LOGGING INDUSTRY RESEARCH ASSOCIATION

NEW ZEALAND

PROJECT REPORT

SMALLWOOD HARVESTING

Notes on an European Study Tour
1982

P.R. 21 1983

N.Z. LOGGING INDUSTRY RESEARCH ASSOCIATION (INC.)

P.O. Box 147 Rotorua New Zealand

N.Z. Logging Industry Research Association Inc.
Project Report No. 21
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SMALLWOOD HARVESTING

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1. OBJECTIVES

The objectives of this trip were :

(i) To present the New Zealand Status and Planning Report on the "Felling and Bunching of Small Trees" to the IEA-FE-CPC7 conference in Denmark;

(ii) To present the New Zealand view on the future direction of this project;

(iii) To look at developments in smallwood handling in the United Kingdom;

(iv) To make contact with ARMEF and gain a better appreciation of their approach to logging research and development;

(v) To inspect the harvesting and processing of whole trees in Germany, at a centralised processing plant.

2. INTRODUCTION

A series of international co-operative research projects had been set up under a Forestry Energy Agreement between countries involved in the work of the International Energy Agency. New Zealand has been involved for several years in this work through the Forest Research Institute. Mr J. Tustin of F.R.I. is a member of the Executive of the Planning Committee overseeing work in the harvesting and transportation area.

In 1982, LIRA were contracted to become the New Zealand agent for participation in an IEA research project on smallwood handling. The project was titled "Felling and Bunching of Small Trees on Easy Terrain with Small-scale Equipment".

This was originally set up as a five year project to be carried out in four stages, with the long-term aim of designing, building and testing a series of prototype machines specifically designed for felling and bunching small trees. Because of the differences in forest management practices and harvesting operations and in terrain characteristics, New Zealand had reservations about continuing with the project for the whole five years, but felt there were significant benefits to be gained from participation in the first two years, involving information exchange and the setting up of design criteria.

The project appealed to LIRA because :

(i) It tied in with the strong emphasis on smallwood handling in LIRA's current research and development programme.

(ii) It provided an opportunity to review New Zealand work in the light of overseas experience.

(iii) It provided a chance to meet overseas researchers with a particular interest in this field.

(iv) It provided an opportunity of influencing machinery design.

(v) It provided outside funding from F.R.I. and the Liquid Fuels Trust Board for the first two years of this project.

A N.Z. Status and Planning Report was prepared using the format suggested by the project managing agent, P.T. Brenoe of the Danish Institute of Forest Technology. This report provided an overview of the national forest and energy scene, discussed the potential of forestry for energy production, summarised the New Zealand small tree resource and current harvesting proposals, outlined commonly used techniques, listed equipment specifications and reviewed the most promising areas of research and development. It also included copies of selected LIRA and F.R.I. reports and an extensive bibliography.

The LIRA Board, at a meeting in October 1982, accepted the Director's recommendation that L. Vaughan should present this report at the conference in Denmark in November and suggested that a further two weeks be spent examining aspects of smallwood harvesting in western Europe.

Arrangements were made to visit smallwood operations in Forestry Commission Forests in northern Scotland and southern Wales, to look at work being done by ARMEF in France and to view whole-tree handling at a centralised log processing plant in southern Germany.

3. TOUR SUMMARY

In the interests of rapid dissemination of information to LIRA members, these notes are intended to highlight aspects of the trip of particular interest and relevance to N.Z. Detailed diary notes have been placed on LIRA file 3/3/13G and further information can be obtained from the author at LIRA.

3.1 IEA Conference

There were eight countries represented at this conference held in a small hotel in central Jutland. They were all northern hemisphere countries; two from central Europe (Austria and Belgium), two from Scandinavia (Denmark and Sweden), one from western Europe (Ireland), and two from North America (Canada and the U.S.A.).

3.1.1 National Reports :

The reports of the European countries highlighted their conservative approach to forest management with the establishment of stands at high initial stockings (5,000-10,000 stems per hectare), apparently to allow early commercial thinning. This thinning is usually carried out around age 25-30 (height 7 metres) to leave 2,000-3,000 stems per hectare. However, this has become uneconomic with conventional thinning systems. Row thinning has become increasingly common to handle the small piece size in these very dense stands. The low demand for pulpwood has been offset, to some extent, by the development of local markets for green chips produced from whole tree chipping. The chips are dried and burnt in specially-designed furnaces. A lot of work has been carried out into determining where the conversion from roundwood to chips should be carried out and on the best ways of handling and storing them. Other options include converting the green chips into pellets or combining them with residues, such as bark and sawdust, and producing briquettes.

Most of the North American work has focused on development of mechanised systems, including harvesting options for handling residues in cutover. Of interest was the work being done in the U.S.A. on the development of a continuous shear, using a Rome shear mounted on a crawler base with a mechanism for directing the motor power from the tracks to the shear and then back to the tracks after cutting. Work at Lakehead University, Ontario, had involved using a forwarder as a base machine to mount a grapple and crane, the Morbark chipper and a trailer.

Swedish forests are being established at lower stockings than elsewhere in Europe (2,000-2,500 stems per hectare) and most of the felling (95%) uses motor-manual systems. Harvesting of "tree sections" is substantially cheaper than both the motor-manual (shortwood) and the mechanised shortwood systems that are conventionally used, because the delimbing cost is

passed on to industry. However, this can only be carried out in forests where soil nutrient status is relatively high and these areas are not extensive. The systems used to transport tree sections in large containers depend on forming a highly compressed bundle and require trees with small light branches, something hard to envisage with radiata pine.

Of particular interest was a system developed in Sweden and demonstrated in Ireland, called the Vandraren, which translates as "the walker". This operates from a tractor with a single winch, using a rope of 100-200 metres long (but can be up to 400 metres), on which a piece of strong rubber cable is fitted, providing a five metre extension when tensioned. The winch rope passes over a series of intermediate supports, basically, two open pulleys supported by a belt around a tree, which provide adequate lift over longer distances. Specially designed choker hooks are placed on the winch rope and attached by polypropylene strops to thinnings, either tree length or short wood. The system operates through the tensioning and releasing of the rubber cable by using the tractor winch, which causes the winch rope to move back and forth over five metres. The choker hooks will only move one way along the winch rope by gripping the rope when it is tensioned, but allowing it to slip through when released. In this way the log slowly moves to the landing. Although this system has only been used on flat country, it would appear to have potential for New Zealand hill country thinning where some form of low cost technology is important.

