

Malaysian-German Sustainable Forest Management Project



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Deutsche
Gesellschaft für
Technische
Zusammenarbeit

SKYLINE YARDING SYSTEMS FOR LOW-IMPACT HARVESTING IN TROPICAL NATURAL FORESTS

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14 04 1998

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INTRODUCTION

Logging can cause substantial changes in any forested catchment area. Poorly executed harvesting operations can have long-term negative ecological and economic consequences.

Changes arise from felling and extraction and from associated earthwork needed to form skid tracks, landings and roads. Logging can affect the physical and chemical properties of the soil, the quality of stream water, and the animal and plant life in the area. It can also produce dramatic visual changes in the landscape and affects the forest's capacity to regenerate itself. It is for such reasons that logging operations must always be executed carefully and in a planned way.

Cable crane system execute the harvesting operations in a more economic and ecological way.

In a very undulating terrain and less stocked area, the combined application of a cable crane and tractor should be given consideration, with the tractor being used primarily as supplier to the cable crane.

1 TIMBER HARVESTING PROCEDURE

With a timber harvest we pursue various objectives. On the one hand the aim is to ensure the conservation of the ecological functions of the forest, on the other hand we wish to utilize the timber as economically as possible and place it at the disposal of consumers.

Terms and definitions

Work procedure

Work procedure refers to the technical means of performing a task. With regard to timber harvesting this refers to all necessary tasks for the extraction of timber.

Work flow

Each work procedure is based on a specific work flow. This indicates the location and schedule of the tasks to be carried out. The work locations are in the forest, on the skid trail, at the stumping point and on the forest road.

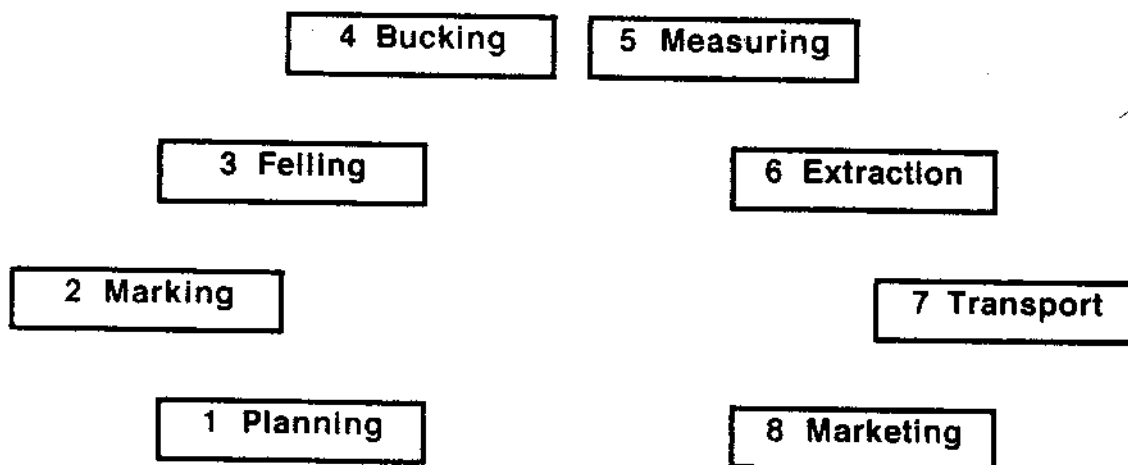
Work method

In order to carry out a particular task, we apply a specific work method. This work method is influenced by the available tools and machines, and their application by the people concerned.

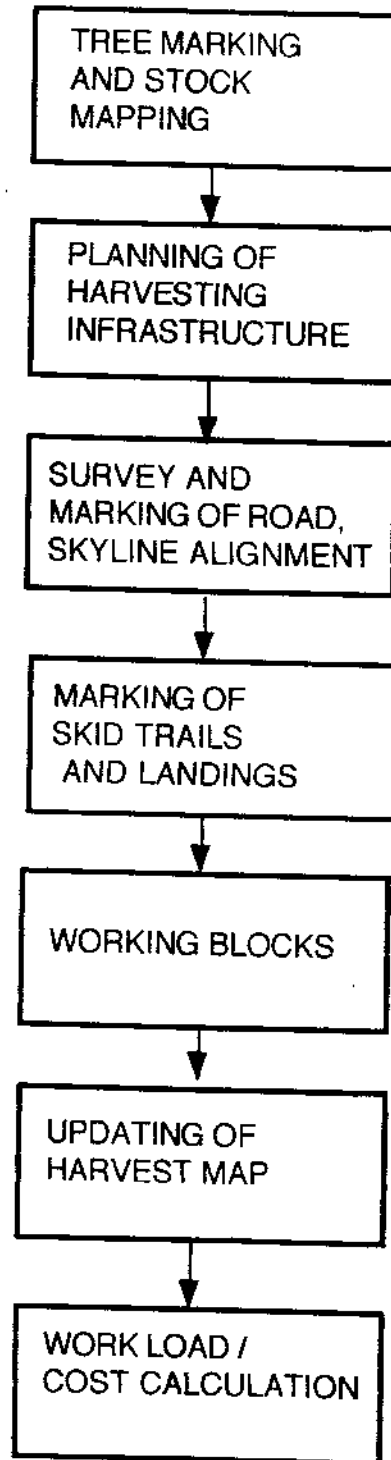
Working technique

This refers to the individual execution of the task according to the prescribed work method.

1.2. Sequence of activities in timber harvesting



2. HARVEST PLANNING



2.1. RECOMMENDED PROCEDURE FOR TACTICAL PLANNING

The total required time for preparation, planning and logging of one compartment will require appr. 24 months, after completion of the strategic plan.

The time frame below is valid for east-Sabah.

1st year (12 months)				2nd year (12 months)			
1 Jan-March	2 April-June	3 July-Sept	4 Oct-Dec	1 Jan-March	2 April-June	3 July-Sept	4 Oct-Dec

STRATEGIC PLANNING

Step 1	Total required time: 3-5 months, depending on area/ha
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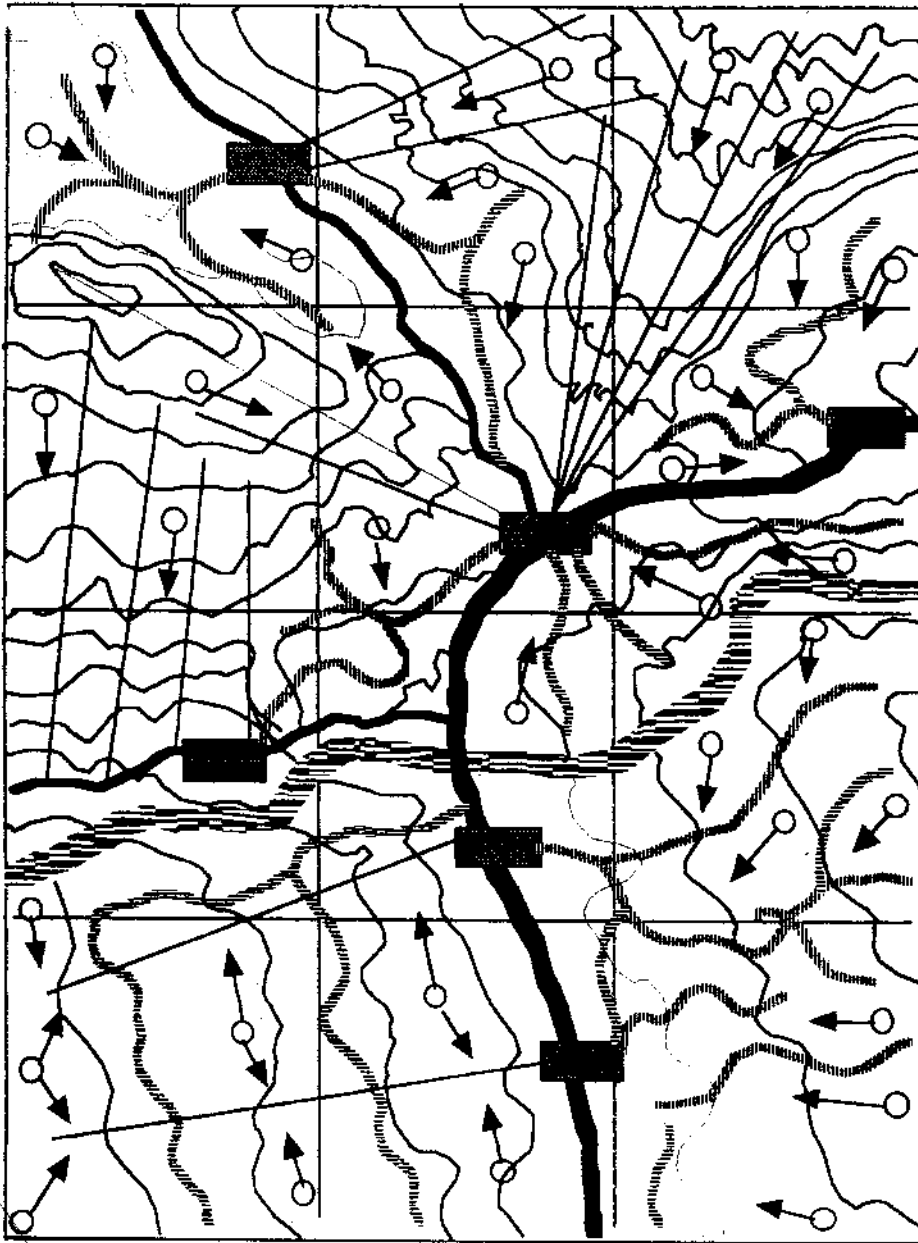
TACTICAL PLANNING FOR ONE COMPARTMENT (+/- 350 ha)

