IDENTIFYING MANPOWER, MACHINERY AND FINANCE FOR HARVESTING OF NEW ZEALAND'S FORESTS

A.G.D. WHYTE and
G.H. ALEXANDER
SCHOOL OF FORESTRY
UNIVERSITY OF CANTERBURY

SUMMARY

Broad indications from recent publications of the likely manpower, machinery and finance needs in the logging and transport fields over the next twenty years or so are quoted. The means of forming these forecasts are briefly outlined and reasons why they should be regarded as tentative are discussed. The nature of a modelling framework which should allow better estimates to be obtained is then briefly described, as is the likely progression of a research study on this topic.

INTRODUCTION AND OBJECTIVES

The aim of this contribution is to provide an insight into the likely demands throughout New Zealand for manpower, machinery and finance in the forest harvesting and transport field over the next thirty years or so. The difficulty in translating wood supply forecasts of the kind just described by the previous speaker into resource flows in terms of men, machines and money is that several major assumptions have to be made. Among these assumptions are: (1) likely market demands (both domestic and export) for each of various kinds of wood products; (2) size, location and kind of processing plants; (3) cutting strategies in various forests to feed processing plants and so meet market demands for products; (4) types of harvesting system, machinery and men employed; (5) methods of transport (road, rail, barge or other) used; (6) the total amount of national resources that can be allocated to the whole of the forestry sector. There are so many possible options and combinations of options for these assumptions that the forecasts of forest harvesting and transport requirements can range far too widely to be of real help to anyone. What we intend to do, therefore, is to provide a couple of published indications of what will be needed, review the basis on which these estimates were founded, suggest ways in which better estimates can be obtained, recommend how people at this conference and their colleagues can assist in this exercise and finally outline how one line of research is likely to proceed in the near future.

FORECASTS OF MANPOWER, MACHINERY AND FINANCE

In the last twelve years total roundwood production from indigenous and exotic forests throughout New Zealand has risen from about

8 million to 10 million cubic metres per annum (Ref 8). Less than 10 per cent of that production came from indigenous forests; indeed, in 1982 the figure was about 5 per cent and it is likely to drop even lower with the passage of time. The numbers employed in felling, extracting, cutting and transporting that roundwood production has ranged from 2700 to 3250 but the correlation between the two variables for individual years is not close. As the quantity of indigenous logging declines and as the nature of the exotic resource changes with the phasing out of the old crop, the manpower and machinery requirements per m^3 of production are also likely to alter. We have, therefore, to look closely at the nature of the future log supplies in order to make realistic guesses with regard to the harvesting implications.

The N.Z. Forest Service Planning Division made such forward estimates in a booklet published in 1980, (Ref 7) a summary of the relevant results from which is given in Table I.

Table I *Roundwood removals by ownership, logging method, species and log size*

Estimated Roundwood Removals (millions of m^3/annum) in Year

	1978	1993	2013
Forest Service	5.1	6.2	19.5
Other owners	3.5	6.2	16.9
Total	8.6	12.4	36.4
Cable logging	1.5	3.6	16.4
Tractor logging	7.1	8.8	20.0
Thinning	0.6	0.6	0.6
Clear felling	8.0	11.8	35.8
Radiata Pine	6.4	11.3	35.0
Douglas fir	0.5	0.6	1.2
Other species	1.7	0.5	0.2
Big logs	6.1	9.9	32.9
Small logs	2.5	2.5	3.5

It was also estimated that logging alone would employ 3500 at the turn of the century and require a total investment in additional logging equipment of around $75 million at today's prices. Corresponding figures for transport were 3000 men and $77 million respectively. Road upgrading to support this removal could amount to $100 million in the next 20 years.

There have been refinements made to these national figures since then, but all should be regarded as tentative on account of the methods used to derive them. This holds also for the seemingly more refined regional information in the CNIPS study. (Ref 2) The CNIPS Core Scenario, about which more later, showed the following figures for the Central North Island alone (see Table II).

Table II Production and Machinery Requirements in Central North Island over next 25 years.

