SMALLWOOD HARVESTING - SOME DEFINITIONS

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1. INTRODUCTION

It is appropriate at this stage of the seminar to discuss what is meant by smallwood and by smallwood harvesting in some detail. This should ensure that during the seminar we all speak the same technical language. It will also set a frame of reference for dicussions during the seminar.

In defining smallwood we immediately run into the problem of deciding: "how big is small?". The answer, of course, is that "it depends". A recent article originating in the Pacific Northwest Coast of America, titled "New Yarder Ideal for Smallwood", decribes a 145 kW (193 hp) hauler logging trees averaging one cubic metre in size. At the other end of the scale a recent Finnish study discusses research work aimed at coming to grips with harvesting trees which require 25 or more to make one cubic metre. And in New Zealand? Well, the purpose of this paper is to set down working definitions suited to our own harvesting operations at the present time.

To develop a definition for smallwood it is necessary to ask: What kinds of trees or wood are we concerned about? What categories of trees present the special problems that gave rise to this seminar? Then, we can look at the options of systems to harvest these categories of timber.

1.1 The Problem Area in Harvesting

The first point is that the timber is small so that delimbing costs are high relative to the volume involved. Because of the small size there is also the problem of aggregating a full payload behind any extraction machine. The second point is that the value of the timber is generally low. Usually it is not suitable for sawlogs and is harvested mainly for pulpwood, which has an intrinsically lower value. There are some exceptions to this, such as posts and poles, and small log export sales. However, these exceptions generally require special handling so that their logging cost is accordingly higher.

Thus the timber we are concerned with is characterised by high logging costs and generally low value product. Since we are investigating logging operations in this seminar, it is consistent to define smallwood according to the kinds of operations undertaken to produce it.

2. WHAT IS SMALLWOOD?

Following on from the above, smallwood is now defined as the product of the following operations:

2.1 *Thinning operations from which the majority of the products are too small for sawlogs in New Zealand. These generally produce pulpwood but there are also many operations producing posts and poles, and a few producing special export grade small logs.*

2.2 *Clearfelling stands of young trees or stands of unthrifty species where the products are too small for sawlogs in New Zealand. The main products will therefore be pulpwood with some posts and poles and small log exports. In the future there will possibly be material used as a base for energy production.*

2.3 *Harvesting logging residue in a second phase operation. These operations mainly produce pulpwood from head and branch material left behind after a clearfelling operation.*

In terms of tree or piece size, these definitions cover a reasonably wide range, although the majority of trees considered would be between 0.1 cubic metres and 0.35 cubic metres. For radiata pine this corresponds to trees with diametres of 10 cm to 25 cm. Other studies have shown that logging costs increase very sharply when tree size decreases below 0.2 cubic metres. While the greatest effort and potentially the greatest return may come from research and development into logging methods for the smaller sized stems, any improvement in the economics of logging the slightly larger stems will still prove worthwhile.

The definition of smallwood given here deliberately excludes those small logs which are produced at the same time as larger sawlogs in many clearfelling operations; especially in old crop radiata pine. These small logs (sometimes called arisings) pose special problems in sorting, loading and transport. However, as they are not fully harvested from the stump area as a small tree or residue, they have not been included within the scope of smallwood for this seminar.

3. SMALLWOOD HARVESTING SYSTEMS

There is a great range of possible systems for harvesting smallwood. While this can confuse a discussion it helps if these systems can be grouped into a few general types. Once again, there are several methods of categorising logging systems, but the one described here is fairly widely accepted and understood. The basis is the relative amounts of human work and machine work used to get the logs onto a truck; i.e. the relative degree of mechanisation.

3.1 Basic Systems Classification

(a) Motor-Manual Systems (See Figure 1)

Motor-manual systems are characterised by having felling and delimbing carried out by a man with a chainsaw:

(i) Motor manual shortwood logging systems: those where manual crosscutting and stacking of short lengths of timber (shortwood) occurs in the forest, or less commonly on the landing.

