DIVERSIFICATION AND OPPORTUNITIES IN FORESTRY IN THE SOUTH ISLAND HIGH COUNTRY*

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ABSTRACT

A survey of exotic trees in the Canterbury high country has identified an unexploited forestry potential. Five conifers are suited for forestry development in parts of the high country: Douglas fir (Pseudotuga menziesii), *Corsican pine* (Pinus nigra), *radiata pine* (P. radiata), *ponderosa pine* (P. ponderosa), *and European larch* (Larix decidua). *Exotic trees currently occupy less than 0.1% of the region's 1.8 m ha. Growth rates are largely determined by the steep east-west rainfall gradient, and in the moist region they are high by any standard. The possible scale of any forestry development, and points for and against high country forestry are discussed. A case is presented for promotion of a roundwood industry, mainly for poles, using Corsican pine and Douglas fir. Markets are discussed. It is concluded that forestry is a viable land use option for the South Island high country.*

INTRODUCTION

"Diversification" and "opportunity" are topical words in discussions on land use today. "Opportunity" could be considered a keyword in our history, for many of our forebears came to New Zealand because it offered opportunities not available in their home countries. "Diversification", on the other hand, is a comparatively new word. On the agricultural scene it conjures up visions of kiwifruit and deer products unheard of as major exports even 20 years ago. In forestry, the long period between planting and harvesting means that opportunities for diversification must be recognised well in advance. If diversification is to be taken seriously, astute assessments of future market opportunities need to be made and forest resources of sufficient size established to ensure continuous wood supplies. Logistics would

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mean that such a resource would best be concentrated in one region particularly if the resource was composed of a "minor" species requiring specialised growing conditions, management, and processing.

The South Island high country is a large tract of land which has experienced relatively little agricultural development over the last 100 years. This is despite considerable encouragement in the form of advice and financial subsidies, which have led carrying capacities to rise dramatically elsewhere in the country. High country farmers are still being urged to improve production by increased subdivision and fertiliser inputs, with the goal of raising stock numbers from 2.5 to 10 million stock units (Douglas, 1984). Farmers contemplating such action are being advised to budget for a maintenance superphosphate application of 25 kg/stock unit (Sinclair and Floate, 1984). This equates with an annual fertiliser dressing of almost half an adult ewe's liveweight or approximately 5 kg of fertiliser for every kilogram of wool produced. The sustainability of such a system must be questioned.

In 1983 a hill and high country seminar was held at Lincoln College with the theme "Intensify, diversify, economise or perish" (Robertson, 1983). Speakers talked of diversification in terms of moving from traditional grazing plants towards less moisture- and nutrient-demanding forage species and fodder trees, changing the animal farmed from cattle and sheep to deer and possibly goats, and changing from grazing alone to more diversified uses such as recreation and tourism (Robertson, 1979) and wood production. Of the changes advocated forestry has received comparatively little attention. This is surprising as the planting of trees has been practised in the high country for longer than any of the other options mentioned, even if only on a small scale.

SOUTH ISLAND HIGH COUNTRY

Most of our work over the past two years has involved quantifying tree growth in the Canterbury high country. The area covers approximately 1.8 million hectares (Fig. 1) out of a total South Island high country area of around 3.5 million ha. About two-thirds of the 1.8 million ha lies above 900 m and plays a minor role in high country primary production. The remaining third is mostly farmed on an extensive basis, carrying, on average, around one stock unit per hectare.