	1983	1993	2008
Roundwood Production (millions m^3)	6.2	7.4	14.8
Total jobs in growing and harvesting (men/year)	3328	3347	6031
Annual cost of growing and harvesting ($ millions)	64.7	83.5	137.4
Machinery required:			
Gang buses	266	269	494
Thinning Tractors	27	29	21
Thinning Loaders	12	12	10
Clearfelling & other Tractors	192	214	429
Clearfelling Loaders	131	164	372
Runabouts	79	81	147
Power Saws	1068	1253	2612
Haulers	20	53	168

The N.Z. Forest Service Planning Division has been very careful to point out that these figures are only indicative and should not be regarded as prescriptive. Unfortunately, no matter how strong the disclaimer, users of the data tend to be less discriminating and this appears to be the case in the CNIPS exercise. The Core Scenario for CNIPS was "not intended to be prescriptive nor ... claimed to be a reliable forecast of what will happen", but more "a data base for further scenario work and sensitivity studies, and ..... a benchmark against which comparison can be made". The Project Team, however, did take it to be prescriptive in its subsequent studies (e.g. transport), it didn't do any real sensitivity analysis of supplies, and did not compare alternative cutting strategies. It merely took the one chosen cutting strategy and derived everything around that. The forecasts made in the CNIPS report, therefore, should be treated with due scepticism.

PREPARATION OF FORECASTS

The Forest Service has, at present, the statutory responsibility for forest sector modelling in New Zealand. The forecasts for the 1980 and 1982 publications just referred to are obtained from a suite of models. Firstly, the area/age class distributions by crop types (species/locality/silvicultural regime/production curve combination) are simulated by the IFS model (Ref 3) to produce volume yields over time. The areas are classified into terrain suitable for tractor or hauler logging, and with or without logging roads, whereas the volumes are broken down into pruned buttlogs, big logs and small logs.

Simple equations are then used in system GROHA (Ref 6) to derive the amount of logging manpower and machinery needed to harvest the volumes available. For example, gang production in m^3/ha is calculated from a regression on mean tree size.

MOVPRO (Ref 5) contains three components: transport; processing; marketing. Transport may be by road, rail or barge. The flows of logs and products is governed by a scenario specified by the modeller after having first satisfied commitments to existing industry. For example in CNIPS, sawmilling was allowed to grow gradually as sustainable surpluses of potential sawlogs became available, whereas it was necessary to accumulate sustainable increments of 240 000 m^3 of roundwood equivalent per annum before one new TMP mill was built, and when two extra TMP mills were established at one location, an additional newsprint mill was commissioned. The only other production increase allowed was a fixed jump in particle-board manufacture from 56 000 to 92 000 tonnes per annum during the 5 year period 1996-2000. All subsequent studies of transport, finance, port-handling, energy use and manpower were predicated on the assumption that this is what would happen. It is little wonder, then, that one CNIPS major conclusion was (see page 4, Summary of Findings),

> "Most of the expansion of the exotic forest output from the central North Island will not occur until after 1995",

since that was the supply scenario that was specified at the outset!

RSUM, the fourth and last simulation routine in the suite, aggregates all previously determined resource flows and calculates foreign exchange requirements, net revenue with and without foreign exchange weighting, present net worth and internal rate of return of the scenario, and employment creation and dependency indices (Ref 4).

These models have been useful for providing a broad indication of the potential for the forest sector to develop, but they require many scenarios to be examined in detail, each of which is highly demanding of people's time, and they must not be regarded as prescriptive until much further deliberation and evaluation have taken place. There is a need for increased interaction and active participation from a wide range of contributers. Included in this list are loggers, and others that should be represented are forest owners, growers and managers, wood users and consumers, regional and national planners, local government and national politicians, forest machinery and equipment suppliers, researchers and so on. Until ways of incorporating the views of all these kinds of people and also of examining queries they may have in the models themselves, the planning will continue to be disjointed.

FORESTRY COUNCIL WOOD SUPPLY MODELLING

An important pre-requisite to better coordination of various points of view is the need to provide access to and exchange of nationally important data on all major elements making up the forest sector. The Forestry Council is now, through the Forest Service, mounting a major exercise in annual stock-taking and reporting forest resource statistics county by county. Results output will include areas of one year age classes by species, ownership category, crop type, harvesting terrain class, location and yielding capability. This information is to be refined and re-published annually. It will be an extremely valuable document on which to base rolling forward plans.

MODELLING APPROACH AT UNIVERSITY OF CANTERBURY

Another approach adopted (Refs 1,9,10) is to look comprehensively at the whole forest sector in New Zealand and to provide a framework for modelling at a coherently structured range of levels. At the upper-most level, a set of large-scale mathematical programming models are run to determine optimal strategies for managing the whole forest sector throughout the country in terms of: re-establishment and new planting; silvicultural tending; harvesting; processing that matches resources and manufacturing potential with possible market demands; movement and transport of logs or intermediate and final products; and location, kind and size of processing capacity. This coverage enables us to characterise a large number of important elements (not just potential wood supplies) in the whole system so that a coherent picture of the investments needed for growing and harvesting the resource, transporting and processing it, and marketing the outturn can all be broken down by kind and period, together with the infra-structural support that will also be needed.

