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FACTORS AFFECTING SKIDDER PERFORMANCE

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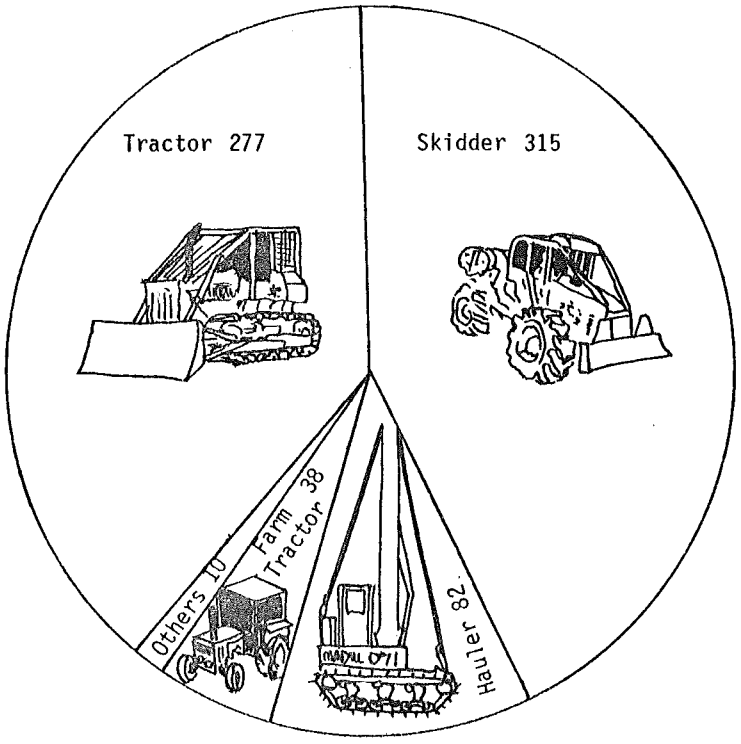
INTRODUCTION

Various forms of rubber tyred skidder have been in use in New Zealand since the Mid 1950's. During this time skidder technology and expertise has developed to a stage where the skidder is now the most widely used and cost efficient extraction system. It is used on terrain varying from flat to very steep.

Extraction Machines by Number and Type in New Zealand



Information taken from LIRA Vol. 10 No. 10. A survey of the Logging Industry 1985
*Ref 1

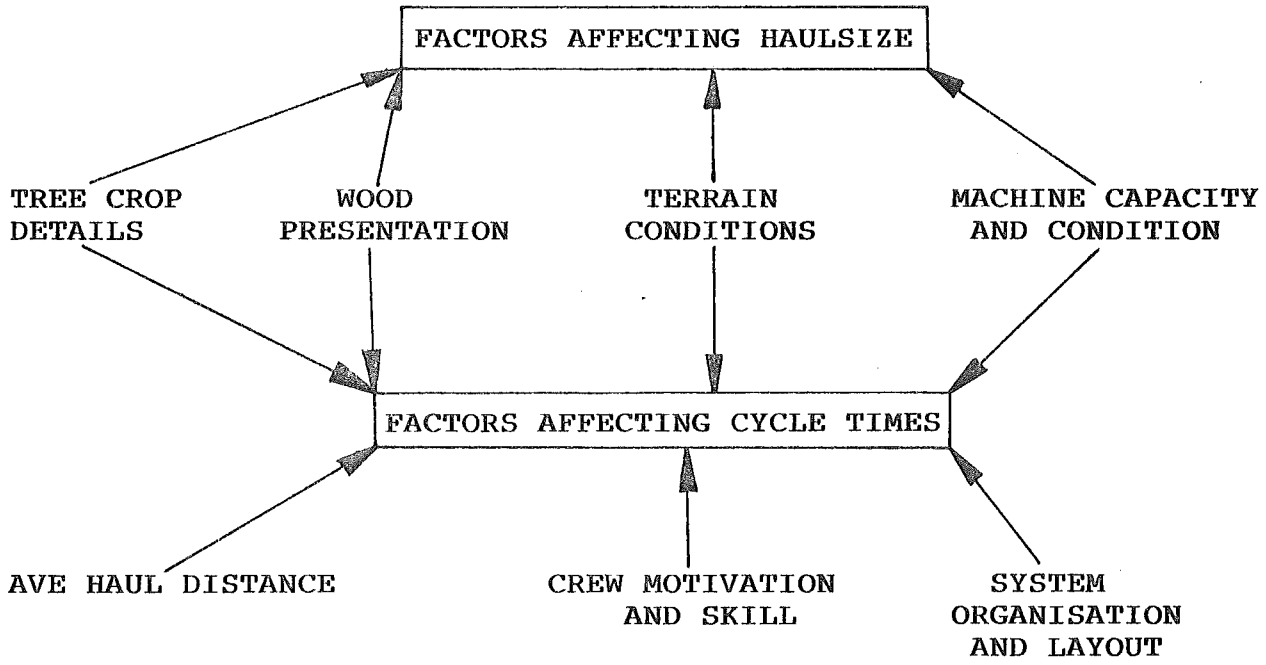
Of the 315 skidders in use approximately 309 or 98% are rubber tyred machines fitted with cable winches. Accordingly this paper will address the main factors affecting the performance of rubber tyred cable skidders and then look at ways in which this performance can be improved.

