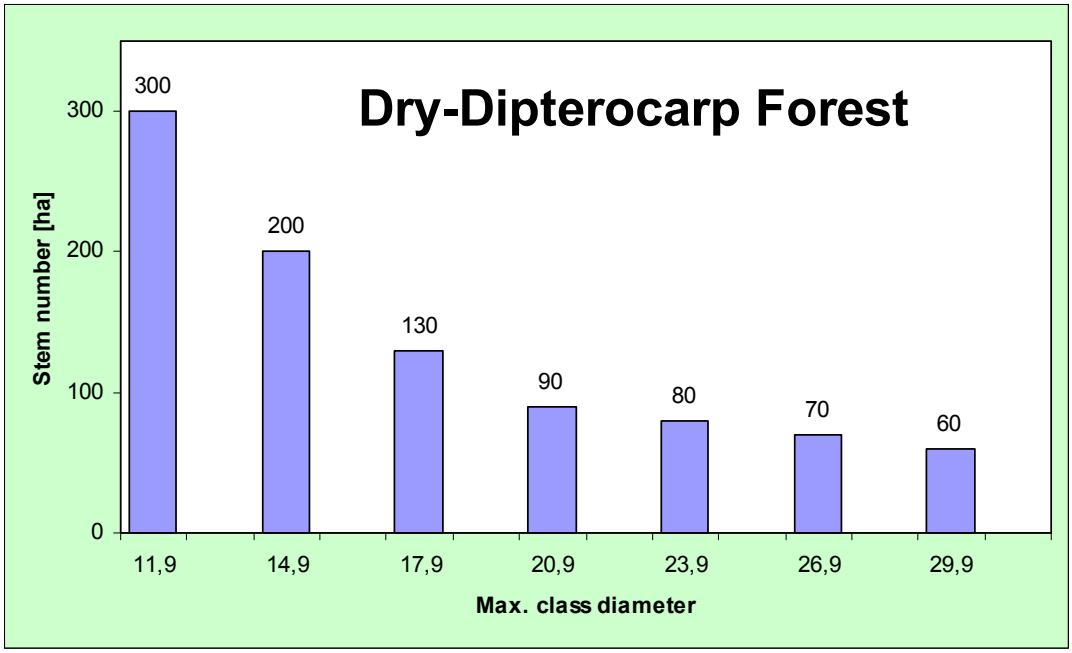


Figure 1: Sustainable Forest Model for Dry-Dipterocarp forest in Dak Lak province

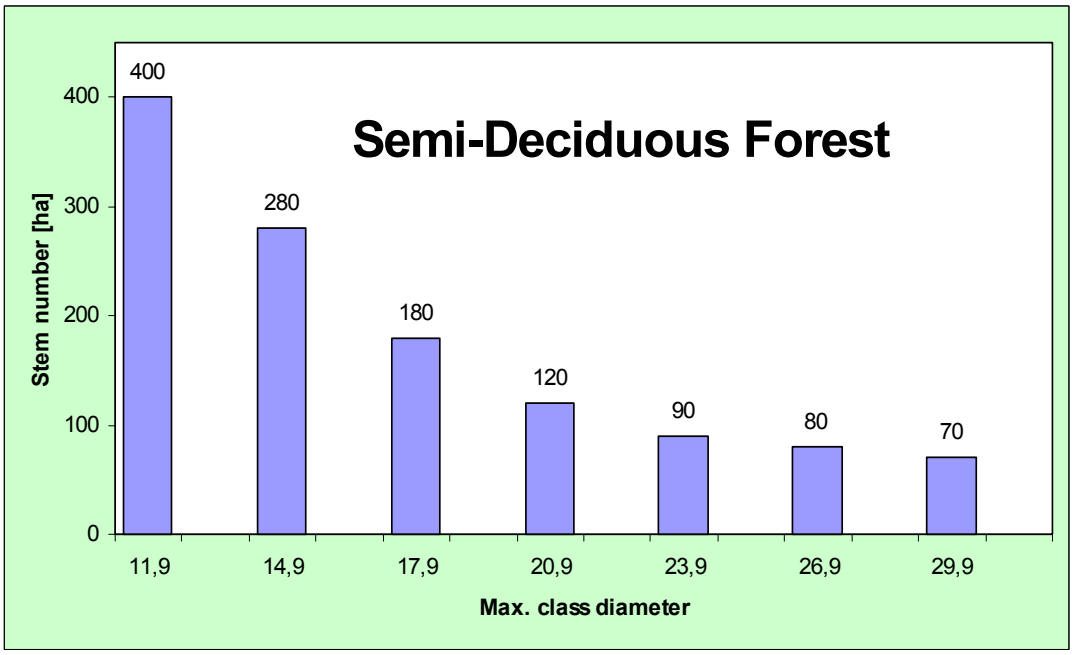


Figure 2: Sustainable Forest Model for Semi-Decidious forest in Dak Lak province

3. PRE-HARVEST PLANNING

3.1. Species selection criteria

Identification of species that are not allowed to be harvested as defined by the State and the community

Before selecting individual trees for harvesting, it is necessary to identify species that are not allowed to be harvested such as:

- Valuable and rare species as detailed in the Red List[1] and the Decree 48/2002/ND-CP on the list of wild, valuable and rare animals, plants and trees in Vietnam.
- Valuable and rare species that have a cultural significance for traditional communities (e.g. graveyard trees, worshipping trees,…)
- Trees and species that need to be protected as source for propagation or as important source for NTFPS (bark, leafs, fruits, resin etc.)