There has been a significant amount of planting with Sitka spruce and contorta pine in Ireland since the mid-1950's and many of these stands are scheduled for thinning over the next decade. Growth rates are high, with a mean annual increment of 14 m^3 (16-22 m^3) per hectare. Much of these forests have been established on peat bogs which were deep ploughed prior to establishment. They have been testing small thinning machines with low ground pressure requirements, but these have been expensive. Local innovators have come up with a home-made forwarder based on two Massey Ferguson tractors with the front wheels removed and fitted back to back, a motor on one end and a pivoting grapple on the other that was used to clasp the bundle of shortwood on the ground and lift and pivot the bundle through 180° for extraction.

3.1.2 Conference Notes :

In view of the reservations that had been expressed by New Zealand and several other countries about further participation in the project, it was pleasing to find that the project managing agent had modified the original proposal. He suggested there should be four different levels of co-operation for further work and that each country should identify their field of interest and desired level of co-operation. In this way it should be possible to establish co-operative groups. The four levels of co-operation were :

Level A - Test and evaluation of existing methods and machinery. The

research to be organised and carried out in comparable systems.

Level B - Description/development of a set of demands and criteria for development of relevant machinery and equipment. Silvicultural, technical and economical restrictions should the bases for the results.

Level C - Final description of a machine system. This level should be joined by countries who are already working in this field.

Level D - Initiation and evaluation of new techniques and methods.

It should then be possible to establish co-operative groups. Each group would select a country to be a sub-project leader and prepare a plan which could be adopted by the participating countries. It was also proposed and agreed that funds raised in each country would be used for work within that country, with only a small amount for project administration to be paid to the common fund. It was felt that this approach would be a more realistic basis for international collaboration and act as a stronger stimulus to apply results.

The meeting identified eleven sub-projects, based on the information in the national reports and from the ensuing discussion, as being relevant to the project. Of these, four were seen to be of particular interest to New Zealand. These were :

1. Bunching with winches.

2. Bunching with grapples.

3. Motor-manual felling systems.

4. Rigging (strops and chokers).

New Zealand was asked to lead the 'Bunching with Winches' sub-project. This plan was prepared and distributed in March 1983. Appendix 3 summarises the on-going work of the CPC7 group, the involvement of the different countries and includes the work plans for these four sub-projects. The results of these studies will be condensed into joint reports to be presented by the sub-project leaders at the next CPC7 meeting in September 1983.

3.2 Field Trip Notes

3.2.1 Denmark :

A one-day field trip in Northern Jutland viewed a demonstration of thinning operations in young Norway Spruce stands, in a Danish Forest Service forest in the Klosterheden district. Motor-manual felling methods were limited to row thinning as the high initial stocking (6,400 stems per hectare) made it difficult to fell the trees (stand age 32 years, height 7 metres). Harvesting of this very small material (7 metres dbh, .02 m^3) was expensive (N.Z.$640 per hectare) and yields only a small quantity (40 m^3 per hectare) of pulpwood. Holder

tractors (A60), fitted with Loft hydraulic tongs, were being used for extraction.

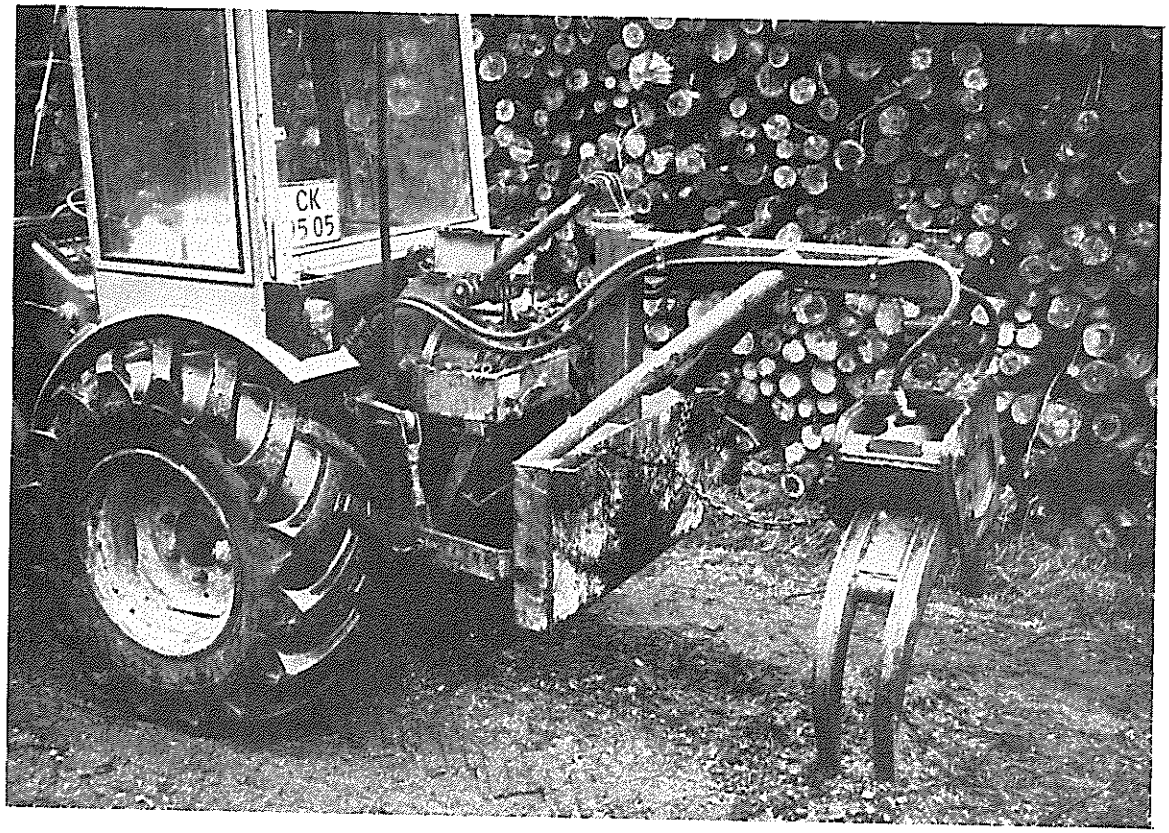

FIG. 1 - LOFT hydraulic grapple mounted on a Holder A60 tractor to extract row thinnings, Denmark.

