REDUCED IMPACT LOGGING GUIDELINES FOR INDONESIA

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FOREWORD

By

Ir. A. Fattah DS

Director General

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This book, “Reduced Impact Logging Guidelines For Indonesia” has been long awaited by logging practitioners in the field. It is designed as a guide to environmentally sound logging operations in Indonesia. Reduced Impact Logging (RIL), as many forest practitioners perceive, is part of the effort to attain sustainable forest management.

To meet the needs of users, the book uses simple language to make it easy to understand, and is presented in a unique and handy format, making it easy to carry in the field.

It is our pleasure to acknowledge the contribution of the ITTO, through ITTO Project PD 12/97 Rev.1 (F), and to offer our thanks to CIFOR and FORDA for their collaboration in the project’s implementation, to PT INHUTANI II for its contribution to research and testing the adoption of RIL techniques, and to the many people who helped at various stages in the writing of this book.

It is our hope that this book will provide a useful reference that will enhance the performance of forest management in Indonesia.

December 2001

FOREWORD

By

Dr. Mafa Chipeta

Deputy Director General of CIFOR

The world has committed itself to achieving sustainable forest management (SFM), which balances production goals with environmental and social ones. In the field of harvesting, achieving SFM requires environmentally responsible logging, hence the growing interest in reduced impact logging (RIL). The Center for International Forestry Research (CIFOR) is therefore very pleased to have benefited from the financial support of the International Tropical Timber Organization (ITTO) and the strong cooperation of the Forestry Research and Development Organization (FORDA) of the Government of Indonesia to do practical research on RIL in the tropical rain forest of Kalimantan, Indonesia. Unlike common research that is based on small plots, the CIFOR investigations were conducted on a commercial scale on the concessions of PT INHUTANI II, a state-owned timber company.

Central to the successful adoption of the RIL study findings is a clear set of guidelines that define the actions necessary to achieve it. These guidelines, which were adopted by the project, conform to TPTI regulations—the Indonesian silviculture system for dryland natural forest. They also reflect close attention to the ITTO Guidelines

for the sustainable management of natural tropical forests and the FAO Model Code of forest harvesting practice.

In preparing these Guidelines, CIFOR has been motivated by the real shortage of simple, easy to understand, and practical guidelines on RIL that field operators would find convenient to apply. There is a multitude of regulations and other guidelines on how to harvest forests in a sustainable manner, but few offer the easy format and handy presentation of the present book. In recommending these Guidelines to the industry, CIFOR also invites practitioners to provide feedback on how well their application goes in the field so that continuing improvements can be made. CIFOR commits itself to continue working towards the progressive improvement of RIL practice, in partnership with the Government of Indonesia, industry and others that have an interest in responsible logging.

For making possible the development of these Guidelines as an important achievement of the project, I take this opportunity to express, on behalf of CIFOR, my sincere thanks to the ITTO for funding the project; to PT INHUTANI II for collaborating in the research and in testing the adoption of RIL techniques; and to FORDA for working together with us to make the project a success.

December 2001

FOREWORD

By

Dr. Untung Iskandar

Director General

Directorate General of Production Forest Ministry of
Forestry

Forests, as a national development resource, have a very real function for human life, helping to achieve a dynamic balance of ecological, economic and socio-cultural benefits. For this reason, forests must be managed, protected and utilized in a sustainable manner for the prosperity of all Indonesians, not only current but also future generations.

Logging is one means of utilizing forest located in production forest zones. In practical terms, logging still entails many problems, such as damage to residual stands and the environment from field activities that focus on logging and pay insufficient attention to regeneration and rehabilitation. Environmental damage caused by logging activities includes land opening, soil damage and erosion, residual stand damage and logging waste.

Despite the negative impacts of logging on forests, logging is necessary in order to realize the full economic value of the forest; it also provides a source of funding for forest management. What is needed is a logging method that has a low negative impact.

One such method is Reduced Impact Logging (RIL). With regard to this, the Directorate General of Production Forest has issued an official memo (No. 274/VI-PHA/2001 dated 23 February 2001) concerning Reduced Impact Logging (RIL). The memo consists of technical guidance for natural forest operation units that intend to implement an environmentally sound logging system.

In anticipation of the successful implementation of RIL, we appreciate the efforts of the ITTO, FORDA CIFOR and INHTANI II in producing these RIL Guidelines.

We hope this book will be of benefit to all.

Jakarta, December 2001

FOREWORD

By

Ir. H. Arifin Trihastoyo, MM.

Director General

PT INHUTANI II

The importance of forest values for people is unarguable; forests have a role as a source of support for life. Forests provide multi-benefits—environmental, social and economic. Therefore we have to ensure their sustainability.

Looking at the current situation of severe forest degradation, especially degradation of natural tropical forest, it appears that a common perspective on the forest itself is needed. We should see the forest as a process of natural production, using the sun's energy to process and produce raw materials such as water, minerals, and air in a sustainable manner; these benefits are not a commodity in the form of deposits which can be mined, for example.

We welcome the publication of the book on RIL Guidelines by CIFOR as the result of their collaboration with PT INHUTANI II. We hope that the book will support attempts to maintain sustainability and to enhance the quality of natural forest production processes that will yield optimal and sustainable benefits for human life.

We also hope that our collaboration can continue, and carry on giving maximal support to the development of forest science and forest management.