Local communities have to be consulted and a common agreement reached before any decision can be made. The species list as developed during the PFRA analysis should be used as reference and species of cultural significance indicated separately.

Species selection for utilisation

Prior to selecting trees for extraction in the field, the community has to define a list of species desired for:

- House construction, stables for livestock, bridge construction…
- Fire wood consumption
- Commercial timber sale
- …

The objective is to ensure that extracted timber will meet the demand of the forest users and at the same time ensure that harvesting operations will not focus on one or two main timber species only which could result in a depletion or extinction of species.

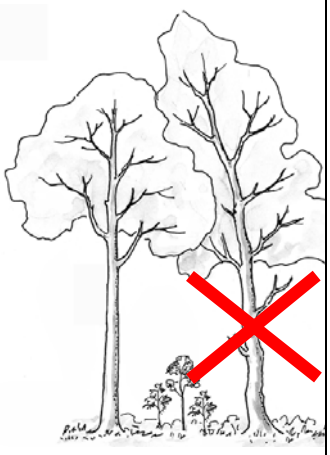
Tentative species harvesting list

No	Species		Utilisation purpose
	Common name	Local name	

[1] IUCN Red List of threatened species created in 1963

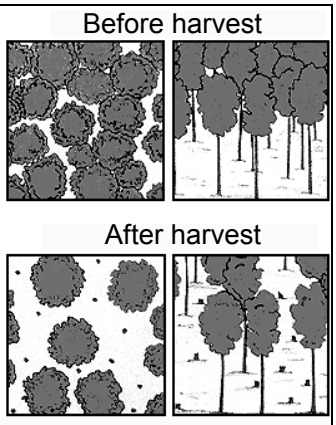
3.2. Tree selection criteria

The selection of trees for harvesting has to be based on comprehensive criteria since harvesting is the most important silvicultural intervention which is defining the future production potential and environmental functions of the forest.

Selection criteria for timber trees	Illustration
Canopy competition (main criteria) **Potential Crop Trees (PCT) have to be provided sufficient space for optimal growth conditions. This can only be achieved by providing sufficient space and limiting competition from undesired trees through thinning.** **Only trees with crowns higher or at the same height as the PCT can cause competition. Smaller trees have no effect on the growth of the PCT and should only be extracted if desired for their direct products.** **Trees to be protected until they reach final harvesting diameter have to have the following characteristics:** ➢ **Vital, not diseased and no major bark injuries** ➢ **Straight with a round stem** ➢ **Wide and dense crown** ➢ **Species with production potential (timber or NTFP)** ➢ **Dominant or co-dominant position in the upper canopy layer**	
Trees to be extracted from smaller diameter classes should be limited to trees that are: ➢ **Diseased or dead with a potential risk of spreading diseases to remaining trees in the forest** ➢ **Trees with undesired stem form (bended or forked)** ➢ **Trees of undesired species competing with a good timber species**	

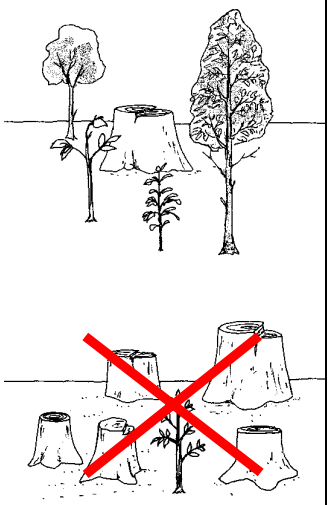
Timber extraction should never cause big openings in the canopy layer which can increase the risk for weed invasion and soil erosion.

After harvest at least 50% of the ground should be covered by a dense canopy (canopy closure at least 50%).



For every tree cut, enough smaller trees of various species have to be available as replacement, otherwise labour intensive enrichment planting has to be carried out.

In areas with insufficient natural regeneration, mother trees have to be retained as future seed source.

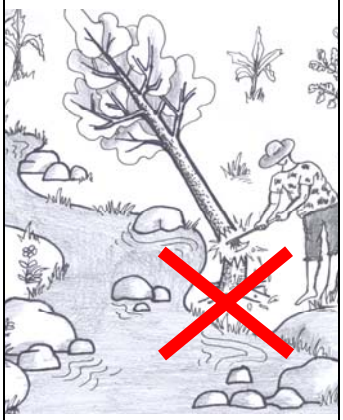


No trees to be harvested within the bufferzone of streams or rivers. Tree shade is effectively protecting sources of drinking water and fish population.

River width (m)	Bufferzone width (m)
< 1	*No bufferzone*
1-10	20 m
11-20	50 m
21-40	80 m
> 40	200 m

(Source: SFDP Song Da)

Do not cut timber-sized trees on extreme slope or in areas with loose rock outcrops to avoid risk of soil erosion and damage to the remaining stand.