WHAT DO WE MEAN BY SKIDDER PERFORMANCE?

By skidder performance we mean Productivity and in LOGGERS TERMS this means "LOADS ON SKID" at the end of the day. In Management terms the ultimate Performance measure of extraction is $/Tonne on skid.

High levels of machine availability and utilisation are prerequisites for efficient skidder operation. Apart from these two important requirements a combination of factors affect either or both of the two key elements in a skidder operation;

- Haul Size
- Cycle Time



FACTORS AFFECTING HAUL SIZE AND CYCLE TIMES

1. MACHINE CAPACITY AND CONDITION

The Kilowatt rating of the machine and its mechanical condition can have a large bearing on Haul size and Cycle Times.

The average Haul Size achieved by a skidder is of critical importance. The optimum for most machines is 50% to 60% of skidder weight (J. Collins *Ref 2). Recent work by Collins in the same publication found that in seven different skidder operations the machines studied only averaged a haul size equivalent to 38% of skidder weight. If these machines had been loaded to capacity production would be considerably higher.

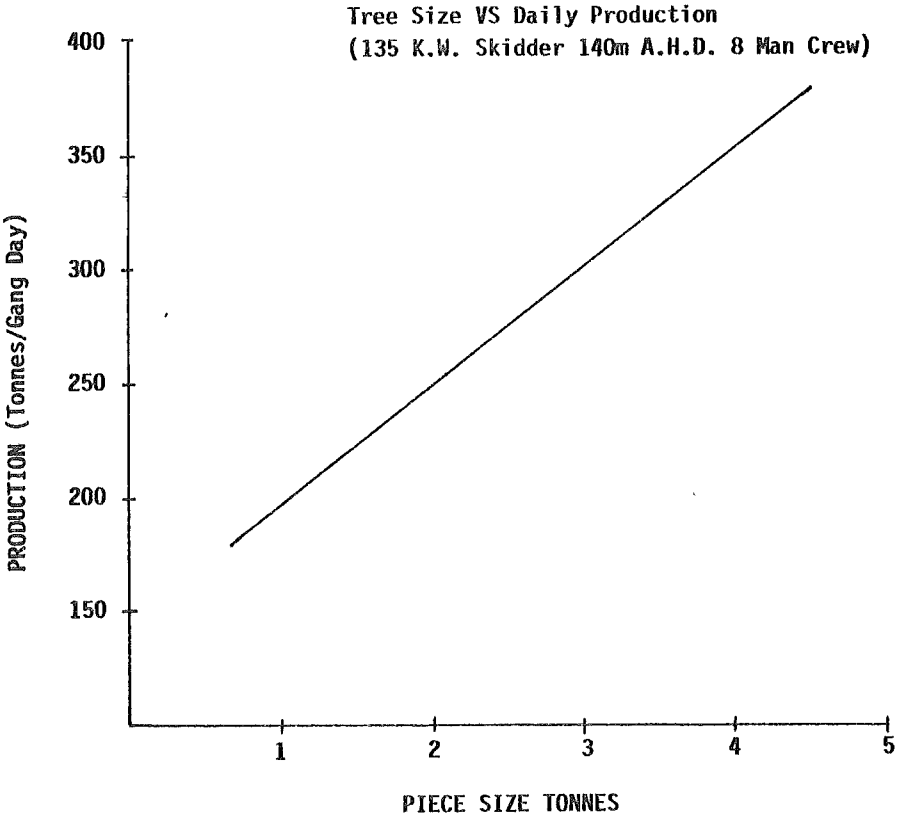
The winch capacity of the machine is also an important factor affecting the breakout times and Haul size of the machines. A general "rule of thumb" conway *Ref 3 states that a skidder has to have enough power to pull two times the weight of the logs in order to break them out.