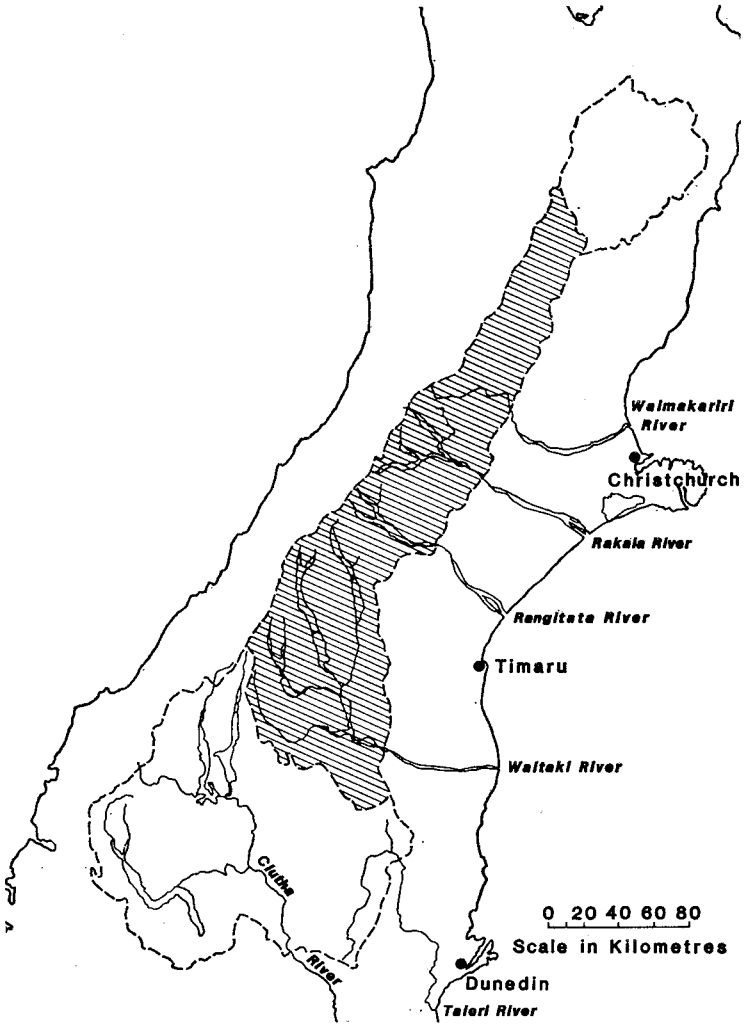


FIG. 1: *The high country region of the South Island. The shaded area represents the high country region of NZFS Canterbury Conservancy and includes the southern headwater catchments of the Waitaki which are part of Otago province.*

Exotic trees occupy only 1240 ha or much less than 1% of the approximately half million hectares currently farmed in the Canterbury high country. Most of this area has a forestry potential.

Our work indicates that parts of the South Island's high country possess favourable conditions for the growth of some conifers. Some of the stands measured contained volumes of timber rarely equalled elsewhere in the country.

Growth Rates

The Canterbury high country, particularly the Waitaki catchment, is affected by a very steep rainfall gradient. Over a distance of less than 50 km, rainfall varies from less than 500 mm to over 8000 mm (N.Z. Meteorological Service, 1978), although few exotic trees have been planted in areas receiving above 2000 mm. Not surprisingly, rainfall plays the major role in influencing tree performance, in some species explaining over 80% of the variation in growth rate.

TABLE 1: MEAN GROWTH RATES (m^3/ha/yr) FOR FIVE RAINFALL ZONES IN THE CANTERBURY HIGH COUNTRY

Rainfall Zone	*Radiata Pine*	*Corsican Pine*	*Ponderosa Pine*	*Douglas Fir*	*European Larch*
<600 mm	13.0	8.8	10.0	9.0	9.0
600- 800 mm	19.0	13.2	15.0	14.5	12.0
800-1000 mm	25.0	18.0	20.6	20.2	15.0
1000-1200 mm	29.0	21.8	25.0	25.6	18.0
>1200 mm	30.0	24.4	27.5	30.0	20.8
MA1 vs rainfall (2^0 regression R^2 values	0.67	0.79	0.88	0.82	0.52

Table 1 gives the mean annual growth rate (m^3/ha) for five rainfall zones in the Canterbury high country. The table was prepared from regressions comparing growth rate with rainfall, the data for which were obtained from 169 sample plots. For the moister regions (>1200 mm rainfall) mean annual increments averaged around 30 m^3 for Douglas fir, 27 m^3 for ponderosa pine, 24 m^3 for Corsican pine and 20 m^3 for European larch, whereas in the drier areas of the MacKenzie Basin, only the two pines will survive and grow readily, producing around 5-10 m^3/ha annually. Radiata pine, although a marginal species over much of the high country because of its susceptibility to frost and snow damage, can produce 30 m^3/ha/yr on more favourable sites in the catchments north of the Waitaki.