Distance between two mature trees permitted for harvesting

A minimum distance between two mature trees to be extracted within the same harvest is defined for the two biggest diameter classes of the SFM.

This ensures that harvesting is not concentrated within a small area but more equally distributed within the entire the forest block.

Ni/ha SFM	Appropriate distance (Li) between two trees (m)	The space required for one tree (m^2/ha) (Sti)
20	25	159
30	21	106
40	18	80
50	16	64
60	15	53
70	13	45
80	13	40
90	12	35
100	11	32

Technical note for reference:

The minimum distance between two trees allowed for cutting is calculated based on the number of trees for the respective diameter class following the respective SFM:

$$Sti = \frac{10^4}{Ni/ha}$$

$$Li = 2\sqrt{\frac{Sti}{\pi}}$$

Ni: = number of trees/ha in certain diameter class

Sti = space for one tree in certain diameter class

Selection criteria for firewood	Illustration
Limit firewood collection to: ➢ **Dead, diseased or bad formed trees** ➢ **Trees without timber potential (for self-consumption and sale)** ➢ **Trees that are competing with valuable trees** ➢ **Crown material from felled trees and thinning material** **Potential timber species should be strictly protected to grow into higher diameter classes.**	

3.3 Tree marking and preparation of tree list

Selection criteria	Illustration
Trees that are selected for harvesting will be marked with oil paint in two positions: one at breast height and the other one near the stump below the felling scarf. **The mark below the felling scarf will serve as identification mark for the post-harvest monitoring.** **Marked trees are defined in terms of species, diameter class and then recorded in a timber list. This will serve as baseline data to compare the number of trees marked with the annual harvesting plan of the forest block.**	

Species (local name)	Number of trees marked per diameter class							Total trees Harvested per block
	Black	Stripes	Blue	Dots	White	Saw	Red	
Total trees marked/block								
Total trees as in annual work plan								

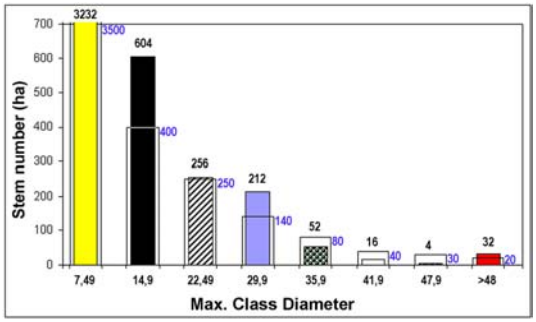
3.4. Harvesting season

Description	Illustration
Timber harvesting, preparing a skidding track for transportation, tree logging, timber cutting, transportation and post-harvest activities need to be done in the dry season. **Harvesting season depends on the weather as well as the availability of labour. Therefore, a harvesting plan should be made together with communities to ensure a suitable timing for all harvesting related activities.**	

Harvesting planning agenda

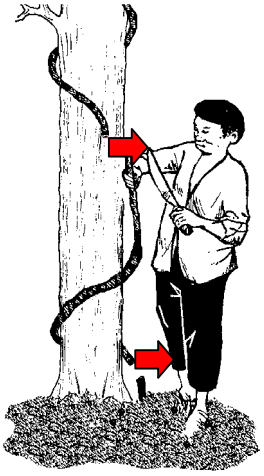
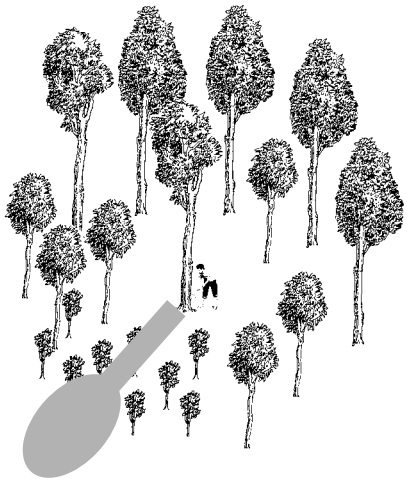
Activity	Time	Location	Responsibility
Tree selection			
Prepare skidding trail			
Harvesting operations			
Processing, skidding			
…			

