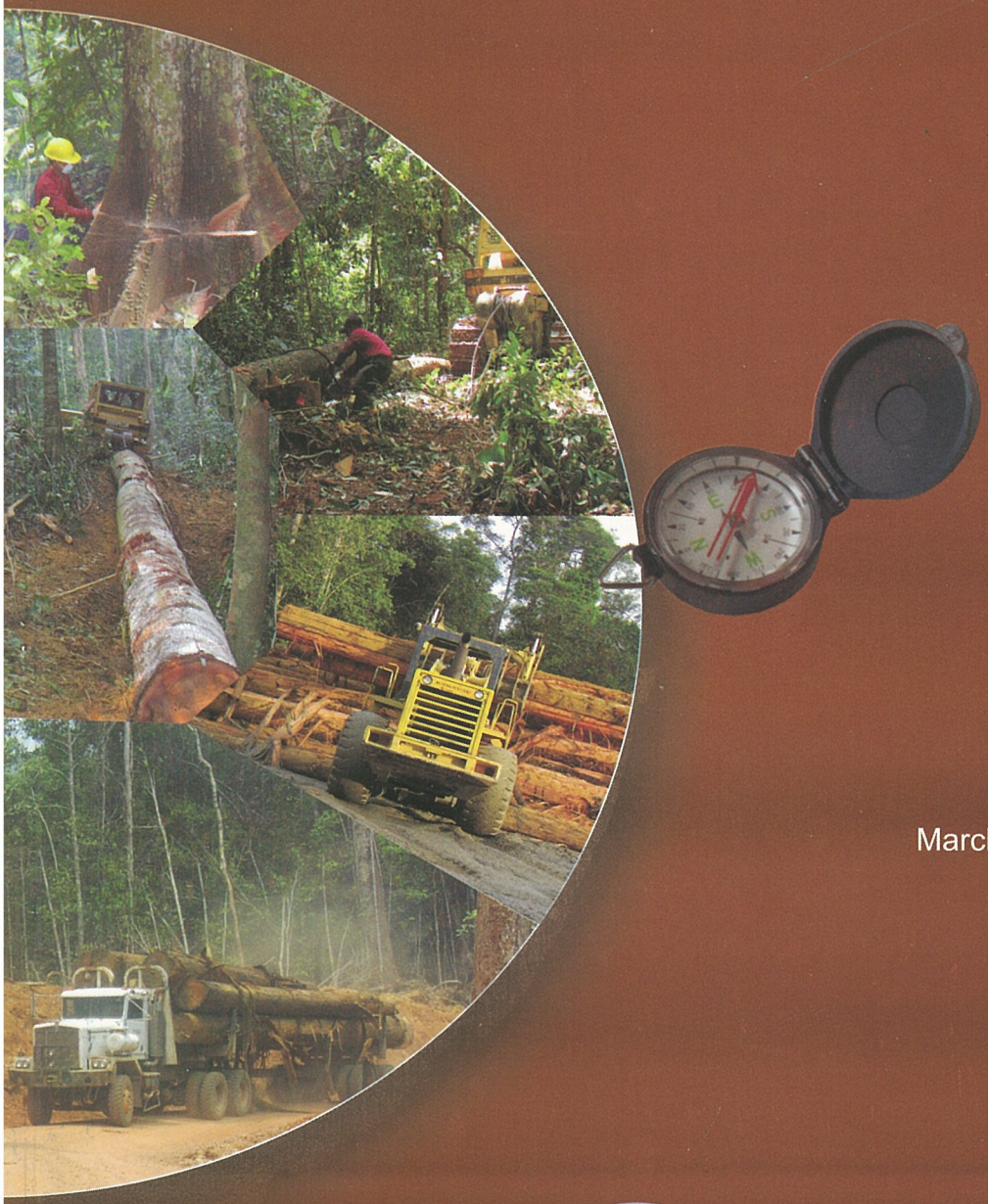
OPERATIONAL CONSIDERATIONS FOR REDUCED IMPACT LOGGING



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TROPICAL FOREST FOUNDATION

ITTO

Ministry of Forestry

OPERATIONAL CONSIDERATIONS FOR REDUCED IMPACT LOGGING

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Forestry Departement
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Association of Indonesian Forest Concession Holders

THIRD TECHNICAL PROCEDURES MANUAL

PROJECT ITTO PD 110/01 REV.4 (I) :

"PROGRAM TO FACILITATE AND PROMOTE ADOPTION
OF REDUCED IMPACT LOGGING (RIL) IN INDONESIA
AND THE ASIA PACIFIC REGION"

Operational Considerations for Reduced Impact Logging

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FOREWORD

This procedures manual is the third in a series of technical manuals intended to provide clear, technical guidance on the various stages of implementing a Reduced Impact Logging (RIL) management strategy in the lowland and hill dipterocarp forests of Indonesia.

This Manual on "Operational Considerations for Reduced Impact Logging", deals with all operational aspects of the logging activity starting with the opening of the skid trails, through to the implementation of felling and skidding activities. It also deals with the issue of deactivation of the skid trails system as part of normal operational activities.

The starting point of this Manual is the "Planning Considerations for Reduced Impact Logging" published by the Tropical Forest Foundation (TFF) in August 2005. In the Planning Manual, we explore the various considerations and standards which should be taken into account when planning logging activities under an RIL regime. We then take the reader through the recommended steps for preparing such a plan.

The first Manual in this series, Technical Procedures for Topographic Forest Surveys and Tree Mapping", provides the starting point for this 5-book series which provides technical guidelines for the implementation of RIL. In the first Manual, we provide a step-by-step procedure for collecting inventory and contour data and for producing an accurate tree position and contour map from this data.

RIL practices are grounded in the Indonesian regulatory framework. This technical procedures manual provides practical implementation guidelines on how to achieve the desired objectives and results intended by the existing regulations.

These manuals have been prepared by the Tropical Forest Foundation and endorsed by the Association of Indonesian Forest Concession Holders (APHI) under a funding grant from the International Tropical Timber Organization (ITTO). The executing agency for this grant is the Centre for Forestry Education and Training (CFET) with implementation activities shared by TFF and CFET.

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This manual is available free of cost on request while copies last. This manual is also available as a PDF file and can be downloaded from the TFF website *www.tff-indonesia.org*.

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Reduced Impact Logging takes a holistic view and encourages efficiency within the logging operation, as well as the adoption of practical measures to ensure that the impact of the logging operation is minimized.

The first step in achieving a reduction in logging impact, is an improvement in operational planning. Good planning in turn, requires good data. The first two manuals in this series provide practical guidance on the collection of data and on the planning preparations for the implementation of RIL.

This manual provides guidance on how to implement reduced impact practices during the logging operation.

Photo 1 : A tractor operator being briefed before he opens the skid trails in a new operating area.

CHAPTER I

OPENING THE FOREST

1.1 Introduction

Starting assumption: This manual begins with the assumption that skid trails have been planned and are already located in the field. It is also assumed that standards to guide the location of skid trails have been developed and were followed when the skid trail system was being planned and located.

For more information on the skid trail planning, refer to the TFF publication **"Planning Considerations for Reduced Impact Logging"**.

For more information on data collection and ground-based mapping, refer to the TFF publication **"Technical Procedures for Topographic Forest Surveys and Tree Mapping"**.

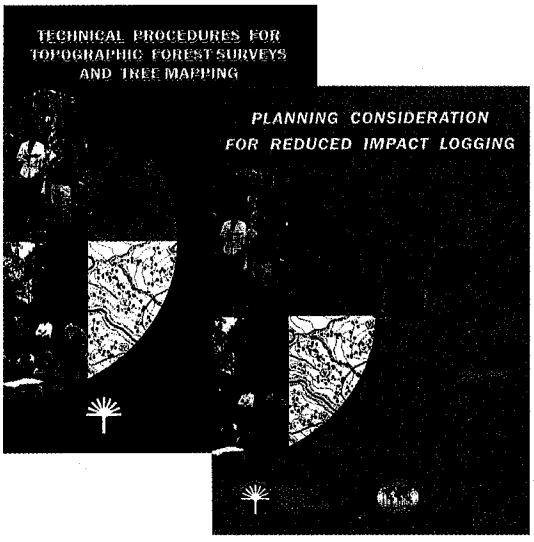


Figure 1 : Relevant supporting documents

*TFFs **"Technical Procedures for Topographic Forest Surveys and Tree Mapping"** provides the technical guidance for producing accurate contour and tree position maps. In the second manual on **"Planning Considerations for Reduced Impact Logging"**, clear instructions are provided regarding the organization of the working area taking into account topographic constraints and natural boundaries.*

1.2 Opening Skid Trails Before Felling

Based on extensive experience in conducting RIL trials in the Dipterocarp forests of Indonesia, the position of the Tropical Forest Foundation (TFF) is clear that . . .

Skid trails should be opened before felling starts.

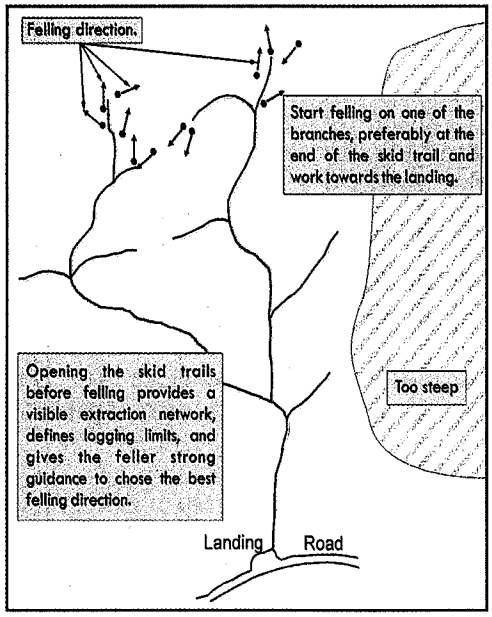


Figure 2 : A typical skid trail system reflecting the strong control which topography and drainage has on the location.

Why?

- to provide easier access for the faller.
- to provide an easy-to-see reference for the faller. This will help him decide on the best felling direction in order to make log extraction more efficient.
- to make it easier for the faller to decide which trees not to fell since he will know where the extraction network is and, consequently, which trees cannot be reached.
- The large size of the trees and the stocking density in a Dipterocarp forest, make it virtually impossible to find the skid trail locations if the trees are felled before the skid trails are opened.

1.3 Standards for Opening Skid Trails

A logging team almost always consists of one faller and one tractor operator. In this working relationship, it is best if one main skid trail and all its branches are opened by the tractor as the first activity. The tractor should then construct the landing while the faller starts felling, preferably at the end of one of the branch trails (Figure 2).

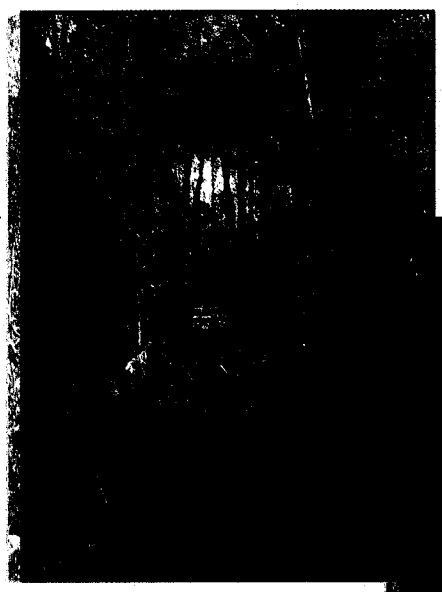


Photo 2 : Opening a skid trail marked with red flagging tape. On gently slopping ground, the tractor should keep its blade raised. (below)

Photo 3 : Poles and saplings provide ground protection and reduce skidding impact. (above)

Guidelines for Opening Skid Trails

11. On gently sloping ground, keep the blade slightly raised. Leave woody debris such as poles and saplings on the skid trail.

22. On steeper ground, minimize the side cutting as much as possible.

33. Wherever necessary, the fallers should walk in on the main skid trail ahead of the tractor. He should cross cut fallen trees which block the skid trail location in order to minimize the impact of opening the skid trail.

44. Avoid creating sharp turns in the skid trail. Remember that the logs being pulled out may be over twenty meters in length.