Step 2	- Stock mapping, incl tree numbering on map - Slope description, marking or map (>45% or 25°) - Revising of topographic maps, field surveys - Updating of maps	x	xx															
Step 3	- Harvest planning - Opening -up of forests by feeder road, skid trails, skyline		x															
Step 4	- Road construction (Feeder roads) - no traffic allowed for 6 months										xx	xxx						
Step 5	- Logging operations										x	xxx	xxx	xxx	xxx			









Remark: one (x) is indicating one month

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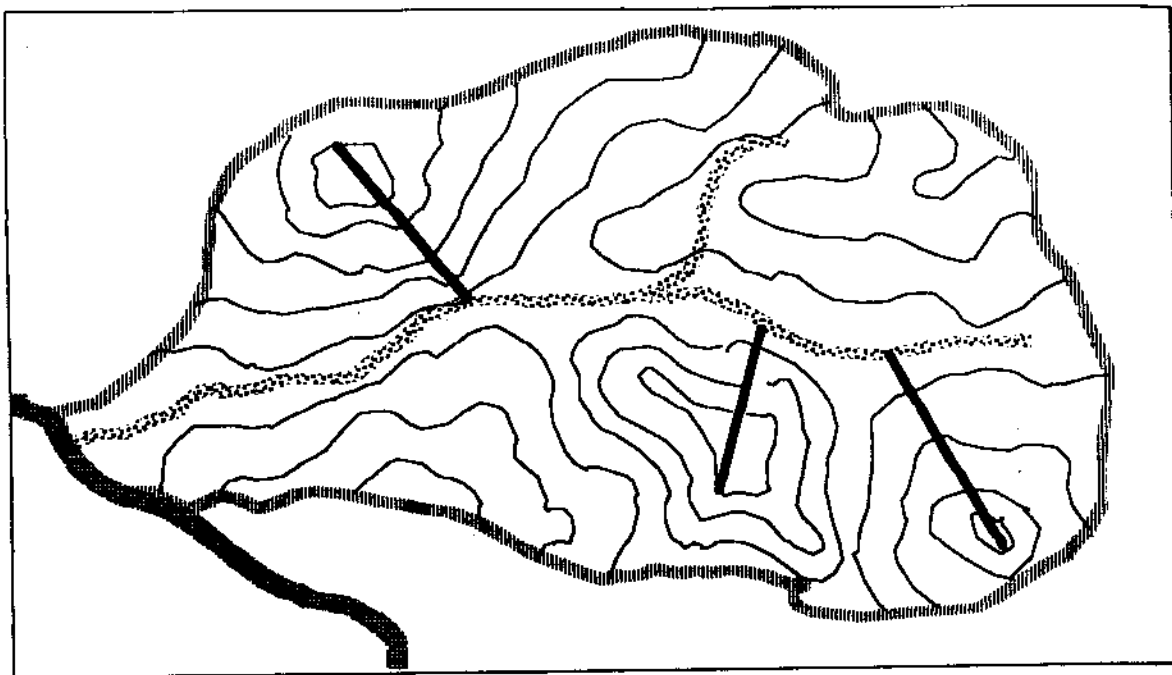
2.2. TACTICAL PLANNING MAP FOR HARVESTING OPERATION







Legend:

-  Access road
-  Main forest roads
-  Secondary forest road, feeder roads
-  Skid roads
-  Skyline crane
-  Yarding direction
-  Log landing
-  River

3. OPENING UP WITH ROADS AND CABLE CRANE LINES



-  Compartment boundary
-  Main forest road
-  Feeder road
-  Cable crane corridor

The cable crane lines are for general planning. The officer in charge has to inspect the area and to assess from his experience, whether the cable crane can be installed and the installation is economically justified.

Criteria for Cable crane logging coup:

General

- Stands are ready for treatment (density, stability, vitality, species, etc.)
- A road is crossing the proposed cable crane line at least once and a logyard/unloading place can be installed within reach.
- The output of timber is high enough to justify the installation of a cable crane from an economic point of view.
- Anchor possibilities for the skyline are given (deadman, one tree or multiple tree anchor)

Gravity System

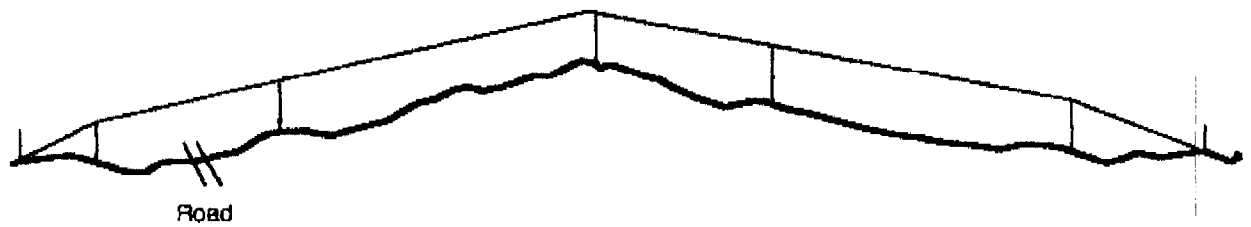
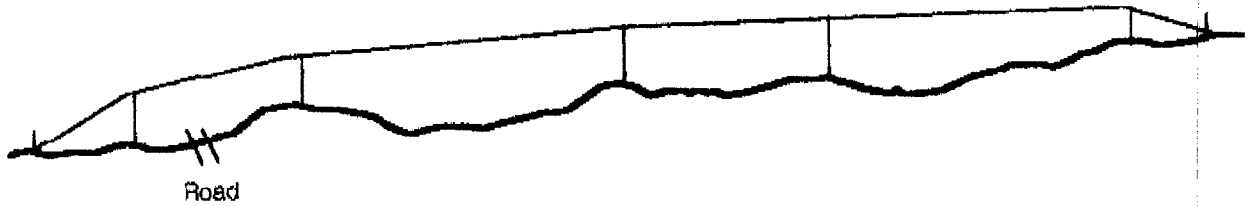
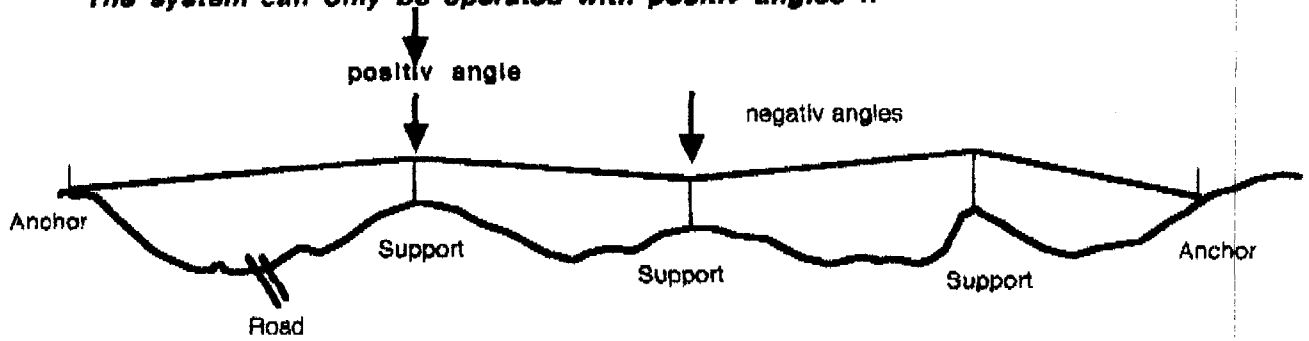
- Slope has an overall inclination of at least 15% (8°) but not exceeding 100% (55°), for short spans 12% (7°) are possible;
- For the SEIK- carriage, a slope of at least 7% (4°9' is required;