Jakarta, November 2001

FOREWORD

By
The Authors

The Principles and Practices for Forest Harvesting in Indonesia (2000) have been developed to provide a uniform set of minimum standards for logging practices in the Production and Limited Production Forests in Indonesia. They provide the standard for WHAT is involved in planning and implementing logging activities in natural forest and WHY certain operations should be undertaken. The Reduced Impact Logging (RIL) Guidelines for Indonesia provides the mechanism for HOW the standards will be applied in the field or “how to do the work”.

Tractor skidding – mostly by crawlers and skidders – is the most common system (ca. 90%) used in the Indonesian Selective Cutting and Planting (TPTI) System. Considering the fact that familiarity with more environmentally friendly logging system (such as cable and aerial logging) is still lacking in Indonesia, often due to cost, etc., RIL Guidelines focus on ground-based harvesting which can be implemented in the lowland and hill forests in Indonesia.

This booklet has been prepared for use in the selective cutting silvicultural system of tropical natural forests and based on the Principles and Practices for Forest Harvesting in Indonesia (2000), RIL Pocket Book (Elias, 1999) and Ground Based Reduced-Impact Logging Guidelines for Lowland and Hill Dipterocarp Forest in Indonesia (Sist,

Dykstra and Fimbel, 1998). Other technical inputs are provided from results of the Reduced-Impact Logging Research of the ITTO funded project on Forest Science and Sustainability: Bulungan Model Forest (PD 12/97 Rev. 1(F)) carried out in Malinau, East Kalimantan, the Code of Practice for Forest Harvesting in Asia-Pacific (1999), Indonesian industry and from actual situations and conditions in the Indonesian forests.

Target groups of the guidelines are production supervisors, RIL planners, block inspectors, road network planners, road construction supervisors, road construction foremen, machine operators, chainsaw operators, tractor operators and their assistants.

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INTRODUCTION

Background to the RIL Guidelines for Indonesia

In Indonesia, forest management and logging operations are regulated under the Indonesian Selective Cutting and Planting System (*Sistem Tebang Pilih Tanam Indonesia/ TPTI*). RIL practices are recommended under TPTI; however, these are seldom applied in the field for numerous reasons, including :

1. Lack of regulatory control over harvesting practices.
2. Limited specificity in how to conduct RIL techniques.
3. Lack of understanding of the benefits of RIL.
4. Lack of understanding of the steps necessary to implement RIL and lack of specific technical skills.

There is general recognition that existing logging practices need to be improved to ensure a viable residual stand for the successive cutting cycles. As an International Tropical Timber Organization (ITTO) member, such recognition by Indonesian foresters is linked with ITTO's "Year 2000 Objectives" of achieving sustainable forest management.

Progress towards sustainable forest management will be promoted by the implementation of RIL techniques, which aim at minimising soil disturbance, impacts on wildlife, and damage to the residual stand.

What is RIL?

RIL is a systematic approach to planning, implementing, monitoring and evaluating logging.

RIL embraces a host of improved road building, felling and skidding practices.

RIL requires forethought and skill, and a policy environment that encourages them.

Why RIL?

Forest managers are increasingly endeavouring to improve their practices and implement higher standards of forest management. One means of doing this is to implement RIL techniques.

There are a number of reasons why RIL is recommended for implementing RIL, etc.

■ Environmental and social risk reduction

■ Economics

■ Markets

■ Appropriate policy and regulatory framework

RIL IMPLEMENTATION AND TPTI

Et-0 : logging time (year); (-) before logging

LOGGING PLANNING

PRE-LOGGING PLANNING

Inventory

Undertake a forest inventory, map preparation and stock mapping.

The following manuals provide details of appropriate methods:

- *Pedoman dan Petunjuk Teknis Tebang Pilih Tanam Indonesia (TPTI) pada Hutan Alam Daratan* (Departemen Kehutanan RI, 1993)
- *Petunjuk Dasar dalam Timber Cruising dan Survei Topografi* (Ruslim, 1998)
- *Prosedur Survei Topografi Hutan* (TFF&APHI, 2001)

Map Preparation

Contour and stock mapping at a scale of 1:2 000 -1:5000 with contour line intervals of 5-10 m can be produced manually or by using computer-based software, e.g:

- FIEPLP (Forest Inventory and Product Linking Programme) from TROPENBOS Foundation Project
- GENESIS and GENAMAP Programme from SFMP-GTZ Project
- ROADENG Software
- SIPTOP (*Sistem Informasi Pohon dan Topografi*) from PT. INHUTANI I

Example of field sheets for data to be recorded as part of the inventory and topographic survey.

Tally sheet of inventory

Tree Number	Species Code	Diam (cm)	Height (m)	Code	Vol (m ³)	X	Y	Note	Tree Position	
5	MD	40	18	4						
4	MD	55	16	1						
3	NYR	37	16	4						
2	MD	25	12	4						
001	MM	80	22	1						

	5 ■
	4 ●
	3 ●
	2 ●
	1 ■

Tally sheet of topo-survey

Station	Azim (°)	Horizontal Distance	Slope (%)	Height Difference (m)	Elevation (m)	Elev. Corr.	Contour lines, Gully, Stream, etc.
3							
	360	20.4	+19				
2							
	360	20.4	+19				
1							
	360	10.1	+14				
0		10.5	+33		690		

