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STEEP COUNTRY THINNING SYSTEMS

W. M. Foran
G. C. Wells

INTRODUCTION

Production thinning objectives are improving the quality of the crop, maintaining forest health, and increasing the total forest yield. The major problem in fulfilling these objectives is the high cost incurred, particularly in early thinnings.

On steep country the harvesting problems and costs are compounded. In the past extraction thinning on steep country was avoided, but the current situation is forcing the industry to harvest smallwood on steep slopes. New Zealand is faced with the dilemma of needing to develop new markets in anticipation of the large resource that lies ahead, but having limited wood with which to do so. Through the 1980s the only way that supplies can be increased is by greater production of smallwood. If extra smallwood is required then an increasing volume must come from steep country thinnings.

The work on which this brief report is based aimed to draw together all the information available and to assess those systems which have been used to thin steep country in New Zealand. The systems are described and evaluated on the basis of their physical limitations and the factors affecting their productivity. Model systems representing a range of those in operation were costed and a cost of production calculated. The full report will be available as a LIRA Project Report at a later date. Comparative appraisal of the systems and their costs is shown in the centre pages and a description of the systems is on Page 4 of this report.

For the purpose of this report, steep country is terrain on which a rubber-tyred four-wheel-drive skidder cannot operate except on ridges, gullies, or tracks.

USING THE INFORMATION

To achieve minimum cost it is essential to determine the most suitable system. In choosing from those available many factors must be considered. In this study each system was weighed up against physical, silvicultural, operational, and economic criteria. The results are summarised in the tables. Generally, there is no clear point where one system becomes better than another. Also, it is not possible to give an absolute ranking to any one system, as individual forest owners will place more importance on some constraints than will others. However, it is possible to describe the most suitable forest conditions for each system:

The low capital investment of manual gravity extraction systems are best suited to early thinning on short uniform clean slopes, and the required end product must be shortwood.

Ground skidding systems will be more economic with larger logs and are more appropriate on broken country with few steep slopes of short to moderate length.

Helicopters are unlikely to become an important steep country thinning method, as other systems generally are not as complex to manage and will produce cheaper wood.

TABLE 1 : STEEP COUNTRY THINNING SYSTEMS APPRAISAL

CRITERIA	THINNING SYSTEM							
	Gravity Cable	Chutes	Crawler Tractor	Skidder	Crawler + Skidder	Ag.Trac. + Winch	Small Hauler	Heli-copter
<u>Physical Criteria</u>								
Sensitivity to slope steepness	H	H	M	M	M	H	L	L
Sensitivity to slope length	H	H	M	H	M	H	L	L
Sensitivity to slope uniformity	H	H	M	M	M	H	M	L
Damage to soil	L	L	H	M	H	M	L	L
Sensitivity to undergrowth	H	H	L	M	L	M	M	L
Sensitivity to road placement	H	H	M	M	M	M	M	L
<u>Silvicultural Criteria</u>								
Sensitivity to Merch.Vol/ha	H	H	M	M	M	H	H	L
Sensitivity to piece size	H	H	M	M	M	H	H	H
Damage to residual crop	L	L	H	H	H	M	M	L
Silvicultural flexibility	H	H	M	M	M	M	L	H
<u>Operational Criteria</u>								
Operational flexibility	L	L	H	M	H	M	M	H
Sensitivity to felling & loading phase	H	H	M	M	M	M	M	H
Man-day productivity	L	L	H	H	H	M	M	M
<u>Economic Criteria</u>								
Total cost	L	L	M	M	H	L	M	H
Cost of production	H	M	L	L	L	M	M	H