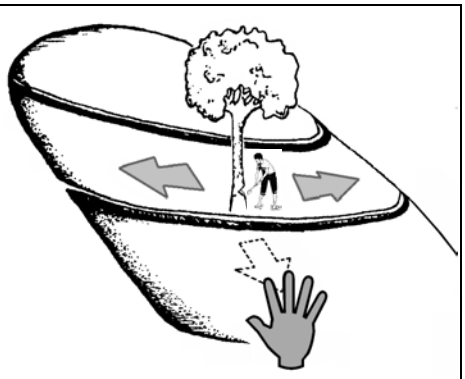
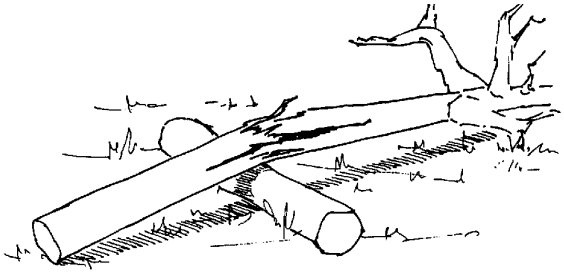
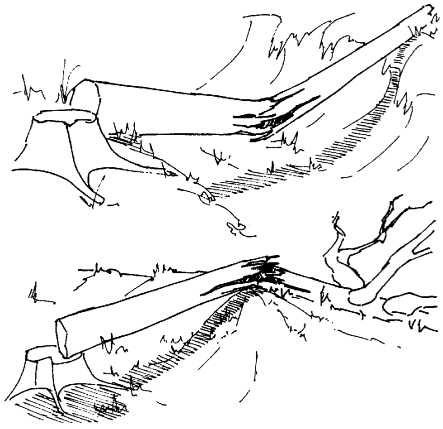
3.5. Permitted harvesting amount

Permitted number of trees for harvesting	Illustration
Any timber extraction has to be based on the approved five-year forest management plan for the respective forest block. **The planned harvesting/thinning operations therefore have to be within the permitted harvest quota for a five-year period.**	 **Example of inventory data analysis**

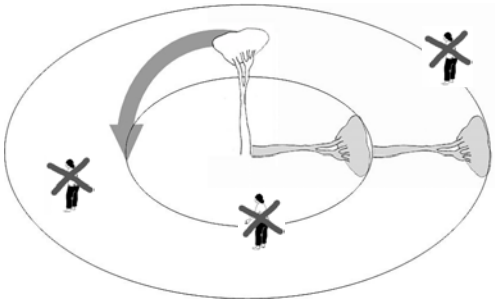
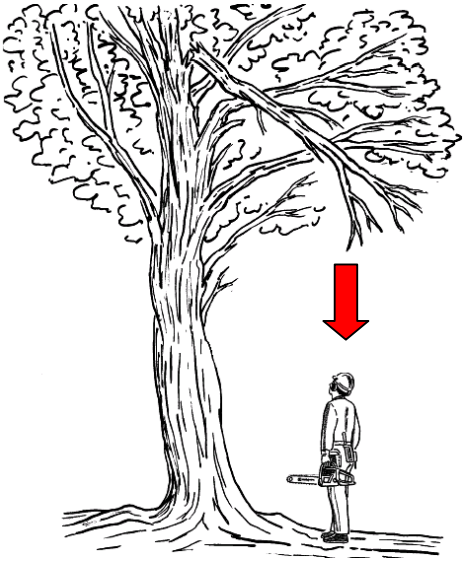
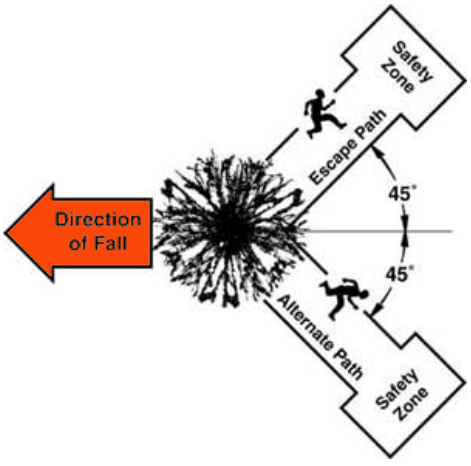
4. TIMBER HARVESTING

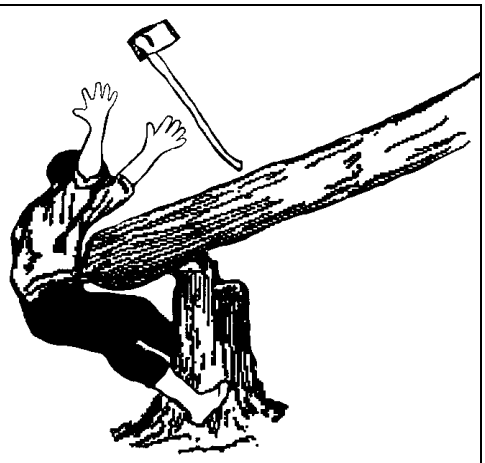
4.1. Harvesting preparation

Harvesting preparation	Illustration
Cut climbers with diameters larger than 2 cm some time before harvesting. As climbers can bind tree crowns together damage can increase to other trees and create potential risks for the logging crew. **Climbers can furthermore strangulate the host tree and can cause deformation of the stem and loss of timber value.**	
Directive felling	**Illustration**
Select felling direction to reduce damage to remaining stand. **Try to fell trees into open areas or areas with only young trees or regeneration which can easily recover after the crown material has been removed from the felling site.** **Do not fell trees during stormy weather as the wind might change the direction of the falling tree and create potential safety risks for the logging crew.** **Before starting to cut, remove shrubs and other vegetation around the tree base that could impede your work.**	