3	
2	
1	
0	

FOREST AREA ZONING

Exclusion Areas

- Identification of exclusion areas is important for defining and locating the net productive area for timber production
- Timber production zone = total area of a forest management unit - exclusion areas
- The timber production zone forms the basis for the determination of the Annual Allowable Cut (AAC)
- Exclusion zones, include the following:
 - ◆ Cultural areas
 - ◆ Shorelines, lagoons, lakes and water storage areas
 - ◆ Landslip areas
 - ◆ Designated watercourses
 - ❖ Conservation and protection zone
 - ❖ Community forests and local community zones
 - ❖ Biological diversity conservation zone
 - ❖ Wildlife conservation zone
 - ❖ Scientific research zone
 - ❖ Buffer zone, e.g:

Production Areas

- An example of a forest zoning map

Legend:

1. Biological diversity conservation zone
- 2, 5. Town surrounded by a community use forest zone
3. Scientific studies forest zone
4. Wildlife conservation zone
6. Watershed conservation zone
7. Production forest zone

■ Buffers for exclusion areas

	Minimum Width for Buffer Zones
Cultural areas	30 m
Lakes Lagoons Shorelines Water storage areas	Slope < 17% = 50 m Slope > 17% = 100 m
Designated watercourses	Class 1 stream = 30 m each side Class 2 stream = 20 m each side Class 3 stream = 10 m each side
Waterways	Catchment area 2 ha, no extraction within 5 m each side

■ Stream buffer exclusion areas

Management of Exclusion Areas

Areas excluded from logging are managed as follows :

- No trees to be felled within exclusion areas and their buffer zones
- Machine access is prohibited, except where watercourse crossings are permitted
- No earthworks or spoil from earthworks is to fall within the exclusion areas
- No logging debris is to be pushed into the exclusion areas
- Trees should be felled away from buffer zones and watercourses

■ Watercourse protection areas

LOGGING PLANNING

Road Planning

The following references provide details of how to undertake road planning:

- A Manual for the Planning, Design and Construction of Forest Roads in Step Terrain (FAO, undated)
- *Pembukaan Wilayah Hutan* (Elias, 1997)

■ Collection of engineering data

Important data to be collected consist of:

- Aerial photographs
- Topographic map at a scale of 1:5000 - 1:25 000
- Forest map at a scale 1:25 000 or 1:50 000
- Soil map
- Geological map
- Forest Opening Up Guidelines and Regulations
- Road construction costs
- Timber harvesting costs and timber prices
- Forest Management Plan

■ Demarcation of planning area

An example of planning area demarcation

■ Evaluation of proposed road location

- Need to identify:
 - Access points to public roads and existing forest roads
 - Proposed road location and logging areas
 - Areas with gentle slopes to assist with location, better alignment and log landings
 - Stream crossing points
 - Gravel deposits (quarries)
 - Steep slopes
 - Swamps
 - Landslides
 - Deep canyons
 - Protected forests

An example of positive and negative cardinal points/zones

■ Road network planning

■ Parallel road network patterns

■ Circular road network patterns

- Road network planning on a contour map (scale 1:5000 up to 1:25 000)

Road planning criteria, maximum road grade:
main road 10%; branch road 15%; feeder road 18%

- An example of a road network corridor

- **Choose!** road alignment on stable areas.

- Road location should be at least 100 m from the edge of a stream.

- **Avoid!** areas of cultural importance, steep areas and swamps.

- **Avoid!** sensitive landslide areas.