Reasons for the high levels of productivity include:

— an adequate and even annual distribution of rainfall,

— low incidence of pathogens, resulting in the longer maintenance of foliage and high stocking rates,
— the warm day/cool night temperature pattern over the growing season which means low night-time respiration losses of the carbon fixed by day-time photosynthesis.

In addition, many plots in the wetter areas were located on good soils.

Forestry Potential

Apart from the relatively good growth rates in some areas, there are other reasons for favouring forestry as a land use in the high country:

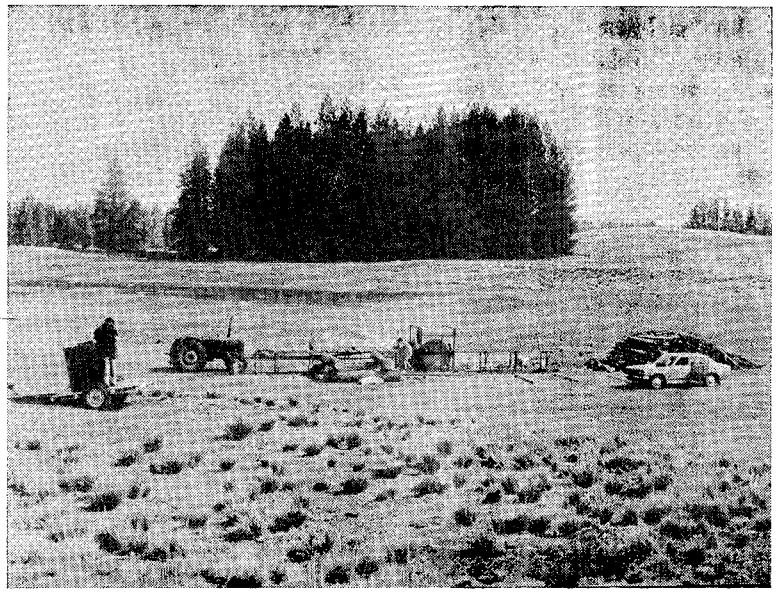
— easy topographies, which reduce access and harvesting costs — approximately 0.5 million ha, within the Waitaki and Waimakariri catchments have slopes of $<15°$ (Hayward, 1967; Waitaki Catchment Commission, 1982),
— minimal weed competition — on unimproved tussock grasslands competing vegetation is largely herbaceous and produces <350 kg of dry matter/ha (O'Connor, 1961) on some sites,
— low incidence of pathogens,
— good access to export ports — the distance of the major high country basins from export ports is less than 140 km by road or rail,
— limited alternative land uses (Robertson 1979, 1983).

Some factors count against larger scale forestry:

— greater risks of climatic damage, especially to species such as radiata pine (Hughes, 1969, 1973; Wilson, 1976),
— possible conflicts with other land values (*e.g.*, scenic and ecological),
— The risk of tree spread on to undeveloped land (Benecke, 1967; Hunter and Douglas, 1983).

Species

The small area of exotic trees in the Canterbury high country is dominated by five species of conifer — Corsican pine (35% of area), ponderosa pine (20%), radiata pine (13%), European larch (12%), and Douglas fir (9%). Other conifers (mainly *P. contorta, P. muricata,* and *P. pinaster*) cover 10%, and broadleaf species occupy just 1% of the area. Many other species have been tried since the first European settlers occupied the high country over 100 years ago, so that the present situation probably



A mobile sawmill in the Canterbury high country. There are obvious advantages for the on-site milling of small plantations well away from established sawmills.

reflects the relative suitability of these species for much of the area. Corsican and ponderosa pines are hardy species which can tolerate most sites; radiata pine has difficulty in establishing where extreme winter cold or unseasonal frosts are likely, and larch and Douglas fir prefer sheltered (particularly larch) moist slopes where rainfall exceeds 800 mm.