55. Stream crossings cannot always be avoided. Ensure that the located crossing is in the best possible place, preferably where the stream bed has a rocky bottom and where the

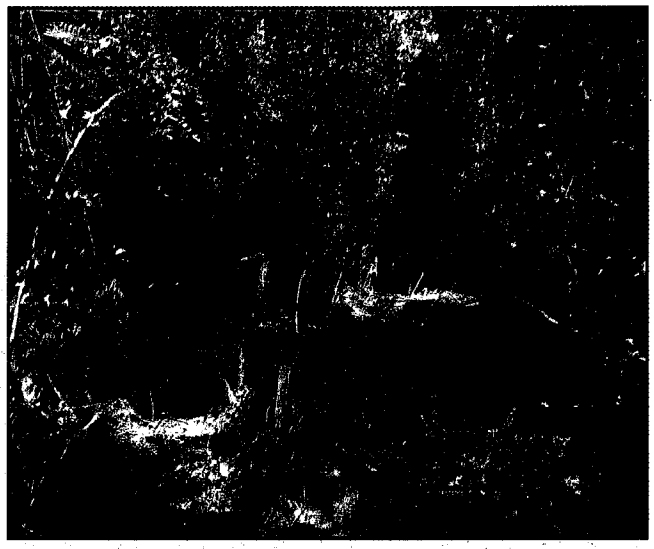


Photo 4 : An old Bankirai wind-throw may still be sound after many years lying on the forest floor. Bucking such old logs that lie across the skid trail location, minimizes the damage to surrounding trees which would have been caused if the tractor had tried to push the dead tree out of the way.

alignment of the skid trail is at right angles to the stream. Arrange for a faller to fall nearby, poor quality trees so that a matting of logs and woody debris can be used to fill the stream channel. This will minimize skidding impact on the stream and reduce the sedimentation load.

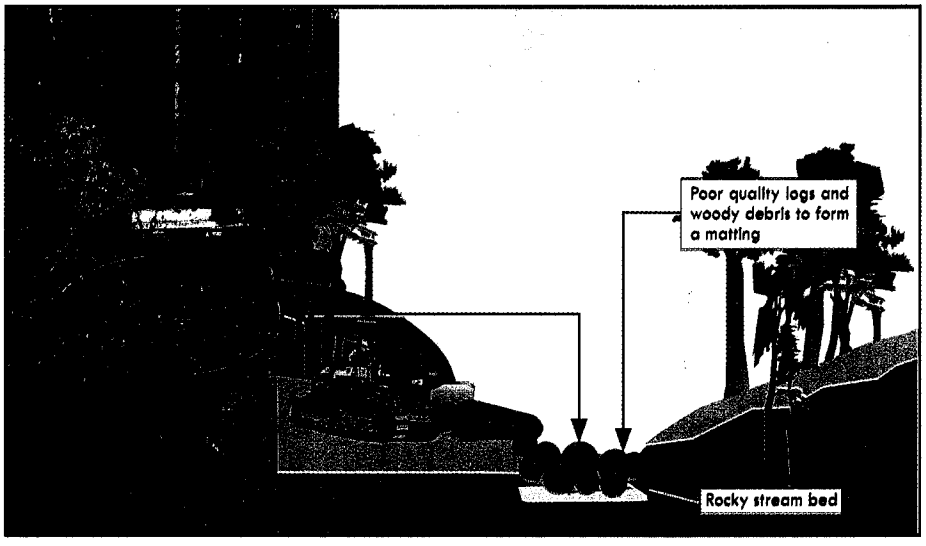


Photo 5 : Note the matting in the middle of the photo. This stream was crossed effectively while minimizing the impact on water quality.

1.4 Construction of Landings

Landings should have been located and marked by the planning team. The tractor operator must be given some direction on the size and boundaries of the landing. This will depend on the estimated volume which is expected to be processed through this landing.

Guidelines for Constructing Landings

1. Keep the landings as small as possible. Size of a landing should not be more than 900 sq.m. and should be determined by the number of trees which are likely to be skidded to the landing.

2. Clear topsoil to provide a firm base.

3. The landing should be located on slightly sloping ground, preferably on a ridge top location.

4. When clearing the site of a landing, ensure that the landing will drain well.

5. Make sure that the landing does not impinge on a streamside buffer zone. The edge of the landing should be at least 50m from the edge of a stream.

6. Ensure that water will not run from the landing directly into a stream. Direct drainage into the surrounding forest area.

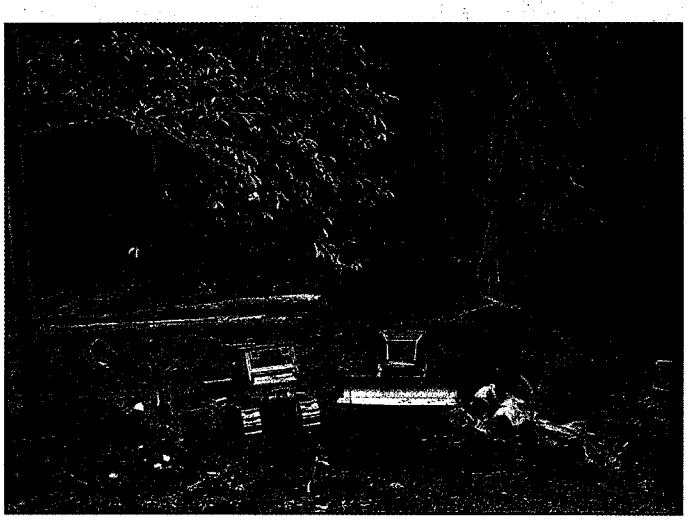


Photo 6 : Keep landing size as small as possible.

area which is one thirty-fifth of the total concession area (based on a 35 year cutting cycle).

The company is now free to harvest trees above the minimum diameter limit within the defined area up to the approved cutting quota, whichever comes first.

This allows the company a great deal of freedom to choose the best trees and the best portions of those trees as long as it stays within the area and volume cut control mechanism. This mechanism, which has remained unchanged since the Indonesian concession system first began, has institutionalized wasteful practices and is a major barrier to better resource use.

2. Uniform royalty system

In the Indonesian concession system, royalties are levied on a per net cubic meter basis according to broad species groups. There is no distinction of log quality, consequently a number one peeler log is assessed the same royalty per net cubic

Photo 8 : High quality, "avoidable" waste from the butt log. A common sight in most concessions. Waste from this portion of the stem typically represents +/-15% of all "avoidable" logging waste.

meter as a saw log of the same species even though the end use value of the saw log is much less and the recovery is much lower. This lack of distinction of the inherent differences in the value of the wood of differing quality, discourages the use of second quality logs or logs with defects, and encourages wasteful practices.

3. Inflexible regulations make it almost impossible for a company to utilize trees under the minimum diameter limit which are knocked down during the road construction or logging activities. This results in a large volume of waste of high quality wood being left on the ground.

4. No awards / no penalties: This summarizes the current situation with respect to resource use in the natural forest from the regulatory perspective. There are too many regulatory constraints which prevent companies from making good use of the trees it fells or from trees that are knocked down during road construction and logging activities.

   Companies are penalized if they try to make better use of second quality wood, and are not provided with any incentives for maximizing the recovery of wood from their annual cutting area. Similarly, there is no standard regarding acceptable levels of damage and no inspection system to ensure that damage to the residual stand is minimized.

Factors under the control of the forest company

The institutionalization of wasteful practices as related to inappropriate government policies, is often a convenient excuse for forest companies to continue their own, inappropriate practices.

5. Industry configuration: Many concession companies supply logs to plywood factories belonging to the same corporate group. The focus on plywood manufacture which can only use the best logs, and the frequent lack of a solid wood manufacturing facility, discourages more effective use of a raw material supply of variable quality. The result is that trees are often felled and then left lying in the forest even if they have only a relatively small hole.

   Many companies have policies which make it impossible for the forest manager to sell the second quality wood that the

company's own plywood mill doesn't want, to other wood working industries.

6. Industry perception and habits: Old habits die hard. The forest industry's perception of an inexhaustible wood supply from the natural forest, resulted in the development of a very exacting log quality standard which the concession company still has to comply with. While it is now generally recognized that the wood resource is shrinking rapidly, few industries have actually modified their expectations in terms of log quality in response to this reality.

   Corporate policy in most cases, locks the forest manager into a marketing arrangement where he has to sell his logs only to an industry within the same corporate group, and to the quality standard that the industry dictates and at a price which was also set by the industry. The result is a very high level of waste. Many of these constraints still prevail and are major barriers to more efficient allocation of the raw material and to better utilization.

7. Transportation constraints: Most concessions in Indonesia rely on river transport to move their logs to a manufacturing industry. Where the river access point is too far upstream to permit access by pontoons, the concession company faces restrictions on the species which it can utilize. In such cases, it is common that sinker species are excluded from the felling list.

8. Illegal logging keeps the industry supplied with high quality wood at low prices, thus undermining any effort to make better use of the forest resource. In many cases, the concession company could take a more proactive position in eliminating illegal logging from its concession area.

2.2 Purpose of Utilization Standards

Most companies have some form of utilization standard which determines how a grader trims the logs at the landing and how a faller bucks the trees in the forest. In most cases, utilization policy is set by the manufacturing industry and the forest concession company has little option but to conform its bucking standards to the industry's utilization policy.

In most companies, industrial utilization standards for logs were established when the concession licenses were issued some +/- 20 years ago and have not been revised since. Twenty years ago, the prevalent attitude was one of an inexhaustible wood supply. The situation has changed dramatically with many concessions depleted and industries shutting down due to a lack of raw materials, however, few companies have actually examined the appropriateness of their utilization standards and even fewer have begun to do something about utilizing their timber resource more effectively.

The sustainable management of the forest resource is the main purpose of a reduced impact logging management regime. RIL encourages the achievement of sustainable forest management and, therefore, promotes and adoption of policies which ensure optimum utilization of the trees that a company is allowed to harvest.

The need for forest companies to re-examine their utilization policy and standards to ensure optimum wood recovery from the forest, is an urgent necessity for virtually every concession company.

Improvements to forest utilization may require an investigation of the feasibility of new investments in more efficient or appropriate processing equipment or product lines. This will need to be dealt with at the corporate level.

However, much can be done at the concession level without any additional investment. Companies can examine their current felling, bucking, and skidding practices to ensure that good quality wood is not wasted due to poor bucking practices or that felled logs are not forgotten in the forest due to poor planning or supervision. To achieve such relatively simple but significant improvements, will require the establishment and socialization of improved utilization standards (see section 2.4).

The benefits of improved utilization which can be achieved through the development and promotion of better utilization standards are easy to demonstrate.

- Better income for fallers on volume-based income.
- Greater volume recovery per hectare.

- Reduced costs/cubic meter for such fixed cost items as road construction and road maintenance.
- Improvements in skidding costs per machine unit
- Generation of higher cash flow for the forest operation
- Overall better economic performance of the company
- Better revenue returns on the timber resource

2.3 Defining Avoidable Logging Waste

There is a need to define "avoidable logging waste" within the context of the many external constraints facing the forest concession industry. Clearly any improvements in utilization will be primarily focused on eliminating the causes of waste which are under the control of the company. This, in turn, sets the parameters for establishing a definition of "avoidable waste".

> ***"Logging waste will be considered avoidable if it is a portion of the main stem of a tree, which conforms to the company's utilization standard but is left in the forest due to improper bucking or skidding practices."***

Implicit in this definition, is the need to establish a realistic utilization standard and to enforce it through adequate supervision.

Specific examples of avoidable waste include:

Excessively high stumps

This is a highly visible form of avoidable waste and is easy to avoid though proper supervision of the felling activities. Studies have shown this typically represents 1-2% of the total avoidable waste.