■ Road location

■ Contour/slope road

■ Ridge road

Uphill
skidding

■ Valley road

Downhill
skidding

Conversion table for slope measurement

Deg- ree (°)	Per cent (%)	Distance (m)												
		4	5	6	7	8	9	10	20	30	40	50	100	
1	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
2	3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.06
3	5.2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.05	0.07	0.14
4	7.0	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.05	0.07	0.10	0.12	0.24
5	8.7	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.08	0.11	0.15	0.19	0.38
6	10.5	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.11	0.16	0.22	0.27	0.55	
7	12.3	0.03	0.04	0.04	0.05	0.06	0.07	0.07	0.15	0.22	0.30	0.37	0.75	
8	14.1	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.19	0.29	0.39	0.49	0.97	
9	15.8	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.25	0.37	0.49	0.62	1.23	
10	17.6	0.06	0.08	0.09	0.11	0.12	0.14	0.15	0.30	0.46	0.61	0.76	1.52	
11	19.4	0.07	0.09	0.11	0.13	0.15	0.17	0.18	0.37	0.55	0.73	0.92	1.84	
12	21.3	0.09	0.11	0.13	0.15	0.17	0.20	0.22	0.44	0.66	0.87	1.09	2.19	
13	23.1	0.10	0.13	0.15	0.18	0.21	0.23	0.26	0.51	0.77	1.03	1.28	2.56	
14	24.9	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.59	0.89	1.19	1.49	2.97	
15	26.8	0.14	0.17	0.20	0.24	0.27	0.31	0.34	0.68	1.02	1.36	1.70	3.41	
16	28.7	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.77	1.16	1.55	1.94	3.87	
17	30.6	0.17	0.22	0.26	0.31	0.35	0.39	0.44	0.87	1.31	1.75	2.18	4.37	
18	32.5	0.20	0.24	0.29	0.34	0.39	0.44	0.49	0.98	1.47	1.96	2.45	4.89	
19	34.4	0.22	0.27	0.33	0.38	0.44	0.49	0.54	1.09	1.63	2.18	2.72	5.45	
20	36.4	0.24	0.30	0.36	0.42	0.48	0.54	0.60	1.21	1.81	2.41	3.02	6.03	
21	38.4	0.27	0.33	0.40	0.46	0.53	0.60	0.66	1.33	1.99	2.66	3.32	6.64	
22	40.4	0.29	0.36	0.44	0.51	0.58	0.66	0.73	1.46	2.18	2.91	3.64	7.28	
23	42.4	0.32	0.40	0.48	0.56	0.64	0.72	0.79	1.59	2.38	3.18	3.97	7.95	
24	44.5	0.35	0.43	0.52	0.61	0.69	0.78	0.86	1.73	2.59	3.46	4.32	8.65	
25	46.6	0.37	0.47	0.56	0.66	0.75	0.84	0.94	1.87	2.81	3.75	4.68	9.37	
26	48.8	0.40	0.51	0.61	0.71	0.81	0.91	1.01	2.02	3.04	4.05	5.06	10.12	
27	51.0	0.44	0.54	0.65	0.76	0.87	0.98	1.09	2.18	3.27	4.36	5.45	10.90	
28	53.2	0.47	0.59	0.70	0.82	0.94	1.05	1.17	2.34	3.51	4.68	5.85	11.71	
29	55.4	0.50	0.63	0.75	0.88	1.00	1.13	1.25	2.51	3.76	5.02	6.27	12.54	
30	57.7	0.54	0.67	0.80	0.94	1.07	1.21	1.34	2.68	4.02	5.36	6.70	13.40	
31	60.1	0.57	0.71	0.86	1.00	1.14	1.29	1.43	2.86	4.28	5.71	7.14	14.28	
32	62.5	0.61	0.76	0.91	1.06	1.22	1.37	1.52	3.04	4.56	6.08	7.60	15.20	
33	64.9	0.65	0.81	0.97	1.13	1.29	1.45	1.61	3.23	4.84	6.45	8.07	16.13	
34	67.5	0.68	0.85	1.03	1.20	1.37	1.54	1.71	3.42	5.13	6.84	8.55	17.10	
35	70.0	0.72	0.90	1.09	1.27	1.45	1.63	1.81	3.62	5.43	7.23	9.04	18.08	
36	72.7	0.76	0.95	1.15	1.34	1.53	1.72	1.91	3.82	5.73	7.64	9.55	19.10	
37	75.4	0.81	1.01	1.21	1.41	1.61	1.81	2.01	4.03	6.04	8.05	10.07	20.14	
38	78.1	0.85	1.06	1.27	1.48	1.70	1.91	2.12	4.24	6.36	8.48	10.60	21.20	
39	81.0	0.89	1.11	1.34	1.56	1.78	2.01	2.23	4.46	6.69	8.91	11.14	22.29	
40	83.9	0.94	1.17	1.40	1.64	1.87	2.11	2.34	4.68	7.02	9.36	11.70	23.40	
41	86.9	0.98	1.23	1.47	1.72	1.96	2.21	2.45	4.91	7.36	9.81	12.26	24.53	
42	90.0	1.03	1.28	0.54	1.80	2.05	2.31	2.57	5.14	7.71	10.27	12.84	25.69	
43	93.3	1.07	1.34	1.61	1.88	2.15	2.42	2.69	5.37	8.06	10.75	13.43	26.86	
44	96.6	1.12	1.40	1.68	1.96	2.25	2.53	2.81	5.61	8.42	11.23	14.03	28.07	

■ Road marking

Category	Field Marking
Main road	Centerline with 1 vertical stripe as high as possible on two sides aligned with the road direction (red colour)
Branch road and feeder	Centerline with 1 vertical stripe as high as possible on two sides aligned with the road direction (red colour)
Log landing	Marked with L and number as per harvesting plan on tree at location (red colour)
Stream crossing (bridges)	Marked on trees with B (red colour)
Stream crossing (culverts)	Marked on trees with C (red colour)

■ Marking of zero line on the ground

The zero line is determined using a clinometer and is marked on the ground with stakes

■ Centre line (axis) and cut and fill

■ Zero line and centre line drawing

■ An example of a forest road network

- : Block boundaries
- : Existing forest road
- - - : Planned forest road

N
4
Scale 1:10 000

Logging Plan Development

■ Identify log landing locations

Preferred landings are:

1. Large, flat area with slope of up to 6°
2. Top of hills
3. Not located in Protected Areas
4. Not near streams or watercourses

■ Identify skidtrail network

1. Skidtrails are designed as straight as possible following the contours.
2. Skidtrails should avoid steep areas, ravines, swamps and unstable ground.
3. Skidtrails should minimise the number of stream crossings. If a skidtrail crosses a stream, a small bridge should be constructed.
4. Skidtrails are designed to be used as intensively as possible.
5. Slopes of skidtrails must not exceed 45%.
6. Skidtrail network must avoid exclusion areas.
7. Skidding distances should be minimised.
8. Maximum width of skidtrails is 4 m.

■ Identify felling and skidding direction

: Possible felling direction

: The best possible felling direction

An example a Logging Plan

Pre-Logging Operation

■ Road specifications

■ Cross section of contour road

1. Steeper grades (up to 20%) for short sections (maximum 500 m) would be acceptable if it reduces soil disturbance from road construction
2. Any two sections of road at absolute maximum gradient should be separated by 100 m of level, or lower-gradient road

■ Road grade specification

Road Class	Maximum Allowable Grade (%)	Maximum Adverse Grade (%)	Length at Maximum Grade (m)
Main road	10	8	1000
Branch	15	10	750
Feeder road	18	12	600

■ Road width specification

	Maximum Road Width	
	Gravel Surface (m)	Compacted Clay Surface (m)
Main road (2-way)	10.0	15.0
Main road (1-way)	6.3	11.0
Branch road	6.0	7.3
Feeder road	5.0	6.0