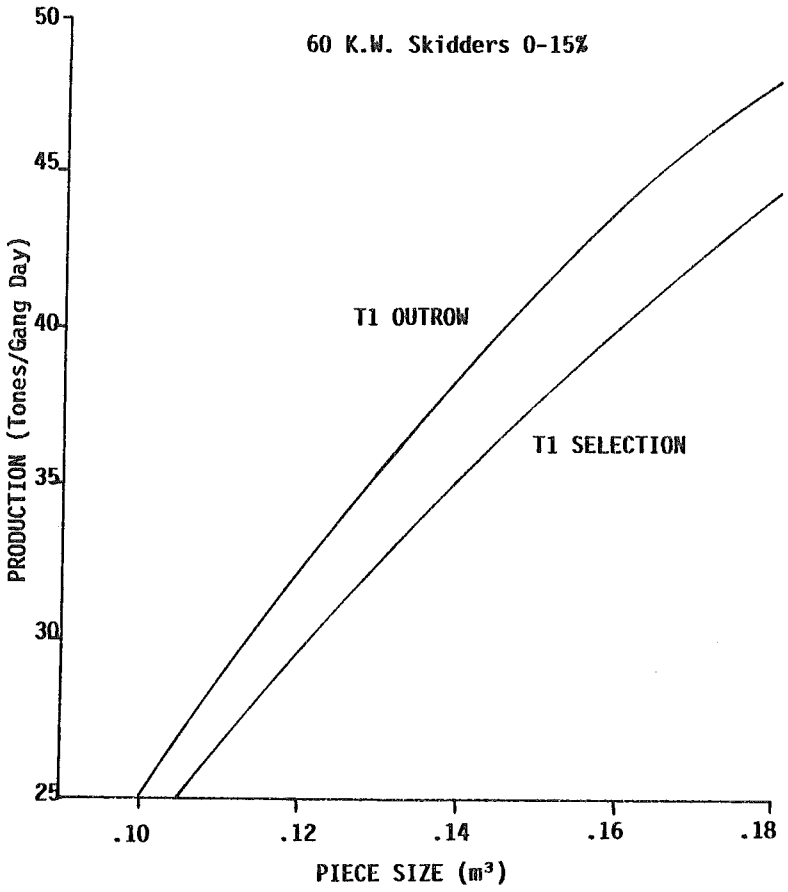
A high level of machine availability is a pre-requisite for an efficient skidder operation. Excessive downtime can cause severe productivity and cashflow problems for contractors or escalating costs for the Company who owns the gear. Downtime can be minimised through having an effective maintenance strategy and good operator training.

2. TREE CROP DETAILS

(1) TREE SIZE

Tree size is one of the most important factors affecting skidder productivity and Logging costs. In any skidder operation and most Logging Operations there is a strong relationship between tree size and productivity.





The main reasons skidder productivity reduces with reducing tree size are;

(a) Reducing tree sizes generally reduce the average payload.

(b) Reducing tree sizes increase cycle times as more logs have to be hooked on to gain a payload.

(2) TREE SPACING

Stand density or stems per Hectare can have an important influence on performance. Generally in wider spaced stands with small piece size, the skidder spends more time manoeuvring to try and gain a full payload. This leads to increased cycle times and often smaller payloads than desirable ie; less productivity.

(3) OTHER STAND FACTORS

The number of Dead stems present and the height of trees also affects skidder cycle times and haulsizes. Very tall trees and Dead trees generally incur more breakage which often means more pieces to hook on and reduced drag sizes.