On present evidence, probably just two species would be favoured for any larger scale forestry — Douglas fir in the wetter areas and Corsican pine in the drier. Radiata pine, despite its rapid growth in some sites north of the Waitaki, must be a marginal candidate because of establishment problems and its susceptibility to damage by snow. Lesser roles could be considered for European larch and ponderosa pine, but site requirements would restrict the range of the former, and ponderosa pine is not widely accepted on the local market place as a sawn timber (N. Clifton, N.Z. Forest Service, Canterbury, pers. comm.).

Scale of Land Use

If 10% of all Canterbury's farmed high country were to be converted to farm forestry, a forest estate of 50 000 ha would

result. Such an area would comprise only 2.7% of the total Canterbury high country, but would be equal to the present exotic forest estate in the whole Canterbury province. However, wise land use involves many forms of land management, and any forest development must be integrated with existing forms of land use — principally pastoralism. The best farm land exists within Land Capability Units (LCU) 3, 4, and 5, and within these, trees will probably be restricted to shelterbelts and small woodlots of just a few hectares. At the other end of the scale, LCU 8 and much of 7 can be excluded from consideration for production forestry on the basis of climatic, edaphic, or topographic limitations. The remaining areas fall more naturally into the category of "forest-suited" land (Table 2).

TABLE 2: LAND AREA (ha) SUITED FOR FORESTRY* WITHIN THE CANTERBURY HIGH COUNTRY

Rainfall Zone	*Waitaki*	*Rangitata/ S. Ashburton*	*Rakaia*	*Waimakariri*	*Hope Waiau*	*Total*
<800 mm	213 665	3 158	1 003	—	—	217 826
800-1000 mm	26 899	21 600	16 451	12 548	—	77 498
1000-1200 mm	20 830	8 100	9 250	13 300	3 095	54 575
1200-1600 mm	22 225	3 898	14 578	15 356	7 291	63 348
Total	283 619	36 756	41 282	41 204	10 386	413 247

*Land Capability Units (LCU) 3, 4 and 5 excluded on the basis that these units are best suited for more intensive farming. All LCU 8, 80% of LCU 7, and 5% of LCU 6 are excluded on the basis of climatic, edaphic, or topographic limitations.

If the area in Table 2 is divided into wet (>800 mm rainfall) and dry (<800 mm rainfall) components, the following simple forestry options can be considered.

Rainfall >800 mm (approx. 200 000 ha):
Sloping sites (approx. 66% of area) — Douglas fir possibly larch on more sheltered sites).
Flat sites (approx. 34% of area) — Corsican pine.

Rainfall <800 mm (approx. 324 000 ha):
All sites — Corsican pine (and possibly some ponderosa pine).

Landscaping

Large and virtually treeless vistas are a well-known component of the high country scene, and if forests are to be planted more widely, their integration into the existing landscapes must be well planned. It should not be difficult for such a large and

varied area to absorb the sometimes conflicting values which local residents and visitors place on trees. Well-designed woodlots can complement the development of the more intensively used areas, whilst in the more remote regions, where pastoral farming on poorer land is more extensive, opportunities exist for larger forest areas.

All tree planters in the high country should be aware of the possibility of natural regeneration into undeveloped tussock and scrub country. Tree spread need not be a problem as long as:

— Plantations are not located on "take-off" sites (ridges, hilltops or sites on or adjacent to slopes facing into the prevailing nor'west winds).
— Land immediately adjacent is managed so that livestock control wildings.
— Checks are made once every 5 years for lone "outlier" trees, which must be removed promptly.