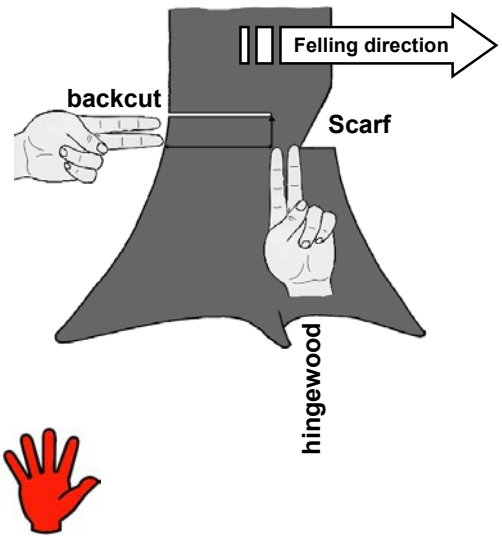
Do not fell trees down the slope unless their downhill direction is too dominant for directed falling. Try to fell trees along the contour lines. **This will help to minimise breakage of felled trees and damage to the remaining stand.** **By looking at the lean of the tree, the location of the heaviest branches and the general crown weight, you'll be able to select the felling direction.**	
Avoid felling a tree over a ditch, hillock or other logs as the stem might crack and loose its value. **Try to direct your felling to place tree crowns of several harvested trees into the same area to reduce disturbance in the remaining stand.** 	

4.2. Safety regulations

Safety regulations	Illustration
Before felling a tree, Check that there are no other persons, children or animals in the danger zone. **The danger zone is the distance twice the length of a tree to be harvested (twice the length of the falling tree, as it might hit another tree which can also fall). This distance should be increased if felling is directed downhill.**	
Check for any dead or broken branches that may stuck in the crown and fall into the work area as the tree falls. This is particularly common in old trees and causes serious accidents. View the tree from different angles so you don't miss anything. **Check for branches interlocking with branches of other trees. These can break off as the tree falls and drop into the work area, pull the tree away from the desired direction of fall, or cause other trees to uproot and fall.**	
Having assessed the work area and tree to be felled, prepare the site for felling. **If there are any low branches that may get in the way during the felling, cut them off.** **Clear an adequate work area around the base of the tree and provide an escape route diagonal to the rear.**	

Look forward in the tree fell direction and identify any hazards such as stumps, logs, or ground undulations that may cause the fallen tree to kick backwards or sideways on contact. **Back off from the falling tree as soon as the tree shows any sign to give in, make sure to get away from it.** **Do not stand behind the falling tree, as its butt might kick back and injure the logging operator.**	

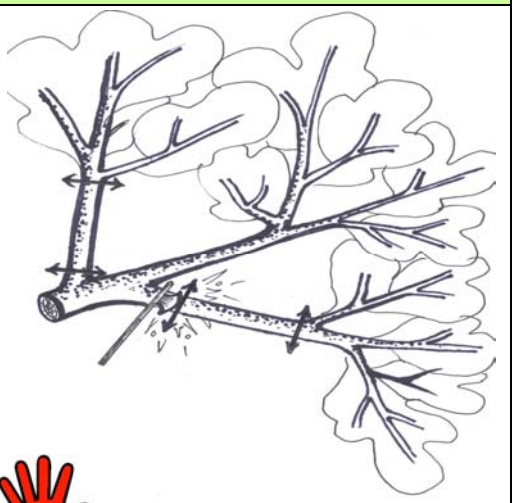
4.3 Harvesting techniques

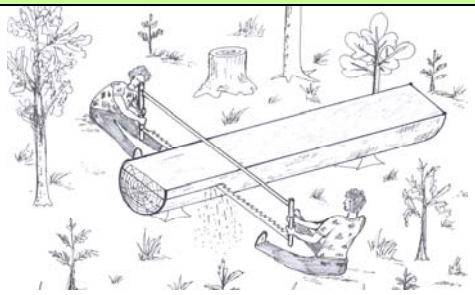
Felling instructions	Illustration
Cut the scarf in felling direction. The top cut is made first at a 45° angle between one-quarter and one-third of the tree's diameter. The cut must accurately face the desired direction of fall and finish level. The bottom cut must be made level to meet the top cut and form a clean, uniform "V" right across the diameter of the tree when the cut section is removed. **If your tree has a diameter of around 30 cm place the backcut from the other side "two fingers" above the base of the scarf. For a bigger tree increase to 3-4 fingers.** **The backcut is the last cut and will finally fell the tree. The backcut is made level and always above the 'V' of the scarf (around one-tenth of the tree diameter). The backcut does not cut all the way through but stops until there is an even amount of hingewood about "two fingers" (or one-tenth of the diameter) parallel before the scarf to remain the hingewood.** **The hingewood controls the felling direction and prevents the tree from twisting or breaking sideways when falling.**	 **Once the backcut has been done and the tree begins to fall:** ➢ **Remove saw from cut and switch off** ➢ **Move into the planned escape route** ➢ **Watch for falling material** ➢ **Watch for the tree kicking back or bouncing as it hits the ground**