H = High M = Medium L = Low

TABLE 2 : MODEL SYSTEMS COST

Steep Country Thinning System	Machine Owning Cost (\$/day)	Machine Operating Cost (\$/day)	Labour Cost (\$/day)	Other Cost (\$/day)	Total Cost (\$/day)	Man-day Production Range (tonnes/day)	Total Production Range (tonnes/day)	Cost of Production Range (\$/tonne)
1. Gravity cable	5.50	2.25	100	73.75	181.50	3 - 6	6 - 12	15 - 30
2. Alkathene chutes	3.75	0.50	100	73.50	177.75	4 - 7	8 - 12	15 - 22
3. Small crawler tractor	77.50	71.00	200	95.50	444.00	10 - 15	40 - 60	7 - 11
4. Rubber-tyred skidder	86.50	77.00	200	96.00	459.50	10 - 15	40 - 60	8 - 11
5. Tractor + skidder	163.75	148.00	350	134.25	796.00	10 - 15	70 - 105	8 - 11
6. Ag. tractor + double-drum winch	55.00	37.50	200	79.50	372.00	4 - 6	16 - 24	15 - 23
7. Small 3-drum hauler	57.50	69.25	250	96.50	473.25	5 - 7	25 - 35	14 - 19
8. Helciopter	~\$600/hr		350	147.00	1337.00	7 - 8	39 - 45	30 - 34

Note : All produce long length wood except gravity cable, chutes, and helicopters. In the helicopter system, shortwood is cut for four days and helicopter extracts on fifth day for 7 hours at a rate of 28-32 tonnes/hr; maximum lift 1 tonne.

THE SYSTEMS

The systems examined are in four groups: gravity systems; ground skidding systems; cable systems; and a helicopter system. A brief description of each is as follows:

GRAVITY SYSTEMS - Shortwood can be extracted downhill suspended on a wire rope, or slid down chutes. In the wire rope method, bundles can be slid down a cable which is tensioned at the bottem end, usually by a vehicle and purchase blocks. The cable acts as a live skyline and is lowered for hooking on the bundle of logs and raised for the logs to slide down. This system is suitable for steep concave slopes. It has been tried and proved feasible, but is not currently in use in New Zealand.

In the chute method, six metre lengths of open alkathene chute are laid up and down the slope and bolted together. Short billets of wood are manually placed in the chute and slid to the bottom of the slope. There, they are stacked ready for loading. This method is suited to even slopes, either concave or convex, between 18 and 35° and less than 120 metres long. Less than 10 of these systems are currently in use in New Zealand. They have found a place both in small forest woodlots extracting posts, and in large forests where they can be used to thin small areas for pulp, which are not suitable for other systems.

GROUND SKIDDING SYSTEMS - Systems using skidders or tractors alone, or in combination, can be successfully used to thin steep country, producing either short or long wood. The choice of system is determined mainly by topography, together with soil structure and road placement. Skidders on their own can only be used where slopes are short enough to permit trees to be hooked on from either gully or ridge tracks. On longer slopes, tracking will be required and for this purpose a small crawler tractor can be used: if the tracking requirement is extensive, an angle blade will be needed. Crawler tractors can generally operate on narrower tracks than rubber-tyred skidders, and for this reason may be preferred where tracking is required. Track spacing will probably be no more than 30 metres and tracks should be parallel to each other and along the contour. Tractor and skidder systems are most commonly used for thinning as they offer great flexibility.

CABLE SYSTEMS - Using cable haulers to thin radiata pine is currently practised extensively in only one major forest. Three-drum skyline haulers are used and work uphill and downhill with a maximum haul of approximately 300 metres. The thinning pattern usually applied is to cut four metre wide corridors at 20 metre centres with selective thinning between. Both short and tree length logging can be carried out. Cable logging systems are used on long, very steep slopes, and where tracking is not possible. Because of high capital costs, a number of alternatives have been considered. One is an agricultural tractor with a double-drum winch and a running skyline systems, and another is a Capstan winch with an endless line inhaul procedure. Neither system is currently being used in a full production situation.

HELICOPTERS - Helicopters have been used for extracting thinnings from steep country where special constraints apply: usually that roading is very limited and soil disturbance must be kept to an absolute minimum. To make helicopter operations successful a very high level of planning and management expertise must be applied.

To harvest over a wide range of forest and terrain conditions, a system should be flexible. However, flexibility does not necessarily mean that for each type of forest wood will be produced at a minimum cost. For lowest cost it is usually necessary to have specialised systems.

In many cases the choice of thinning system for steep country has been limited by the equipment available, or by lack of skilled manpower. If greater volumes of wood are to be thinned from steep country, then some specialisation may be warranted, with associated reduction in costs.

For Further Information Contact:	N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC. P.O.Box 147, ROTORUA, NEW ZEALAND.	Phone 87-168
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