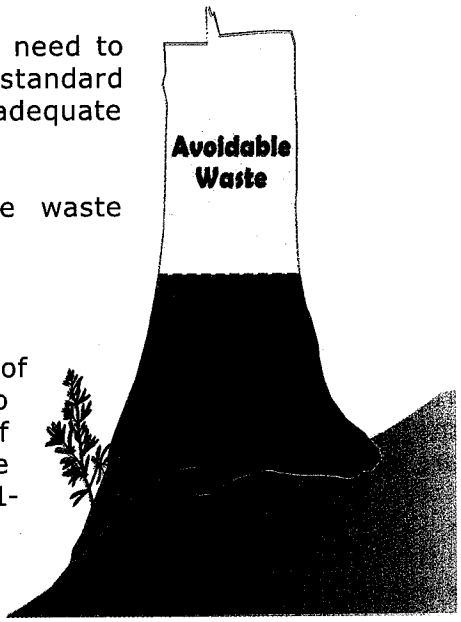


Figure 3 : High stump

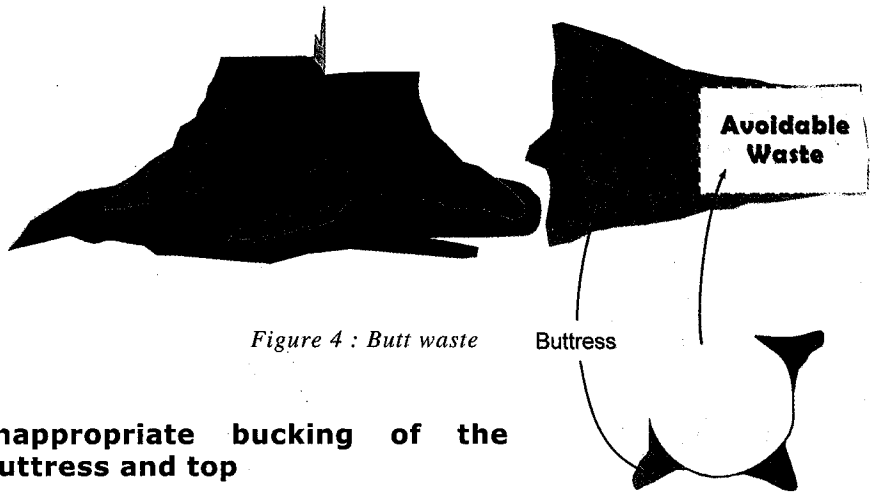


Figure 4 : Butt waste

Inappropriate bucking of the buttress and top

How a log is bucked from a felled tree, represents the largest potential for improving utilization. It is common for fallers to buck the buttress well above where the diameter of the bole begins to diminish due to the presence of buttresses, rather than trimming off the buttresses.

Perhaps there is also a small hole in the butt log which results in a significant volume of high quality wood being bucked off the butt log when, in fact, it could have been skidded to the landing as part of the whole log and recovered as useable volume.

Bucking waste from this portion of the tree typically represents +/-15% of the total useable and avoidable high quality waste of the main stem volume.

Most companies still allow their fallers to buck the top of the log

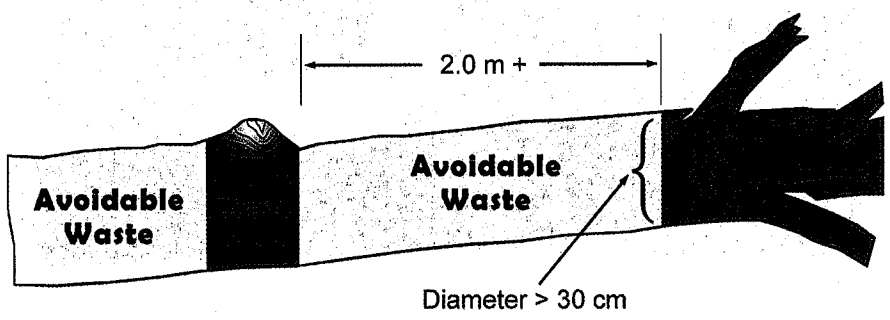


Figure 5 : Top waste

at the first defect, even if this is a relatively minor one. In many cases, significant defect free portions of the main stem are left as waste in the forest. This high quality wood could be extracted as part of the main stem if the faller simply adjusted the position of the top cut to the point where the tree begins to branch out.

Avoidable waste of the main stem volume which falls under this category, typically represents 35-55% of the total avoidable waste of the main stem volume.

'Forgetting' felled trees in the forest

A forest concession which does not practice RIL, generally does not monitor its logging crews very closely and typically does not have a procedure in place for systematic logging block inspection.

A logging team is usually assigned a working area. The faller starts felling and the tractor operator must then find the trees which have been felled. If the faller gets too far ahead or if the terrain is fairly broken, some logs are almost invariably 'forgotten' in the forest.

Photo 9 : This tree should not have been felled. A vertical "test" cut would have quickly determined the size of the hole and would have resulted in a decision to leave the tree standing.

In a typical forest concession this category accounts for 25-50% of the total avoidable logging waste.

Identifying trees which should not be felled

There is another common category of waste which does not necessarily result in a wasted volume which could be recovered under normal economic and regulatory constraints, however, it can and should be avoided through simple adjustments to operational procedures.

The felling of trees which have very large holes thereby making them uneconomical to extract, should be avoided since it creates unnecessary damage to the residual stand. The hollow tree is also a valuable seed tree and in many cases, performs a useful ecological function in the forest.

A hollow tree often shows visible indicators of its condition. The faller should be trained to recognize indicators of internal defect such as swelling of knots, excretions of sap, termite mounds at the base of the tree, and the fruiting bodies of decay organisms visible on the upper portions of the bole.

Usually a faller can suspect whether a tree is hollow by taping it with his parang. If a tree is suspected of being hollow, the faller should make a vertical incision with his chain saw to determine the size of the hole. If the tree has a hole greater than the tolerance limit set in the company's utilization standard, the tree should not be felled.

2.4 Creating a Company-Specific Standard

Trees which are eligible for felling are defined in Ministry of Forestry regulation. Companies are required to conduct a 100% inventory of proposed cutting blocks and to mark all trees eligible for felling with a red label.

A company will generally provide direction to its inventory crews regarding which trees to innumerate and label, as well as which trees to exclude, from the inventory. Typically, trees which, on visual inspection, show obvious defects, will not be included in the inventory. In most cases, trees which cannot be utilized by the industry, will also be excluded from the inventory.

When a faller enters a new working area, he should have clear guidelines from the company as to what quality standards to use and what defects are acceptable and not acceptable. Armed with these simple guidelines, the faller then becomes a major decision maker since he decides whether or not to fell a tree and how the tree will be bucked into logs for extraction. Further trimming may occur at the landing when the company grader prepares the logs for transportation.

Creating a Utilization Standard

	Comments
Species	
Species eligible for felling	A simple list of desirable species should be prepared and socialized to the fallers.
Protected species	Similarly, the fallers should be well informed on all species which are protected under national or provincial regulations and should be able to recognize these species in the field.
Felling	
Stump height	Felling height should be as near the ground as possible in non-buttressed trees. On buttressed trees, felling height should not be above the point where the diameter of the bole begins to diminish.
Assessing defective trees	Fallers should be instructed to make vertical exploratory cuts in any tree which they suspect of being hollow.
Bucking – Defect tolerance	
Buttress	Buttress to be bucked from the but log at the point where the diameter of the bole begins to diminish. Any remaining buttress flanges to be trimmed off.
Hole	Heart rot can be tolerated in logs with a diameter >50cm as long as the maximum diameter of the hole is not more than 25% of the diameter of the log.
Clear sections of the main stem past the first knot	Bucking of the top should be at a point which includes all sections of clear wood 2 meters or longer (**see Figure 5**)
Knots	Tolerance in terms of number of knots per meter and size of knows should be clearly specified.
Spiral grain	Spiral grain is usually not permitted. Any tolerance of spiral grain needs to be clearly elaborated in the bucking standard.
'Crocodile eyes' (matta buaya)	Generally only permitted in saw logs.
Ring shake	Usually allowed in saw logs with conditions (ie. only one in logs >50cm diameter, or, as a percentage of the diameter)
Off-centre heart (hati pinggir)	Specify the tolerance for ply logs; usually tolerated in saw logs.
Bucking – diameter and length tolerance	
Preferred bucking lengths	Specify the preferred bucking lengths to guide both the faller and the grader at the landing. The faller should be supplied with a measuring tape.
Minimum diameter	30 centimeters

Table 1 : Considerations for creating a company utilization standard

The most significant thing a company can do to improve utilization in its operational areas, is to pay much closer attention to its felling, bucking, and general logging practices. The first step in doing this, is the developments of a company-specific utilization standard. Table 1 provides some guidance for the creation of such a standard.

Photo 10 : Evaluating waste left after a logging operation provides the forest manager with meaningful feed-back on the implementation of utilization policies.

In Summary, there are many things a company can do to improve utilization despite the external disincentives.

- The company should formulate a more rigorous utilization standard and put it into an easy-to-understand guideline for the fallers and the graders. A small, plasticized pocket book or plasticized card containing felling and bucking standards should be issued to each faller and grader.

- Skid trails should be planned, located, and opened prior to commencement of felling.

- Improve supervision of the logging activity to avoid left logs, poor bucking, and unnecessary felling of defective trees. This may require the creation of a block inspector

position in the company organization structure (see section 4.1).

- Investigate the possibility of new investment to pre-manufacture waste wood within the concession.
- Allow the forest manager to sell waste wood and/or unwanted logs.

The key is proper bucking to maximize utilization of main stem volume. The assumption is that the faller is the first and most important decision maker when it comes to implementing a company's utilization standard.

A company which is attempting to improve the utilization of its forest resource must pay close attention to informing all production personnel of its policies and, to creating a procedure to ensure that the implementation of its utilization policies are achieving the desired reduction of "avoidable logging waste".

Photo 11 : An example of proper bucking at the point where the main stem divides into major branches.

CHAPTER III

FELLING, BUCKING, & SKIDDING

3.1 Organization of Working Area

Under Indonesian Ministry of Forest regulations, forest concession companies have the option of organizing their annual operating areas using either a geometric grid to define compartments, or using natural boundaries such as streams, ridges, or existing roads.

Many concessions still lack maps of adequate scale and accuracy to reliably plan and delineate cutting blocks within the annual operating areas, according to natural boundaries. Consequently, the most common method of dividing the annual working area into cutting blocks, is using a one kilometer grid where square blocks of 100 hectares are delineated as the basic administrative unit for organizing all forest management activities from forest inventory to logging and post harvesting activities.

Regulations specify that block boundaries and the external annual operating boundaries, should be established 3 years prior to harvesting using a blazed and painted line. The 100% inventory should be carried out two years prior to harvesting and the road system is constructed during the year before harvesting.

Once the annual harvesting permit is granted, it is up to the company on how it organizes its work activities. An approach still used by many companies, is to divide each 100 hectare block into four, 25 hectare compartments using North/South and East/West lines to subdivide the block (Figure 6). Such an arbitrary approach to organizing the working area, ignores the location of streams, topographic features or any other natural feature which could impact on logging efficiency. The result is often an extreme impact on the forest hydrology as well as an inefficient and high cost logging operation.

The conventional approach to arranging the working areas within individual cutting blocks, requires no planning or additional information. Lines separating the working areas are established in the field using a compass bearing. The resulting compartments

are assigned to logging teams with each team being responsible to fell and extract marked trees in its compartment to the nearest road within the cutting block.

Multiple stream crossings are common and the sedimentation impact on the forest stream system is often severe. In addition, access to difficult portions of a working area will often require skidding through difficult terrain when easier solutions based on a good understanding of the topography, could produce much more efficient logging solutions.

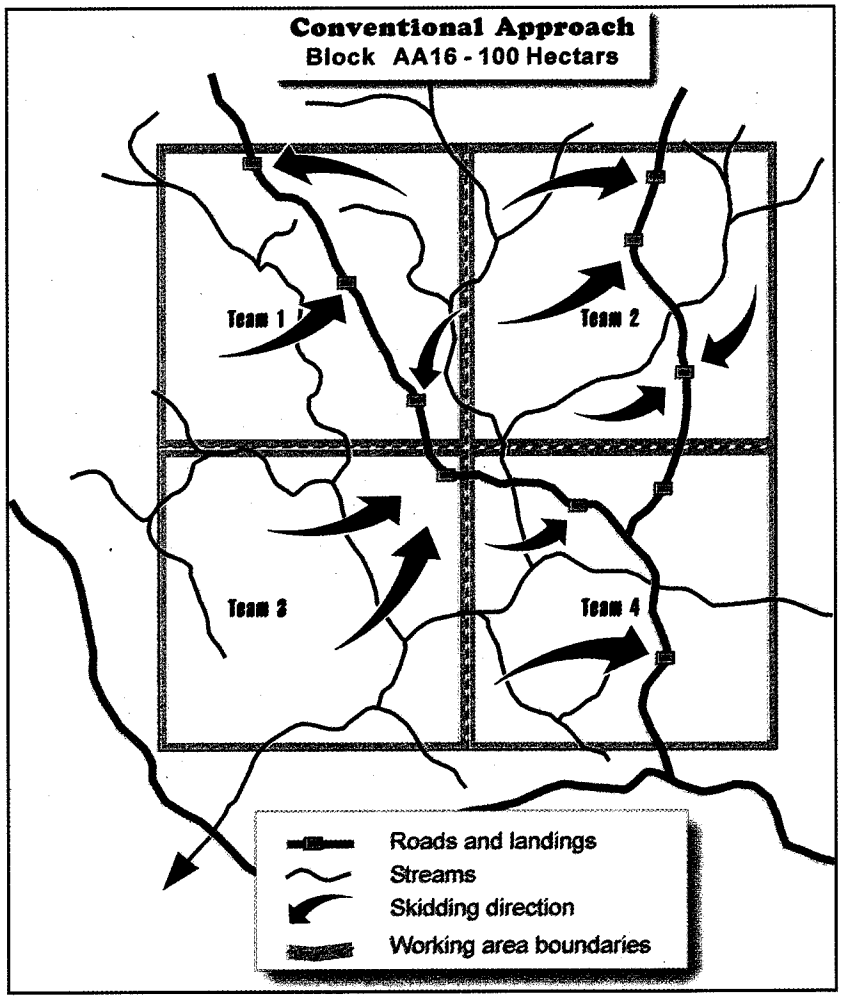


Figure 6 : Conventional approach to organizing the working area within an individual logging block.