Common Felling hazards
Felling uphill: Be aware that the tree may slide back or kick up into the work area once it hits the ground. Move quickly along the escape route away from the stump. Always watch the path and progress of the tree you have felled. **Felling trees along the contourlines: Make sure you are not in the path of a rolling tree. Move back along your escape route away from the falling tree.** **Trees without crown (crown breakage after storm or heavy rain): Make the scarf slightly deeper (max. to half of the diameter). Place a wedge in the backcut as soon as possible to ensure correct felling direction as there is no crown to force the tree in the felling direction.** **"Hung-up" Trees: Where a tree is hung up in another tree it must be brought to the ground before continue any other work. Do not leave such trees unless you have marked the area while you seek assistance, or someone else is present to warn other people of the hazard.**

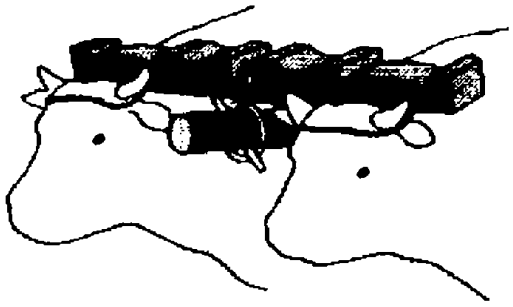
5. POST-HARVEST ACTIVITIES

5.1. On-site processing

Trimming (cutting off branches)	Illustration
Before starting examine the felled tree for any hazards (tensions, breakages etc.) **Check trees adjacent to the felled tree for any damage or hazard.** **Make sure the tree is stable and will not roll or move when you start to work on it. Place chocks if you think movement is possible — especially on slopes.** **Only trim trees that are firmly lying on the ground; do not work with a chainsaw above shoulder level (1.5m).** **Beware of a tree suspended by its branches as one large branch may hold the tree up.** **When a tree is held up off the ground, trim the large branches from out- to inside by making a couple of cuts to test the stability.** **Always work on the uphill side of a tree on a slope.**	 **Watch out for limbs that are under tension. These can spring back and inflict severe injury. Stand on the side away from the tension and release the tension with two cuts — first on your side and then on the other side.**
Crosscutting	**Illustration**
After trimming the stem it can be cut into the desired lengths for house construction, fencing, farm material or firewood. **Check that the stem is lying stable and cannot roll, drop or swing. Look for any defects such as rot or large branches that may affect your crosscutting.** **Don't crosscut logs that are suspended more than 1.5 meters above the ground. Crosscutting above this height means the saw is being used above shoulder level.** **Clear a sufficient area to operate in.** **Make sure the carry-through of the saw does not bring the chain into contact with the ground or objects that may damage it.**	 **Always finish a cut from the uphill side to avoid the stem rolling against you. Make sure others are not**

	endangered if the cut log rolls down the slope.
On-site processing	**Illustration**
Heavy logs should be sawn into smaller planks directly at the logging site to reduce cost and to reduce the damage to the soil and the remaining stand by transport with heavy machines. **Sawn planks can easily be transported manually or by animal skidding without need for a road network.**	
Cleaning of harvesting site	**Illustration**
After the logs have been removed from the harvesting site, bigger crown material and branches should be used for firewood. **Remove and leave limbs and bark directly at the felling site. Small branches should then be cut into smaller ones and spread evenly in the forest.** **A large proportion of tree nutrients reside in the bark and foliage. Leaving limbs and bark at the felling site will thus contribute to improved growth of future trees.**	

5.2. Skidding

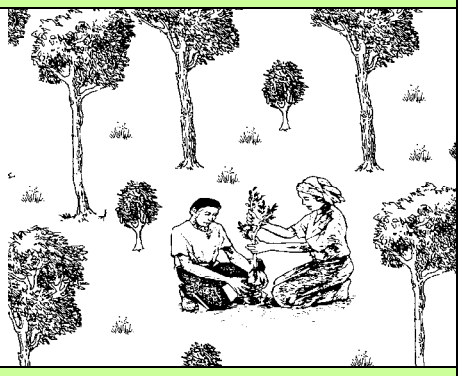
Safety regulations	Illustration
The principles to reduce damage to the remaining trees when transporting timber is as follows: ➢ **Check and select suitable trails for transportation (use a map with contour lines)** ➢ **Use as much indigenous knowledge and local resources as possible (use animals, transport timber on streams or rivers)** ➢ **Devices such as skidding pans or sledges can greatly improve productivity in animal skidding because they reduce skidding resistance and thus allow larger loads to be pulled.** **Improper extraction operations of big logs can lead to:** ➢ **loss of log volume or value during skidding process** ➢ **excessive damage to soil and streams** ➢ **excessive damage to residual trees and seedlings**	  **Animal skidding must allow for short extraction distances (typically 200 m or less) and relatively gentle slopes only.** **Proper harnesses are essential in order to prevent injury to the animals and to avoid cumulative discomfort over long working periods.**