■ Road off-trailing specification

Radius (m)	Off-Trailing (m)
25	1.65
30	1.20
40	0.95
50	0.80
60	0.70

Radius (m)	Off-Trailing (m)
75	0.55
100	0.40
150	0.35
200	0.20

- Curve widening will be required on corners to allow for off-trailing of trailers
- Off-trailing on curves based on a vehicle with overall length of 14 m
- Additional width is required in each lane, i.e. a two-lane road requires a total widening of the roadway width to twice the tabulated value

■ Road curves

	Design Speed		
	30 kph	50 kph	80 kph
Minimum radius (use may require signs)	25 m	30 m	55 m
Desirable minimum radius	35 m	75 m	140 m
Minimum sight distance required	30 m	64 m	120 m
Meeting sight distance	50 m	100 m	220 m

- The minimum radius of the curve is related to visibility and speed of vehicles travelling on the road

■ Road drain spacing

Centerline Gradient (%)	Maximum Drain Spacing (m)	
	Unstable Soil	Stable Soil
0–15	40	60
16–20	20	40
21–25	10	20

- Drain all roads to minimize sediment production
- Road drains should be constructed as follows:
 - ❖ At changes of slope
 - ❖ Within 50 metres of watercourse crossings
 - ❖ Additional drains to meet the maximum spacing requirement

■ Drainage on ridge road

■ Drainage on contour road

Log clusters with soil fill
are **NOT PERMITTED**

Good drainage

- Drain out-flow

- Drain out-flow should be diverted into surrounding vegetation at least 50 m before a watercourse

■ Silt traps on drains

■ Sediment traps around cross-drain outlets

Measures to minimize erosion on batter slope

Do

- Planted vegetation on batter slope

- Sediment trap at roadside drain

■ Road construction

Timing

Road construction should be conducted one year before logging and should not take place during the wet season.

■ Timing of construction

Opening and clearing

Removal of trees, stumps, roots and organic matter from the road construction area.

■ Opening

Red stripes showing alignment

■ Clearing

Grading and forming

Grading and forming of the road is undertaken after area has been opened and cleared. Earthmoving is done by bulldozers over short distances. Dump trucks and loaders are used for longer distances. Bulldozers and motor graders are the basic equipment used for grading and forming.

■ Grading and forming

Surfacing

All-weather forest roads require a surface application of rock, gravel or acceptable surface material. This material is usually brought from local quarries. The material is hauled by dump trucks and spread with motor graders.

■ Surfacing

Compacting

Compacting the road is important. The vibration roller is the basic equipment needed to compact the soil and roading material.

■ Compacting

Finishing

The final step in road construction is the crowning, sloping of shoulders and slopes and ditching. This is usually accomplished with a motor grader.

■ Finishing

■ Watercourse crossings

■ Steel bridge

■ Steel and wooden bridge

■ Wooden bridge

■ Wooden bridge

Timber species for bridge construction

In fresh water	In salt or brackish water	Above water level
Balau (<i>Dipterocarpus mundus</i> V.SI.)	Belian (<i>Eusideroxylon zwageri</i> T.et.B)	Balau (<i>Dipterocarpus mundus</i> V.SI.)
Bangkirai (<i>Shorea laevis</i> Ridl.)	Resak (<i>Vatica</i> spp.)	Bangkirai (<i>Shorea laevis</i> Ridl.)
Belian (<i>Eusideroxylon zwageri</i> T.et.B)	Keranji (<i>Dalium</i> spp.)	Belian (<i>Eusideroxylon zwageri</i> T.et.B)
Chengal (<i>Hopea</i> spp.)		Chengal (<i>Hopea</i> spp.)
Giam (<i>Vatica flavovirens</i> V.SI)		Giam (<i>Vatica flavovirens</i> V.SI)
Keranji (<i>Dalium</i> spp.)		Keranji (<i>Dalium</i> spp.)
		Kempas (<i>Koompassia malaccensis</i> Maing)
		Merbau (<i>Intsia bijuga</i> (Colebr.))

■ Temporary bridge

Perspective

Log culvert permits water to flow through

Cross section

min 600 mm

Road surface

Geotextile to retain backfill if required

Compacted backfill

Natural ground line

Cut flat

■ Timber bridge

Cross section

Running planks or gravel

Timber deck

Stringer

Back fill

Cribbings

Abutment

Elevation

Running planks or gravel

Protection beam

Stringer

Cribbings

Abutment

■ Culverts

Pre-logging Field Preparation

Marking of exclusion areas

Marking of landings and skidtrails

Cutting of lianas

Marking of trees with felling direction

■ Marking of exclusion areas

■ Buffer zone marking

Category	Field Marking
Buffer zones	Perimeter with an "inverted T" as high as possible on one side facing the logging area

■ Marking of landings and skidtrails

■ Skidtrail marking

Category	Field Marking
Major skidtrail	Central line with 1 vertical stripe as high as possible, front and back of trees, spaced at approx. 10 m intervals
Major skidtrail ends	Marked with 2 parallel stripes as high as possible facing the track
Minor skidtrail	Central line with 1 vertical stripe as high as possible, front and back of trees, spaced at approx. 10 m intervals
Temporary stream crossings	Marked with S on the trees on either side of stream

