Forestry: a sustainable land use for degraded high-country lands

M.C. Belton

Only seven years ago MAF scientists were promoting the idea that high-country pastoralism could be intensified from 2.5 to 10.0 million stock units through land development (Douglas, 1984). At that time it was seldom acknowledged that trees and forestry could play anything more than a minor and complementary role to high-country pastoralism.

Now forestry is being promoted as a sustainable landuse option for the severely degraded high-country lands affected by rabbits and hawkweeds (Hieracium spp). This attitude change results from a recognition of the magnitude and urgency of the land degradation crisis, and the realisation that trees offer a sustainable and productive landuse, and more importantly, soil rehabilitation.

The ecological crisis affecting dry tussock grasslands has been brought into sharp focus with the recent release of the report by Helen Hughes, Parliamentary Commissioner for the Environment, "Sustainable Landuse for Dry Tussock Grasslands in the South Island" (Hughes, 1991), and the Report on Hawkweeds from the Mountain Lands Committee, Lincoln University (1991).

Both reports examine the degradation of tussock grasslands ecosystem under pastoral management. The Report on Hawkweeds concludes that high-country pastoralism and nature conservation are "so threatened by degradation that within ten years we may expect only a skeleton fine wool industry in the mountains and few representative tussock grasslands in the conservation estate". In critically affected areas below 600mm rainfall the land degradation is characterised as desertification (Hughes, 1991). The problem is manifested as rabbit infestation, hawkweed dominance, reduction in native and introduced pasture species, reduction of soil fertility, collapse of pastoral production and accelerated soil erosion.

The report on Hawkweeds suggests that the current stock levels may need to be urgently reduced by half a million sheep on the more seriously affected lands, and that sustainability of a further half million stock units is at risk. The report concludes there is little prospect for continued pastoral use on unimproved land unless radical programmes of pastoral development, restricted grazing and land retirement are undertaken. The Lincoln report then proposes "agroforestry or large-scale forestry as a sustainable landuse must be considered".

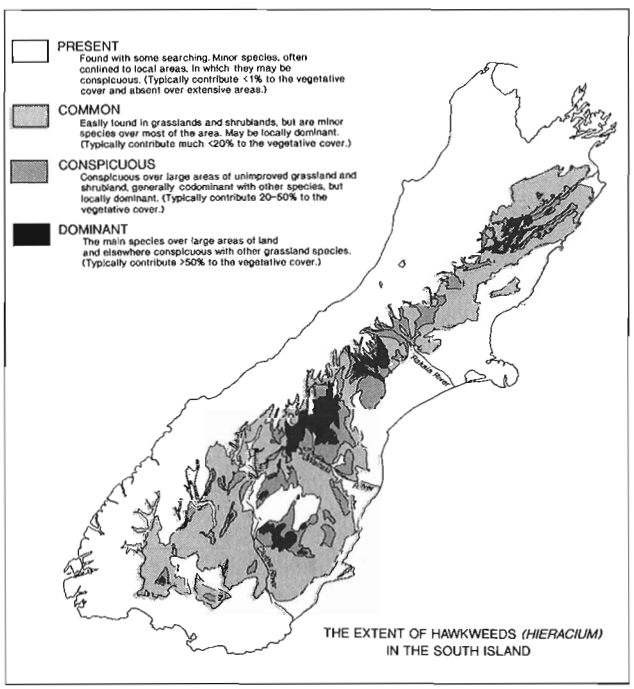
Hughes is more explicit about a role for trees and paints a visionary picture of the Mackenzie basin. "A future scenario for the Mackenzie basin, for example, might see an aesthetic blend of reshaped and more financially robust pastoral properties grazing cattle, sheep, goats, deer, as appropriate to land type and management need; having areas in agroforestry with larger blocks of production forestry either as wide shelterbelts or stands on severely degraded land or land with aluminium toxicity; and with some landholders operating on farm activities for tourists and conservationists. Elsewhere larger blocks of privately managed plantation forests across formerly desertified lands could blend in with managed conservation areas and rural townships designed to service and process products from or for the land."

Behind the findings of both reports is a DSIR survey of Hawkweed distribution as at 1989/90 (G. Hunter, 1991). The survey showed hawkweeds dominate ground cover (greater than 50%) on over half a million hectares of drier high country, and are conspicuous (20-50% of cover), and increasing, over another million hectares. The Hawkweed dominance zone generally corresponds with area of most severely degraded dry high-country grassland.