Subsequent thinning made use of the space resulting from the outrow thinning to provide access for a small harvesting machine, such as the Gremo TH25, that could selectively thin and process trees from the adjoining inter-rows.

The rising costs of imported oil for central heating had forced medium and large institutions to look at alternative fuel sources when installing new furnaces. In this region of Denmark, forest and mill residues were available in sufficient quantity and at a suitable price to provide a viable alternative to oil and several furnaces had been installed that were capable of burning forest and mill wastes.

The local forest management had capitalised on the development of this market by introducing a tractor-mounted chipper to process the manually-felled row thinnings. The rear-mounted chipper had in-feed rollers and as the tractor backed up the rows, pulling a chip trailer, the felled trees were fed butt-first into the chipper. Half of the green chips underwent further processing into heating pellets at a local alfafa pelletising plant where, during the winter and spring, the green chips were pulverised, dried and extruded as heating pellets, with a 10% moisture content. The additional costs of processing were claimed to be offset by its easier handling and storage and its higher calorific value.

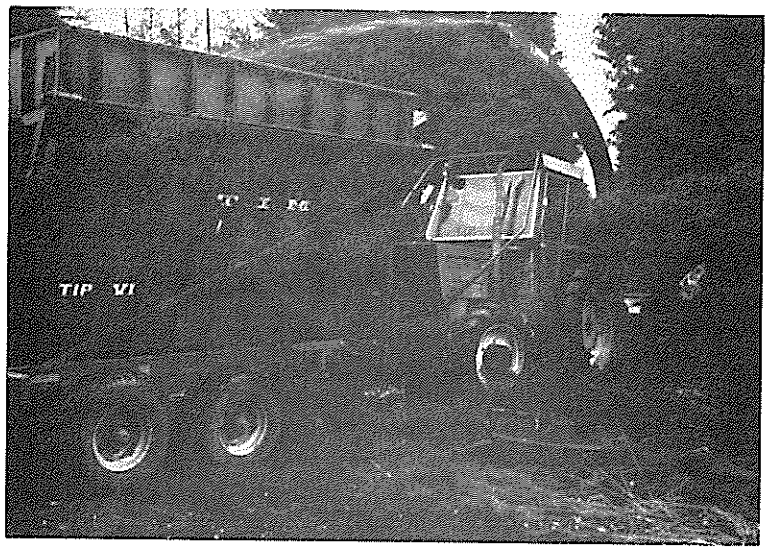

FIG. 2 - Rear-mounted TP 950 chipper processing whole trees in a young row thinned Sitka spruce stand, Denmark.

FIG. 3 - Green chips from chipping of thinnings using a tractor-mounted chipper, Denmark.

FIG. 4 - Heating pellets produced from green chips, Denmark

A small (100 person) boarding school (Lomborgung Domskole) was using green chips to fuel a 700 kW boiler for domestic and central heating. In Aalestrup, a large heating plant, serving 950 households, was fuelled by green chips, bark and wood waste. This recently commissioned plant included a specially designed furnace, with a fully automated system for controlling air-flow, fuel feed rate, the drying of the incoming wood waste and the outgoing water temperature.

Another new school (Pensionthøjskole Norre Nissun) had installed a 320 kW furnace, fuelled by heating pellets, for domestic and central heating. It was claimed that with an operating efficiency of 90%, their costs were only 60% of the oil fired equivalent.

3.2.2 United Kingdom :

Harvesting operations on a number of small Forestry Commission forests in northen Scotland and southern Wales were visited. The closing of the three major pulp mills in the U.K. had eliminated the domestic market for pulpwood and there is currently little demand for British pulpwood from the Scandinavian countries. As a result, almost all pulpwood thinning had stopped and only operations producing smallwood for other special use markets (e.g. mining timber) were still in action.

3.2.2.1 Forwarders :

The biggest change in smallwood handling in the U.K. in recent times has been the introduction of forwarders into thinning and clearfelling operations, whenever justified by the economies of scale. These are replacing small haulers on slopes up to 40% and rubber-tyred skidders and modified agricultural tractors on easier terrain. The change was made in response to projected manpower shortages, as much as for economic reasons, but had the following advantages :

(i) Separation of the extraction phase from the felling phase;

(ii) Making extraction independent of weather;

(iii) Better operator protection;

(iv) Ability to handle moderate slopes without tracking;

(v) Ability to handle wet ground conditions and soils with low bearing capacity;

(vi) Ability to unload and stack on road edge;

(vii) Ability to keep logs clean for subsequent handling and processing.

The Forestry Commission are relying on their own workforce to carry out most of the harvesting and have taken

responsibility for machine purchase and operator training. On the forests visited, there appeared to be a shortage of logging contractors with the skills, the motivation and the capital to purchase and effectively utilise new machinery. The contractors seen had old equipment and relatively low levels of production, partly due to the small scale of operation, a consequence of the size of resource. It was only in southern Wales, with its deeply entrenched union problems, that there were moves to introduce contract operations. In mid-Wales and northern Scotland, the Forestry Commission operations were considered to have satisfactory levels of production. One major difference between the two types of operations was considered to be related to the methods of costing of machinery. The Forestry Commission tended to maximise machinery production by over-manning, while contractors tended to maximise manpower productivity by over-capitalising on equipment.

Forwarder operators were carefully selected and underwent a three week course on machine operation and basic maintenance procedures. Most forwarders are serviced by Forestry Commission workshops and their mechanics receive instruction in the repair and maintenance of hydraulic and hydrostatic systems.

In an effort to improve economies of scale, and make better use of harvesting equipment, the Forestry Commission have proposed the amalgamation of small forests into districts and the re-distribution of staff to strengthen districts and give them greater autonomy.