■ Cutting of lianas

■ Marking of trees with felling direction

■ Tree marking decision chart

■ Marking of felling direction

■ Felling direction

LOGGING OPERATIONS

SUPERVISION OF OPERATIONS

■ Organization Structure

■ Job Descriptions

■ Production Supervisor

- Direct involvement in pre-logging planning
- Train and familiarise staff with the operational and safety requirements
- Coordinate logging operations
- Direct supervision of logging operations
- Maintain and submit accurate records as required by the company
- Render first aid as required
- Arrange rapid evacuation to hospital of any injured worker as required

■ Block inspectors

- Direct involvement in pre-logging planning
- Monitor progress of felling and skidding activities (incl. providing guidance)
- Check and evaluate results of felling, skidding and post-logging activities
- Report result of the evaluation and appraisal by felling compartment to the Base Camp Manager, Timber Production Division and Forest Planning Division
- Calculate and prepare payment/salary proposal based on tariffs for felling and skidding, to be submitted to the Base Camp Manager

■ Felling and skidding foremen

- Ensure that only authorized and adequately trained workers operate machines and equipment
- Coordinate, improve and provide guidance in skidtrail construction, felling and skidding operations
- Control and monitor production process in order to achieve the targeted quality and quantity
- Ensure that all equipment and facilities are properly inspected and maintained

■ Feller

- Maintain chainsaws in a safe operational condition
- Be responsible for felling activities
- Fell each harvestable tree according to the planned or proper felling direction
- Buck the felled trees according to cross-cutting rules and procedures
- Open skidtrail and winching path

■ Helper for felling

- Assist feller, especially in informing him about the location of harvestable trees
- Assist in checking whether all trees to be cut have been felled
- Construct safety or escape lines for the feller
- Assist in removing branches from the felled trees and in measuring log lengths for bucking at the felling site
- Mark stumps left by the felled trees with tree number as well as logs produced with log numbers
- Carry chainsaw bars and chains, maintenance tools and lubricating oil
- Carry food and drinking water
- Clean chainsaw and all other tools

■ Tractor Operator

- Be responsible for the tractor and its accessories
- Construct landings and skidrails
- Adhere to technical standards of skidding as planned
- Conduct preventive measures against post-harvest damage to residual stands and the environment
- Be responsible for skidding activities

■ Helper for Skidding

- Assist the tractor operator in the maintenance of tractor
- Be responsible for choker/hooks and cables
- Locate logs to be skidded
- Install chokers/hooks for winching
- Direct the tractor operator to the location of logs to be skidded
- Pull winch cable towards logs to be winched and attach it to the chokers/hooks
- Signal the tractor operator to start winching
- Assist the tractor operator in taking measures to prevent further post-harvest damage

- Information and discussion on logging plan and operations

All crew members involved should know their duties and responsibilities, expected work procedure and standards

‘Morning Talk’ :

Meeting of skidding/felling foremen, chainsaw operators and tractor operators

‘Weekly Meeting’ :

Meeting of production supervisors, block inspectors, skidding/felling foremen, chainsaw operators and tractor operators

FELLING OPERATIONS

Chainsaw Maintenance

The following parts of chainsaw are to be checked daily:

- ❖ Saw chain
- ❖ Guide bar
- ❖ Gears
- ❖ Oil filter and fuel filter
- ❖ Spark plugs
- ❖ Exhaust system
- ❖ Chain brake and front handle guard

Keep the saw chain sharp before felling and sharpen regularly!

Opening of Landing and Skidtrails

- ❖ Landing and skidtrail openings should be set up prior to felling
- ❖ Tools to be used: logging plan and chainsaw

1. Landing and skidtrail network map

2. Felling to open the landing and skidtrails (Et-0)

* Et = Time of logging (year); (-) = Before logging

■ Skidtrail opening procedure

1. The team required for opening landings and skidtrails consists of a chainsaw operator and a helper
2. Chainsaw operators open landing areas and skidtrails by cutting all trees with $\varnothing \geq 15$ cm within these areas
3. The felling begins from the end of the prospective skidtrail to the landing with felling direction away from the landing
4. Undercuts and backcuts are made as low as possible, with felling directions coinciding with the skidtrail direction or right on the skidtrail

Felling

■ Felling procedure

1. The Felling commences according to the felling pattern on the map
2. Check felling condition, determine felling direction, prepare work site, open escape routes and caution all persons in vicinity of felling area (danger zone)
3. Make the notch and the backcut on the stump as low as possible
4. Top and limb the fallen tree
5. Clear buttresses from the stem
6. Measure and buck stem according to specifications
7. Place tree number on stump and on the bottom of each log section
8. Open winch trail
9. Proceed to other harvestable trees

AVOID!

- Trees falling across rivers or in Protected Areas
- Damage to potential crop trees and protected trees

Choice of felling direction

■ Felling direction

Procedures:

1. The best felling direction is towards or away from skidtrails at an angle of 30° - 45° (herringbone pattern), or the tree should fall in a parallel position on the skidtrail away from the skidding direction
2. If possible, the felled tree should be directed to an open site. Preferably other trees should be felled into the same gap (maximum 3)
3. On steep areas, the felling direction should be towards the side of the slope (along the contour)

Preparation of work site

■ Preparation

■ Danger zone

Directional felling techniques

The use of felling wedges is recommended to give additional control over felling direction

■ Felling technique for leaning trees

Directional felling for leaning tree:

- Notch is cut according to expected felling direction
- Create asymmetric hinge, stronger end opposite the leaning direction
- Use of felling wedges to give additional control over felling direction

■ Set up of notch, backcut and hinge

Wrong

Correct

■ Cutting technique of backcut

■ Small tree

■ Big tree

■ Felling technique for normal tree

Work steps:

- ① The first cut is a horizontal cut as deep as $1/4$ - $1/3$ of tree ϕ at a maximum height of 50 cm
- ② The second cut is a slanting cut, making an angle of 45° towards the end of the horizontal cut
- ③ The third cut is a backcut. It is made about 5—10 cm above and on the opposite side of the horizontal cut
- ④ Leave a hinge of $1/10$ to $1/6$ of the tree ϕ

■ Felling technique for large tree

1. Create notch

3. Backcut 10–20 cm above the undercut of the notch

2. Make hole at the center

■ Utilization technique of stem with buttresses

Clean the buttresses after tree is felled

Large buttresses are cut before felling the tree

■ Felling technique for leaning tree

Small tree

→
Felling
direction

Work steps:

1. Create notch
2. Create backcut by cutting from left and right side of the backcut
3. Cut from the front of backcut

Large tree

→
Felling
direction

Work steps:

1. Create notch
2. Create backcut by cutting from left side of backcut
3. Cut from right side of backcut
4. Cut from the holding wood

■ Felling technique for trees with buttresses

1 = Undercut

2 = Removal of lateral buttresses

3 = Backcut

a = Felling direction

b = Height of undercut

c = Height of backcut

d = Hinge

e = Wedge

Work steps:

1. Create notch
2. Remove buttresses on the right and left side of backcut
3. Create backcut

■ Felling technique for leaning tree with buttresses

a.

b.

c.

➡ = Leaning direction

➡ = Felling direction

- The tree is leaning in the felling direction
- The tree has to be felled against the lean
- The tree has to be felled slanting to the direction of lean

Numbers 1, 2, 3, 4 indicate sequence of work
(prepare notch, remove the lateral buttresses, backcut and
cut the supporting buttress)

Log preparation

■ Log preparation

1. Stem should be measured and its log sections should be determined before cutting the stem. Cross-cuts are no more than 10° from vertical

2. Cutting of tension stems
 - a. Cut on the compression side
 - b. Cut on the tension side

3. Stem cutting technique

Winch trail preparation

■ Winch trail preparation

SKIDDING AND LANDING OPERATIONS

Tractor Maintenance

Tractor maintenance should be undertaken by the tractor operator and his helper every morning before operating and every afternoon

■ Parts to be checked

Before operating:

- ❖ Check lubrication oil at:
 - Engine
 - Steering
 - Master clutch
- ❖ Check radiator water
- ❖ Check all:
 - Wheels and tyres
 - Propeller shaft
 - Spring/U-bolt
 - Battery
- ❖ Check Mounting at :
 - Engine
 - Radiator
 - Transmission
 - Transfer

During warming up:

- ❖ Check function of:
 - Water temperature gauge
 - Fuel pressure gauge
 - Air pressure gauge
 - Ampere meter
- ❖ Check engine smoke
- ❖ Check engine sound
- ❖ Discard water in tank
- ❖ Check all transmission and transfer functions
- ❖ Check work functions of :
 - Brake pedal
 - Hand brake
 - Gears
 - Steering

After operating:

- Fill fuel tank on level ground
- Park the tractor
- Switch off machine after 5 minutes
- Clean up inside cabin
- Clean dirt off wheels and tyres
- Clean dirt off lamps
- Ensure cab doors are securely closed

Landing and Skidtrail Construction

■ Landing construction

Stored litter and top soil

- Size of landing: 900 m²
- Drains should be constructed and must empty on to stable vegetated areas

■ Skidtrail construction

Steps for skidtrail construction:

Et-1*

Skidtrail network map

Et-1

Skidtrail marking

Et-0

Skidtrail construction

Et-0

Skidtrail opening

* Et = Time of logging (year); (-) = Before logging

■ Steps for skidtrail construction

- Skidtrail construction begins with skidding team and tractor after completion of skidtrail opening and felling activities
- To finish up the skidtrail construction simply remove trees already cut (surface is not to be disturbed)
- Avoid cutting and filling
- Small stems and branches are to remain on skidtrail surface to help soil protection

Skidding Operations

■ Skidtrail procedure

- Skidding operations commence after the construction of the skidtrail
- The helper sets the choker cable/hook on the log
- The helper gives signals to the tractor operator to assist winching operation
- The helper pulls the winch cable out and hooks the choker cable on the log to be winched
- The helper moves to a safe place and gives the signal to start winching
- During winching the tractor should remain on the skidtrail
- After winching, the log is skidded along the skidtrail to the landing
- The helper looks for other log(s) consulting the Logging Map

AVOID ..!

1. Skidding during rain and when soil is still wet
2. The tractor moving off the skidtrail looking for logs to be skidded
3. The blade contacting the soil surface and standing trees during skidding activities
4. The tractor moving into protected areas (exclusion zones)

■ Skidtrail equipment

- Logging plan map from felling team
- Tractor equipped with winch, blade < 4 meter (wide)
- 2–4 cable chokers/hooks
- 1 block
- 2 pairs of boots/shoes
- 2 helmets
- 2 pairs of gloves
- 2 sets of work clothing
- 2 food caters and 5 litres of drinking water

Use of choker

■ Types of cable choker

■ Technique for setting choker on log

■ Avoidance of obstacles

a.

b.

c.

d.

e.