(4) CUTOVER CLEANUP SPECIFICATION

The severity of cutover specifications or minimum length requirements for Pulp recovery can have a significant effect on skidder performance. In most cases average skidder payloads are substantially reduced and cycle times increased through having to hook on more small pieces.

(5) TREE FORM

Malformed trees generally allow less trees to be hooked on per drag and take more time to prepare for breakout.

3. WOOD PRESENTATION

Improved wood presentation by fallers generally leads to faster hook up times, faster breakout times and increased payloads due to reduced breakage. Increased Grade recovery is also another significant spin off of reduced breakage.

(1) ORGANISED FELLING IN THINNINGS

Recent work done by L.I.R.A. in 1985 (*Ref 4) showed that organised felling led to faster overall cycle times and substantially larger drag sizes in butt pull areas. The results of the study showed an overall reduction in logging costs of 10% taking into account the extra cost of the organised felling.

(2) BUTTPULL OR HEADPULL

Work done by Calvert and Garlick in 1968 (*Ref 5) showed a 15% reduction in force when logs were skidded butt first as opposed to top first.

Butt pulling has definite advantages over headpulling in most situations especially when the machine is operating at long haul distances and payloads are close to maximum capacity.

Felling to facilitate butt pulling is generally reliant on skids being correctly located relative to the prevailing lean. This should be determined by the Logging Planner. However in some cases over-riding factors often mean that skids are not placed to facilitate butt pull. For instance on moderate to steep downhill slopes felling is often downhill for headpulling.

4. TERRAIN CONDITIONS

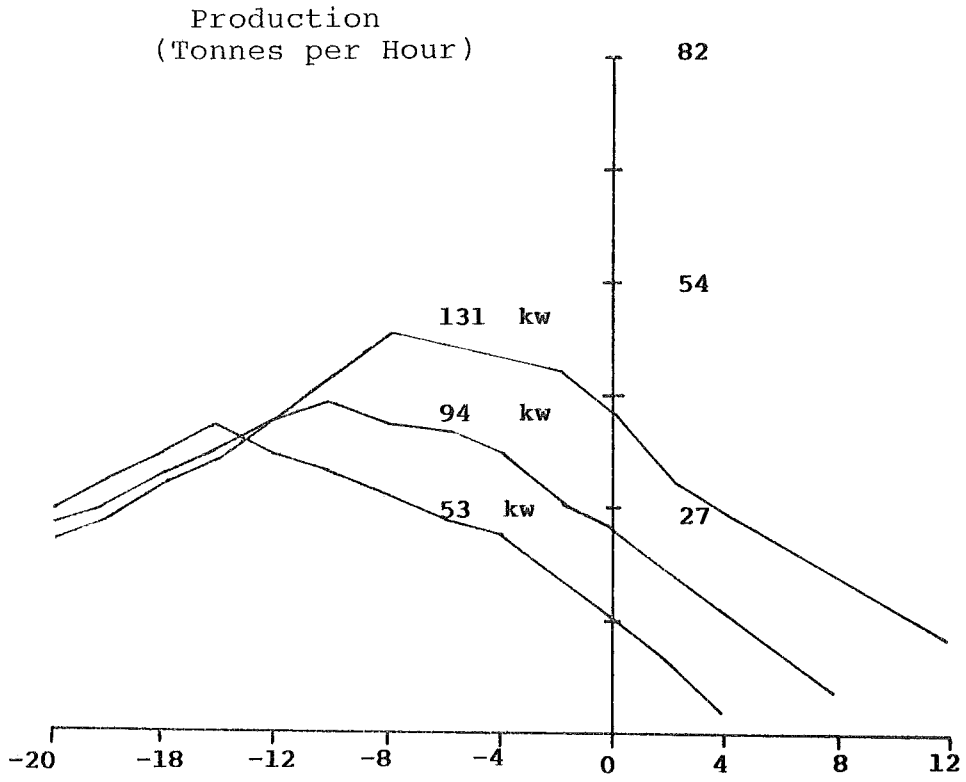
The combined effect of prevailing terrain conditions can have a marked effect on both skidder Haul sizes and cycle times. Two major terrain conditions SLOPE and SOIL STRENGTH have the biggest effect on productivity although other frequently encountered conditions are obstacles like rocks, windthrown trees, and gullies.