In some situations, portions of a compartment are left unlogged if access from within that compartment is simply too difficult, even though such an area could have been easily accessed from a neighboring compartment.

Figure 7 illustrates how an RIL approach to organizing the logging activities in a 100 hectare block might look. Natural boundaries become the primary consideration for working area organization.

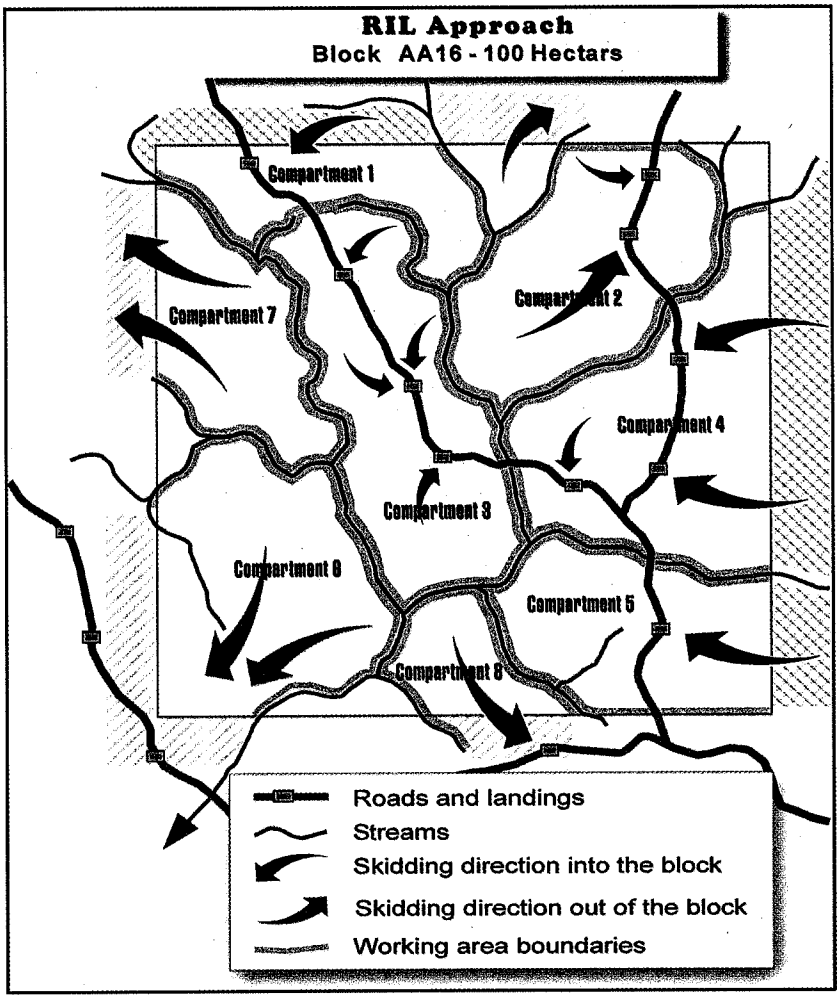


Figure 7 : RIL approach to organizing the working area within an individual logging block.

The objective in using this approach is to minimize impact to the stream system by avoiding stream crossings whenever possible. Logging efficiency is also improved since contour and steam information together with tree position data, can be used to design the optimum extraction network to ensure the achievement of lower impact as well as greater productivity.

Using this approach, block boundaries become secondary considerations within the annual cutting area. Compartment boundaries commonly extent outside of the individual block boundaries. Logging activities are organized according to consideration for improved efficiency and reduced impact, not according to arbitrary administrative considerations.

3.2 Worker Safety

Most companies operating in the tropical forest, do not pay enough attention to worker safety and safety training. This section provides a brief introduction to this important topic. Specific manuals on worker safety and safety training should be consulted to ensure that a full program of worker safety is in place.

Work hazards

Off all the forests in the world, the tropical rain forest is the most dangerous working environment. In the Southeast Asian Dipterocarp forests, trees are typically well over 40 meters tall with large and irregular crowns. In hilly terrain, it is often difficult to determine the lean of a tree. Morphology of the bole and crowns often present additional difficulties in felling and in predicting felling direction. In a tropical rain forest it is also common to have greater interconnectivity within the canopy in terms of interconnecting branches and lianas.

Safety Procedures

During the felling activity, hazards often occur in unexpected ways.

- A faller usually works with a helper. This team should have a simple but effective procedure for communicating when a tree is about to fall. A faller should never start the final cut without knowing that his helper is in safe position.

Figure 8 : Felling hazards

① Trees may be connected to each other with lianas or branches causing other trees to get pulled down during the felling process.

② Branches from the falling tree or from neighboring trees are often broken off as the tree falls.

③ A neighboring tree bent over by the falling tree can suddenly snap and "kick- back" in unpredictable directions.

④ Lianas are torn off or may break and snap back, or cause the falling tree to rotate unexpectedly.

⑤ A falling tree may push over another large tree, thereby expanding the impact zone to almost two full tree lengths from the felling site.

- On rare occasions when more than one faller works in a compartment, falling teams should maintain a safe working distance from each other and should agree to a division of the working area before the work starts.

- Wait a few minutes after a tree has fallen before proceeding with the bucking of the tree. Broken branches are often caught in the crowns of neighboring trees and can fall unexpectedly.

- When working near a road or place where people are likely to pass, signs should be posted warning of felling activities in progress.

- Falling is not a "spectator sport"! When observers are allowed to visit a felling site, they should be thoroughly briefed on safety protocols and their movements should be strictly controlled. Observers should maintain a safe distance from a felling site of at least two tree lengths.

- Tropical trees are often buttressed and can have large, irregular crowns. Felling such a tree, requires a good technical understanding in order to minimize safety risks and in order to ensure that the felling does not result in wasted wood (refer to section 3.4).

- The company should supply the faller and his helper with basic safety equipment such as safety helmets and gloves, and should enforce the use of such equipment at all times.

Safety Equipment

In Indonesia, most forest concession companies employ their fallers as contract workers paid on a 'piece work' basis. Few companies supply their fallers with minimum safety equipment or, do not adequately enforce the use of such safety equipment. Regulations covering safety equipment are largely lacking or are often not enforced.

Under an RIL system, safety considerations have an important role to play in ensuring the well being of the forest worker. Basic safety equipment should include:

① A good quality safety helmet to be worn by both the faller and his helper. This is part of the minimum safety equipment which should be supplied by the company.

② Proper gloves are also part of the safety equipment which should be supplied to each man in the falling team.

③ Hearing protection.

④ Full face protection visor.

⑤ Asbestos fiber pads or safety trousers.

⑥ Safety boots with steel toe caps.

⑦ Chainsaws should be equipped with an automatic chain break.

Figure 9 : Safety equipment

3.3 A Decision Making Framework for the Fallers

The felling activity is without question, one of the most decisive activities in terms of impact on the forest. The faller is the ultimate decision maker since, despite all tree inventories, stock maps, and tree marking, it is the faller who makes the final decision whether or not to cut a tree and in which direction to fell the tree.

The faller also bucks the tree into logs and is therefore a principle decision maker for the implementation of a company's utilization policy. The faller, therefore, needs to be properly trained and empowered so that these crucial activities are carried out correctly.

- Whenever possible, the faller should try to orientate the felling direction so as to facilitate skidding.
- Felling into existing gaps in the forest will minimize impact.
- The location of future crop trees or protected trees should be considered when choosing the felling direction.
- An experienced faller will try to avoid irregular ground when choosing a felling direction so as to avoid having the tree break, resulting in the loss of valuable wood plus extra work bucking out the break, not to mention the reduced income for the faller

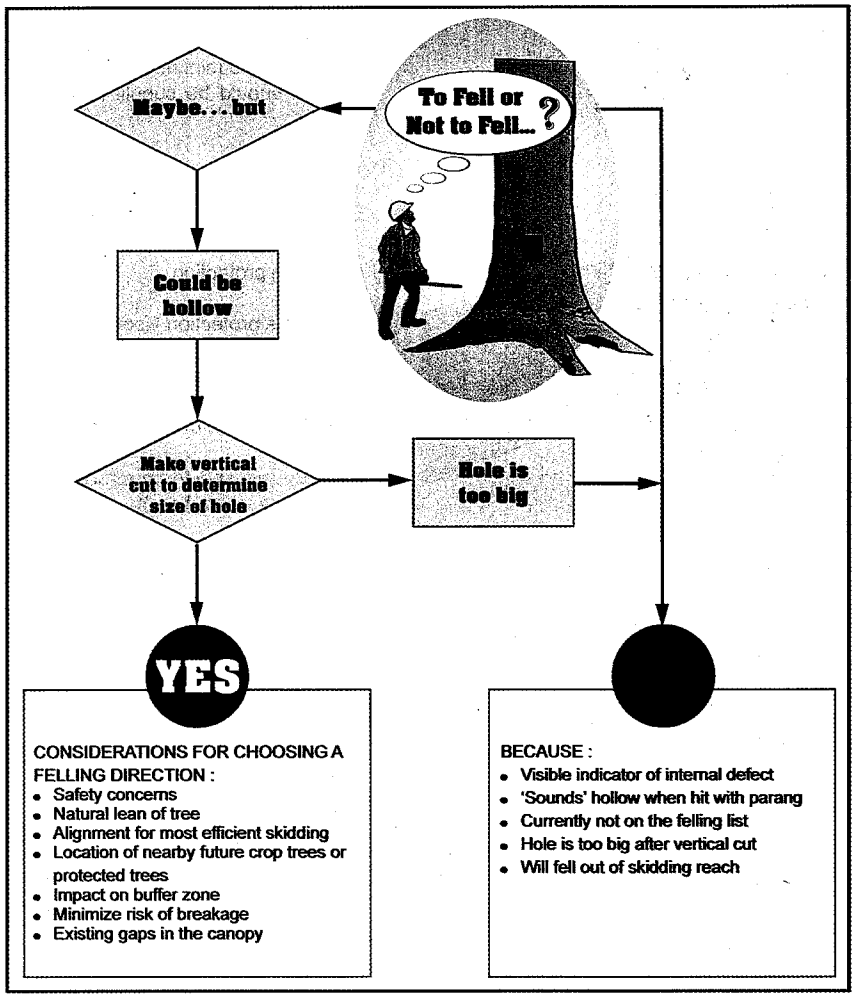


Figure 10 : Decision making framework for the faller.

- The faller should be provided with a map for his working area. The map should show all topographic features, tree locations, tree numbers, constraints to felling such as buffer zones, and excessively steep areas. All located skid trails should be clearly shown so that the faller can more effectively orientate the felling direction to facilitate easy extraction of the logs.

- The faller should also be supplied with a plasticized pocket copy of a simplified felling and bucking guideline which reflects the utilization policy of the company.