Hawkweed and rabbits can be seen as symptoms of land degradation rather than its cause. Hawkweeds are arguably a more serious problem than rabbits as they affect a far wider area, and no economic farming method exists for recovering the worst affected dry tussock grassland. Hughes cautions against introduction of biological control for Hawkweed for the reason Hawkweeds are virtually all that is holding the soil over many areas. In fact bare soil is already the companion of Hawkweed over large areas, and severe wind erosion creating the most spectacular dust storms seen in the Waitaki basin have occurred this last summer (B. Scott, 1991).

The $25 million Rabbit and Land Management Programme funded by Central and Regional Government is intended, over a five-year period, to achieve rabbit control and establish sustainable landuse on 100 high-country properties. With the programme now in its second year it is apparent the the landuse problem affects a far wider area, and that a whole suite of alternative landuses as well as sustainable pastoralism need consideration (Hughes, 1991).

Hughes realistically emphasises the need to establish the right mechanisms and legislative frameworks to achieve the goals of arresting land degradation and of establishing productive sustainable landuses appropriate to land type. The great majority of affected lands are Crown lands, under pastoral lease, and administered according to the provisions of the Lands Act 1948. Hughes pointedly notes that these existing arrangements have failed to protect the resource under pastoralism, let alone allow changes to sustainable alternative



THE EXTENT OF HAWKWEEDS *(HIERACIUM)* IN THE SOUTH ISLAND

The author, Mark Belton, works with the Ministry of Forestry, Christchurch.

landuses. The Land Act is currently under revision. Hughes recommends that pastoral lease conditions be relaxed to encourage alternative landuses such as forestry. She also re commends a categorisation of pastoral lease land based on landuse suitability, and this approach be used to clarify landuse goals in preparation of Property Plans.

Forestry Roles

It is worth considering what trees can offer in these degraded dry lands. Shelter systems are already a key feature of many high-country land improvement programmes because of strong north-west winds and the significant reductions in evapotransportation, crop damage, and soil loss that can be obtained with shelter. Concepts of forestry grazing systems are much less developed and more experimental. Parklands of trees at variable densities, species mixes, and tree ages would be more visually attractive than regimented designs.

In the dry zone scattered trees are frequently surrounded by a small 2-3m^2 area of improved pasture growth due to topsoil nutrient enrichment from litter fall. This herbaceous vegetation response around trees is often highly visible with the presence of clover or lotus, and sweet vernal or other more nutrient demanding grasses, or just healthier hawkweeds. How this flush of growth might translate in terms of useful pasturage has not been analysed. In terms of soil influences the benefits in nutrient cycling and increased litter and soil organic matter from fully stocked forests would likely be greater than from more lightly stocked agroforests.

Enrichment of plant available phosphorus in topsoils under conifers is greatest for the drier high-country soil sets, those most affected by rabbits, hawkweeds and soil degradation. On average Olsen-phosphorus levels under conifer stands on high-country dry land soils are three times greater than for adjoining grasslands (Belton, O'Connor, Robson, 1991). The benefits in soil fertility also appear to persist long after forest harvesting (M. Davis, M. Lang, Pers. Comm.).

Timber production and economic performance from wide-spaced agroforestry regimes in the high country have yet to be assessed, but are likely to be minimal at best. Only good provenances of Corsican and Ponderosa pine would retain reasonable form as open-grown trees, and even then timber production capability would be compromised by greater branch size, stem taper and a higher incidence of stem malformation from exposure; in summary agroforestry in this environment would yield much smaller quantities of lower-grade timber.

Forest regime options for drier areas are limited. Ledgard and Belton (1985[1]) favoured Corsican pine roundwood regimes as the best choice for areas below 800mm rainfall.

GROWTH RATES* OF CONIFERS FOR SEVEN CANTERBURY HIGH COUNTRY RAINFALL ZONES (m^3/hr/yr)

Rainfall	Radiata pine	Corsican pine	Ponderosa pine	Douglas fir	European larch
400-500mm	9.5	6.0	6.5	NA	NA
500-600mm	13.5	9.0	9.9	NA	NA
600-700mm	17.0	11.8	13.2	13.4	11.1
700-800mm	20.2	14.3	16.0	16.1	12.6
800-1000mm	24.0	17.6	19.6	20.5	14.6
1000-1200mm	27.7	21.3	23.5	26.1	17.4
1200-1400mm	29.6	24.0	26.2	31.2	20.4

*Maximum Stemwood Volume Increments of fully stocked stands prior to Age 50. Values are from regressions in Ledgard and Belton (1985).