The mini-Brunett 578F has been the Forestry Commission's choice for a small thinnings forwarder. It is a hydro-static machine with mechanical final drive to the wheels and is highly regarded for its design, performance, reliability and operator comfort. It can carry loads up to 7 tonnes on slopes up to 40%, but is limited to a maximum load length of five metres. Load distribution is important for stability with all forwarders, but more so for smaller forwarders and oversize or poorly distributed loads have toppled machines on gentle side slopes. Future forwarder purchases will favour the medium size machines, with an 8-11 tonne load capacity, selected from the more common Scandinavian makes, such as Kockums, Valmet and Lokomo, following extensive testing by the Forestry Commission.

A Volvo 868 (8 tonne payload) was seen operating on slopes up to 45% in wet conditions in Inchanecardoch Forest, northern Scotland. It was fitted with chains on the front wheels and aggressive band tracks on the back wheels to improve traction. It was handling slopes that had previously been worked by haulers, but was close to its physical limit for climbing unloaded and returning loaded.

On soils of low bearing capacity, forwarder ground pressure can be reduced by the use of flotation band

FIG. 5 - Mini-Brunett 578F forwarder loading pulplogs, Scotland.

FIG. 6 Volvo 868 forwarder loading sawlogs, Scotland.

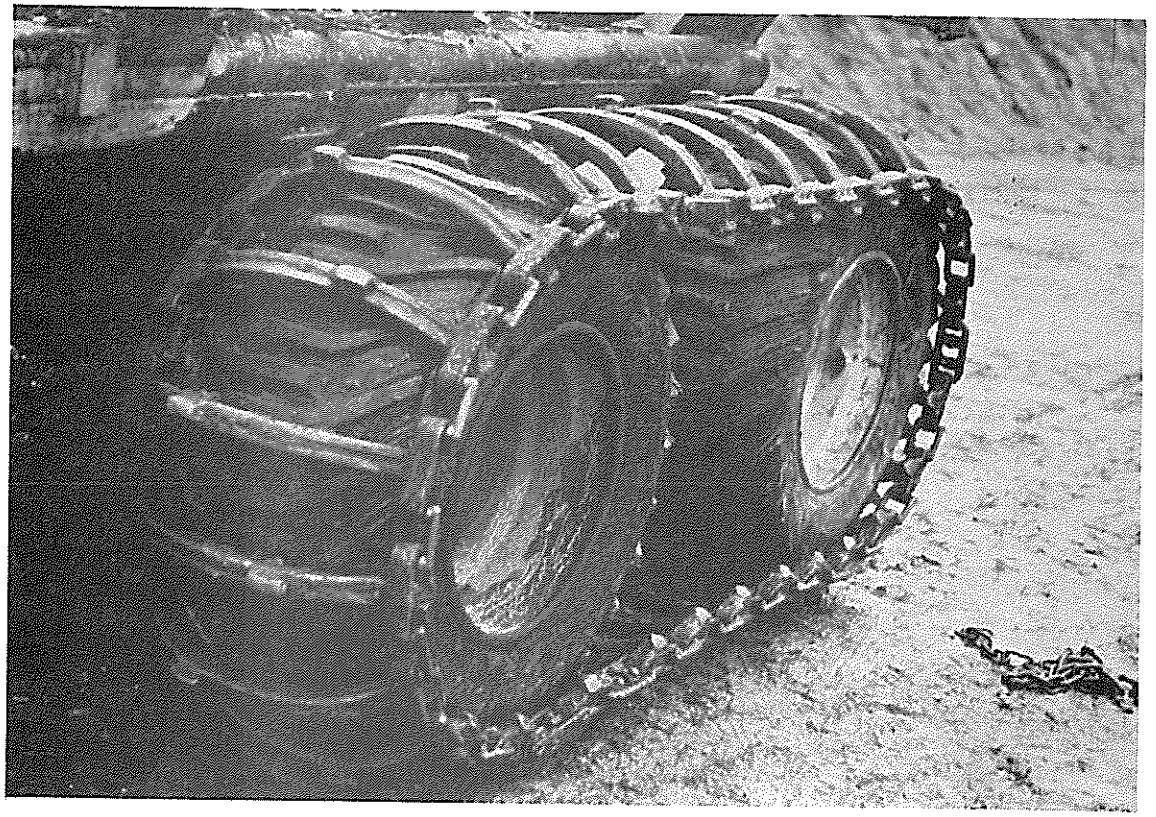

FIG. 7 - Agressive band tracks fitted to rear bogey of Volvo 868 forwarder, Scotland.

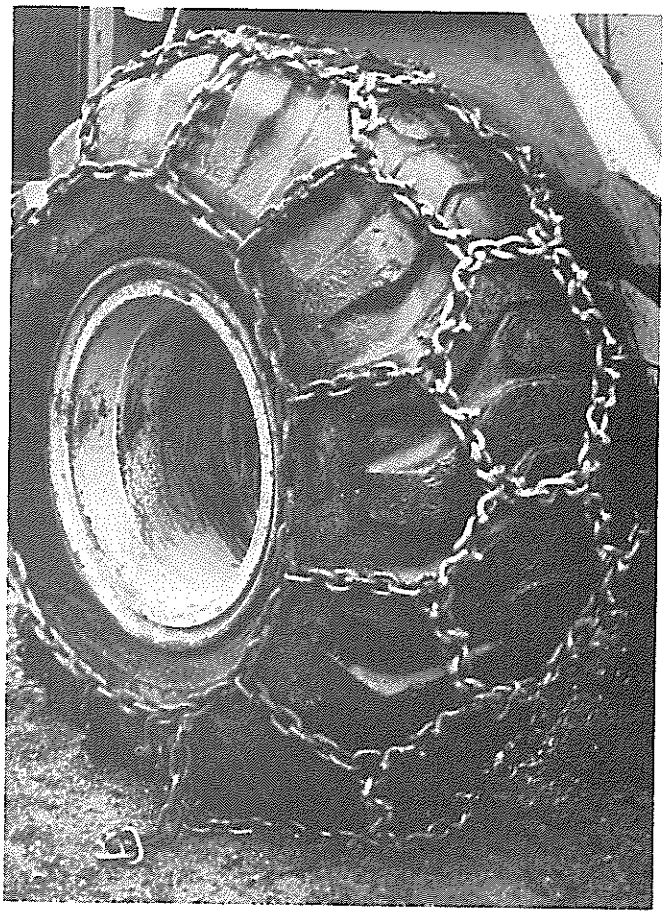

FIG. 8 - Chains fitted to front wheels of Volvo 868 forwarder,Scotland.

tracks and by utilising the slash for the machine to travel over. Forwarders operating on steep terrain often have spiked chains slung between the stanchions to hold the load off the deck and reduce the chance of losing the load when travelling forwards uphill.