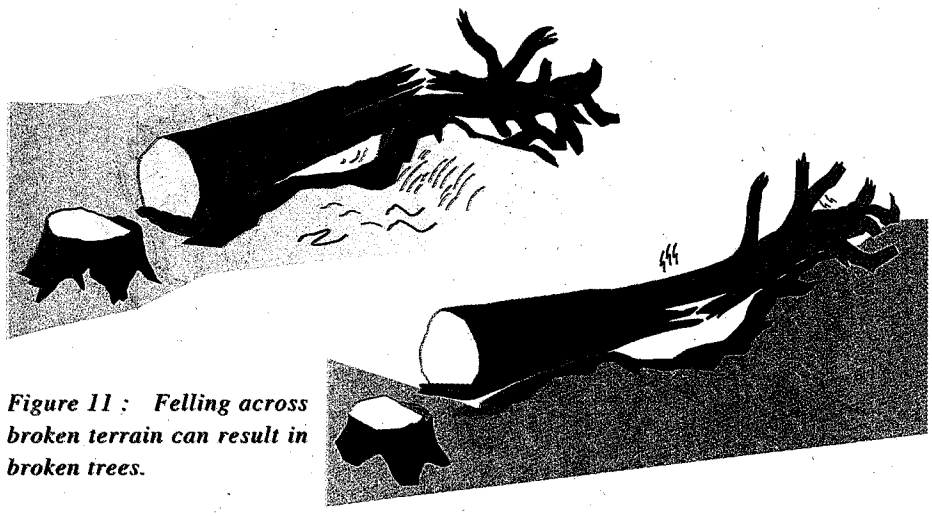


Figure 11 : Felling across broken terrain can result in broken trees.

3.4 Technical Aspects of Felling

Much has been made of directional felling and indeed, much can be done to minimize the impact of felling on the surrounding trees and on maximizing the recovery of volume from the tree being felled. In the previous section we have discussed a "decision making framework" for the faller. We have also provided an introductory section on worker safety.

Both the decision making framework and the safety considerations, should be expanded into the technical aspects of the actual felling and bucking activities. Appropriate training, adequate tools and clear instructions are the essential ingredients for ensuring optimum results.

Preparing the tree for felling (Figure 12)

① The faller determines the target felling direction.

② He examines the base of the tree and removes dirt and bark in preparation for the chainsaw.

③ Lianas connected to the tree, should always be cut.

④ Meanwhile, the helper clears the vegetation around the base of the tree and clears escape routes.

⑤ The faller now begins the undercut at right angles to the intended felling direction.

Figure 12 : Preparing a tree for felling.

Basic felling techniques

The "ideal" tree is one which has a round bole and a uniform, balanced crown and no lean. Such a tree can theoretically be felled in any direction using proper felling techniques.

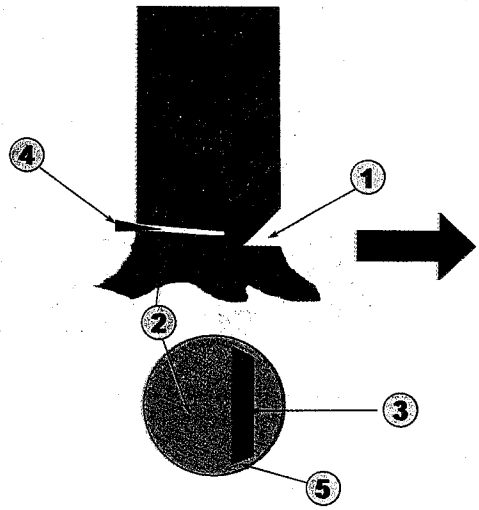


Figure 13 : Cutting sequence for the ideal tree.

① The undercut should penetrate about one quarter of the diameter into the tree

② The back cut should be horizontal and about 5 cm higher than the base of the undercut (slightly less on small diameter trees and up to 10 cm on large diameter trees).

③ The hinge is necessary to guide the tree as it begins to fall. It should have the same width on both sides and should be approximately one tenth of the diameter of the tree.

④ It is strongly advised that each faller should carry at least two felling wedges to assist in directional felling and bucking.

⑤ Small lateral cuts on the sides can be useful to reduce tearing, particularly in the case of softer woods.

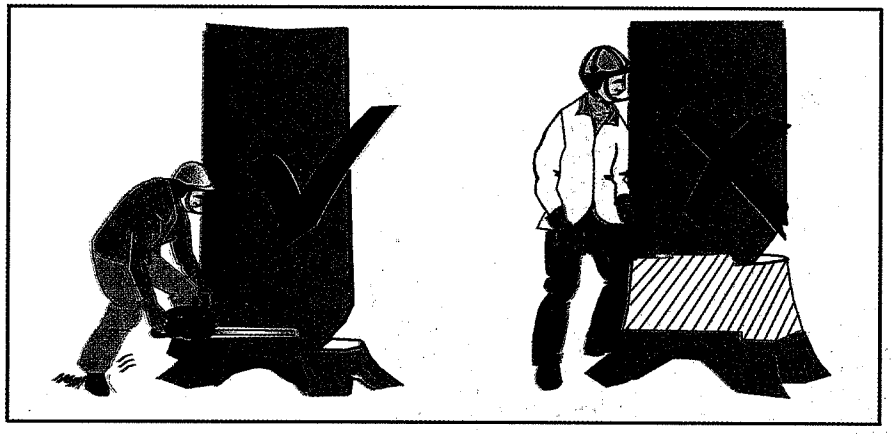


Figure 14 : Miximizing volume recovery during felling.

DON'T leave good quality round wood on the stump. Maximize recovery of the main stem volume by felling the tree as close to the ground as possible. (for exceptions see "Felling techniques for buttressed trees")

DON'T try to save time by making the undercut too shallow, even if you are confident the tree will fall in the desired direction. The result can easily be a splitting of the trunk which will not only create a lot of wasted wood but also presents a serious safety hazard since the tree may "kick-back" unexpectedly as it splits.

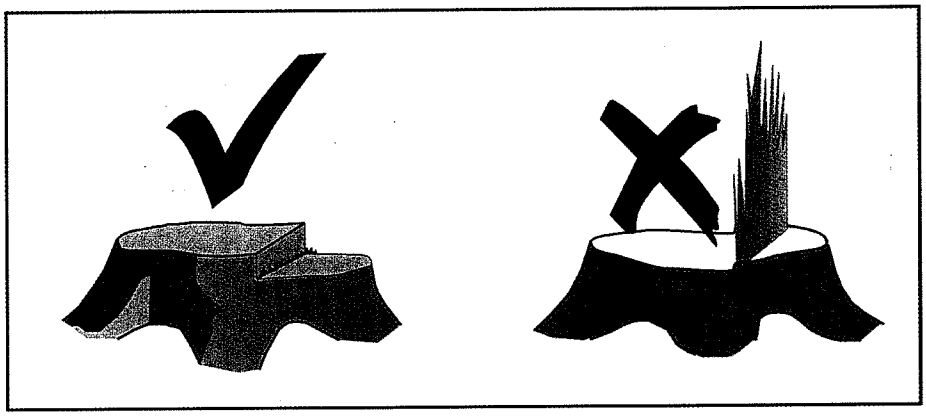


Figure 15 : Back-cut too low.

NEVER make the back cut at the same level or lower than the undercut. This will result in wood loss due to fiber pull. More importantly, it creates a serious safety hazard as the tree is likely to rock back on the back-cut, pinching the chainsaw bar and creating a very difficult to control and dangerous felling situation.

Photo 12 : A faller's helper inserting a felling wedge as the faller makes the back-cut on a large Bangkirai.

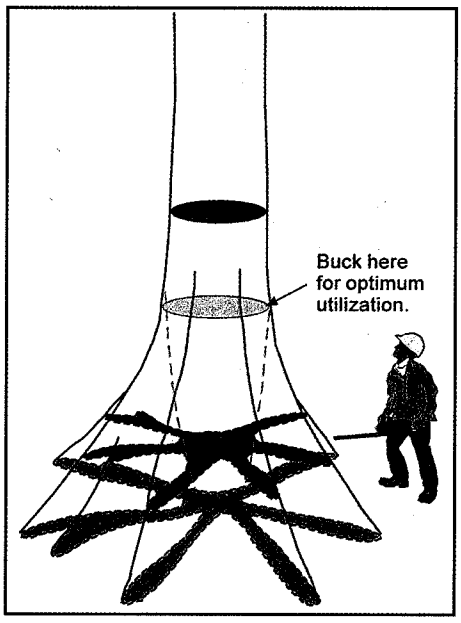


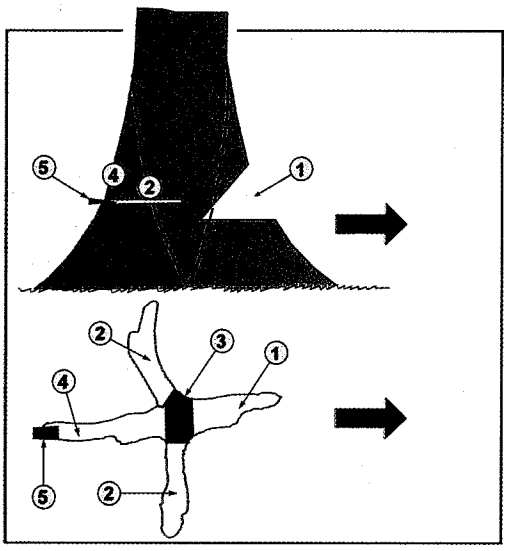
Figure 16 : Cross sections of a typical buttressed tree.

Felling techniques for a buttressed tree

Unfortunately, the "ideal" tree is very rare in the hilly terrain of South-east Asia and the Pacific Region. Trees often have buttresses which complicate the felling process. Even more problematic is the fact that tropical trees often have crowns which have larger branches on one side than on the other. Combined with naturally occurring lean, these factors create a complex felling challenge and an increased safety hazard.

A tree can have three or more buttresses in a wide variety of configurations. Each tree will have to be evaluated separately depending on the position of the buttresses with respect to the intended felling direction.

Figure 16 illustrates the cross-sectional profile of a typical buttressed tree. The cylindrical shape of the bole often begins to taper into an inverted cone a few meters above the ground. This is the point at which the tree will have to be bucked after felling.



The cutting sequence for falling a buttressed tree will vary a great deal depending on the configuration of the buttresses. (Figure 17)

Figure 17 : Cutting sequence on typical buttressed tree.

① The undercut is positioned at right angles to the desired felling direction. The opening of the undercut is usually wider than for a non-buttressed tree.

② Side buttresses are cut next.

③ Make sure that the hinge wood is retained as in a non-buttressed tree.

④ The remaining buttress opposite the desired felling direction, is cut last.

⑤ In case of any uncertainty in successfully achieving the desired felling outcome, use a felling wedge to secure the felling direction.

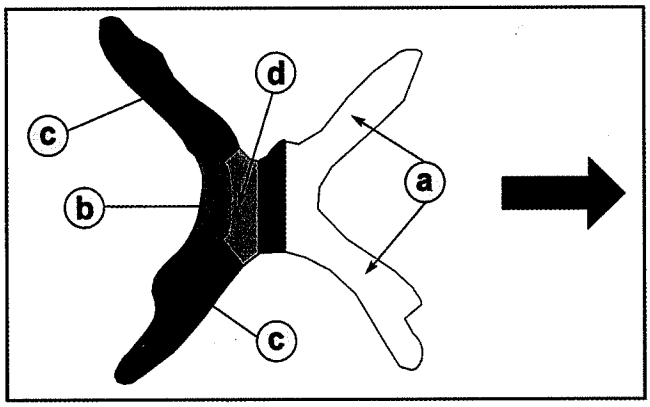


Figure 18 : Different shaped buttresses require different cutting sequences.

A similar approach is used for all buttressed trees but the cutting sequence will depend on the shape of the buttress. In Figure 18, the cutting sequence is shown by the letters "a" to "d".

The cutting sequence will be different if the buttressed tree has a natural lean. (see the next section, "Felling techniques for leaning trees")

Felling techniques for a leaning tree

Most trees in the hill forests of South East Asia, have a natural lean if they are growing on sloping ground. It is also common for trees growing on sloping ground to have a crown which has more and larger branches on the downhill side.

General decision making framework for a choice of felling direction still applies although the felling options will be more limited.

If the leaning tree has a **rounded bole**, follow the cutting sequence in Figure 19.

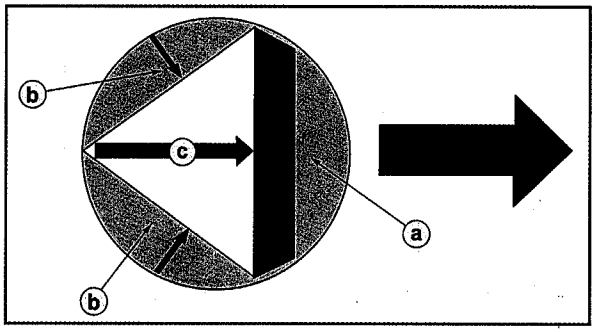


Figure 19 : Cutting sequence for a leaning tree with a round bole.

Even **leaning trees** can be felled to a point about 30 degrees on either side of the lean ①This will require a modified felling technique (Figure 20).