All-terrain System

- No slope is required but the system can be operated only with positive chordlength angle

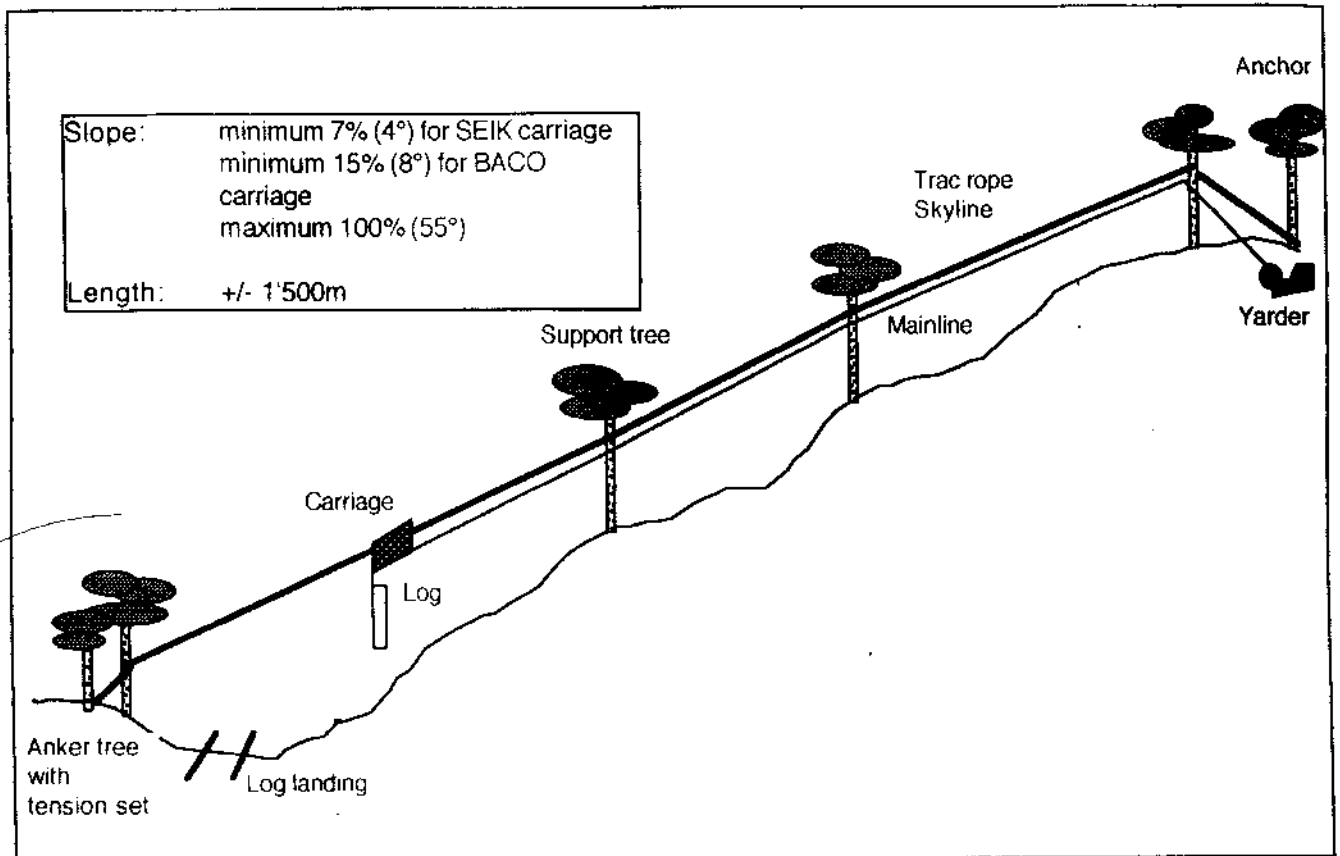
4. SUITABLE TERRAIN AND INSTALLATIONS FOR CABLE CRANE SYSTEM

The system can only be operated with positiv angles !!



3. OPERATIONAL METHODS

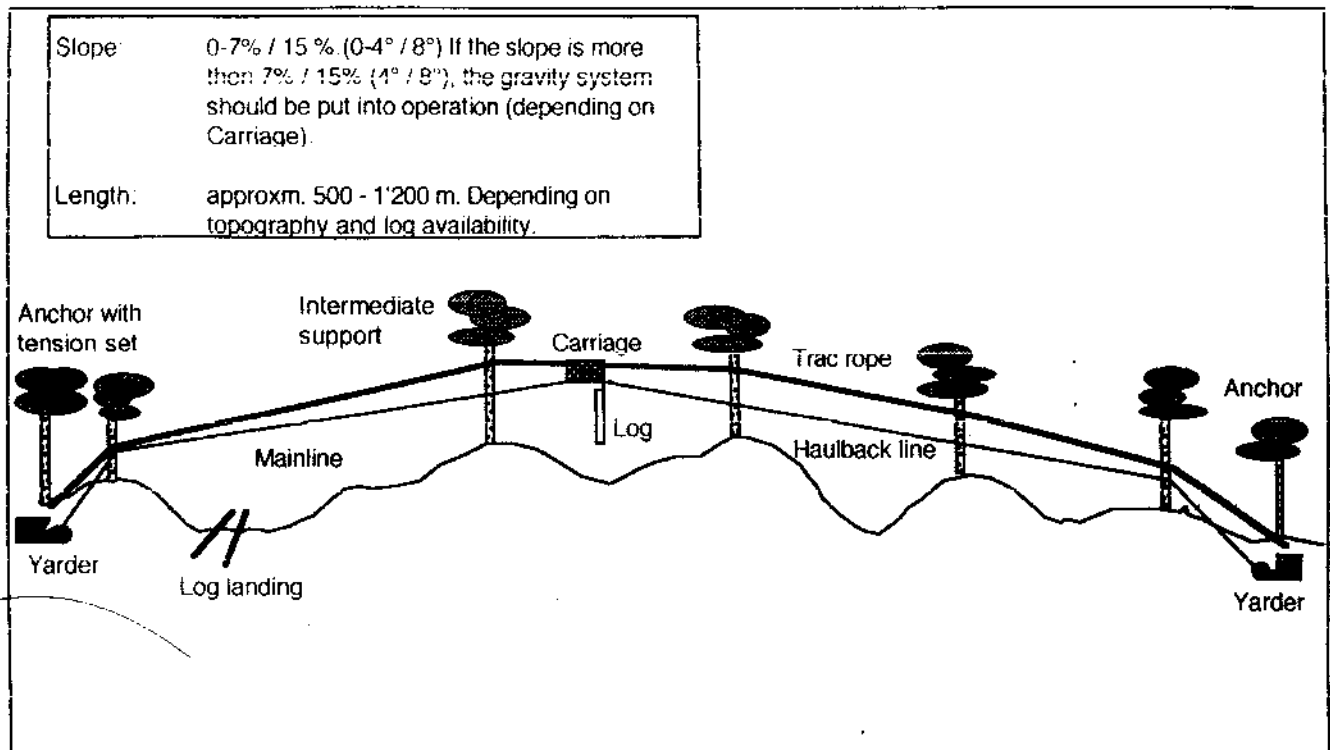
5.1. Downhill gravity system



The „standard“ set-up for a cable system is the gravity setup on slopes with a minimum slope gradient of 15% (8°) for BACO- Carriage and 7 % (4°) for SEIK- Carriage.