(1) SLOPE

Rubber Tyred skidders can operate on slopes up to a maximum of 30° in good soil conditions with no tracking. Most areas in New Zealand have some soil limitations and skidders are generally used loaded on slopes ranging from -20° to +5°.

Assuming soil conditions are constant skidder productivity steadily increases as downhill loaded slopes increase up to -12°. Once slopes become steeper than this skidder productivity reduces.

EFFECT OF SLOPE ON SKIDDER PRODUCTIVITY



Production in relation to slope for three skidders of different kilowatts. Log Length Load, Turn Weight 4.10 Tonne. Cone index 689 KPA. Slope Distance 30.5 metres

*Ref 6

(2) SOIL CONDITIONS

Soil conditions can have a major effect on skidder productivity. Soft, Loose and wet soils all cause traction problems which result in reduced payloads and increased cycle times.

Poor weather conditions combined with sloping soils of low strength adds up to Low Productivity or No Productivity. In these situations skidder logging should be planned for "summer logging" or another logging system selected:

(3) TRACKING

Tracking can be used to reduce the effect of side slopes and allow skidders to log steep country with favourable soil characteristics, Grade Limitations still apply to the tracks.

Track Formation costs extra money. In many cases however the Tracking cost and logging costs combined are less than the cost of logging without tracks or with an alternative machine. This system has been used with a good deal of success at Golden Downs Forest with relatively stable moutere gravels.

Tracking is also frequently used in Tasman's operations. Small adverse portions of larger skidder blocks are generally tracked to facilitate skidder extraction. This is more cost efficient than shifting an entire tractor crew just to do one small area.

FACTORS AFFECTING CYCLE TIMES

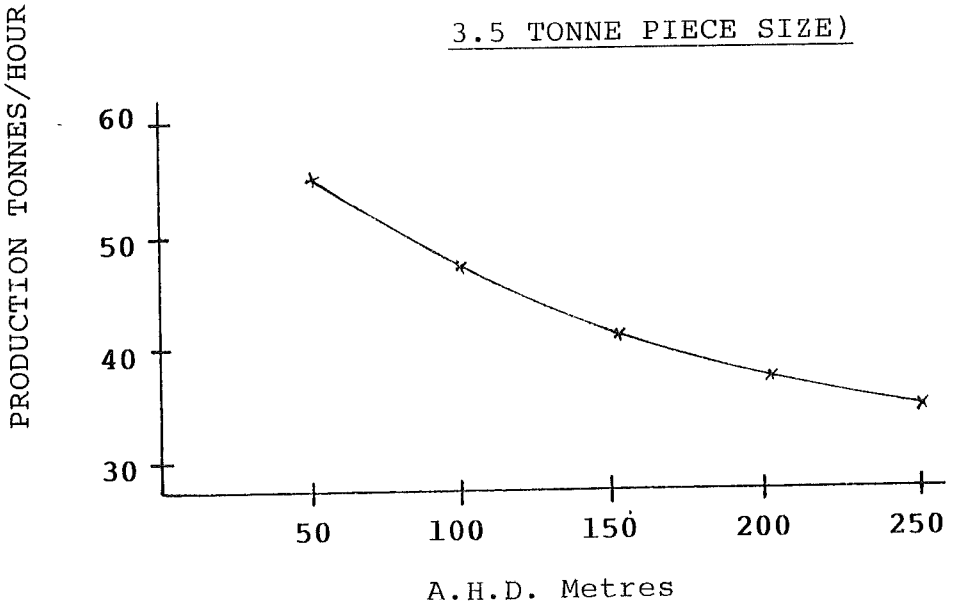
1. AVERAGE HAUL DISTANCE

Skidder hauling distance is an important variable affecting skidder productivity ie; shorter average haul distances equate to shorter cycle times and higher productivity.

EFFECT OF HAUL DISTANCE ON SKIDDER PRODUCTIVITY

(135 KW MACHINE 140m AHD 8 MAN CREW

3.5 TONNE PIECE SIZE)



The Logging Planner can have a major effect on the numbers and placement of skids and therefore the average Haul distance but is often constrained by a number of other factors.

a. Maximum allowable skid and road densities. Current guideline in Kaingaroa is 400m^2 per Ha.

b. Road and skid formation costs, particularly in steep and/or erodable country.