The undercut ② is positioned at right angles to the intended felling direction ③. The 'holding wood' or hinge ④ should be kept larger on the side to which the tree is to be felled.

In addition, a wedge ⑤ should be inserted into the back cut ⑥ on the side of the lean to help direct the tree's fall in the desired direction. For most effective use of wedges, the faller should carry a heavy sledge hammer.

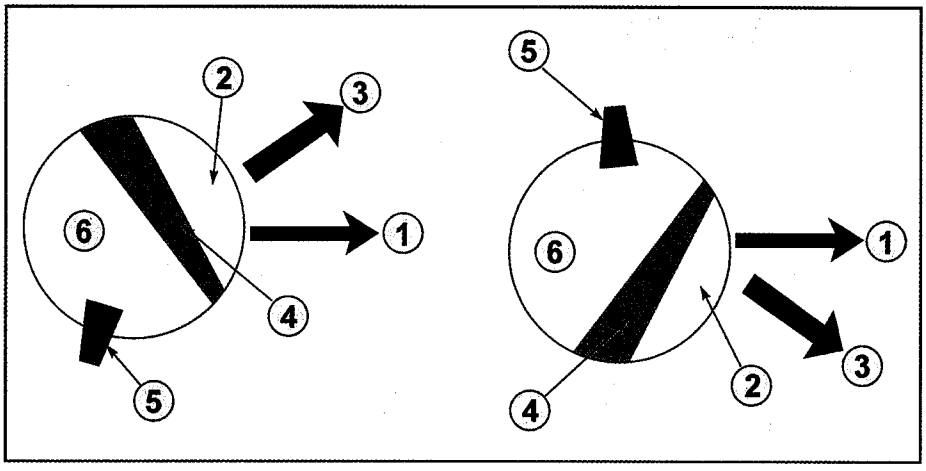


Figure 20 : Using the holding wood to influence the felling direction on a leaning tree.

If, however, the tree has a buttress or an elongated bole on the uphill side, follow the following cutting sequence in Figure 21.

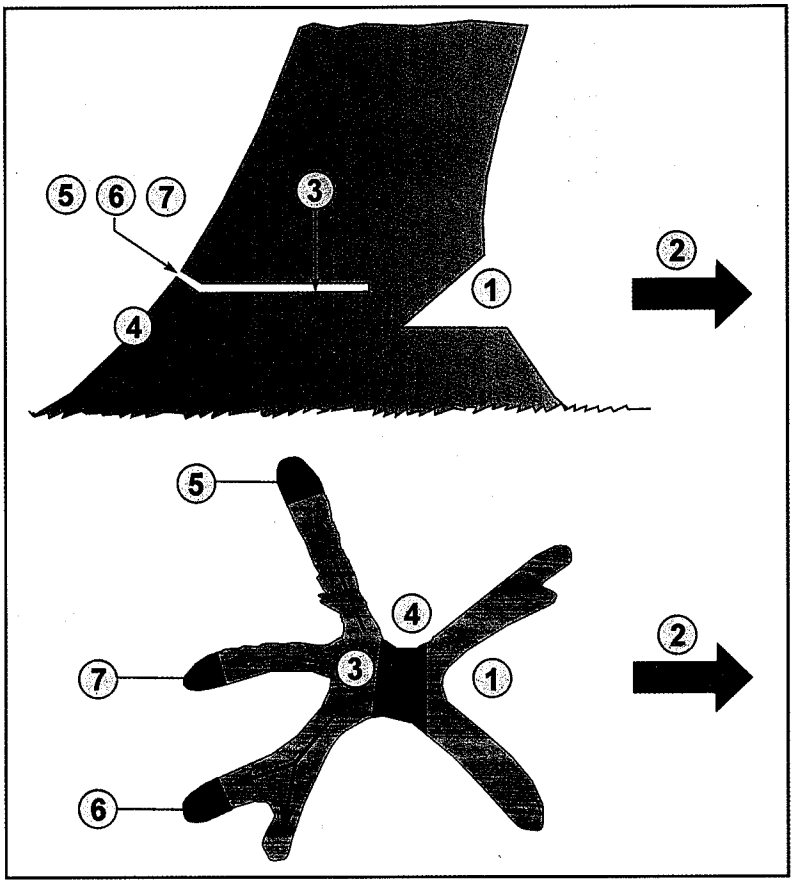


Figure 21 : Cutting sequence for a leaning tree with buttresses.

1. Make the under cut ① in the desired felling direction ②. The under cut on a leaning tree will not be as deep as a straight tree.

2. The back cut starts with a boring cut ③ on the buttresses making sure an adequate hinge ④ is retained and "holding" wood ⑤⑥⑦ is maintained on the buttresses.

3. The tree is now poised to fall and is held up only by the holding wood.

4. Cut the holding wood at an oblique angle. The last cut ⑦ should be on the holding wood in line with the felling direction. (Figure 21)

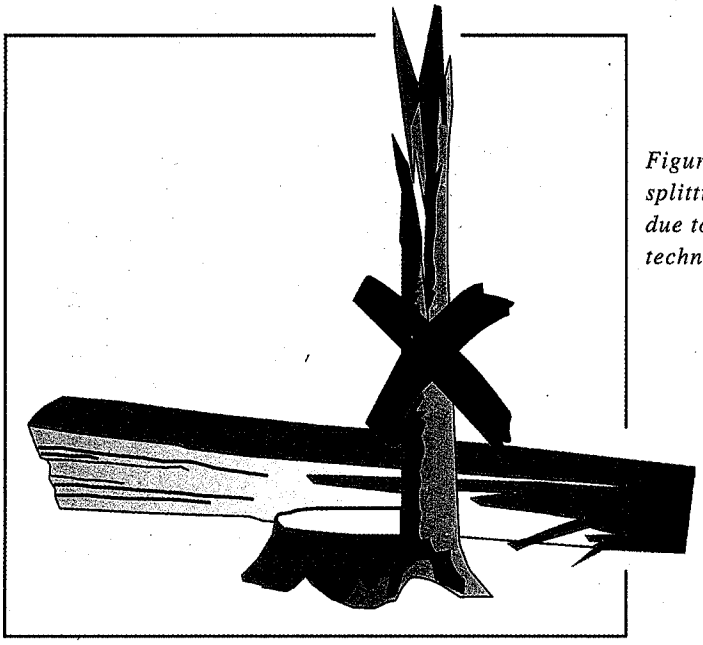


Figure 22 : Serious splitting of the tree due to poor felling techniques.

DON'T take short cuts with leaning trees by thinking that you can avoid making an undercut. The result is likely to be that the tree will split up the middle spoiling a significant section of the main stem volume and possibly creating a serious safety hazard by "kicking back" towards the faller.

3.5 Bucking

Bucking includes all the activities related to cutting the tree into logs ready for extraction from the felling site. This activity is essentially the company's translation of its overall utilization policy, into concrete action and is usually given a practical context through the formulation of simple bucking standards which should be issued to every faller.

Bucking is also the beginning of the log tracking system which will enable the company to monitor its log inventory and log movements. Once the faller has trimmed the butt end of the log, he should attach one portion of the three-part, red plastic tree label to the butt end of the log. One portion of the label is re-attached to the stump, and the third portion is retained by the faller and submitted to the logging foreman as proof of his day's falling production.

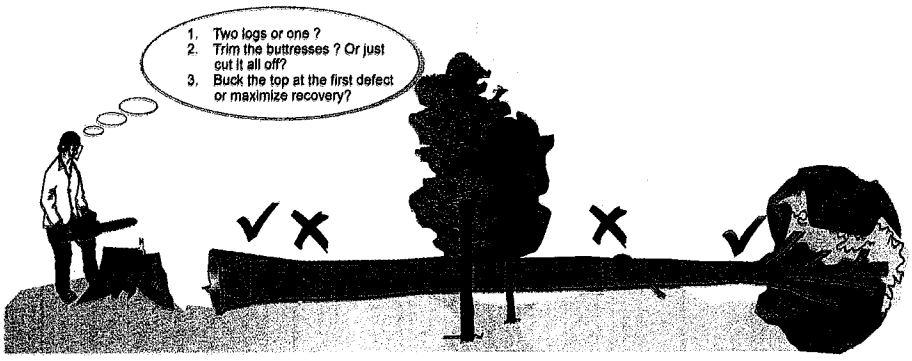


Figure 23 : Maximizing main stem volume recovery through correct bucking.

Safety considerations

As the faller re-enters the felling site, he should beware of overhead hazards. Broken branches are often caught up in the neighboring crowns and could fall without warning. Wear a hard had at all times!!

Branches and small trees pinned down by the fallen tree are often under a great deal of tension and can easily snap.

When bucking trees on a steep slope, be particularly conscious of potential hazards. Evaluate the tensions in the stem due to its position carefully before planning the cut. Always consider safety first.

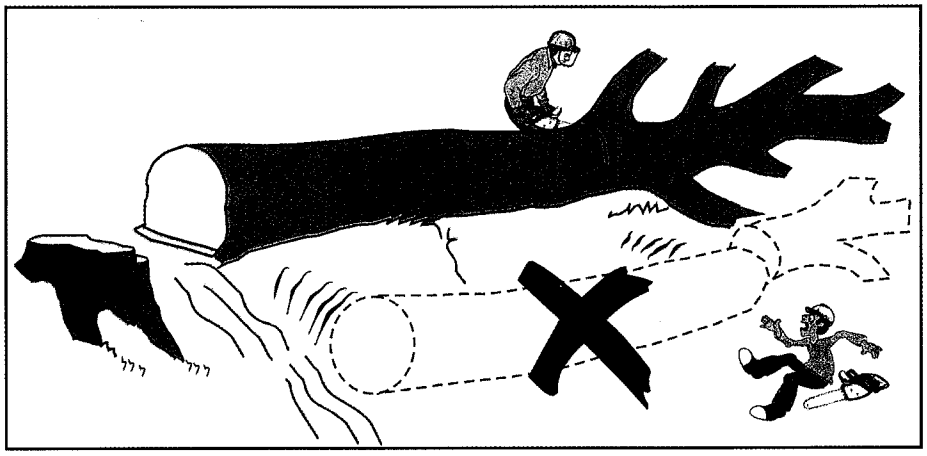


Figure 24 : When bucking a fallen tree on a slope, make the cut in a safe position on the up-slope side of the tree.

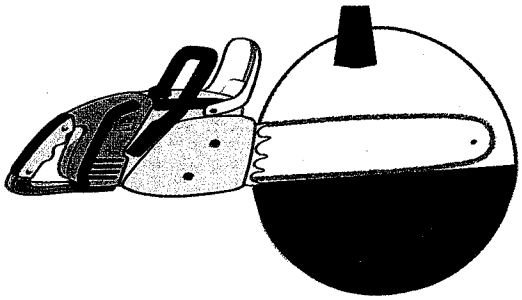


Figure 25 : When bucking trees under tension, use wedges to keep the tension wood from binding the saw blade.

Applied bucking standards to maximize utilizeable volume

Chapter 2 provides a thorough discussion of bucking considerations to maximize the utilization recovery of the felled tree. Companies should set clear utilization policies which aim at optimum economic recovery from the trees that have been selected for felling.

This policy should be put in the form of simple bucking guidelines and issued to both the faller and the scaler working at the landing. The faller is the key to determining whether the company's utilization policy is effectively implemented or not.

Fallers are usually quick to respond to the adoption of a more rigorous bucking standards because it usually means a higher volume recovery for virtually the same level of effort, hence better income.

Apart from the quality considerations discussed in Chapter 2, there are also some simple techniques which need to be followed to ensure minimization of waste resulting from incorrect bucking techniques.

Recognizing when the log is under tension or compression will determine the cutting sequence. Incorrect bucking will result in the chainsaw bar getting pinched, thus resulting in long delays in the work as the faller removes the pinched bar.

Using an incorrect cutting sequence can also result in the log splitting. This will require additional cutting to remove the spoiled wood (Figure 26) and will result in significant volume loss.