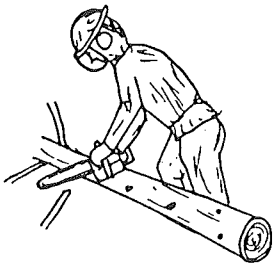
(ii) Motor manual longwood systems: those where the tree lengths are extracted to a landing. A small amount of manual crosscutting may occur, but most subsequent operations are carried out by specialised machines.

Figure 1

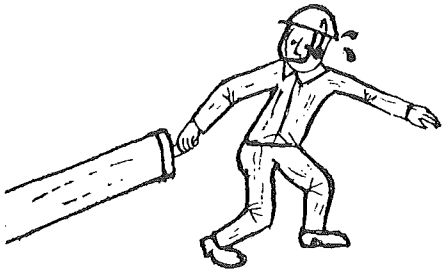
MOTOR-MANUAL - CHARACTERISED BY MANUAL FELLING AND MANUAL TRIMMING
(Labour intensive)

TYPE (A) - SHORTWOOD

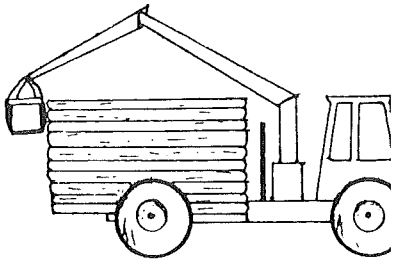
Manual felling



Manual trimming & crosscutting

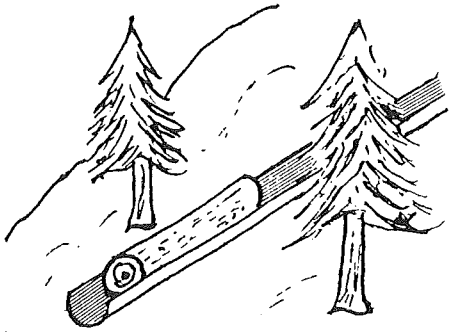


Manual stacking



Forwarder (or skidder) extraction

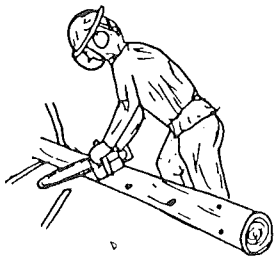
or



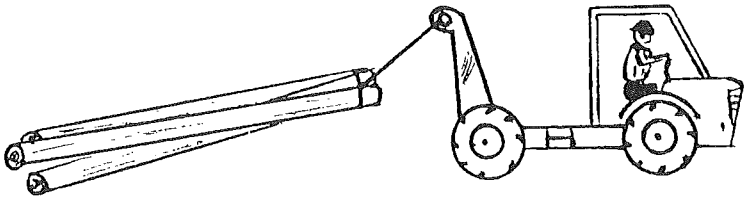
Chutes, on steep terrain

TYPE (B) - LONGWOOD

Manual felling

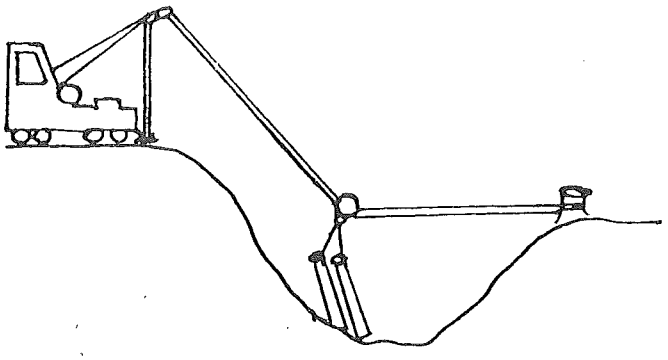


Manual trimming



Skidder extraction

or



Cable systems on steep country

A variety of machines and methods may be used to extract timber from the stump to a landing and to load it from the landing to a truck. In New Zealand skidders and agricultural tractors are most commonly used on moderate terrain and small haulers on steeper terrain. Forwarders for extracting shortwood are not common although they would represent a common method overseas. A small number of operations utilise gravity to extract timber in short lengths, such as wire rope or chute methods. Rubber-tyred front-end loaders are commonly used to load trucks. Some equipment specialised for loading smallwood is also used, such as self-loading trucks, stacked out trailers, and bunks loaded by knuckle-boom cranes or sometimes by hand.