Marketing Prospects

As has been experienced with so many of this country's more recent export agricultural crops, the major problems do not lie in growing the produce, but in trying to sell it at a profit. The current marketing prospects for possible high country tree crops are:

— existing markets for Corsican pine and Douglas fir sawlogs,
— limited, but potentially large markets for Corsican pine posts and poles (Ellis *et al.*, 1984),
— limited domestic markets for larch timber and rails — conversely, the limited supply may not have allowed the full market potential to be expressed,
— poor markets for ponderosa pine sawlogs.

It is probable that Corsican pine and Douglas fir sawlogs and their processed end products will continue to be valued international trading commodities. What is less predictable is the price they will fetch once they mature 40-50 years from now. However, timber is increasingly valuable, and it would be reasonable to expect values to be maintained, especially if world wood supplies decline.

New Export Crop

Shorter rotation lengths involve fewer financial and environmental risks, and for this reason regimes involving Corsican pine,

and perhaps Douglas fir, for roundwood (mainly poles) may be viewed favourably. Roundwood if allied with the country's expertise in wood preservation, could have an unexploited export potential (Bunn, 1981). The following points favour such a crop.

— Corsican pine and Douglas fir are internationally recognised as good pole producing species (Bourke and Aldwell, 1983),
— The South Island high country is a major region which could specialise in Corsican pine. *Dothistroma pini,* pine needle blight, has severely restricted the growth of this species throughout most of New Zealand, but limited available evidence indicates that it is unlikely to become a major problem in the high country, particularly in the drier areas (P. Gadgill, F.R.I., pathologist, pers. comm.),
— Swiss needle cast fungus, *Phaeocryptopus gaumanii,* has significantly reduced the vigour of Douglas fir in the North Island but to date it appears to be benign in the South Island high country (R. Smith, F.R.I. Forest Health Officer, pers. comm.),
— Rotation lengths for poles would be about 30 years (depending on rainfall), shorter than that for other regimes,
— Corsican pine and Douglas fir plantations can carry high stockings, particularly when grown for pole production.

In addition, potential export markets do exist. Regular enquiries for poles from overseas exceed our annual production of around 43 000 m^3, approximately 107 000 poles (Bourke and Aldwell, 1983). However, logistical problems arise from the large size of the orders, competition from other nations is increasing, and costs of internal handling and freighting would have to be cut to make our prices competitive. Most of these problems could be tackled if a commitment to pole production was made. A larger scale industry could make significant cuts in handling freight costs (currently about 60% of the cost of getting poles to their export destinations), and, if coupled with an aggressive marketing approach, could increase sales substantially.

If New Zealand can attract an unsolicited request for 100 000 poles/yr from one small country (Greece), with at least six other larger countries also expressing interest (*N.Z. Forest Service,* 1982), it might be reasonable to surmise that an annual export of 500 000 poles is possible. On a 30-year average rotation, a forest estate of at least 15 000 ha would be required to meet this demand. This would surely make the feasibility of

floating a specialist forestry enterprise in the South Island high country attractive.

One potential problem has been identified in our study. It is vital for a product such as poles, grown for structural load-bearing roles, to possess guaranteed wood strength. The density of the outer 20% of a pole is closely related to its strength (Cown and Hutchinson, 1983), and D. Cown (pers. comm.) considers an outerwood density of 450 kg/m^3 is necessary for uses where the poles are non load-sharing (*e.g.*, transmission lines, orchard windbreaks). A preliminary study of the density of Corsican pine grown in the high country indicates that some stands would not meet this specification. Further investigations are needed before undertaking any larger scale plantings of Corsican pine for roundwood.

CONCLUSION

Compared with the remainder of New Zealand, most of the South Island high country has seen little change in land use since its occupation over 100 years ago. Our survey has shown that trees can grow well in most of the Canterbury high country area. Good land management must always strive to balance biological productivity and economic opportunities. The potential of forests for diversification of land use in the high country should not be overlooked.

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