The winch is always installed at the uphill end of the cable way. The carriage travels to the yarding site by the force of gravity. This type of system can be operated up to cable way-lengths of 1'500 m, depending on the mainline rope diameter and the yarder drum capacity.

5.2. All-terrain system with two yarder (one corridor)



After felling of the timber, the logs are skidded to the cable way and then yarded to the landing. The road-side winch operates the mainline while the mainline of the winch at the other end inside the forest becomes the haul-back line. If terrain conditions allow, both winches can be operated independently on a gravity set-up.

6. PLANNING OF HARVESTING INFRASTRUCTURE



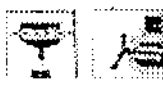
6.1. General Considerations

Road, skid trail and cable crane alignments shall be planned to minimize incidental damage to soil, residual trees, future crop trees, seedlings and water quality.

The stock map prepared during tree marking is used to help determine the location and density of roads, skid trails and skyline corridors.

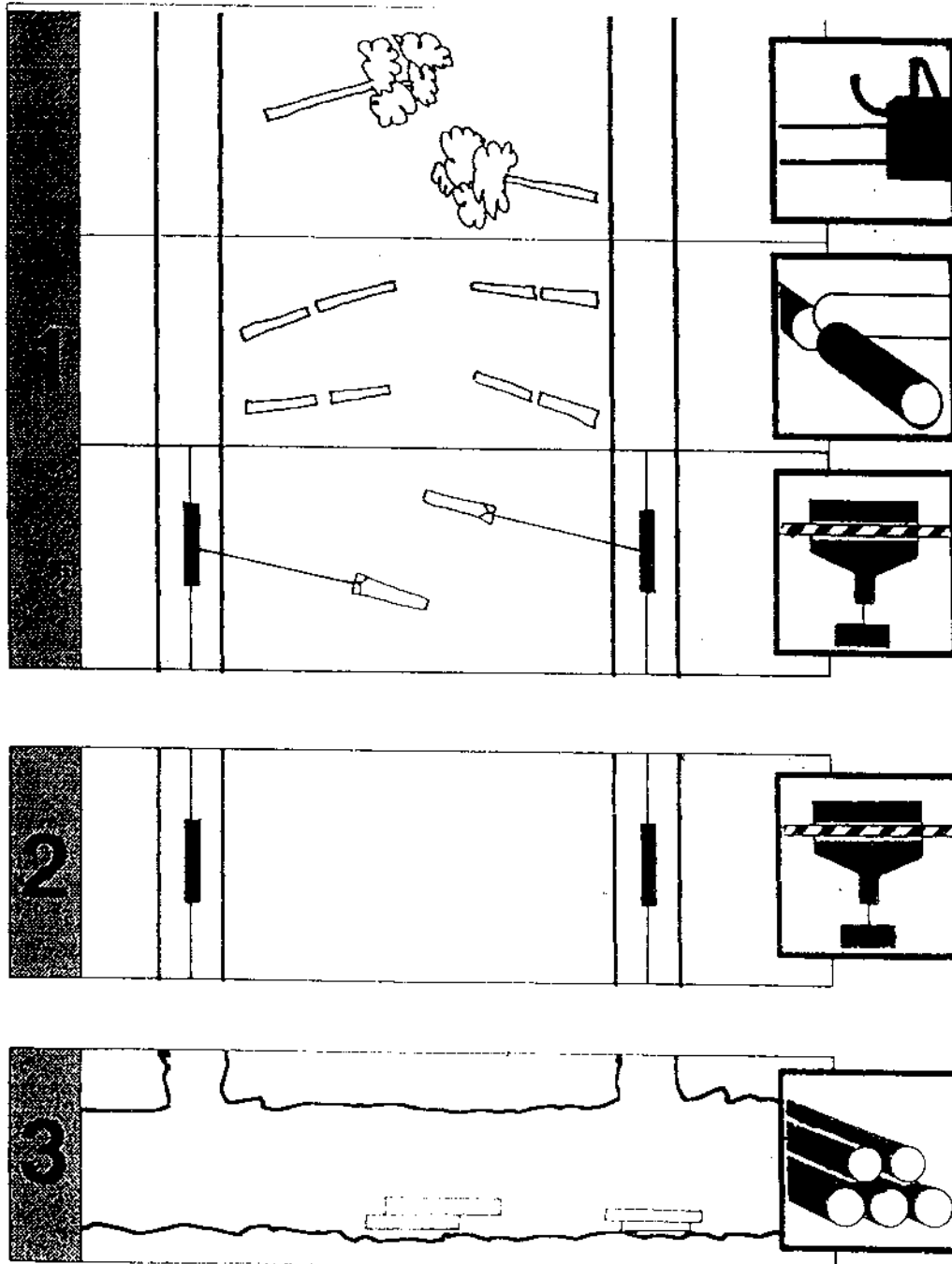
6.2. Extraction method

The topography and location of harvest trees as shown in the map allows to determine the general extraction method based on the following criteria:

	Extraction method	Selection criteria
	ground skidding with tractor	for flat areas generally and easy terrain conditions
	airborne system with skyline	difficult terrain conditions such as steep slopes, swampy soft soils and preferred when timber stocking is uniform
	combined tractor-skyline system	for undulating terrain conditions with a mix of moderate to steep slopes, preferred also when timber stocking is patchy

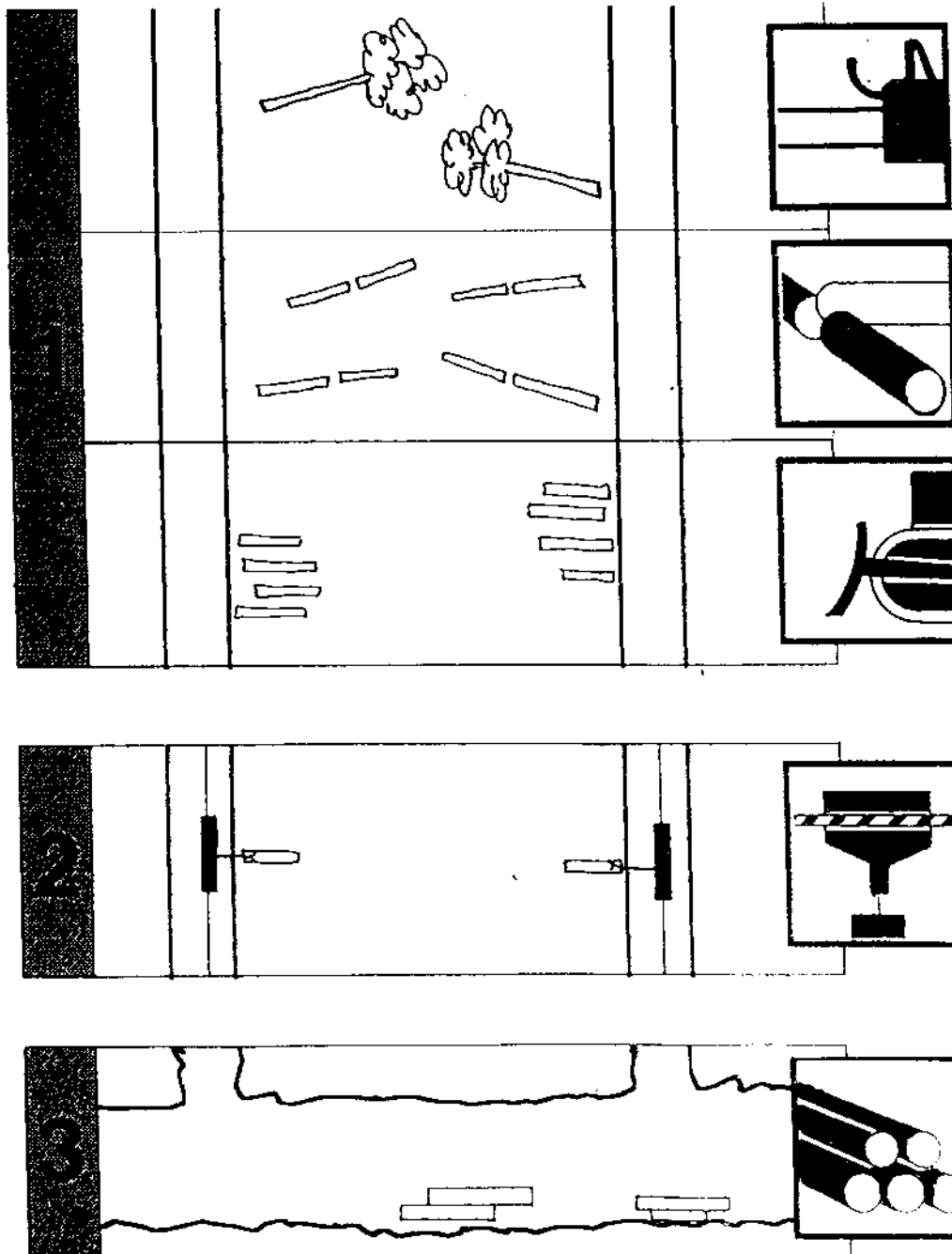
6.3. Manual motorised procedure using cable crane