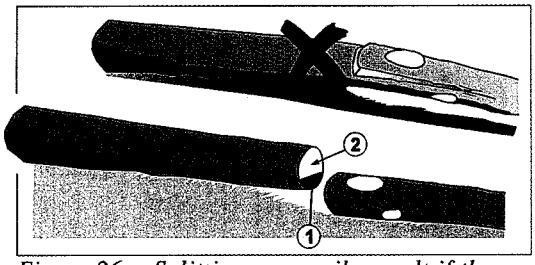
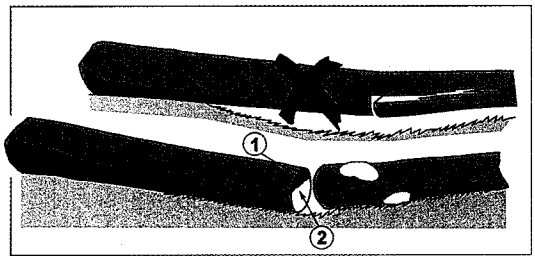


Figure 26 : Splitting can easily result if the right cutting sequence is not followed



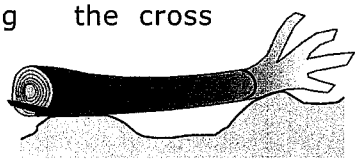
When a log is under tension, it will easily split if the cross cutting starts on the side which is under tension.

Proper sawing techniques will reduce the danger of splitting to a large extent and will also prevent pinching of the chainsaw bar.

Always remember to cut first on the side of the log which is under compression ①. Then complete the cut on the side which is under tension ②.

As the final cut nears completion, the log may move suddenly as the tension is released. Be sure to stand in a position of safety when making the final cut.

Similarly, when bucking the crown of the tree, evaluate the weight distribution based on the way the tree is lying before starting the cross cutting.



Follow the sequence of cuts shown

Figure 27 : Sequence of cross cutting when the tree is under tension and compression.

in Figure 27 by making the first cut in the compression wood and the final cut to relieve the tension wood.

3.6 Skidding

The skidding activity is where much of the logging damage occurs, primarily as a result of excessive machine movements.

By opening skid trails prior to felling under an RIL system, there is a strong potential to greatly reduced the impact of the skidding activity. Further gains in reducing impact can be assured by a small additional effort in terms of effective supervision and monitoring.

The skidding team must be provided with a few simple guidelines.

Skidding guidelines

1. Stay on the located and opened skid trails.
2. If there are trees which can be reached only by constructing a new skid trail, get approval from the foreman or supervisor first.
3. Trees within 20 meters of the skid trail should be accessed from the trail using the winch.
4. If the tractor has to leave the trail to access a more distant log, it is recommended to reverse into a suitable winching position rather than entering the forest and then turning the machine around.
5. No machine access in designated buffer zones except at designated crossing points.

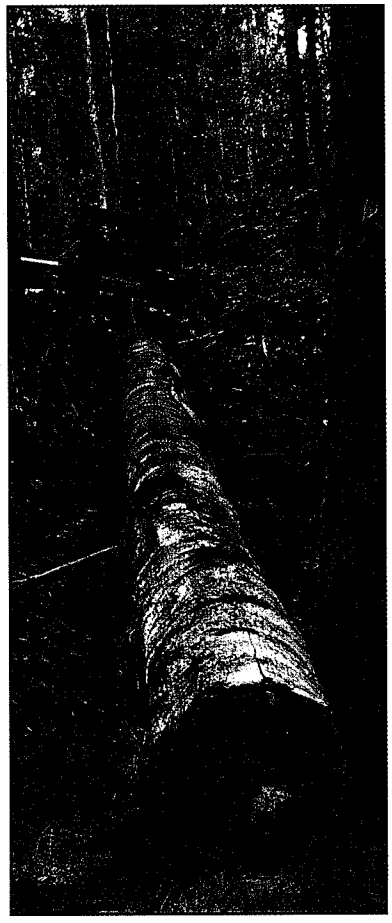


Photo 13 : Tree length skidding.

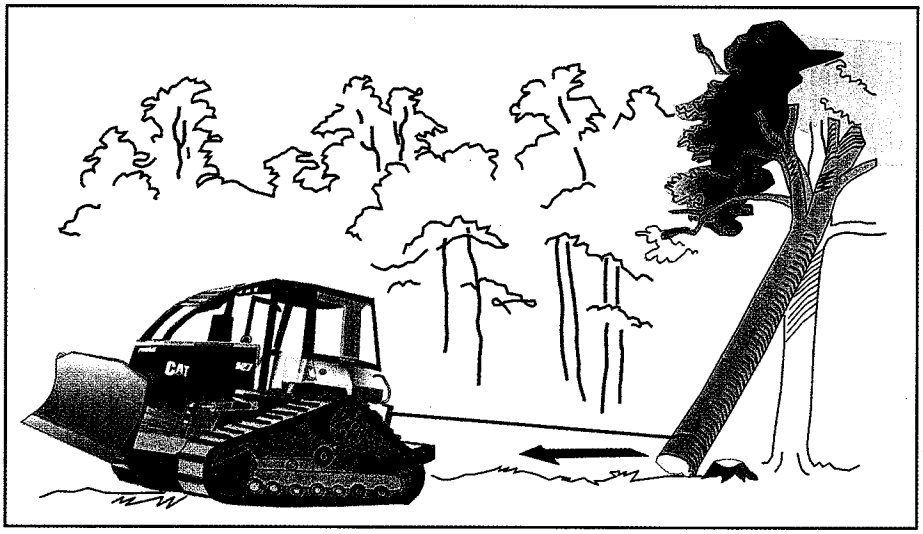


Figure 28 : On occasion, the tractor operator may have to assist the faller when a trees gets held up by surrounding trees.

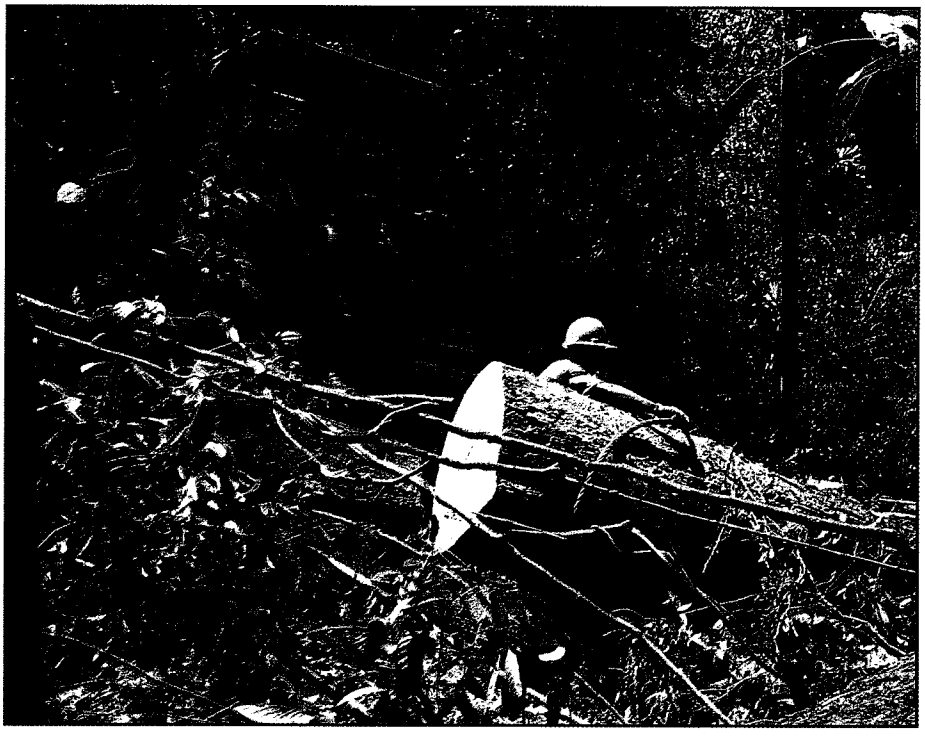


Photo 14 : Preparing to winch a log.

3.7 On the Landing

It is common practice to skid tree length logs to the landing whenever possible. The landing is the final and most visible implementation point of a company's utilization policy.

Activities at the landing

- Debarking to reduce wood borer attack.
- Trimming rough ends and unavoidable waste.
- Bucking to grade and to the desired length for trucking.
- Applying S-nails to reduce splitting.
- Applying log information to permit log tracking and inventory control.
- Applying the licensed government hammer mark.

The landing is the place where the grader makes the final decision regarding the implementation of the company's utilization standard.

In many companies, these standards are a direct reflection of an outdated utilization policy imposed by the companies own manufacturing industry. In applying a RIL management strategy, it is recommended that forest companies re-examine their utilization policies in the context of the shrinking raw material supply.

What is waste to one company could well turn out to be a high value raw material for another company. To explore the potentials of this new paradigm will, however, require a fresh look at existing policies that result in such high levels of waste.

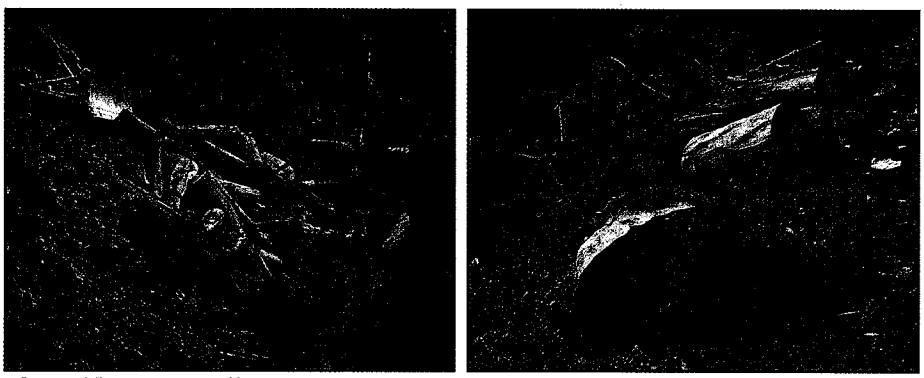


Photo 15 : It is still common practice to leave large volumes of apparently good quality wood at the landing

Wood tracking arrangements

Whether a company is trying to achieve the implementation of an independently audited chain-of-custody system, or simply applying existing regulations to achieve a more effective log inventory control, the landing is the starting point for the effective implementation of a good tracking system.

Government regulations require that companies inventory the proposed cutting areas and label all trees eligible for harvesting with a 3-part red plastic label. One part of this label must be attached to the log at the felling site.

When the log is skidded to the landing, it can be identified by the original inventory tree number of the red tag. Government wood tracking requirements also call for the permanent attachment to the log of information regarding its origin, species, and size.

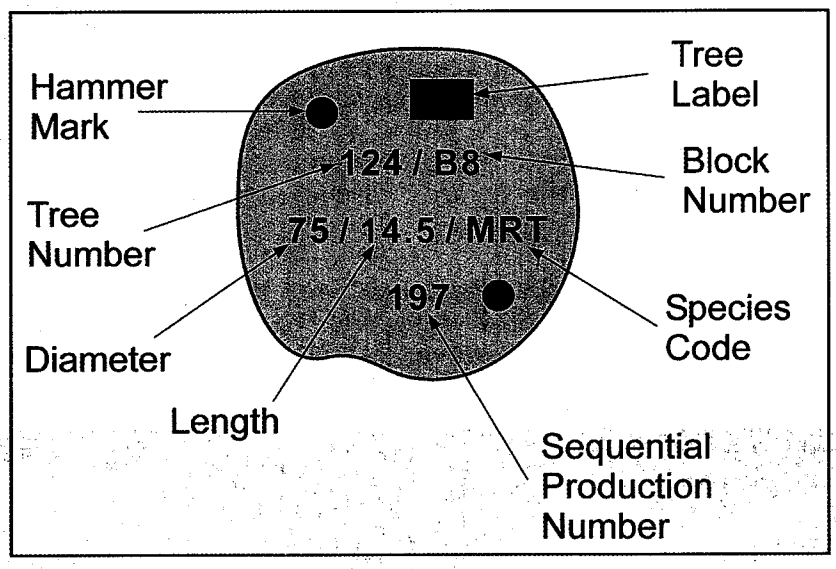


Figure 29 : Sample information on the end of a log ready for transportation.

This information can be attached in various ways. One of the most durable ways is to etch the information into the ends of the logs using a specially designed chisel. This is accomplished very quickly and provides a permanent way of identifying the individual log. This information is permanently attached to the log and can only be removed by bucking off the end of the log.

Photo 16 : A locally manufactured chisel is an effective way to very quickly etch the essential information onto the end of the log.