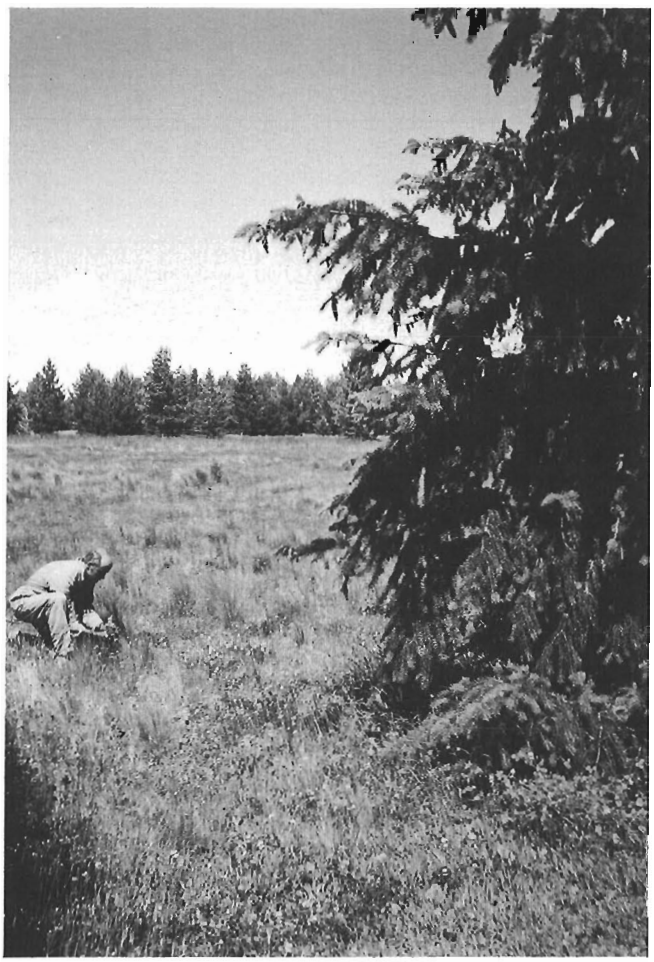
LANDS PHYSICALLY SUITED TO FORESTRY IN LOWER RAINFALL ZONES OF THE CANTERBURY HIGH COUNTRY

RAINFALL ZONES mm	CATCHMENT AREAS (ha) Waitaki	Rangitata	Rakaia	Waimakariri	Totals
800-1000mm	32,099	24,025	20,942	16,281	93,347
700-800mm	41,796	6,762	1,420	-	49,978
600-700mm	66,558	-	-	-	66,558
500-600mm	110,855	-	-	-	110,855
400-500mm	53,764	-	-	-	53,764
Total	305,072	30,787	22,362	16,281	374,502

Note : For reasons of climatic, soil, and topographic limitation, all L.U.C. Class VIII, and 80% of Class VII were excluded.

This table extends Table 10 in Ledgard and Belton (1985).

They noted some special advantages for high-country forestry which include absence of *Dothistroma pini,* which can debilitate Corsican and Ponderosa outside the eastern South Island, and very low costs of land, establishment, and harvest. Average maximum growth rates of fully-stocked Corsican stands in the desert areas of the Mackenzie between 450mm and 600mm rainfall, fall between 6 and 10m^3/ha/yr and rotation lengths for sawlogs, after production thinnings for roundwood, could be circa 50 years. While extremely low by New Zealand radiata-based standards, high-country growth rates are still respectable by comparison with, for example, Sweden, where forests average 3.6m^3/ha/yr and full rotations for sawlogs are circa 100 years.



Unimproved dry tussock and herbacious response around conifers.

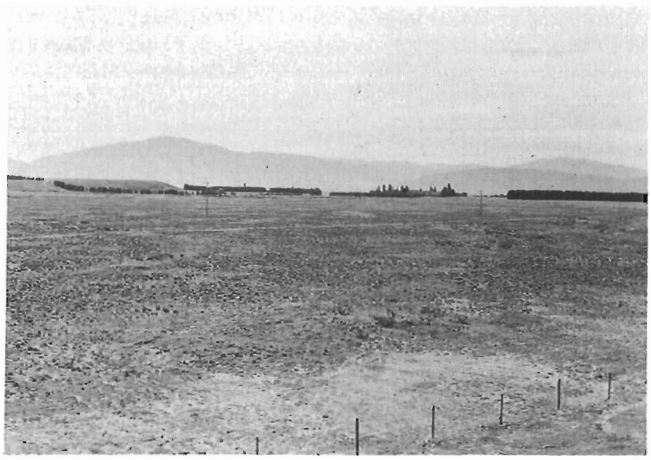
Economic viability of dry land forestry will depend on keeping establishment, tending and overhead costs to an absolute minimum. Direct seeding is an option widely demonstrated by wilding tree spread. Forest Research Institute investigations into direct seeding (Davis, 1989) suggest drilling conifer seed could provide an orderly and cost-effective establishment option. Aerial seeding is also an option but results are likely to be much more variable, and no less expensive than direct drilling. Variability of results from direct seeding to date prevent its acceptance as a reliable establishment method and further work is needed.