1. The trees are felled using a chain saw and cross-cut into logs according bucking rules.
2. The logs are pulled forward with the cable crane in one operation and transported to the road



5.4. Combined manual motorised procedure with forwarding using tractor and cable crane

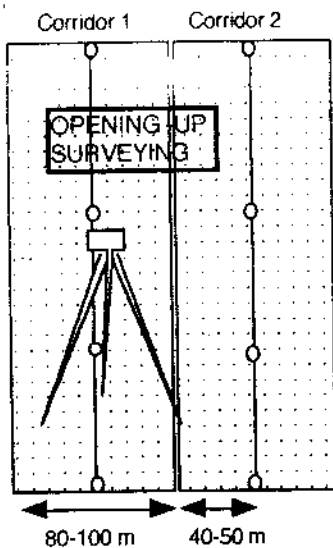
1. The trees are felled using a chain saw and cross-cut into logs.
2. The logs are then pulled forward by the cable crane in one operation and transported to the forest road.
3. Logs located in a distance from the cable way of over 40-50 m are transported by the tractor to the cable way, from where they are taken up by the cable crane and transported to the forest road.



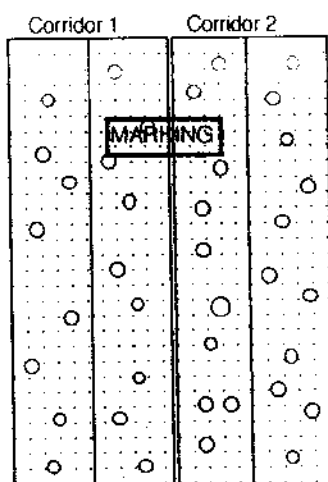
7. WORKING STEPS

7.1. MANUAL MOTORISED PROCEDURE WITH FORWARDING USING CABLE CRANE

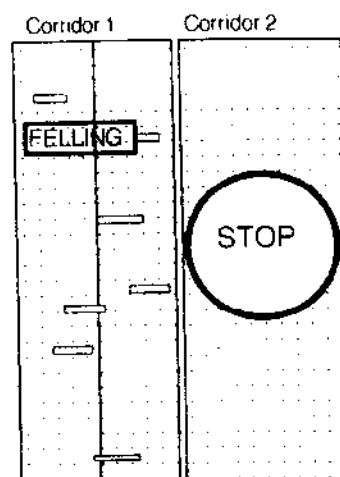
Step 1



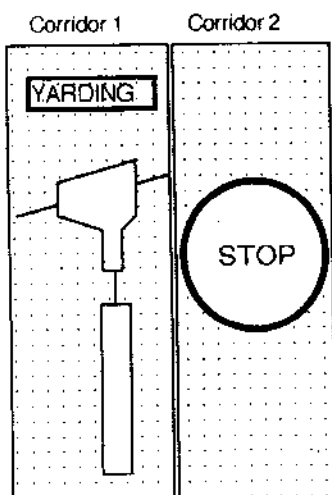
Step 2



Step 3



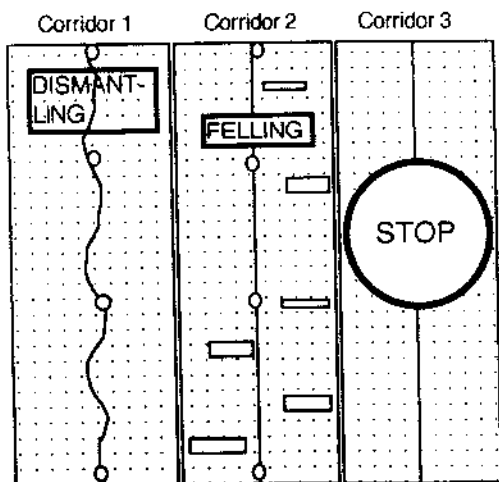
Step 4



Estimated time required for one corridor:

Rigging/Dismantling = 4-6 days
(depending on corridor length)

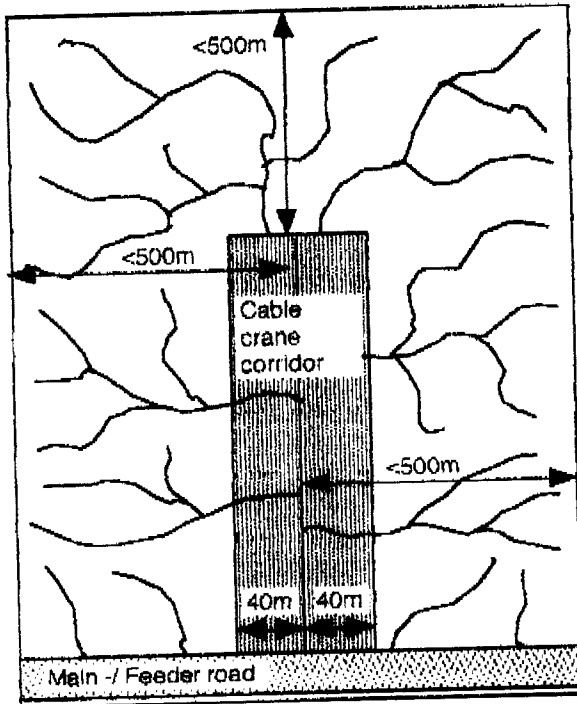
Step 5



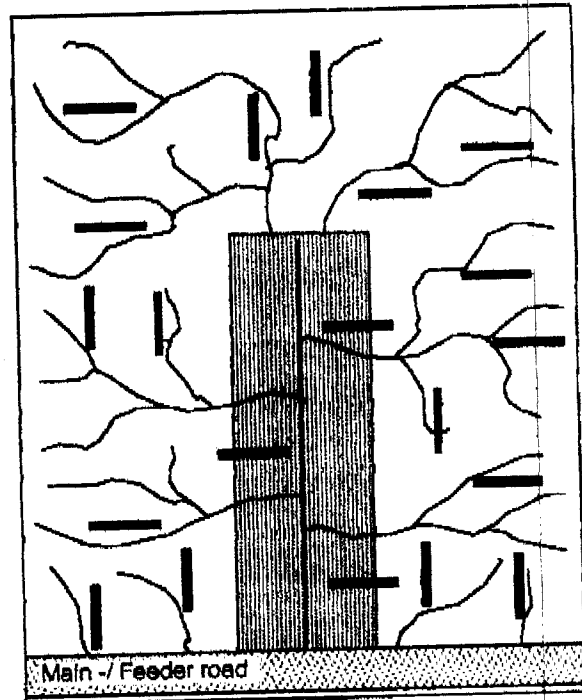
Continue with
step No. 3 / 4 / 5
for the corridors No. 4 / 5 / 6 .