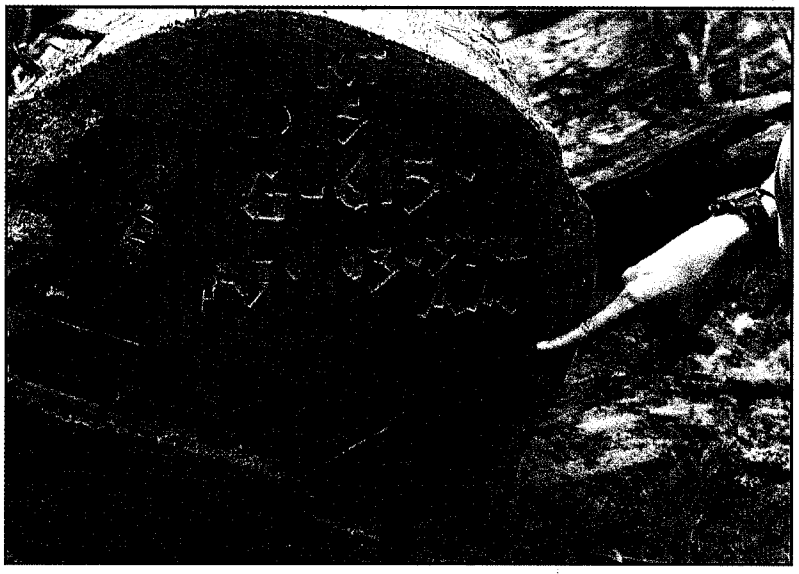


Photo 17 : Etched log data. Note the original red plastic tree number tag and the S-nails.

CHAPTER IV

POST HARVESTING ACTIVITIES

Post harvesting activities refer to those activities which need to occur after the logging activities have been completed in order to ensure that the objectives of the RIL system have been met.

The objectives of RIL can be restated as:

1. Minimize the impact of logging operations, and,
2. Maximize the economic performance of the logging operation.

4.1 Monitoring Functions

Monitoring activities are carried out in conjunction with harvesting activities.

Purpose of monitoring activities

- To ensure that no logs are left behind.
- To ensure that felling and bucking standards are implemented according to the company's utilization policy.
- To ensure that machine activity is confined to planned and opened skid trails as much as possible.
- To provide support for the logging crew in checking any areas which have been overlooked in the skid trail planning and, in finding and marking the best access into such areas.
- To ensure that buffer zones are respected.
- To ensure that data collection on trees harvested and trees left is complete and that the original planning map is updated as logging progresses in the cut block.

Operational aspects of monitoring activities

Company's implementing a RIL system must evaluate whether the monitoring function can be carried out as part of existing staff functions or whether it will require a new staff position.

In most cases, the existing supervisory staff already have enough responsibilities which prevent them from carrying out the detailed monitoring that would be required to ensure successful compliance with RIL objectives and procedures.

As a company changes to RIL approach in organizing the working area and implementing RIL operational practices, it may be advisable to conduct a comparative study to evaluate the benefits of changing to an RIL system. These benefits could be defined as improved productivity, greater volume recovery, better condition of the residual stand, and lower environmental impact.

If a company decides that monitoring functions can best be carried out as a new job function, it must ensure that this function is clearly identified and that reporting requirements and chain-of-command are clearly stated and well understood by all personnel involved in the production activities.

4.2 Deactivation of Skid Trails and Landings

What does "deactivation" mean?

Deactivation, in the context of a logging operation, means putting out of use, or "decommissioning" the infrastructure used for logging. In the immediate sense, this refers to the skid trails and landings.

For skid trails, this includes activities such as cross-ditching and removing matting from stream crossings.

Why deactivate skid trails?

Deactivation of skid trails is not something which the average forest manager would consider as part of his responsibility or indeed, an activity which the average forest manager has even heard off.

On the other hand, most forest managers have had experience dealing with local communities who complain that their water supply has become muddy and that it is increasing difficulty to catch sufficient fish in the local streams to meet the community's needs. Increasingly, such complaints are leading to violent confrontations between local communities and the forest company.

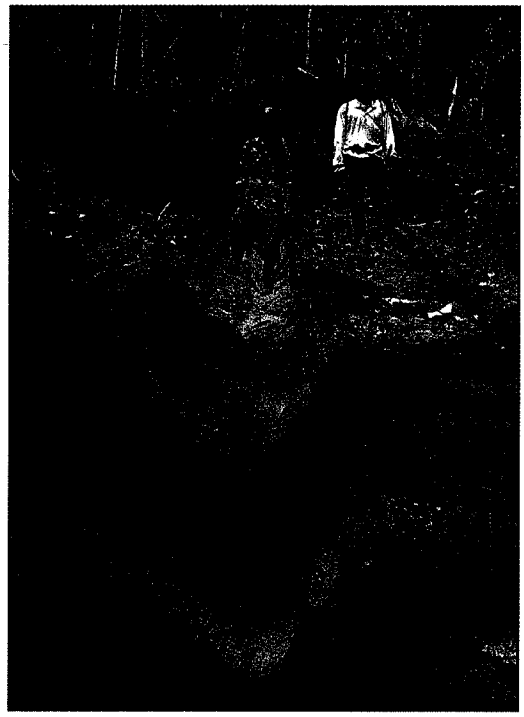


Photo 18 : An erosion channel on a major skid trail.

The connection between the conventional approach to road construction and logging and a heavily sedimented stream system is undisputed. The resulting social conflict and its connection to a high logging impact is equally clear. The cost to the company can become very significant.

The solution to this social problem is rooted in the company's approach to the logging activity and is relatively easy to achieve. Through proper planning, stream crossings can be minimized and stream buffer zones create an awareness of the importance in minimizing impact on the stream system.

At the operational stage, proper supervision and operational standards will further reduce the risk of erosion and stream sedimentation. However, once an area has been logged, the skid trail network can become a major source of erosion if prompt preventative action is not taken.

Who's job and how to ensure it gets done?

Deactivating skid trails refers primarily to the cross-ditching of the trails to prevent the skid trail from becoming an erosion channel which delivers sediment into the stream system during periods of heavy rainfall.

This can be easily carried out by the tractor operator. Once all logs have been extracted from a particular skid trail, the tractor operator should create simple cross drains along the skid trail as he leaves the area. The cross drains should be at a slight angle to the skid trail so that they intercept run-off and direct it into the

Photo 19 : Cross ditching a skid trail on the way out of an operating area.

adjacent forest area.

Frequency of cross drains will depend on gradient, rainfall intensity, and profile of the skid trail. In most cases, the tractor operator can easily chose suitable sites for cross drains. Refer to Table 2 for general guidance.

The company should establish its own guidelines for the cross ditching of skid trails. Such guidelines would be influenced by the topography and soil erodability in each concession area.

For this activity to succeed, the company will have to integrate this activity into the job description of the tractor operator and check the completion of this activity as part of the monitoring functions and post harvesting evaluation.

In most situations, the additional effort required to perform adequate cross ditching will not be more than a few hours for a 100 hectare logging block.

A company may be able to get its tractor operators to carry out this additional activity without additional compensation since considerable time savings and increased productivity should have been the outcome of proper skid trail planning and location.

Alternatively, the company may also choose to consider incentive payments or penalty deductions, or a combination of both to ensure that tractor operators routinely carry out this job function.

Deactivating landings

Deactivation of landings should first of all ensure that the landing is left in a condition that does not contribute to the sedimentation of a nearby stream. This may require the construction of drainage channels to direct run off into the adjacent forest and away from direct access to a stream.

Secondly, deactivation of landings should include the planting of trees in the spoil areas surrounding the landing. Fast growing trees planted in spoil areas could become future crop trees if they reach maturity within one cutting cycle or if only part of the landing is used in the next cutting cycle.

Deactivation of landings could also include the scarification of the compacted surface and the planting of the entire landing area. However, experience has shown that trees planted in the main portion of the landing will grow only very slowly and even for fast growing species, they cannot be expected to achieve a commercial size within the time span of a normal rotation cycle.

The decision to replant the most compacted portion of a landing should, therefore, be part of an overall company policy where the costs and benefits have been analyzed in the context of the likelihood that the landing will be used again for the next cutting cycle. Planting the compacted portion of a landing is optional and should only be carried out if the landing is not expected to be used in the next cutting cycle.

Creating deactivation guidelines.

Most forest concessions seldom carry out deactivation activities apart from roadside planting and in some cases, planting of landings.

In most cases, therefore, it will be necessary for a company to establish its own guidelines and implementation standards to ensure that the objectives of skid trail and landing deactivation are achieved.

Table 2 provides an approximate guide to the establishment of cross drains on skid trails based on slope.

Table 2 : Cross drain spacing on skid trails

	Slope (%)	Cross Drain Spacing
Skid trail cross drains	<10%	No cross drains required
	10-20%	Every 30 m
	>20%	Every 20 m

4.3 Post-Harvesting Evaluation

Purpose

The adoption of new practices usually requires an adjustment period to allow for staff to become acquainted with their new job activities.

Management also needs to be able to monitor the adoption of new practices to ensure that the desired results are being achieved.

This requires a clear statement of objective of the post harvesting activities as well as a thorough job description for the persons responsible for the evaluation activities.

The purpose of a post harvesting evaluation is to:

1. Provide company management with a measure of the success at implementing the logging plan.

2. Identify problems in implementing the logging plan according to the RIL standards. These could include unnecessary skid trails, violation of buffer zones, inappropriate skid trails, poor bucking, left logs, inadequate cross ditching, etc.

3. Identify areas which will need corrective action. This could include cross ditching, opening stream crossings,

and identification of areas requiring planting due to heavy logging impact.

Job description

Post harvesting evaluation is primarily a field activity but it should culminate in a simple report and a copy of the block map showing all existing skid trails, harvested trees, and unlogged areas.

A report should be prepared for each logging block. The report could follow a standard format designed specifically for this purpose by the company. The report and the block map should be closely linked. Findings of the field evaluation should be shown on the map as well as described in the report.

The report should cover at least the following points:

- List of trees cut in the logging block. This would follow the requirements of the production report. Accompanying map to show the location of the harvested trees.
- Status report of utilization. Identify any significant lapses in bucking policy and provide recommendations for corrective action. Any left logs? Etc.
- Evaluation of skid trails. Were planned skid trails followed? Were any new skid trails established and if so, why? Are there problems of skid trails related to stream crossings, buffer zones, excessively steep areas, duplicated trails, etc.? The accompanying map should show all existing skid trails.
- Deactivation activities: Have steep skid trails been cross ditched according to company guidelines?
- Provide an estimate of the areas not logged with reasons given. Highlight these areas on the map.
- Recommendations for corrective action. This could include recommendations for cross ditching, removing stream obstructions disciplinary actions, identification of areas to be planted with number of seedlings required, etc. The accompanying map should show the location of corrective actions being recommended.

Evaluation reports should be concise and should present meaningful information to guide subsequent management activities.

Evaluation reports should be prepared for each logging block or compartment and should form part of the permanent record for that block. A map is an essential component of any post harvesting evaluation report.

Appendix I

REFERENCES CONSULTED

The following is a list of the principle references consulted in the preparation of this technical procedures manual.

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Appendix II

ENGLISH - INDONESIAN TERMS

Annual Allowable Cut (AAC)	:	Batas tebangan maximum selama setahun.
Annual Cutting Target	:	Rencana Karya Tahunan (RKT) or (JPT) Jatah Produksi Tebangan
APHI (Association of Idonesian Forest Concession Holders)	:	Asosiasi Pengusaha Hutan Indonesia (APHI).
Backcut	:	Takik balas - pemotongan akhir yang dibuat sewaktu menbang
Block, cutting block	:	petak, (usually 1000m x 1000m management unit)
Bucking	:	Pemotongan log
Buttress	:	Banir
Ministry of Forestry	:	Department Kehutanan Indonesia (DEPHUT)
Forest Concession	:	Hak Pengusahaan Hutan (HPH)
Felling	:	Penebangan
Future Crop Trees / Potential Crop Trees	:	Pohon inti - pohon yang akan menyediakan kayu komersial di masa mendatang
Hinge	:	Engsel - bagian kayu yang tidak dipotong yang terletak antara takik rebah dan takik balas.
Holding wood	:	Bagian dari batang pohon yang ditebang terakhir
ITTO	:	International Tropical Timber Organization

Landing	:	TPN - tempat di mana log disimpan sebelum diangkut ke logpon
Matting	:	Tempat penyeberangan sungai / parit sementara
RIL - Reduced Impact Logging	:	Pembalakan Berdampak Rendah
Skidding	:	Penyaradan - menarik log dari tempat penebangan ke tpn.
Skid trail	:	Jalan Sarad
T F F	:	Tropical Forest Foundation
TPTI - Indonesian Selective Cutting and Planting System	:	Tebang Pilih Tanam Indonesia
Undercut	:	Tekik rebah

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