The national model comprises eight regionally independent sub-models linked by national assets such as capital, foreign exchange, energy, labour, export opportunities and demands for final products, all of which factors transcend regional boundaries. Each regional sub-model has constraints on areas available for planting, crop productivity, harvesting techniques, location, kind and size of processing plants, and transportation of commodities: all these latter factors require evaluation that is independent of that in other regions. The eight regions are (1) Northland, (2) Auckland, (3) Rotorua and Hawke's Bay, (4) Gisborne, (5) Wellington, Wairarapa and Taranaki, (6) North Nelson and Marlborough, (7) Canterbury and Westland, (8) Otago and Southland. These regions have been demarcated on the basis of (a) size, compactness and species composition of the resources; (b) common export port outlets; (c) uniform intra-regional patterns of transportation; and (d) similarity in crop productivity.

Three basic silvicultural regimes are catered for, namely board, framing and untended. The age classes in each regime are further characterised in terms of suitability for harvesting by tractor or cable logging, first and later rotations, and proportion containing radiata pine. Commercial thinnings of specified yield (they may be zero) are taken at age 10 in regime 1 and at 15 in regime 2. The yield tables provide merchantable volumes broken down into a hierarchy of intermediate product proportions - clearwood, constructional timber, poles, posts, pulp, chips and low-grade residues. There is one notional forest epicentre and one notional processing epicentre per region; the resource statistics for these are finally set at representative values only after more detailed modelling at a lower level (to be described later).

Harvesting is accomplished using either tractor or cable logging systems which are appropriate averages for each regime in each region. The logging costs per cubic metre and manpower logging productivity are identified by species, regime, age, terrain and locality. These data are based on local work study information and on types of machinery that are likely to be used in the near future both for clear-felling and thinning. The figures finally used are based on weighted averages obtained at a lower, regional level of modelling.

In lower level models for one region at a time it is possible to look at individual elements in more detail. There are, for example, ten crop regimes, ten forest areas and ten processing centres. Each of the ten areas and crop regimes are built up from small blocks of forest (say up to 1 000 ha), boundaries for which depend on transportation routes for logs and on the location of utilisation plants or export ports in relation to these blocks of forest and transportation routes out of them.

In the regional models, transport decisions are based on an efficient network code which optimises the flow of several kinds of commodity in changing amounts over the whole planning horizon. These results can then be used to refine more and more effectively the amounts of commodities and distances they are transported in terms of single weighted figures that can be incorporated at the national level. The different levels of modelling are run time and again until the results are compatible throughout all levels.

This technique does not force through pre-determined specific regional industrial scenarios, and then extrapolate from or interpolate between them, but allows the model to weigh the options and make first choices. Then, several people can examine the "best" choice and see, by a trial and error process, if there are other strategies that may be environmentally, or socially, or financially, or biologically, or managerially, or in any other relevant way, which may be nearly as good.

The evaluations are made on the basis of automatic report-writers which allow summaries of the results to be produced very quickly. For example, there can be listings of: regional supplies of wood from forest to mill or port, in various categories and by period; how these supplies are harvested, and the costs, manpower and machinery needed; scheduling transport of commodities and the costs, manpower and machinery needed for this; etc. Alterations can be made to the data to evaluate people's queries at a computer terminal. It is at this stage of the modelling, therefore, that specialists of all kinds can scrutinise the output and identify anomalies or data entries that can be refined. Obviously the crude terrain classification for identifying logging method can be dispensed with if long-term logging plans have already been drawn up for large blocks of forest. Similarly, machinery suppliers can suggest more appropriate matching of needs and offerings.

IDENTIFYING HARVESTING MACHINE REQUIREMENTS

G.H. Alexander is currently trying to improve the forecasts of the kinds of harvesting machines that can best be used for felling and trimming trees and for transporting them out of the forest, by collecting information on machines, reviewing harvesting systems in relation to the nature of the crop, and incorporating these findings in the Canterbury sector model. He needs to have information on productivity and costs over as wide a range of conditions as possible so that appropriate technology and machinery can be made available at the right time in any given locality within New Zealand. Sensitivity analyses of the various possibilities may tell us much more than identifying what may appear to be best. The amount of production thinning done and at what age, for example, will not necessarily be that which maximises value production from any one stand but is more likely to be what is needed to keep industry in successful operation.

In conclusion, therefore, it should be emphasised that existing published figures on manpower, machinery and finance needed in the next thirty years or so for forest harvesting cannot be considered reliable until a much clearer picture of the processing that might be done has been obtained. That clear picture will not materialise until there is a far closer coordination among growers, loggers, transporters, industrialists, suppliers, planners and politicians and interactive, integrated modelling is pursued.

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