7.2. COMBINED MANUAL MOTORISED PROCEDURE WITH FORWARDING USING TRACTOR AND CABLE CRANE

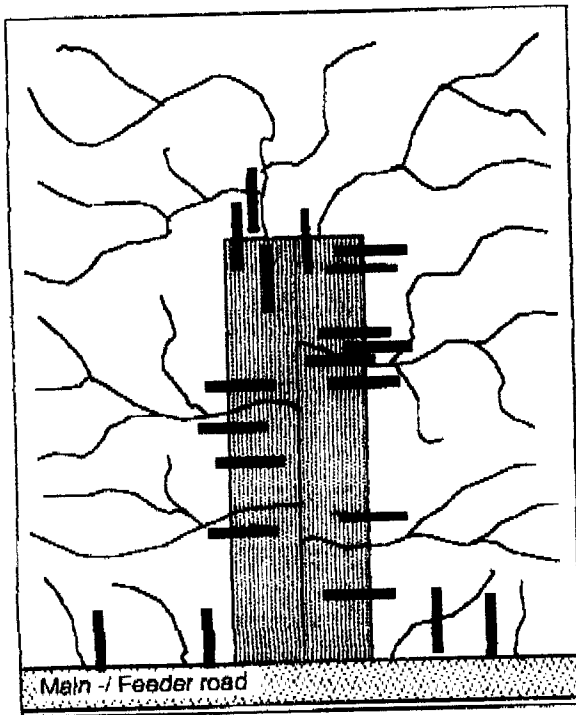
Step: 1: Survey of cable crane corridor, skid trail and landing



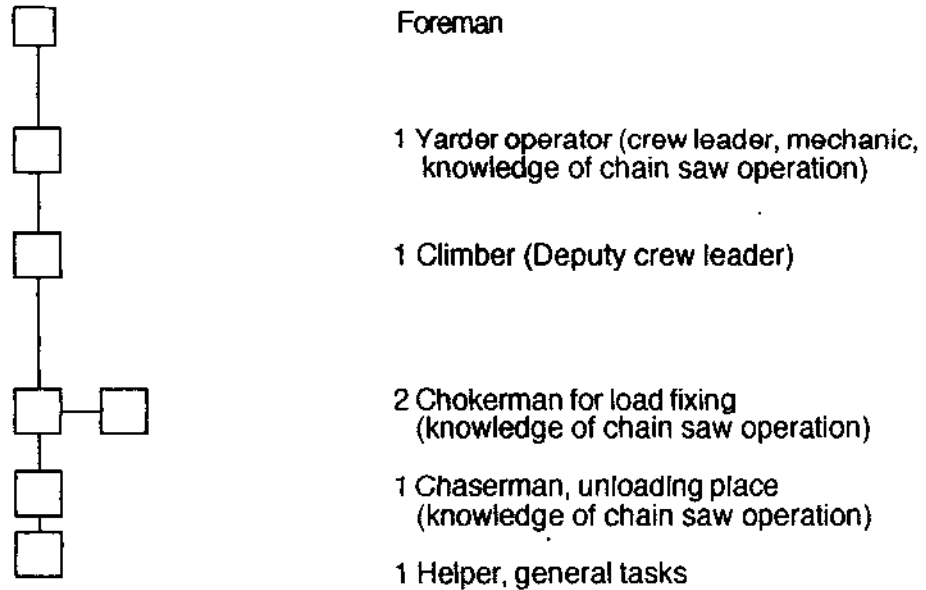
Step: 2: Tree felling within working block. rigging of cable crane



Step: 3: Forwarding, yarding of logs by cable crane



9. ORGANIZATION OF SKYLINE CRANE CREW



- The crew should be composed of 1 Foreman and 6 -8 labours
- This crews should also include the tree fellers

9. PERFORMANCE OF DIFFERENT OPERATIONAL SYSTEMS

Basic calculation for Gravity- and All-terrain cable yarding systems, operated by well trained private company crews.

9.1. Net Working Days

9.1. Annual working days	= 365.0 d/y
(after deduction of 48 days leave + 20% misc.) = 58 d/y	= 307.0 d/y
9.2. Deduction due to weather condition	
= 10% of 307 d/y	= 31.0 d/y
	= 276.0 d/y
9.3. Deduction due to breakdown of machinery	
= 25% of 276.0 d/y	= 69.0 d/y
Net working days	= 207.0 d/y

9.2. Cable Crane Performance (5.0 tone Unit)

9.2.1. Gravity System; Manual motorised procedure with forwarding using cable crane

	Set-up area 4 ha	Set-up area 8 ha	Set-up area 12 ha
- Harvestable volume per ha in m3	40 / 90	40 / 90	40 / 90
- Total volume per set-up in m3	160 / 360	320 / 720	480 / 1080
- Corridor length in m	500	1000	1500
- Average cable crane yarding distance in m	250	500	750
- Corridor working width in m	80	80	80
- Rotation time per trip in Min. =	17	22	28
driving in /out = 5 / 10 / 16 Min			
hocking time = 10 Min			
unhocking time = 2 Min			
- Trips a day by 8 hr	28	22	17
- Yarding volume per day in m3 (5 m3 per trip)	140	110	85
- Total required yarding time in days	1 / 3	3 / 7	6 / 13

9.2.2. All-terrain system; Combined manual motorised procedure with forwarding using tractor and cable crane

	Set-up area 78 ha	Set-up area 48 ha	Set-up area 19.5ha
- Harvestable volume per ha in m3	40	40	40
- Total volume per set-up in m3	3120	1920	780
- Corridor length in m	1000	500	500
- Average cable crane yarding distance in m	500	250	250
- feeding distance by tractor (left, right and back site of the corridor)	300	300	150
- Rotation time per trip in Min. =	22	17	17
driving in /out = 10 / 5 / 5 Min			
hocking time = 10 Min			
unhocking time = 2 Min			
- Trips a day by 8 hr	22	28	28
- Yarding volume per day in m3 (5 m3 per trip)	110	140	140
- Total required yarding time in days	28	14	6

9.2.3. Ratio: Rigging / Yarding

	Gravity system						All-terrain system Combined system cable crane-tractor		
	Set-up area 4 ha	Set-up area 8 ha	Set-up area 12 ha	Set-up area 78 ha	Set-up area 48 ha	Set-up area 19.5 ha			
- Harvestable volume per ha	40	90	40	90	40	90	40	40	40
- Corridor length in m	500	500	1000	1000	1500	1500	1000	500	500
- Total volume to be harvested in m ³	160	360	320	720	480	1080	3120	1920	780
- Required yarding time in days	1	3	3	7	6	13	28	14	6
- Required time for rigging/dismantling	4	4	6	6	7	7	6	5	5
- No. of set-up/year	40	30	23	16	16	10	6	11	20
Ratio: rigging/yarding in %	80:20	57:43	67:33	46:54	54:46	38:62	18:82	26:74	46:54
Total yarding day/year	41.4	88.6	68.9	111.3	95.4	128.1	170.4	152.5	112.8
Total MOH year	331.2	708.7	551.4	890.9	763.3	1025.0	1362.9	1220.4	902.5

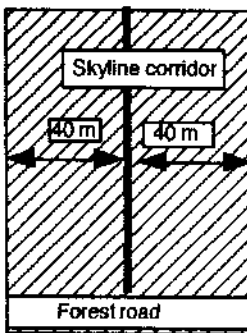
9.2.4. Yearly Performance in m³

	Gravity system						All-terrain system Combined system cable crane-tractor		
	Set-up area 4 ha	Set-up area 8 ha	Set-up area 12 ha	Set-up area 78 ha	Set-up area 48 ha	Set-up area 19.5 ha			
No. of set-up/y: 40 Yarding; 20%=42 d/y	6400								
No. of set-up/y: 30 Yarding; 43%=89 d/y		10800							
No. of set-up/y: 23 Yarding; 33%=69 d/y			7360						
No. of set-up/y: 16 Yarding; 54%=112 d/y				11520					
No. of set-up/y: 16 Yarding; 46%=96 d/y					7680				
No. of set-up/y: 10 Yarding; 62%=128 d/y						10800			
No. of set-up/y: 6 Yarding; 82%=170 d/y							18720		
No. of set-up/y: 11 Yarding; 74%=153 d/y								21120	
No. of set-up/y: 20 Yarding; 54%=113 d/y									15600

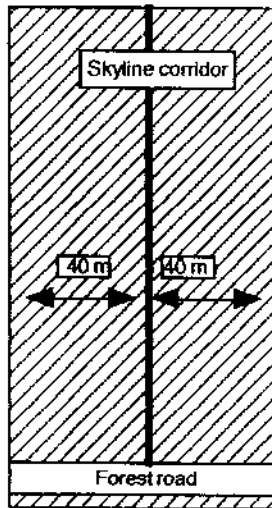
9.3. SET-UP AREAS FOR CABLE CRANE SYSTEMS