Winching

■ Law of 3 H

■ Chain winching technique

1. Tractor reverses down hill, then pulls the log(s) (tractor remains in stationary position)

2. After the winched log(s) come near the tractor, the winch cable is released

3. Tractor moves ahead to the landing (without pulling the log(s))

4. After the tractor has arrived at the landing, winching of log(s) continues until the log(s) reach the landing

Skidding

■ Skidding technique to minimize damage

- Tractor blade should be raised when skidding
- Use arch to lift the end of the log off the ground

Raise the tractor blade when
skidding (± 0.5 m)

Use arch to lift the end
of the log

■ Hand signals for skidding

a. Slacken the winch cable!

b. Winching

c. Stop winching and hold

d. Stop tractor!

e. Tractor may start winching

f. Back up tractor!

g. Drop chokers here!

h. Use upper winch!

i. Go back inside tractor!

j. Move forward!

- Use shunt skidding method for turning logs

The shunt skidding method is applied to reduce disturbance of the residual stand and soil

- Use temporary bridges to cross streams/creeks

Landing Operations

■ Putting S-nail on log

Use log nail or S-nail on log ends to avoid splitting

■ Debarking

Log storage

■ Storage

Loading

■ Loading

MAINTENANCE, CAMP HYGIENE AND SAFETY

MAINTENANCE AND SERVICING

Moving Equipment

- All equipment is to be washed thoroughly before it is moved to a new operational area

Main Fuel and Oil Storage

- Locate in a well-drained area and not less than 100 m from village areas and 50 m from watercourses
- When they must be located on the wharf, they should be:
 - ❖ Located as far away from the sea as the fuel pumping lines permit
 - ❖ Fitted with a proper, leak-proof bund, which in the event of a spill can be pumped to a disposal pit

Fuel Servicing and Maintenance

- Field fuel tank, refuelled points and maintenance areas are to be located:
 - ❖ In well-drained areas such as on landings or road junctions
 - ❖ Outside areas excluded from logging
- Sump oil is not to be dumped in the logging areas, but should be collected and removed to the main disposal facility

Refuse and Toxic Waste Disposal

- Refuse pits should be located at least 100 m from areas subject to inundation by water and at least 1 m above maximum ground water height
- The refuse pit location should be clearly indicated (including signs in all the local languages) and the pit securely fenced
- Toxic materials are to be collected in containers and sealed securely
- All solid waste should be placed in refuse pits and buried as soon as harvesting in the coupe has been completed

- Rubbish to be removed

- Don't push rubbish into watercourses

CAMP HYGIENE

Water Supply

- Camp should be supplied with clean water obtained from running streams, rainwater or wells
- Water storage tanks should be properly screened

Water Ponding

- Camp areas should be well-drained, to avoid water impoundment that creates mosquito breeding areas

Additional Facilities

- Additional facilities in camps should include:
 - ❖ Medical
 - ❖ Educational
 - ❖ Recreational, and
 - ❖ Spiritual facilities

SAFETY

Protective Clothing and Safety Equipment

■ Guide to protective clothing

Logging Crew	Safety Boots	Safety Trousers	Close-fit Clothing	High Visibility Clothing	Gloves	Safety Helmet	Visor	Ear Muffs
Chainsaw Operator	✓	✓	✓	✓	✓	✓	✓	✓
Tractor Operator	✓		✓	✓	✓	✓		✓
Loader Operator	✓		✓	✓	✓	✓		✓
Helper	✓		✓	✓	✓	✓		✓

Equipment Safety Requirement

■ Minimum safety standard

Chainsaw:

- Clearly marked positive on-off switch
- Safety throttle catch
- Chainsaw cutter and chain brake guard
- Exhaust system to direct fumes away from the operator
- Tool kit

Legend:

a = Hard helmet

b = Goggles

c = Ear muffs

d = High visibility vest

e = Gloves

f = Safety trousers

g = Safety boots

■ Minimum safety standard

Tractor:

- Roll Over Protection Structure (ROPS)
- Falling Object Protection Structure (FOPS)
- Securely mounted seat and seat belt
- Rear of cab or frame fitted with protective wire mesh
- Reverse alarms
- Securely guarded pulleys, shafts, belts and fan blades
- Positive, non-returning engine stopping devices
- Suitable fire extinguisher firmly fixed and easily retrievable
- Exhaust system fitted with a spark arrestor
- First aid

POST-LOGGING ACTIVITIES

ROAD CLOSURE

SKIDTRAIL CLOSURE

- Skidtrail cross-drain construction with interval of 20–30 m

Cross-drains should be directed towards the undisturbed part of the forest

Cross section of skidtrail cross-drain

TEMPORARY BRIDGE CLOSURE

- Removal of logs from watercourse

- All crossing material should be removed, so the water in the stream can flow again

- Turn the drainage from the skidtrail to the forest before it reaches the stream

QUARRY CLOSURE

LANDING CLOSURE

CAMP AND WORKSHOP CLOSURE

- Remove all refuse from camp and workshop areas
- All solid waste should be placed in a refuse pit and buried

ROAD MAINTENANCE

- Road maintenance

- Toward permanent road and bridges

■ Road drainage maintenance

- All roads should be graded on a regular basis
- Additional construction equipment such as rollers and watercarts may be used in conjunction with the grader to recompact the road surface
- Road maintenance may require periodic addition of surfacing materials

■ Bridge maintenance

- Bridges should be inspected at least twice yearly, to confirm that:
 - ❖ Waterway is clear of debris
 - ❖ Substructure and superstructure are stable
 - ❖ Wingwall protection is functional and that no erosion has occurred
 - ❖ Scour has not occurred adjacent to abutments
 - ❖ Deck surface is in good condition
 - ❖ Bridge approaches provide smooth access

- Culvert maintenance

- Culvert should be inspected and maintained regularly

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