2. SYSTEM ORGANISATION AND LAYOUT

Can have an important effect on cycle times and productivity. Essentially this is the responsibility of the crew boss and Logging Supervisor. In any skidder operation, the rest of the operation ie; Felling, Skid processing and Fleeting must be adapted to fit the capacity of the extraction machine not the other way around.

The crew boss and Supervisor can maximise productivity by ensuring the following:

i That the skidder works the area to ensure a reasonably balanced flow of wood to the skid.

ii That the crew manpower is effectively deployed.

iii That the skid is of sufficient size to allow room for the skidder to pull, skiddies to process and loader to fleet and load trucks if applicable.

v That Transport is organised to minimise interference with Loggers and to maintain low stock levels so bottlenecks do not occur on skids.

vi That unnecessary delay times are minimised.

vii That wood stacks are properly laid out around the landing to facilitate quick fleeting and loading of trucks.

viii That the machine is correctly rigged and the crew is working sufficient hours.

3. CREW MOTIVATION AND SKILL

The 'Human' Factor in many Logging crews is often overlooked but is perhaps one of the most important factors affecting productivity. The skidder operator and breakerout (if there is one) are key positions as they have a direct influence on the amount of wood pulled.

Productivity of the whole crew is also important as the job is reliant on team work.

Skills can be taught and learn't through experience. Motivation can sometimes be induced financially but is more often a state of mind which occurs naturally or is bought about by leadership or threat.

Most successful Logging Operations usually have several key ingredients.

(1) A boss with good leadership abilities whose 'on the job'

(2) Some form of attainable target or goal, followed up with regular progress information and financial rewards.

(3) Trained manpower, with a good safety record.

(4) Good crew morale, low absenteeism and low rate of labour turnover.

CONCLUSION

Skidder productivity is a complex interaction of machinery, manpower, wood and terrain factors. The basics for an efficient operation are:

- Good Planning
- Well maintained machinery
- Big Payloads and fast cycle times
- Skilled and motivated manpower.

WAYS OF IMPROVING SKIDDER PERFORMANCE

1. CHAIN STROPS

Have been used in small wood with a great deal of success for several years. Studies by L.I.R.A. (*Ref 7) have shown a 6% reduction in strop handling time. Initial cost of chain strops is higher than ropes but life is longer so overall costs are less. Chain strops are much easier to handle, have no spraggs and are easily repaired rather than thrown away.

2. CHAINS

Have been used on skidders to improve cycle times and load pulling capacity in steep and slippery conditions. No figures are available on cost or productivity benefits. Some research work should be done in this area.

3. WIDE TYRES

Can be used to improve skidder performance in areas with severe slope and ground conditions. Advantages here will be covered by another speaker.

4. GRAPPLE SKIDDERS

Use of Grapple attachments in New Zealand has been limited and mostly confined to clearfell operations on flat terrain as they are not really suitable for picking up individual stems in thinnings. Rope machines have remained popular due to their versatility and ability to work steeper and more awkward areas with their larger breakout capacity from the cable winch.

Grapple machnes operate on the principal of slightly reduced payloads and much faster cycle times than rope machines due to faster load accumulation times and drop times. Limited work done in this area indicates Grapple machines can out produce rope machines, by up to 20% and reduce Logging costs by 10%. More research work is needed in this area.

5. USE OF BREAKEROUTS

Some skidder operations still have the machine operator stropping his own logs and only 1 set of strops. When a large number pieces have to be hooked on the strop element can form over 50% of the total cycle time. One way to speed this up is to have a separate breakerout or faller assist the strop up phase. This is faster than just the operator doing the job but with only one set of strops the breakerout is wasting half his time waiting for the machine to return.

6. PRESTROPPING

Utilising a Breakerout with 2 sets of strops and a Prestropping system is far more efficient system than using 1 set of strops and a breakerout. Use of this system enables the breakerout to have the next drag stropped up ready to hook on by the time the skidder returns.

Potential gains from this system increase with reducing piecesize and its success is dependant on keeping track of all the strops.

Prestropping has been around for years and many a contractor has tried it and thrown the idea away. Some highly successful contractors still use it. No hard and fast information is available on Productivity gains but my estimate is at least 10%.

