INFORMATION NOTE
ODW 9.10

Forest Research
The Research Agency of the Forestry Commission
TECHNICAL DEVELOPMENT

LOG CHUTE EXTRACTION OF A BROADLEAVED CROP

Introduction

This Information Note is one of a series derived from a Technical Development Branch (TDB) Outdoor Workshop (ODW). It is produced as a guide to part of a harvesting system suitable for use in small scale broadleaf woodlands. ODWs are a TDB initiative designed to offer practical advice to practical people through presentation, demonstration and user guidance. The ODW programme will involve repeating trials and introducing new systems around Great Britain, so that a wide range of sites, systems and practitioners can be included.

Information has been gathered from equipment and method trials based at a single location. This information therefore must be taken as indicative only. Variation could be expected for other operations where factors such as terrain, crop specification, product specification, operating distances or operator efficiency differ.

The Log Chute was developed on the Glenfinnan Estate where TDB studied a conifer thinnings[1] extraction operation.

A further case study was carried out at Sutton Wood (1995) by Technical Development Branch (TDB) to assess a log chute (Plate 1) where the objectives were to:

- Assess the extraction of small diameter hardwood thinnings on slopes up to 50%, in conjunction with a portable winch.
- Identify safe working methods for laying out and moving the chute across the site.
- Identify a means of reducing the speed of produce in the chute at the extreme slope limits.
- Identify optimal chute spacing.

[1] Forestry Commission (1994). Technical Development Branch, Technical Note 6/94, Glenfinnan Log Chute.

Plate 1

Log Chute

Equipment Description

The chute sections are 2 m long and made of rotary moulded medium density polyethylene. Each section weighs 9.5 kg. Sections are overlapped and secured with 8 mm plated roofing bolts and wingnuts. The effective length of each section is 1.86 m.

A small portable winch, the Kolpe[2], was included in the trial to ascertain if it was a useful accessory. Weighing 14 kg and containing 35 m of wire rope, this *c*. 0.5 tonne maximum pull winch can be readily attached to a suitable tree (Plate 2).

[2] Kolpe Maskin KB, Nykroppa, Sweden.

Plate 2

Kolpe Winch

Plate 3

Log Chute Braking System

Site and Crop

The site at Sutton wood is situated to the south-east of Coalport and is managed by The Severn Gorge Countryside Trust, Ironbridge, Telford, Shropshire. Sutton Wood is an ancient woodland site with trees 20 to 25 years old. The crop to be thinned was mainly sweet chestnut on a steep bank with an overall slope of 44% and a heavy, wet clay-based soil. Work on this sensitive site was complicated by the presence of a large active badger sett on part of the area.

The standing crop, before thinning, was calculated at 137 m^3/ha. The crop removed was *c.* 48 m^3/ha (35%) and had a mean tree size of 0.057 m^3. Produce was cut into 2.0 m or 3.0 m lengths with a few tops cut into 1.3 m long firewood. A total 15.5 m; was extracted. The site was divided into roughly 2 sections. Half was worked with chutes set straight up/down hill at 14 m spacing and the remainder by one diagonal set-up.

Working Method

Thinning conformed to pre-marked chute routes. An exit bend was incorporated in the 2 vertical setups to reduce log momentum at the landing area. Poles were suspended with one end resting inside the chute and acted as effective brakes on the steeper sections (Plate 3).

Tying the chutes together to form a tube was not as effective for the less straight hardwood produce as it had been in straighter conifers. Reliance had to be placed on the careful setting of brakes and banking the chutes on bends to prevent produce jumping out. Material in 2 m lengths was less prone to this than 3 m. Two workers (a 'loader' and a 'stacker') operated the system.

The portable winch was very useful in reducing the workload at the initial set-up.

Extraction started from the top of each set-up. This allowed:

- The upper sections to be moved to the next location by the loader while the stacker completed his task.
- Heavier products to be slid into the open chute end to avoid lifting.
- All produce, including brake material, to be cleared progressively.
- The 2 operators to join forces in stacking the last piles in each set-up.
- The loader and stacker operators to change jobs for each new set-up.
- The new set-up route to be immediately available for use.

Chute relocation was easier if 2 joined sections were moved as a single unit. A 40 m chute spacing is recommended in Technical Note 6/94. The 14 m spacing, in this crop, made presentation easy provided felling direction was adequate. Produce did not have to be dragged sideways for long distances on steep ground.

Felling took place from *c.* 10 m above the diagonal chute line and *c.* 4 m below it.

For ease of stacking, the stacking operator controlled the amount sent down by the loader at any one time. Usually this was between 0.3 m^3 and 0.5 m^3.

Safety

All forestry operations require assessment of risk and operational training to ensure safe and efficient working.

As the operators were totally unfamiliar with the system, a 2-way radio communication was used for the first 2 set-ups. Later, a simple system of whistle commands proved adequate.