(b) Mechanised Systems *(See Figure 2)*

Mechanised systems are characterised by having either felling or delimbing, or both operations, carried out by a specialised machine. The actual degree of mechanisation can be quantified according to the proportion of motor-manual operations performed by a specialised machine. For N.Z. smallwood operations, where felling and trimming are the main non-mechanised operations, 20-25% of time is spent felling and 75-80% spent trimming. Therefore an operation where trimming is mechanised represents a higher degree of mechanisation than one where only felling is mechanised. A similar analysis can be used for operations such as crosscutting and stacking. However, the classification used here recognises only two levels of mechanisation.

(i) Semi-mechanised systems: felling may be undertaken by a specialised machine followed by trimming using a man with a chainsaw. Alternatively, felling may be undertaken by a man with a chainsaw and trimming done by a specialised machine. The second alternative represents a higher degree of mechanisation than the first.

(ii) Highly mechanised systems: both felling and trimming are undertaken by a specialised logging machine. This may be mounted on one carrier or two separate machines may be used.

Mechanised logging systems have made only a small impact on smallwood harvesting in New Zealand. However, both partly and fully mechanised systems are in use. There is a great variety of machines for carrying out the functions of felling and delimbing, many of which have been developed overseas, while a few have been developed within New Zealand. Extraction and loading of wood produced from mechanised systems have not developed differently from methods used for wood produced from motor-manual systems.

3.2 Possible System Options

Having grouped smallwood logging systems into four basic categories, further subdivision of each category is possible to assist in describing a particular logging operation. The basis of this further subdivision is:

(i) The sequence of operations: fell, trim, crosscut, extract, and load, are the main operations.