GRAVITY SYSTEM

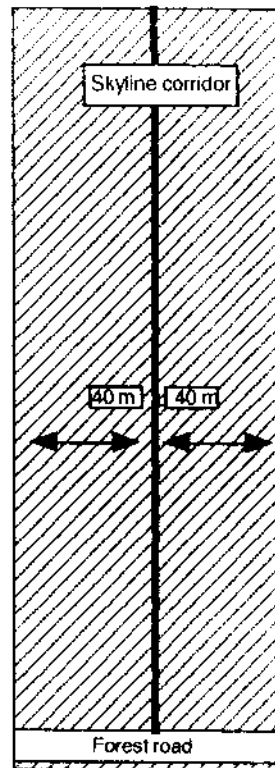
Set-up area 4 ha
Corridor length 500 m





Set-up area 8 ha
Corridor length 1000 m

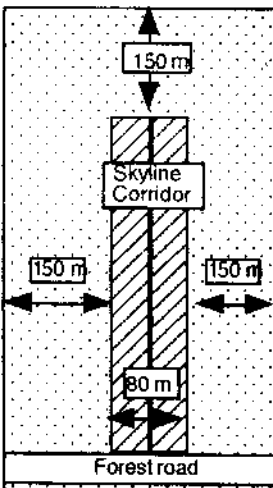


Set-up area 12 ha
Corridor length 1500 m

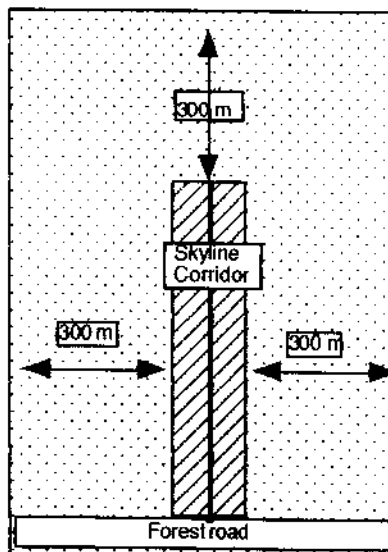


ALL-TERRAIN SYSTEM
(COMBINED SYSTEM;
SKYLINE 
TRACTOR 

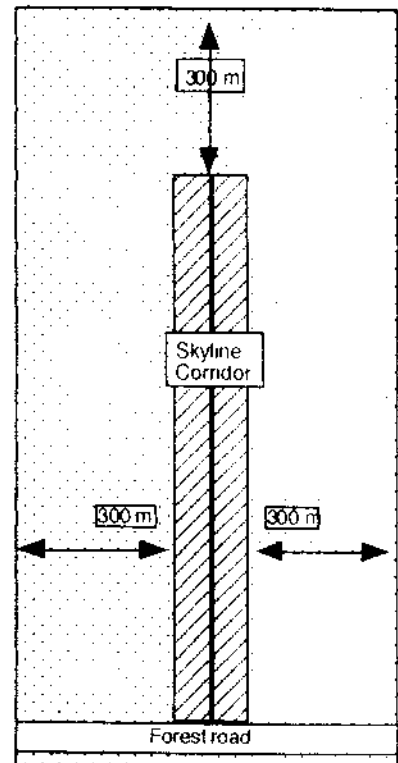
Set-up area 19.5ha
Corridor length 500 m



Set-up area 48ha
Corridor length 500 m



Set-up area 78ha
Corridor length 1000 m



9.4. SYSTEM COSTS (IN RM, Estimate) April 1998

Exchange rate RM DM=2 1

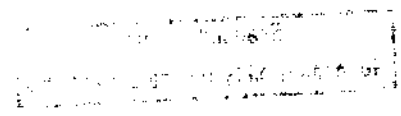
Elements	Gravity System in RM	All-terrain System Combined system; Tractor-Cable crane in RM
Yarder 130 hp (1 pc) Yarder 80 hp (2 pcs)	450'000	550'000
Carriage, SEIK 5 tone Carriage, BACO 5 tone	125'000	260'000
Ropes: Skyline rope Mainline rope Guilne	23'000 10'000 10'000	23'000 20'000 10'000
Accessories: Others (tension block, pulleys, gui lines, trailer, supports, etc. (without transport, insurance)	545'000	545'000
Purchase price (estimate)	1'200'000	1'400'000

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9.2. CABLE CRANE YARDING COST

	Gravity system						All-terrain system Combined system cable crane- tractor		
	Set-up area 4 ha		Set-up area 8 ha		Set-up area 12 ha		Set-up area 78 ha	Set-up area 48 ha	Set-up area 19.5 ha
<i>harvestable volume per/ha</i>	40	90	40	90	40	90	40	40	40

Purchase price in Mio.(RM) DM:RM=2:1	1.2	1.2	1.2	1.2	1.2	1.2	1.4	1.4	1.4
Annual net working days	207	207	207	207	207	207	207	207	207
Annual net yarding days/year	42	89	69	112	96	128	170	153	113
Annual MOH of system (8hr/day)	331	709	551	891	763	1025	1363	1220	903
Performance per MOH (m3)	19.04	15.06	13.30	12.85	10.00	10.54	13.76	17.25	17.25
Labor cost (RM/h)	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Liter Diesel/MOH	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total fix costs (RM/MOH)	374.0	162.0	208.5	128.9	150.5	112.0	98.3	109.8	148.4
Total variable costs (RM/MOH)	1.11	0.24	0.40	0.15	0.21	0.12	0.08	0.10	0.18
Labor costs (RM/MOH)	170.6	79.7	102.5	63.4	74.0	55.11	41.4	46.3	62.5
Labour costs (RM/m3)	8.96	5.29	7.70	4.93	7.40	5.22	3.01	2.68	3.62
Total costs per MOH (RM)	788.0	371.9	476.4	297.5	346.2	259.6	235.0	260.9	351.2
Total costs per m3 (RM)	41.39	24.69	35.82	23.15	34.61	24.63	17.08	15.12	20.35



10. HARVESTING DAMAGE TO THE STAND

(By Dr. K. Uebelhor, GTZ Advisor).

Felling and yarding damages in the residual stand (12.6 ha) after harvesting around 90 m³/ha with a skyline yarding system.

Damage Class	Harvesting Damage in % of Trees in Residual Stand					
	Felling		Yarding		Total	
	15-35 cm	> 35 cm	15-35 cm	> 35 cm	15-35 cm	> 35 cm
Minor damage	3.2	3.5	1.6	1.6	4.8	5.1
Damaged	3.9	3.4	1.3	1.5	5.2	5.9
Destroyed	9.3	4.8	7.3	7.8	16.6	12.6
Total Damage	16.4	11.7	10.2	10.9	26.6	23.6

Soil damage

Area of soil disturbance after harvesting with a skyline yarder

Soil disturbance class	Area (%)
No disturbance	97.6
Litter layer disturbed	1.1
Top soil exposed	0.7
Subsoil exposed	0.4
Subsoil heavily disturbed	0.2
Total	100

11. ADVANTAGES OF SKYLINE YARDING SYSTEMS

- Manageable investment volume for local contractors
- Skills for operation and maintenance locally available
- Flexibility for integrating ground-based systems
- Road requirements in line with access needs for silvicultural operations
- Yarding cost lower than with helicopter logging