Landing zones must be carefully planned for safe working and marked out to warn other workers. During loading operations the stacker must stand in a safe place and keep a careful lookout. A 7.0 m safety zone each side of the set-up was found to be appropriate.

Manual lifting of the heavier pieces was avoided by using the working method described. Longer products demanded most attention to ensure a correct lifting technique. Small lifting tongs, carried in a belt holster, are preferred to 2 pulphooks. These give a better grip on thin hardwood bark and leave one hand free to guide and restrain produce.

Extraction Outputs and Costs

Extraction outputs and costs including moving the chute were calculated for 3 different set-ups (Table 1).

Table 1

Extraction Outputs and Costs

Study No/Chute Type	Chute Length (m)	Product Density (m^3/10m)	Volume Extracted (m^3)	Chute Slope (%)	Output (m^3/shr)	Cost (£/m^3)
4906 Vertical	64	0.67	4.30	44% overall	1.01	18.32
4907 Vertical	59	0.50	2.97	44% overall	0.76	24.34
4908 Diagonal	110	0.75	1.80	27% overall 22% minimum 56% maximum	0.92	20.11

SM or shr - Standard output units include allowances of 10% for Other Work and 23% for Rest.
The hourly capital and labour costs assumed are Labour at ,16.00 (2 operators) and Chute at ,2.50.

Chute Movement

One man chute layout for the first 44% slope was studied for each 25 m of route, to compare the manual and portable winch methods. The winch moved 5 sections at a time.

Manual = 2.71 SM per 2 m chute section. = £0.36 (Labour only).

Winch = 1.96 SM per 2 m chute section. = £0.28 (Labour + £0.6/hr for winch).

Discussion

Compared with the study results achieved at Glenfinnan, the results were disappointing (Table 2).

Table 2

Study Comparison

	Glenfinnan	Sutton Wood
Output (m^3/shr)	2.59	0.90
Time to move chute (SM/m^3)	7.33	13.38
Extraction cost (£/m^3)	7.14	20.55

These differences reflect the density of produce; 1.4 m^3 / 10 m of chute and chute spacing of 40 m at Glenfinnan, compared to a density of 0.66 m^3 / 10 m of chute and chute spacing of 14 m at Sutton Wood.

It was considered that the chute sections would be improved if made in 3 m lengths rather than 2 m lengths. The extra weight would not significantly affect handling and set-ups could be quicker. Also, the design of the chute, with its recessed overlap lip, could be simplified. A straight taper over the chute length could be just as effective and could result in cheaper manufacturing costs through a lower cost of mould manufacture.

The bolt and nut fastening system was awkward to use and would be improved by a system based on a securing pin and wedge similar to the Austrian-made Leykam Logline[3]. This could also improve the fastening of rope guylines needed for chute stability. The present system, using unreinforced holes in the chute edges is unsatisfactory as descending produce can foul the fastenings and rip the plastic.

Apart from disappointing costs, the chutes worked very well and gave no ground damage in the crop.

3 Mercator Allegemeine G.m.b.H., Postfach 94, 2351 WR. NEUDORF, AUSTRIA

Estimated cost for thinning beech, based on Forestry Commission output data for thinning a 0.06 m^3 average tree, is £8.50/m^3.

Total felling and extraction costs ranged from *c*. £27/m^3 to £33/m^3.

Conclusions

Extraction and stacking costs of *c.* £18/m^3 to *c.* £24/m^3, (*c.* £27 to *c.* £33 including felling) are indicated for chute lengths of 59 m to 110 m, with product densities of 0.50 m^3 to 0.75 m^3 per 10 m of set-up.

To give reasonable extraction outputs and costs, these chutes must have a minimum product density of 1.4 m^3 per 10 m of route length. At broadleaved crop thinning intensities this could mean doubling the set-up spacing to 28 m.

Further information is required to determine the effects on felling costs of manually moving produce longer distances to the chute.

Provided the chute slope is over 22%, diagonally rigged routes can be worked with little apparent difference in costs.

On chute slopes up to 56%, control of descending broadleaved products can be provided by rigged brake poles and an exit bend. Tying the chute into a tube was found to be ineffective due to the bent produce. Two metre material was easier to control than 3 m.

The portable winch was found to reduce chute movement time on steep ground by c 28% compared to manual methods and costs by 22%.

Chute capital costs may be lowered by a simplified design.

Recommendations

A produce density of at least 1.4 m^3 per 10 m of set-up should be aimed for.

Extraction should start at the top of the chute to reduce unproductive waiting.

A simple whistle communication system should be used.

Safety training should be provided for inexperienced operators.

The design of the chute should be simplified.

The effect of moving produce to chutes spaced further apart should be investigated.

Acknowledgements

Thanks are due to Mr Jim Waterson of the Severn Gorge Countryside Trust and Mr Clive Hancox, contractor, for all his team's work.

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