Destocking and rabbit eradication of Hawkweed dry lands in the Mackenzie would result in an explosion of tree spread downwind of existing stands and mature wildings. The undesirability of wilding sourced "forestry by default" has been pointed out by Ledgard and Crozier (1991). The Canterbury high-country exotic tree spread survey data (Belton and Ledgard, 1991) clearly illustrates that unconstrained tree spread into the dry Waitaki basin would be dominated by *Pinus contorta*, and to a lesser extent by genetically inferior provenances of Corsican pine. Clearly tree spread must not be allowed to dictate the composition and quality of any new forests in the Waitaki.

Research Needs

The Hughes report highlighted the need for more information on alternative landuse options for degraded high country. This information is needed urgently to help make appropriate landuse decisions in Rabbit and Land Management Programme Property Plans, and therefore, as far as possible, should be sought from existing stands.

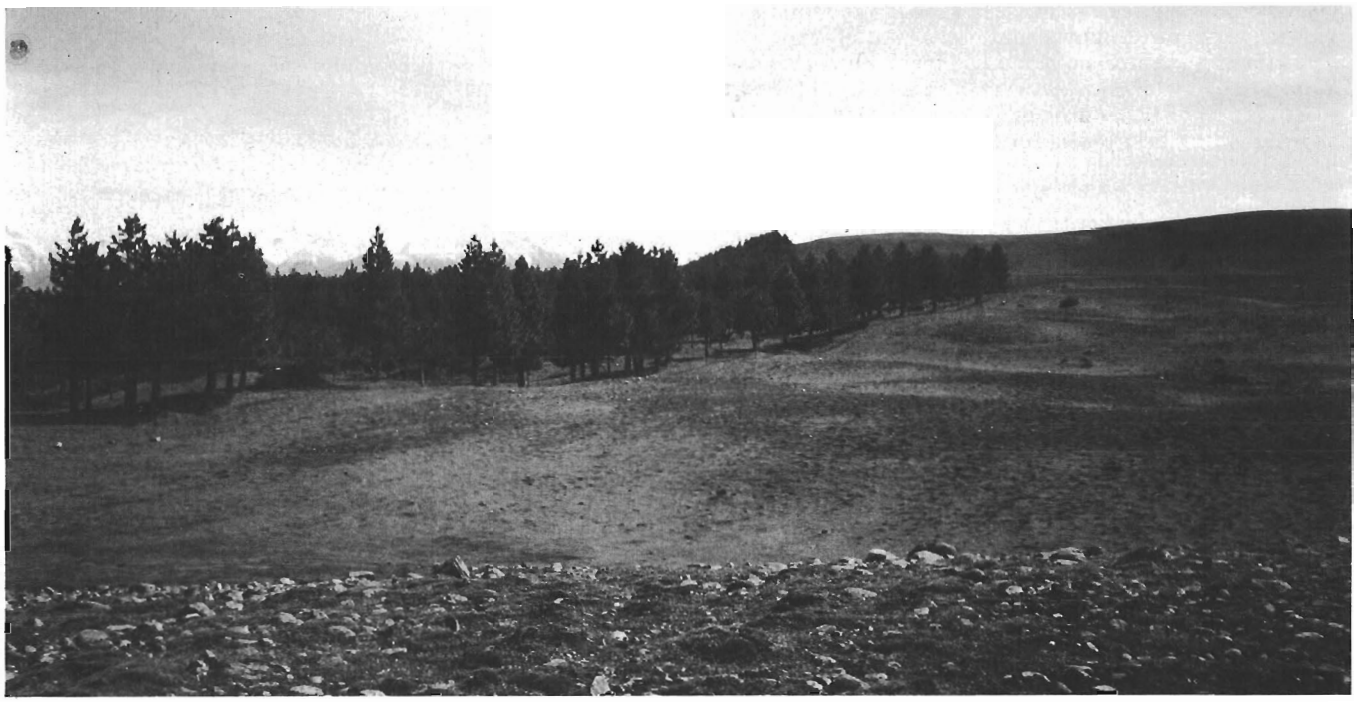
Notwithstanding the cautionary comments about wilding pines, the existing wilding and planted stands represent an extremely valuable information bank precisely because of their variable stockings, histories of treatment, and age and composition, and their far-flung distribution. Useful information should be able to be extracted from these stands on, for example, tree form response to stocking (for roundwood production), and the effect of different species and densities on nutrient cycling and their influence on the growth and composition of associated grassland. Dry land forage shrubs and legumes, for example, could be introduced immediately into existing wilding parklands to test their compatibility with forest grazing. Wilding forest and existing plantations can also provide essential data on recoverable volumes of different log grades. Research is also urgently required into more cost-effective establishment methods.