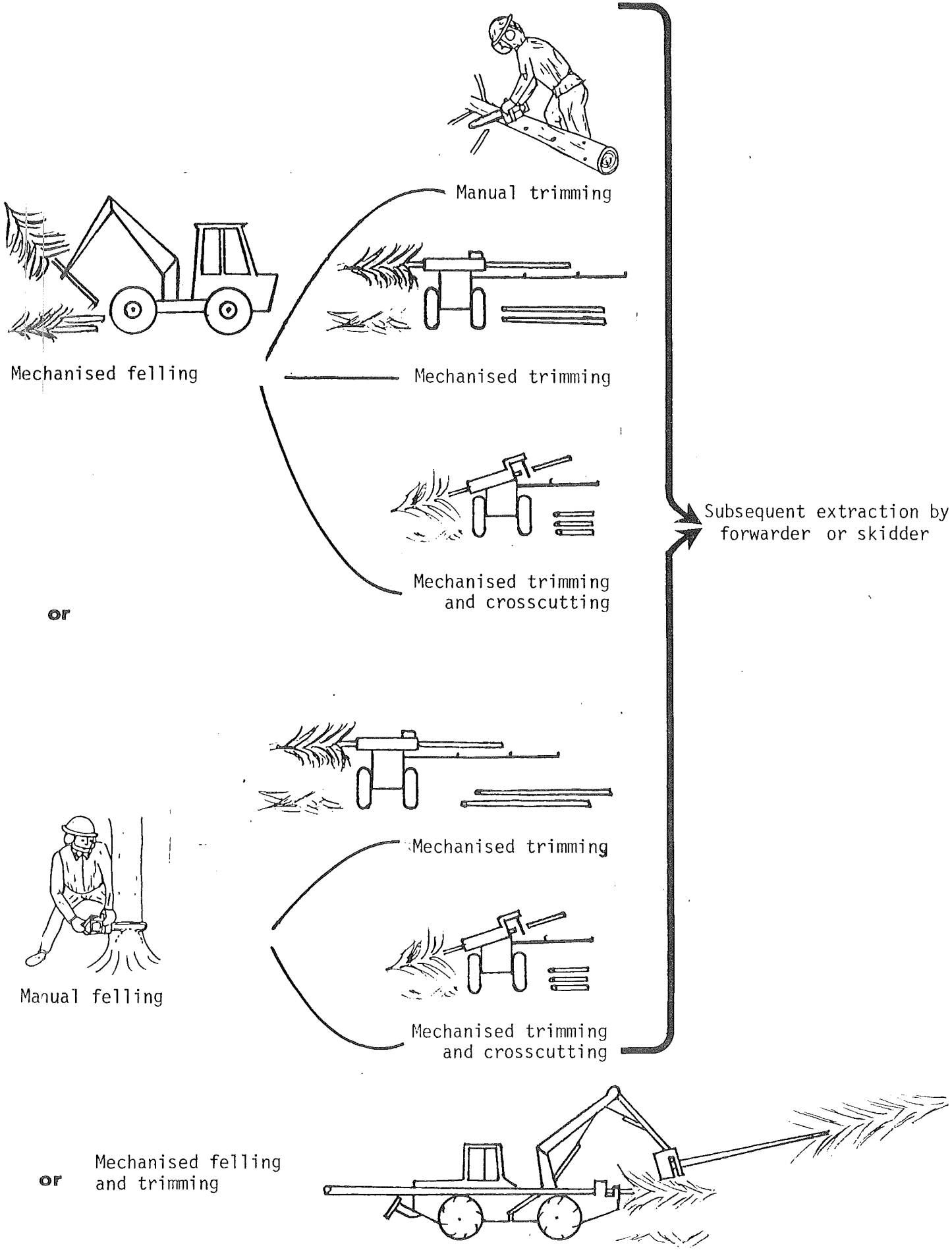
(ii) Location of operation: this may be at the stump area, on a landing, or a central processing yard.

(iii) Method of operation: this describes the equipment used to perform each operation, e.g. chainsaw or felling shear.

Not all of the potential systems are possible. For example, it is necessary to fell a tree before it can be extracted or loaded! However,

Figure 2

MECHANISED - CHARACTERISED BY MECHANISED FELLING, OR TRIMMING, OR BOT



there are several hundred different ways (possibly as many as engineers have the ingenuity and time to design and develop!) for putting together the equipment necessary to get logs onto a truck. These varied possibilities do not give rise to any confusion as long as the same method of description is adhered to in all of them. The following two examples show how this system can describe two widely dissimilar logging systems:

System 1. Motor-manual longwood, slashing on landing, loading to bunks.

Operation Sequence	Fell	Trim	Extract	Crosscut	Load
Location	Stump area	Stump area	-	Landing	Landing
Method	Chainsaw	Chainsaw	Agric. tractor	Mobile slasher	Knuckle-boom crane to bunks

System 2. Highly mechanised, delimber-feller-buncher, grapple skidder extraction

Operation Sequence	Delimb	Fell & bunch	Extract	Load
Location	Stump area	Stump area	-	Landing
Method	Delimbing knives	Shear	Grapple skidder	Front-end loader

4. CHOOSING A SYSTEM FOR SMALLWOOD HARVESTING

This section looks at the factors which have a major affect on the choice of system used in smallwood harvesting. During the seminar these topics will provide a major area for further discussion.