3.2.2.2 Felling Systems :

The Forestry Commission Work Study Units have become deeply involved in method studies and have developed felling systems in thinnings and clearfellings to suit forwarder and hauler extraction. These systems are based on Scandinavian techniques which emphasise ergonomics and safety, but have been modified to suit British conditions with its steeper terrain and larger tree size. An example of a thinning system to suit forwarder extraction on moderate slopes was seen at Farigaig Forest, northern Scotland, in a 30 year old stand of Norway spruce being thinned from 2,500 to 1,200 stems per hectare (stand height 15 metres, tree size .05 m^3). The basic approach was to use an outrow system, with the outrow ("rack") running directly up the hill, providing access for the forwarder to back up. Selected thinnings were felled across the rack to be used as a bench to keep the other thinnings off the ground and at a comfortable height for delimbing. These other thinnings were felled downhill out into the rack and onto the benches and delimbed before sliding (by seesawing, rolling or dragging) to one side and crosscutting. The shortwood was stacked along the side of the outrow in grapple size bundles to facilitate loading. Another modification was the development of a "ladder" system, where the rack spacing (usually 15-20 metres) was based on the forwarder crane reach (usually 4.5-6 metres) and the "rungs" of the ladder are put in to suit the stocking reduction. Thinnings are felled along the rung (i.e. across the slope) and stacked into grapple loads (usually .5 m^3) after delimbing and crosscutting.

In a clearfelling situation set up for forwarder extraction, there are clearly defined "slash" zones (used for machine access) and "timber" zones in which sawlogs and pulp logs are separated and the smallwood stacked into grapple loads. The aim is to maximise forwarder productivity by organising the wood presentation to suit the characteristics of a particular machine.

A detailed manual describing organised felling systems in the U.K. is being prepared by the Forestry Commission Northern Region Work Study Team. It is expected that this will be available by the end of 1983. LIRA will advise its members of its publication in the newsletter.

FIG. 9 - Organised felling for forwarder extraction showing slash zones and timber zones, Scotland.
NOTE: the bunching of pulplogs in grapple-size bunches physically separated from sawlogs.

3.2.2.3 The Sifer Delimber :

A number of Sifers were purchased by the Forestry Commission in the late 1970's and introduced to a number of forests at short notice. As a result, they were often introduced into existing systems and situations that were unsuitable. The Forestry Commission have not been particularly impressed with the machine and, as a consequence of the change to shortwood systems, are now disposing of their secondhand machines to local contractors. Sifers appear to be productive in the right situation, but are regarded as high maintenance machines. They are dependent on a high level of operator skill to achieve high production levels and to carry out daily maintenance.

3.2.2.4 Forestry Commission Work Study Units :

The Work Study section is attached to the Research and Development division of the Forestry Commission and have their headquarters at Alice Holt and teams in regional centres. These teams have carried out some impressive work in method studies and the development of new systems (e.g. organised felling for different extraction systems) and work closely with the Education and Training section to transfer this technology. A period of five years work in one of these two sections is considered important for the younger Forestry Commission staff. This provides a

young and enthusiastic manpower resource and (subsequently) a receptive audience for the acceptance and implementation of their work. Much of this work is published as internal reports and while their results may not be applicable in New Zealand, there is a lot to learn from their systematic approach to method study and their use of data. Steps have been taken to obtain copies of their Work Study Manuals and other relevant reports. They receive copies of the LIRA Brief Reports and were impressed with the commonsense approach that had been adopted and felt they could benefit by using a similar format to extend the results of their work.

3.2.2.5 Work Study Data Logger :

The Forestry Commission Work Study teams in Britain are now making use of an automatic data logger to record work study data in the field. This is a small black box with a touch sensitive keyboard, a built-in quartz clock and sufficient memory capacity to store data from studies of one to three days duration. At the end of the day, the data logger is coupled to an acoustic coupler on the telephone and the data is rapidly fed into a central computer for processing. A print-out of the analysed data is then sent to the originator. The manufacturer is Microfin Systems Ltd, and the model seen was a MTØ1.1. The data logger and automated data processing would have a role in large organisations where a substantial amount of time is spent in collecting and analysing data.

3.2.2.6 Measuring Rod for Crosscutters :

Crosscutters on landings in Forestry Commission forests in southern Wales were observed using a Vidler measuring rod fitted to the chainsaw bar to assist in precise cutting to length. The base bolts to the top of the bar, fitting over and around the chain and the rod can be moved to extend left or right. The rod is made of fibreglass and is light in weight and easily adjusted to length.

3.2.2.7 Double Drum Winches :

Double drum winches are commonly used on skidders and agricultural tractors for extraction of thinnings and clearfelling. Most winches have hydraulic controls and radio control is available for another NZ$5,000, (approx.). Comparisons between winches with and without radio controls have shown there are significant benefits for the use of radio controlled winches in thinnings where it is necessary for the operator to guide the load while winching in.

3.2.2.8 Terrain Classification :

This method has evolved over a long period of time and was based on the Scandinavian system, using maps on a 1:10,000 scale. The results in eastern Scotland indicated that around 60% of the hill country was suitable for forwarders, 36% for skidder and about 4% for cable systems. However, it does not seem to have been widely used as a planning tool outside this region.

FIG. 10 - Timberjack 228D skidder fitted with a double drum winch and chain chokers, Wales.