Desertification in the Mackenzie Basin.

Also required are economic evaluations of dry land forestry options. Economic evaluations available from forestry investigations for moist high-country areas in Canterbury indicate good internal rates of return from forestry (between 8-10%), and annualised returns 10 to 50 times higher than for pastoral farming over the same land type (Belton and Thompson, 1989). A forest productivity map detailing the maximum stemwood productivity of four major conifer species in the Waitaki catchment has been published under the landuse suitability mapping series by the Department of Survey and Land Information (1988). Forest productivity mapping needs to be extended to other high-country catchment areas.

In addressing the possible role of trees in reversing high-country land degradation the economic opportunities should not be overlooked on prime moist site areas where existing stands contain the world's highest recorded growth rates for Douglas fir, Corsican pine, European larch, and Ponderosa pine. For many New Zealanders the idealised myth of high-



Trees can perform well on high-country Hawkweed terrain.

country pastoralism being compatible with wild natural tussock lands will be difficult to change. Images of vast golden tussock country are part of the national psyche. The task of identifying sustainable natural landscapes of national importance, and protecting these, becomes even more urgent. Meanwhile the ecological and economic potentials of forestry and other landuse options for dry high-country landscapes need to be clarified and the information widely disseminated so that reasoned landuse decisions can be made.

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INSTITUTE NEWS

Government has key role to play in future of plantation forestry

W.R.J. Sutton

I have found quite disturbing the recent documentary series on the rise of Japan (Monday evenings on TV1). The way the Japanese Government has been deliberately and successfully focused in the efforts of industry (often at high social costs) provides a counter to those who argue the Government has little or no part to play in the industrial development of a nation. Japan has demonstrated that a lack of energy and natural resources is not necessarily a disadvantage. That the Australian and USSR economies have problems also shows that being well endowed with natural resources does not necessarily ensure continued prosperity.

Where does this leave New Zealand, especially New Zealand plantation forestry?

We have the land, the species, technologies and experience to grow quality trees as fast as almost anyone else in the world. And we can do that with more certainty than anyone else.

We have good reasons for our confidence in plantation forestry. Wood is man's most versatile commodity and is required in massive volumes. For most of man's history wood has been a natural resource to be "mined" in the same way as minerals. We are fast moving to a time when we can no more mine our forests and we must deliberately create the forests to grow our wood. New Zealand is uniquely placed because we were among the first to have done this and we have done much to achieve a leadership position.

From the President

As the natural forest resource becomes exhausted, or locked up for environmental reasons, we have little to fear from competition from other producers because the potential market is large and there are few other potential entrants (the lead time in plantations is very long).

Since all the substitutes for wood are more energy intensive, substitution of wood on any scale will not be possible unless energy becomes very cheap and very readily available. Plantation forestry and wood are very environmentally friendly.

One other major advantage of forestry is that it is fairly labour intensive. Although the work does require more skill than is generally appreciated, a high level of education is not a prerequisite. For an economically advanced country New Zealand has one of the lowest levels of schooling achievements. Plantation forestry is an ideal way of meaningfully employing a large number of semi-skilled people.

Plantation forestry offers New Zealand a significant and sustainable competitive advantage in one of the world's major commodities. Although in the long term plantation forestry can solve many of New Zealand's problems it is naive to believe that the market place alone can turn this opportunity into a reality. Right now the companies have difficulty raising capital for expansion and the market heavily discounts any long-term investments. Even if they could get the capital there will be major opposition to forestry companies buying up large numbers of the nation's farms and converting them into plantation forests. There is a need for us to diversify away from farming and some land suit-