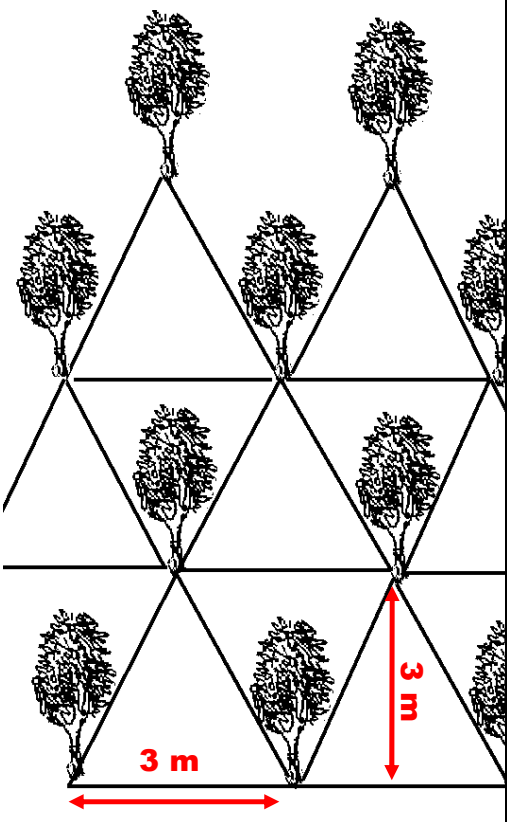
6. MAIN SILVICULTURAL PRINCIPLES FOR FOREST DEVELOPMENT IN CFM

6.1 General Principles

1. Promoting existing natural regeneration through strict protection from grazing, firewood collection, forest fire and during all silvicultural operations.
2. Strict protection of any vegetation growing in open gaps especially along rivers and streams, in areas with steep slope and areas with thin soil layers or with rock outcrops. Regardless of the utilisation potential of the species a vegetation cover has to be maintained for crucial soil protection.
3. Shrubs and non-target trees in the under storey are spared from thinning for improvement of the forest structure and for ecological reasons but can be selectively harvested if desired for firewood consumption.

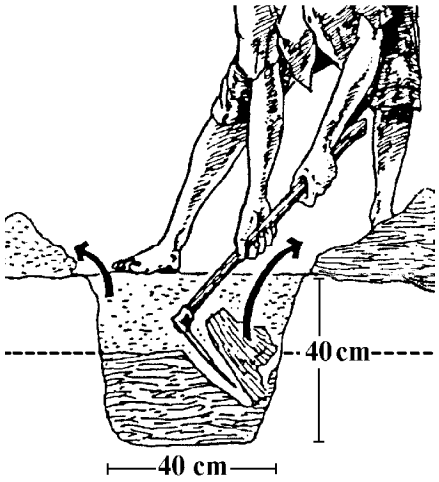
6.2 Forest Enrichment

Definition and Objectives	Illustration
Enrichment planting is a silvicultural option to introduce or increase the availability of valuable tree species into already existing forest structures through additional planting and based on the forest users demand.	
Selection criteria for the necessity of applying enrichment planting	
The necessity for additional enrichment planting can be assessed by the number of existing valuable trees in the understorey. If the existing natural regeneration does not provide a sufficient number of desired trees, enrichment planting can be taken into consideration. **Promotion of indigenous species for afforestation and enrichment planting that would naturally occur on the given site. This will lead to reduced risk of diseases and failures during establishment as indigenous species are adapted to local soil and climatic conditions.** **As enrichment planting is a very labour and cost intensive option with high risk of failure it should be applied only exceptional if the stand can not be expected to develop naturally into the desired forest structure in a realistic time period. It is recommended to apply enrichment planting only if the farmer is really committed to increase the economic value of the stand.** **Enrichment planting requires sufficient labour, investment in seedlings, clearing of shrubs, making rows and planting trees. Therefore, forest enrichment depends not only on the type of forest but also on the availability of local resources.**	

Techniques	Illustration
Enrichment planting should be carried out in small groups rather than in lines to better respond to the micro site conditions. Only gaps of at least 2000m² should be selected for replanting. The height of seedlings for underplanting has to be at least 80 cm of height in the nursery to ensure a good survival rate as trees have to directly compete with existing vegetation and other natural regenerated trees. **Planting design: trees should be planted following triangular spacing with a distance of 3 m between trees.** **No enrichment planting in lines as this option is prawn to negative impact from grazing and weed invasion and forms the most labour intensive option.** **Plant trees inside the forest at least 5 m distance from the edge of the forest.** **No application of pesticides allowed.**	

Species selection for forest enrichment
Selected species should be indigenous tree species naturally occurring in the respective forest type. **Only shade-tolerant or shade-demanding trees are suitable for enrichment planting due to the reduced light under the remaining canopy.** **Selection of species should focus on high-valuable, competitive (against weed and shrubs) and tolerant species (can grow on a wide range of site conditions) which can provide substantial tangible benefits for the local forest users.** **Species selection has to be based on the demand of the local population.** **Extensionists should provide information on species such as economic value, growth and ecological site requirements so villagers can make informed decisions on which species to select. Participatory Technology Development[2] can further be used to test new species.**

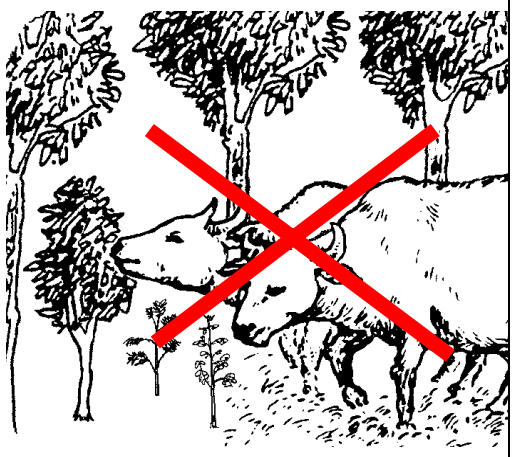
[2] Guidelines for Participatory Technology Development (Bao Huy, 2003).