3.3 France :

France has substantial areas of forest, mostly privately owned, and mostly hardwoods. The annual cut is around 30 million m^3, of which 10 million m^3 is softwood. Much of the resource is in small woodlots which are owned by one or several absentee landowners and intensive forest management is restricted to the state-owned hardwood stands of beech and oak veneer and the larger more recent plantings of conifers in areas such as Landes. Most of the logging is carried out by skidders and there are estimated to be 2,000 units, mostly in the 90 kW range, and mostly from the U.S.A. (John Deere and Timberjack). Locally-made skidders account for approximately 25% of the total. Forwarders are becoming increasingly popular for handling smallwood and it is estimated there are around 1,000 units, mostly locally-made and in the 8-10 tonne class. Many agricultural tractors are used for both agricultural and forestry work, but it is estimated that around 500 tractors have been adapted for use in forests. It was estimated that there are less than 10 haulers operating in France. Many logging contractors are small owner/operators and lack capital for expansion. The industry as a whole is considered to be operating under systems ranging from conservative to archaic.

3.3.1 AFOCEL

In 1962 AFOCEL was set up by the French pulp and paper com-

panies to carry out research into silviculture and forest management. It now employs 120 people and its work includes economic surveys to report on market trends.

3.3.2 ARMEF

In 1965 ARMEF was set up to work on the development of logging machinery. The drive for mechanisation was based largely on projected manpower shortages. It now employs 50 personnel, predominantly engineers and engineering technicians located in regional centres. They have an engineering workshop located at Fontenais, 100 km south of Paris, where most of their mechanical development is carried out.

SIFER is a marketing company set up by ARMEF to market their delimber, after encountering reluctance with French engineering companies to build and distribute it. The absence of forestry personnel in this organisation was attributed to the total lack of engineering and harvesting in their forestry training courses.

FIG. 11 - Small felling head on an ARMEF 730 felling machine using a chainsaw without a bar for row thinning, France.

As a basic philosophy, ARMEF have concentrated on building simple robust, single-function machines that form part of a total system, but work independently of each other. Their recent work has concentrated in smallwood, developing felling machines, processing machines and chippers.

A Sifer felling machine was seen row thinning in young Scots pine. It used a felling head which contained a cutting chain moving around three pulleys and a driving sprocket. After severing the stem, the tree was grasped by holding arms on the felling head and passed over the top of the machine while it was moving forward to the next tree. It is an innovative attempt to produce a machine using a continuous felling action and its productivity of up to 200 trees per hour was intended to balance with a Sifer delimber that would delimb, crosscut and bunch the smallwood. The use of a large chainsaw chain without a bar had been developed because it was considered to be more energy-efficient than alternative cutting devices, such as circular saws, grinding discs or a rotating horizontal cylinder fitted with knives.

Sifer delimbers were seen processing row thinnings of Sitka spruce and Scots pine. The Sitka spruce was being used for groundwood and three passes (forwards, reverse, forwards) were made through the knives to achieve the high standard of delimbing required for a pulpmill in Normandy, 500 km away. In Scots pine, the first metre above ground level was manually trimmed prior to felling, to allow this heavily branched material to be handled by the delimber. Processing rates varied from 60-90 trees/hour.

It was estimated there are about 120 Sifer delimbers operating in France and another 40 in the U.K. Sixty Sifer heads had been set to Sweden to be used on processing machines. There are also three Sifer's working on radiata pine in Sardinia.

An interesting development was the mounting of a Sifer delimbing head at the rear of a large four-wheel drive Renault tractor driven by the power take off. This was fed by a knuckle boom crane mounted on the rear of the tractor which fed whole trees to the delimber, cleared away the branches and tops, and loaded the processed shortwood. It was designed to work alongside a chipper processing the tops and branches.

FIG. 12 - Sifer delimbing head mounted at the rear of a tractor, driven off the power take-off, and fed by a knuckle-boom crane, France.

3.4 Germany :

Most of their forests are owned and managed by the States, rather than the Federal Government, and the research into forest management and harvesting is carried out by the different states. In Baden-Wurttenburg, the State research organisation (FEA-Abt. AWF) employs 100 people. The harvesting research group of nine study logging, roading, evaluation of machinery and systems and the setting of productivity standards. German forestry training at university level has a strong engineering and harvesting content. Intensive roading has been used to minimise harvesting costs on steep terrain and sawlogs are transported in long lengths (12-18 metres) to sawmills in pieces of 1-4 m^3.

3.4.1 Whole-Tree Handling :

A large privately-owned estate of 20,000 hectares in the Black Forest region had looked at rationalising harvesting operations, following rapid wage rises in the 1960's. To overcome the high costs of manual delimbing, they had introduced whole-tree harvesting where trees and branches were brought in specially designed trucks to the sawmill. These passed through a debrancher and debarker before continuing to an electronic scanner for sizing. The branches and bark were shredded, and burnt to generate heat and electricity. The operator of the crosscutting saw would visually scan the incoming logs to check quality and use this, together with the information from the scanner on diameter and length, to determine the crosscutting pattern. After crosscutting the short logs pass through a second scanner and are automatically sorted. The owners are working with Freiburg University on an optimisation programme to maximise value by crosscutting.