4.1 Mill Requirements

This is perhaps the first area which must be looked at before considering which system to use. For a start, the mill will require either shortwood for longwood. If shortwood is required, an extra crosscutting operation must be fitted into the system, at one of the several locations and using one of a wide variety of the methods. Another factor is the standard of presentation of logs required. Some end uses require a very high standard in terms of delimbing and cutting to length. The mill is also likely to set the rate of production. This is discussed below.

4.2 The Forest

An important consideration in the forest is the variability of tree size and terrain. In a variable forest, flexibility is required and this may mean that more than one system is necessary,or that a flexible system should be used. Motor manual systems tend to be more flexible than mechanised systems. This is because a man with a chainsaw can cope with a wide range of tree sizes, and rubber-tyred skidders or tractors can cope with a variety of terrains. When the forest is uniform over a reasonably large area then a mechanised system can be considered.

4.3 Terrain and Environmental Sensitity

High mechanised systems, and in particular mechanised felling, have

production rates which are very sensitive to slope and do not operate well above 10-15°. Mechanised delimbing, however, can take place at a level landing area or on a roadside in steep country. In steep areas and some less steep areas, soil disturbance must be kept to a minimum for environmental reasons. Steep country logging methods such as cables or chutes must be employed.

4.4 Production Rates

The overall production rate required by the end user and the production rate per system must be considered. Mechanised systems generally have a higher production rate than motor-manual systems. It is normally unwise to rely on just one harvesting system to supply the total needs of any one user. Therefore, a relatively low production rate requirement may be catered for by several motor-manual harvesting systems, while a high production rate can be catered for with several mechanised systems, or a larger number of motor-manual systems. The forest size or total production of an area of forest should be considered here also. There is little point in employing a very high producing system in a small forest area, as time spent shifting from one forest area to another will become too large a proportion of the total time. Unfortunately reliable production rates for particualr systems in particular forests are not readily available.

4.5 Capital Availability

The introduction of mechanised logging systems almost always means a high requirement for capital. If this is not available, less capital intensive systems must be used, and this will point to the use of motor-manual systems.

4.6 Machine Servicing Facilities

A very important consideration with any machine is the availability of repair and maintenance facilities. Highly sophisticated machines (that is those used in mechanised logging systems) generally require specialist servicing facilities for hydraulic and electrical components. In New Zealand these specialised machines tend to be present in low numbers and servicing in areas away from major industrial centres can be a very big problem. On the other hand, the common extraction machines used in motor-manual systems tend to be more readily serviced in rural areas.

4.7 Availability of Labour and Labour Skills

All harvesting operations require skilled labour. To start up an operation this labour must be either trained from a locally available labour pool or attracted from elsewhere. Providing other factors favour it, a mechanised logging system does reduce the requirement for skilled labour. However, the intensity of training for the smaller number of men required may be greater and more specialised in the case of a mechanised operation. The problem is obviously greatest in relatively small operations remote from pools of skilled labour. Here, motor-manual systems will have to be used but low productivity can be expected until skills have been acquired.

4.8 The Relative Costs and Production Rates of Labour and Machines

Perhaps the most critical factor, yet one of the hardest to determine, is the final cost of getting a cubic metre of wood onto a truck using the various systems. It is necessary to know both production rates and costs. Possibly because these are unknown or at best poorly understood, this relative cost comparison is rarely made when choosing a logging system for smallwood harvesting.

5. SUMMARY

Smallwood has been defined on the basis of the kind of operation which produces it. The area of concern is for trees which are expensive to harvest and yet which have a generally low market value. Logging systems to harvest this smallwood can be classified according to the relative inputs of man power or machine power. While there is a large number of possible ways of putting together machinery to do the logging work, they can be easily described in a relatively simple listing of sequence, location, and method of operation. When it comes to choosing a particular smallwood harvesting system, many factors need to be taken into account. Unfortunately, some of the most critical are not well understood so that the best decision cannot always be made. It is expected that this seminar will provide some useful information for loggers, logging managers, and planners, which can be used for making rational choices of smallwood harvesting system options.