Preparation of planting site	Illustration
Weeds should be cleared on the entire patch, shrubs and trees with low economic value should be cut if in proximity to the planting holes, trees of high economic value should be protected as potential for timber and NTFP production. **The size of the planting holes depend on each species; it is normally 40 x 40 x 40cm. The surface layer containing organic substances and nutrients should be used for planting.**	

Season for forest enrichment
The preparation for forest enrichment such as clearance of weeds and shrubs should be conducted in the dry season. Planting is carried out on rainy days, or in the morning of cloudy and cool days avoiding hot, sunny or windy weather. **Planting of trees is made in the rainy season. It depends on labour resources and local conditions to make the forest enrichment plan with the villagers.** **Tending and weeding should be stopped after seedlings have grown out of the reach of the competing vegetation. In natural regeneration no tending or weeding is required.** **Tending of additionally planted trees has to be carried out twice a year at the beginning and end of rainy season. In the first year of planting, tending should be done twice for spring planting and autumn planting.** **Tending and protection activities on regenerated area with additional planting should be maintained for 3-5 years. Strict protection from grazing impact is crucial for a successful development.**

6.3 Promotion of Natural Regeneration

Definition and Objectives
Promotion of natural regeneration follows the idea of utilizing the potential of forests to naturally regenerate and to avoid labour and cost intensive measures for replanting or enrichment planting. **Existing natural regeneration should be protected and promoted during all silvicultural operations (including plantation sites) in view of achieving mixed natural forest stands of indigenous tree species.** **Tending and weeding should be avoided and completely stopped after desired crop trees have grown out of the reach of the competing vegetation (usually after 3 years).**

Techniques	Illustration
Promotion of natural regeneration is mainly focusing on protection measures and requires only minimal input in terms of finance and labour. **Main interventions include the following:** **Strict protection of young trees with potential for timber and NTFP production.** **No grazing or fodder collection.** **No burning (including controlled burning) allowed at any time.** **Harvesting of firewood has to be limited to undesired non-valuable trees.** **Climbers are to be removed from desired trees to ensure a good stem development.** **Marking and strict protection of mother or seed trees in areas with insufficient natural regeneration.** **Selection of desired tree species and mother or seed trees has to be based on the demand of the local forest users.** **In areas with the vegetation cover dominated by bamboo the silvicultural option of natural regeneration with or without enrichment planting can only be applied if bamboo is considered a desired species of the long-term management goal. The active elimination of competition of bamboo to support tree regeneration is a very difficult and labour intensive process due to the strong vegetative regeneration capacity of bamboo.** **Existing coppices should be singled, leaving only one or two main branches to develop into bigger diameters.**	 

7. TECHNICAL MEASURES EXCLUDED FROM THIS GUIDELINE

Silvicultural methods not included in this guideline are:

- NTFP management and development
- Afforestation and agro-forestry production on bare land
- Fire prevention and fire fighting measures

The necessity of these silviculture methods depends on each region, community, local resources, market experience and demand of the community. Therefore, technical staff in each region should take responsibility to develop these methods. Some of the principles to develop these silviculture techniques should be noted:

7.1. Development of Non Timber Forest Products (NTFPs)

A participatory assessment of existing NTFPs and their availability should be conducted including a market analysis for selected products.

Use results of research and local knowledge on NTFPs about planting and tending methods to develop NTFPs. In the case where there is no research and indigenous knowledge on NTFPs, PTD can be applied, to test new species in the village.

Conduct a feasibility analysis (i) to select promising products and to identify markets and means of marketing, (ii) to facilitate villagers to select the most promising products and (iii) to form producer groups as the basis of a future organisational structure.

7.2. Afforestation and agro-forestry production

Afforestation and agro-forestry production is following technical procedures as provided by the Ministry of Agriculture and Rural Development (MARD).

Species selection for afforestation should focus on indigenous species which can be developed into mixed indigenous species stands which in the long-run can be converted into permanent forest stands.

Seedlings should be developed from known seed stands with proven quality and preferably from the same ecological region.

Develop practicable and relevant guidelines for farmers on plantation techniques including nursery management, planting and tending, pruning, thinning and coppicing.

7.3. Fire prevention

Natural forests have a limited fire risk compared to monocultures which further depends on each type of forest such as evergreen forest, dipterocarp- or pine forests.

Fire prevention measures should be regulated in the Village Forest Protection Regulations and technical and organizational support at village and commune level should be provided through district Forest Protection officers.

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