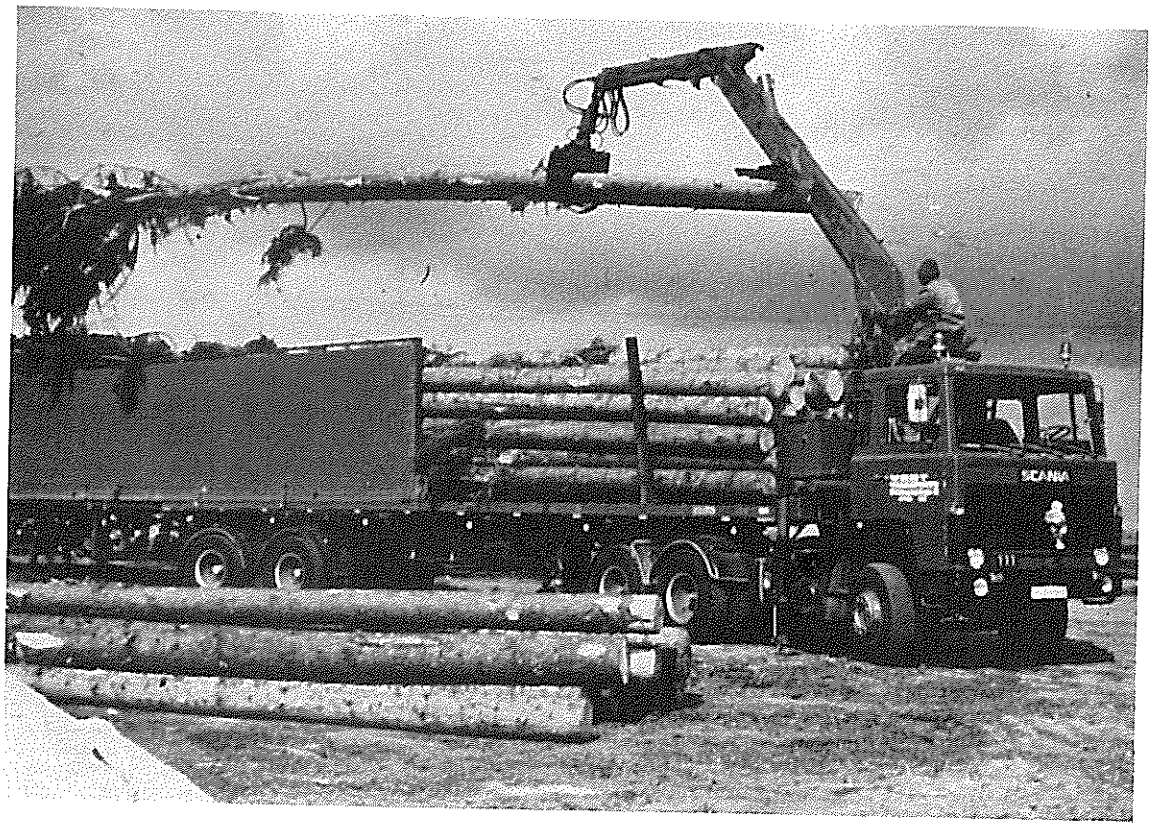

FIG. 13 - Unloading whole trees from a purpose-built trailer, Germany.

4. RECOMMENDATIONS

1. That New Zealand, through LIRA, continue to participate in the four IEA-FE-CPC7 sub-projects. Further participation in 1984 will be reviewed in terms of project proposals and financial assistance.

2. That the logging industry continue with the development of methods of organised felling to suit extraction systems.

3. That the logging industry review the potential of forwarders for smallwood extraction, considering both imported and locally made machines that use common base machines.

4. That LIRA examine the methods used by the U.K. Forestry Commission in studying harvesting systems and analysing work study data.

5. That LIRA arrange to access relevant reports of the Forestry Commission Work Study units.

6. That a visit to mechanised harvesting operations in maritime pine plantations in southern France be considered by industry or LIRA personnel on future study tours in Europe.

APPENDIX 1

ITINERARY

November 15	-	Arrive Herning, Denmark
16-18	-	Attend IEA-FE-CPC7 Conference on Felling and Bunching of Small Trees, to present the New Zealand Status and Planning Report.
19	-	Travel to Inverness, Scotland.
22-23	-	Visit harvesting operations in Forestry Commission forests between Inverness and Fort William, Scotland.
24	-	Travel to Cardiff and visit Compact Forestry Equipment Ltd, the U.K. Sifer agents.
25	-	Visit harvesting operations in Forestry Commission Forests in southern Wales.
26	-	Visit harvesting operations in the Forest of Dean.
29	-	Travel to Paris for discussions with ARMEF Director and staff.
30	-	Visit ARMEF workshop in Fontenais and harvesting operations in forests near Fontainebleau.
December 1	-	Visit harvesting operations in forests near Metz, north western France.
2	-	Travel to Freiburg for discussions with logging researchers on the staff of FEA-Abt.AWF, the Baden-Wurttenberg State Forest Research Organisation and inspect whole tree handling facilities at a centralised wood processing plant on the Prince of Furstenberg's estate, Black Forest, Germany.
3	-	Travel to Basle and depart for New Zealand.

APPENDIX 2

REFERENCE MATERIAL COLLECTED OVERSEAS

1. Denmark

Two publications, in English, from the Danish Institute of Forest Technology, related to the IEA-FE-CPC7 work.

(i) Mechanised felling in thinnings.

(ii) Principles of continuous felling.

Machinery brochures, in Danish, on the TIM chipper and chip trailer.

2. France

A series of publications from AFOCEL and ARMEF, mostly with French texts, and include :

(i) Leaflets and brochures on general forestry information.

(ii) Brochures on wood production and pulp and paper production in France.

(iii) AFOCEL monthly periodical "Information Bois".

(iv) Illustrated leaflets and brochures on logging equipment and machinery and mechanised systems for harvesting and processing.

(v) Various reports and booklets.

3. Germany

A series of booklets and reports, in German, from FVA-Abt. AWF, the Baden-Wurttenburg State Forestry Research Organisation, covering :

(i) History of the forests of the State of Baden-Wurttenburg.

(ii) 1982 Research programme.

(iii) Bibliography of all their research publications, covering the last 80 years.

(iv) A report on the productivity of the different cable cranes on steep terrain in the Black Forest.

APPENDIX 3

IEA-FE-CPC7 SUB-PROJECTS AND WORKPLANS

Sub-Project Number	Level of Co-operation	Subject	Country in Charge	Participating Countries
1	B	Bunching (chokers etc, horses etc)	Belgium	Ireland New Zealand
2	B	Feller chipper	Canada	Austria Denmark Sweden
3	C	Continuous feller-buncher	Denmark	Canada U.S.A.
4	B	Felling principles	Denmark	Canada U.S.A.
5	A	Grapple bunching	Ireland	Austria Belgium Denmark New Zealand U.S.A.
6	A	Winch bunching	New Zealand	Austria Belgium Ireland U.S.A.
7	A-B	Base machines	Sweden	Belgium Denmark Ireland
8	A	Crane-mounted feller-buncher	Sweden	Denmark
9	A	Motor-manual felling, bunching	Norway	Denmark Ireland New Zealand Sweden

Sub-Project Number	Level of Co-operation	Subject	Country in Charge	Participating Countries
10	A	Chassis mounted feller buncher	U.S.A.	Denmark Ireland Sweden
11	A	Felling patterns	Norway	Sweden Denmark

Co-operating Levels

Level A - Test and evaluation of existing methods and machinery. The research to be organised and carried out in comparable systems.