7. PRE TRACKING

Pre tracking can also be used on flat terrain to speed up cycle times. This also helps to reduce wear and tear on machines.

No cost savings in this area have been quantified. Currently this practice is usually only carried out when a Dozer is handy or available as a backup machine.

HAUL SIZE PROBLEMS

In smaller timber the most common problem reducing productivity is under-utilised extraction machines as only 8 or 9 chokers can be handled on 1 winch and Fairlead. This often leads to severely reduced haul sizes and skidder productivity.

When faced with the above situation loggers have 4 main choices.

i Continue with underutilised logging equipment and pay the higher logging costs.

ii Downgrade the skidder size so that the piece size suits the haul capacity of the machine.

iii Increase the haul capacity of the machine by fitting a double drum winch system, and/or

iv Introduce a bunching system to full utilise the haul capacity of the skidder.

8. DOUBLE DRUM WINCHES

Double Drum winch systems have been used with considerable success in Thinning Operations in New Zealand. Currently there are more than 12 in Operation. L.I.R.A. studies (*Ref 8) have shown production gains of at least 15% over single drum machines.

9. BUNCHING SYSTEMS

Bunching systems (eg; using Bell Loggers) have been developed to improve skidder performance in both thinning and clearfell operations.

Prerequisites for these high producing operations are large areas of resource, reasonably flat terrain and a steady market.

A semi-mechanised clearfell and bunch operation operated by Tasman Forestry has production rates 3 times higher than conventional crews and logging cost savings of 17%.

Similar operations in thinnings with manual falling, Bells bunching and skidder extraction have shown increased man hour productivity of around 30% and logging cost savings of 17% also.

FUTURE TRENDS IN SKIDDER SIZE FOR NEW CROP LOGGING

Papers already presented at this seminar have highlighted the changing nature of the resource. The main changes that will have a negative impact on Logging Operations will be

(1) Reduced tree sizes $1.8m^3$ average in framing regimes
$2.8m^3$ average in export regimes.

(2) Reduced volumes per hectare

(3) Trees of Higher Quality with more branches and a Lower conversion factor.

On the positive side, tree size will be more uniform within stands; there will be very few dead or malformed trees and less breakage should occur.

Taking into account the above changes the net effect is liable to be a dramatic increase in Logging costs, especially in managed stands where piece sizes are less than $2m^3$. Pressure to reduce costs will be a certainty.

WHAT SKIDDER SIZE WILL BE BEST SUITED TO FUTURE CROPS?

- Skidder size in the new wood types will ultimately be determined by the system with the "cheapest Delivered cost at Mill".

- The skidder is only 1 part of the total equation, changes in technology could see current "skidder" type operations modified to incorporate Feller Bunchers large Grapple skidders or clambunk machines and delimbers.

- Getting back to reality, however, if we continue with current "skidder" type operations I believe machines in the 130 - 150kw range will be more versatile and cost efficient in the long run.

  Tasmans experience in the Matea region has shown that 'on truck' Logging Costs with 130kw machines and 90kw machines are very similar in wood of $2.2m^3$ Piece Size. (Matea wood has a big range of Piece Sizes with a high proportion of dead stems).

Although there is no real cost advantage in using bigger machines in this size wood currently, there could well be with developments in the future. Other advantages of using big machines currently are:-

(1) Cheaper 'on truck' costs in wood greater than 2.5 tonnes (proposed piece sizes for export Logging regimes are $2.8m^3$)

(2) Greater versatility than smaller machines over a wider range of piece sizes and terrain. In future variations in piece between stands are liable to be large especially if markets are not found for the produce.

(3) Reduced loader costs due to higher production.

(4) Bigger machines tend to have less repairs and maintenance than small machines in larger wood.

FUTURE RESEARCH IDEAS FOR SKIDDER OPERATIONS

Some options that should be researched in depth are as follows:-

(1) Use of Grapple machines and appropriate felling systems to improve the Load accumulation phase in New Crop stands with lower volume yields per hectare.

(2) Look at bunching options to improve skidder productivity in New Crop on easy terrain ie; (feller bunchers, small excavators etc).

(3) Investigation of pre-stropping to quantify advantages or otherwise for rope machines.

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