12. MATERIAL REQUIREMENT FOR CABLE CRANE SYSTEM

12.1. GRAVITY SYSTEM

Parameter: Payload. 4.5 tons
Distance: 1'500 m

POS.	DESCRIPTION	UNIT	QUANTITY
	WINCH		
	- UNIVERSAL SLED WINCH, USW 130	pcs	1
	- Spare part set USW	pcs	1
	CARRIAGE		
	- Carriage BACO, 5 Ton with radio control, 2 transmitter	pc	1
	- Spare part set for carriage	pc	1
	- Skyline support BACO	pcs	5
	SKYLINE TENSION SET		
	- Automatic skyline tension set, part B+C, 30 to for skyline diam. 32mm	pc	1
	LINE EQUIPMENT		
	- Rigging block MR 1H	pcs	4
	- Rigging block MR 2 H	pcs	3
	- Universal block URA 50 H	pcs	5
	- Universal block URA 100 H	pc	1
	- Tailspar block ER 5	pc	1
	- Cable tensioning clamp 1684-5, diam. 5.5-14 mm, 3,6 to	pc	1
	- Cable clamp NG 13, diam. 10-13 mm	pcs	20
	- Cable clamp NG 16, diam. 13-16 mm	pcs	150
	- Cable clamp NG 34, diam. 26-34 mm	pcs	10
	- Shackles HA 2, 1/2", 2000 kg	pcs	20
	- Shackles HA 2, 3/4", 4750 kg	pcs	30
	- Shackles HA 2, 1", 8500 kg	pcs	10
	- Shackles HA 2, 1 1/4", 12000 kg	pcs	10
	- Tensionmeter, Piab 0-5 tone	pc	1
	- Ackija sled winch KMF 422	pc	1
	- Rope for Ackija winch, diam. 6.5 mm, length 100 m	pc	1
	- Spare part set for Ackija winch	pc	1
	- Tackle HIT 16	pc	1
	- Cable for tackle HIT 16, diam. 11mm, length 30 m	pc	1
	- Tackle HIT 32	pc	1
	- Cable for tackle HIT 32, diam. 16mm, length 40 m	pc	1
	- Cable hoist 404 WN	pc	1
	- Tree climbing iron (1 pair)	pcs	2
	- Safety belt complete	pcs	2
	- Line cutter C 16	pcs	2
	- Manila rope, diam. 10 mm, length 40 m	pcs	2
	- Stickwinch, 5 tone	pc	1
	- Twist compensator, 3.2 tone	pc	1
	- Chocker cable, diam. 14 mm, length 3.0 m	pcs	2
	- Chocker cable, diam. 14 mm, length 3.5 m	pcs	2
	- Chocker cable, diam. 14 mm, length 4.0 m	pcs	2
	- Wire rope strap, diam. 32 mm, length 3 m	pcs	3
	- Wire rope strap, diam. 32 mm, length 4 m	pcs	3
	- Wire rope strap, diam. 32 mm, length 5 m	pcs	3
	- Wire rope strap, diam. 32 mm, length 6 m	pcs	3
	- Circular nylon sling 3 t, cl 2 m	pcs	3
	- Circular nylon sling 3 t, cl 4 m	pcs	3
	- Circular nylon sling 4 t, cl 3m	pcs	3
	- Circular nylon sling 4 t, cl 4 m	pcs	3
	- Anker rope strap, length 6 m	pc	1
	- Anker rope strap, length 7 m	pc	1
	ROPES		
	- Skyline diam. 32 mm, length 1700 m, 114 seale, fibre core, breaking load 72 t	pc	1
	- Mainline, diam. 12 mm, length 1800 m, 114 seale, fibre core, breaking load 10.1 t	pc	1
	- Anchoring cable, diam. 14 mm, length 1400 m, 114 seale, fibre core, b1 13 41	pc	1
	ACCESSORIES		
	- Trailer for skyline rope diam. 32 mm with diesel enging 23 HP	pc	1
	- Trailer for skyline rope diam. 14 mm with diesel enging 23 HP	pc	1
	- Splicetool set	pc	1
	- Radio set Motorola GP 900	pcs	4

12. MATERIAL REQUIREMENT FOR CABLE CRANE SYSTEM

12.2. ALL-TERRAIN SYSTEM

Parameter Payload: 4.5 tons
Distance: 1'000 m

POS.	DESCRIPTION	UNIT	QUANTITY
	WINCH		
	- UNIVERSAL SLED WINCH, USW 80 D 1000	pcs	2
	- Spare part set USW	pcs	2
	CARRIAGE		
	- Carriage SF 40-4R with diesel engine-42 HP, 100 m lifting rope diam. 12mm with radio control, 2 transmitter	pc	1
	- Spare part set for carriage	pc	1
	- Skyline support SF	pcs	5
	- Bar for double skyline support	pcs	2
	SKYLINE TENSION SET		
	- Automatic skyline tension set, part B+C, 30 to for skyline diam.32mm	pc	1
	LINE EQUIPMENT		
	- Rigging block MR 1H	pcs	4
	- Rigging block MR 2 H	pcs	3
	- Universal block URA 50 H	pcs	5
	- Universal block URA 100 H	pc	1
	- Tailspar block ER 5	pc	1
	- Cable tensioning clamp 1684-5, diam.5,5-14 mm, 3,6 to	pc	1
	- Cable clamp NG 13, diam.10-13 mm	pcs	20
	- Cable clamp NG 16, diam.13-16 mm	pcs	150
	- Cable clamp NG 34, diam.26-34 mm	pcs	10
	- Shackles HA 2, 1/2", 2000 kg	pcs	20
	- Shackles HA 2, 3/4", 4750 kg	pcs	30
	- Shackles HA 2, 1", 8500 kg	pcs	10
	- Shackles HA 2, 1 1/4", 12000 kg	pcs	10
	- Tensionmeter, Piab 0-5 tone	pc	1
	- Ackja sled winch KMF 422	pc	1
	- Rope for Ackja winch, diam. 6.5 mm, length 100 m	pc	1
	- Spare part set for Ackja winch	pc	1
	- Tackle HIT 16	pc	1
	- Cable for tackle HIT 16, diam. 11mm, length 30 m	pc	1
	- Tackle HIT 32	pc	1
	- Cable for tackle HIT 32, diam. 16mm, length 40 m	pc	1
	- Cable hoist 404 WN	pc	1
	- Tree climbing iron (1 pair)	pcs	2
	- Safety belt complete	pcs	2
	- Line cutter C 16	pcs	2
	- Manila rope, diam. 10 mm, length 40 m	pcs	2
	- Stickwinch, 5 tone	pc	1
	- Twist compensator, 3,2 tone	pc	1
	- Chocker cable, diam. 14 mm, length 3.0 m	pcs	2
	- Chocker cable, diam. 14 mm, length 3.5 m	pcs	2
	- Chocker cable, diam. 14 mm, length 4.0 m	pcs	2
	- Wire rope strap, diam.32 mm, length 3 m	pcs	3
	- Wire rope strap, diam.32 mm, length 4 m	pcs	3
	- Wire rope strap, diam.32 mm, length 5 m	pcs	3
	- Wire rope strap, diam.32 mm, length 6 m	pcs	3
	- Circular nylon sling 3 t, cl 2 m	pcs	3
	- Circular nylon sling 3 t, cl 4 m	pcs	3
	- Circular nylon sling 4 t, cl 3m	pcs	3
	- Circular nylon sling 4 t, cl 4 m	pcs	3
	- Anker rope strap, length 6 m	pc	1
	- Anker rope strap, length 7 m	pc	1
	ROPES		
	- Skyline diam. 32 mm, length 1200 m, 114 seale, fibre core, breaking load 72 t	pc	1
	- Mainline, diam. 12 mm, length 1400 m, 114 seale, fibre core, breaking load 10.1 t	pc	1
	- Anchoring cable, diam. 14 mm, length 1400 m, 114 seale, fibre core, b.l. 13.4 t	pc	1
	- Haufback line, diam. 12 mm, 114 seale, fibre core, b.l. 10.1 t	pc	1
	ACCESSORIES		
	- Trailer for skyline rope diam. 32 mm with diesel enging 23 HP	pc	1
	- Trailer for skyline rope diam. 14 mm with diesel enging 23 HP	pc	1
	- Splicetool set	pc	1
	- Radio set Motorola GP 900	pcs	4

13. BUCKING RULES

for
Skyline System with „BACO“- or „SEIK“-Carriage, 4.5 t load capacity)

Maximum log length (m) in relation to mid-point diameter (cm)
 When ever possible, maximum log length should not exceed 8 m due to yarding reason.

Specific weight: LHW 800 kg
 MHW 1000 kg
 HHW 1300 kg

Mid-point Diameter (cm)

	<60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	160	170
LHW	14	14	14	12	11	10	9	8	7	6	6	5	5	4	4	4	3	3	3	3	3
MHW	14	14	12	10	9	8	7	6	5	5	4	4	4	3	3	3	3	0	0	0	0
HHW	13	11	8	7	7	6	5	5	4	4	3	3	3	0	0	0	0	0	0	0	0

LHW:	MHW:	HHW:
Jelutong	White Seraya	Selangan Batu
Laran	Red Seraya	Nyatoh
Binuang	Yellow Seraya	Merbau
Sepetir	Kapur	Keranji
	Keruing	Resak
	Rengas	Kayu Malam
	Mengarlis	
	O.T.	