Level B - Description/development of a set of demands and criteria for development of relevant machinery and equipment. Silvicultural, technical and economic restrictions should be the basis for the results.

Level C - Final description of the machine system. This level should be joined by countries who are already working in this field.

Level D - Initiation and evaluation of new techniques and methods.

IEA CPC7 Secretariat	PROJECT: - v - March 1983 Date Signature	International Energy Agency Forestry Energy CPC7 Danish Institute of Forest Technology Amalievej 20 DK-1875 Copenhagen V

MAIN PROJECT: Felling and bunching small trees with small-scale equipment

SUB PROJECT : Bunching small trees with winches.

SUB PROJECT LEADER/ESTABLISHMENT: L. Vaughan, LIRA, N.Z.

Date of start: March 1983	Date of completion: June 1984

COUNTRY	WORKING ESTABLISHMENT	NATIONAL PROJECT PARTICIPANT
N.Z.	Logging Industry Research Assn.	Lindsay Vaughan
Austria	Not known	Eberhard Nossek
Belgium	Univ. Catholique de Louvain	Pierre Abeels
Ireland	Forest and Wildlife Service	Henry Phillips
U.S.A.	U.S.D.A. Forest Service	Jim Mattson

BACKGROUND: The productivity of the extraction machine can be greatly improved by first accumulating small trees into bunches of an optimum payload size. Winches are amongst the most widely used equipment for this work but there is a need for better information on machines, methods and productivity.

OBJECTIVE:

To survey, evaluate and document the more commonly used and the most promising machines and methods used for winch bunching of small trees.

EXECUTION/WORKING PLAN:

(1) Survey existing machines and methods.
(2) Evaluate the most productive methods and machines.
(3) Evaluate the most promising methods and machines.
(4) Document the results, including technical specifications on the machines, the method, the stand and the terrain.

COST BUDGET *national currency*	19 83 $NZ	1984 $NZ	19	19	TOTAL *nat.cur.*	TOTAL *US $*
N.Z. Austria Belgium Ireland U.S.A.	1,000				1,000	700
TOTAL						

DOCUMENTATION / APPLICATION OF RESULTS:

National reports to be forwarded by July 31, 1983 for collation and presentation to the CPC7 meeting in September 1983.

OTHER INFORMATION: Funding will be arranged internally by participating countries.

IEA

CPC7 Secretariat

PROJECT: CPC7 - 5

Date 1.2.83

Signature H.P.

International Energy Agency
Forestry Energy CPC7

Danish Institute of
Forest Technology
Amalievej 20
DK-1875 Copenhagen V

MAIN PROJECT: Felling and bunching small trees with small-scale equipment

SUB PROJECT : Testing and evaluation of grapple bunching

SUB PROJECT LEADER/ESTABLISHMENT: H.Phillips Forest Wildlife Service

Date of start: Feb.1983	Date of completion: Dec. 1983

COUNTRY	WORKING ESTABLISHMENT	NATIONAL PROJECT PARTICIPANT
Ireland	Forest & Wildlife Service	Henry Phillips
Austria		Eberhard Nossek
Belgium	Dept. de Genie Rural	Pierre Abeels

Contd. overleaf

BACKGROUND: Manual chokering using conventional wire ropes, choker chains or polypropylene chokers is time consuming and unattractive from operators viewpoint. Rear mounted forest grapples present one possible alternative which could increase overall productivity with little investment or change in existing machinery

OBJECTIVE: To test and evaluate the range of forest grapples currently available on the market and to compare their performance with conventional chokering systems.

EXECUTION/WORKING PLAN: 1. Literature search to identify existing forest grapples and to gather information on performance.
(2) Testing and evaluation of grapple bunching by participants in early thinnings

COST BUDGET *national currency*	1983	19	19	19	TOTAL *nat.cur.*	TOTAL *US $*
IRELAND IR£	3.000				3.000	4.500
TOTAL	3.000					

DOCUMENTATION / APPLICATION OF RESULTS:

Prepare report for CPC7 meeting September 1983

OTHER INFORMATION:

Country	Working Establishment	National Project Participant
Denmark	Danish Inst. Forest Tech.	Jan. Thorn Clausen
N.Z.	LIRA	Lindsay Vaughan
U.S.A,	USDA Forest Service	James Mattson

IEA CPC7 Secretariat	PROJECT: CPC 7 - vii February 3, 1983 Date Signature	International Energy Agency Forestry Energy CPC7 Danish Institute of Forest Technology Amalievej 20 DK-1875 Copenhagen V

MAIN PROJECT: Felling and bunching small trees with small-scale equipment

SUB PROJECT : BUNCHING BY HORSES AND HARDWARE

SUB PROJECT LEADER/ESTABLISHMENT: Prof. P.F.J. ABEELS, Univ.de Louvain

Date of start: February 15, 1983	Date of completion: December 1983

COUNTRY	WORKING ESTABLISHMENT	NATIONAL PROJECT PARTICIPANT
BELGIUM	DEPARTMENT OF AGRICULTURAL ENGINEERING UNIV. CATHOLIQUE DE LOUVAIN PLACE CROIX DU SUD, 3 1348 LOUVAIN-LA-NEUVE	P.F.J. ABEELS

BACKGROUND: Many different equipments are or have been manufactured in the way of hardware devices for the use in hauling and bunching small trees by horses or with small tractors. Those devices are generally local specialities fitted to characteristic conditions.

OBJECTIVE:

1. Collection of datas in order to introduce some comparisons appropriate for improvements in the hauling processes and in work safety.
2. Review of the hardware.

EXECUTION/WORKING PLAN: Establishment of technical forms recalling systematically the most important datas necessary to identify each used devices. Diffusion to all participating countries for the establishment of technical memorandums. One memorandum describe one device. Collection of the memorandums and sorting by subject. Establishment of a condensed report about all the devices. Submission of the report to CPC7.

COST BUDGET *national currency*	19 83	19	19	19	TOTAL *nat.cur.*	TOTAL *US $*
BELGIUM	25000				25000	500
TOTAL						

DOCUMENTATION / APPLICATION OF RESULTS:

National contributions of delegates. General report will be published end of 1983.

OTHER INFORMATION: