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PASTURE MANAGEMENT CHALLENGES IN HIGHER ALTITUDE COOL SEASON RANGELANDS OF NSW

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ABSTRACT
The high altitude (above 300 m) pasture areas of NSW are undergoing significant technical, social, economic and environmental changes. The landscape and climate are highly variable, with grazing being the major agricultural activity. Factors that influence pasture management include pasture degradation, soil acidity and salinity, water use, noxious weed spread, and overriding socio-economic aspects. Progressive urbanisation and subdivision limit restructuring options, and there is widespread uncertainty for the future of the grazing industries. This paper describes the physical problems, the consequences of them and indicates possible solutions to the complex degradation issues facing this important area of NSW.

INTRODUCTION
The southern high rainfall area of the Murray Darling Basin extends from Mudgee in the north to Castlemaine in the south (Figure 1). It represents one of the most challenging and diverse landscapes for which to develop long term policies that are harmonious to commercial agriculture, conservation, water harvesting and eco-tourism. Rainfall ranges from 600-900 mm per annum with small pockets reaching up to 1500 mm. The Mediterranean rainfall pattern is generally non-seasonal, but has high variability, particularly over summer/autumn.

This extremely diverse and undulating to hilly landscape is dominated by pastures (approximately 60% native or naturalised and 40% sown with exotic species), primarily used for sheep and cattle grazing. Less than 10% of the area is suitable for cropping. The region accounts for about 80% of the total water yield of southern NSW.

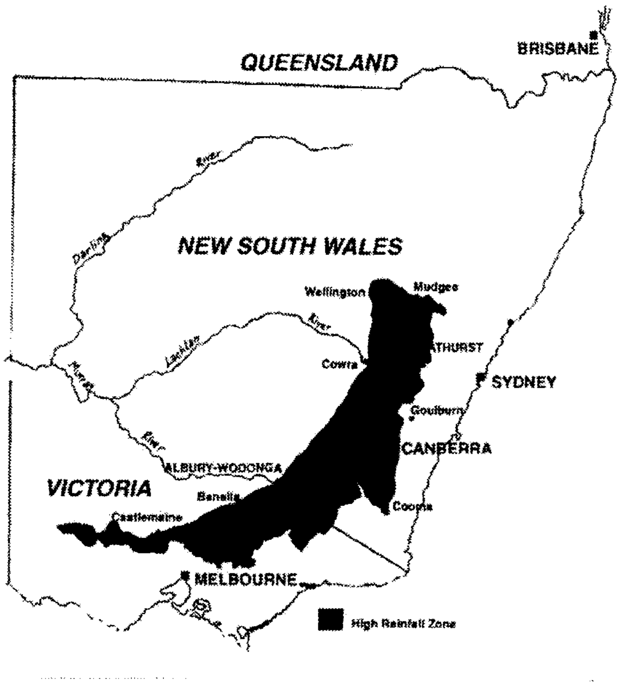

Figure 1. The high altitude, southern high rainfall area of the Murray-Darling basin.

SOILS AND VEGETATION

Soils in the area are mainly derived from igneous (granite, granodiorite, porphyry) or sedimentary (shale, slate) parent materials, and most soils are red or yellow podsolics with some red and yellow earths. Many soils are acid ($CaCl_2$ pH 4-4.3), and soils derived from sedimentary parent material are often acid to depth. Such soils are shallow, and toxicities of Al and Mn may occur. Fertility is low, and deficiencies of N, P and S are common, as well as trace elements (e.g. Mo, B).

The original vegetation was a mixture of eucalypt forest in steeper areas, with woodlands and grasslands on the lower slopes. Some areas have been overcleared, creating extensive areas of secondary grasslands (Foreman 1995). These areas initially were dominated by native perennial grasses. However, composition has changed over time due to disturbance, grazing, invasion of annual species and sowing of exotic species. Considerable areas have been sown in the past, but due to soil acidity, low fertiliser inputs, drought and poor management, much of this has reverted to native grass dominance or has been degraded to annual grass dominance. Previous pasture surveys have shown that pasture degradation is widespread and loss of perennial species is occurring in both native and sown pasture systems (e.g. Kemp and Dowling 1991).

The complex interactions of climate, soils, aspect, slope and past management (grazing and fertiliser) have created a mosaic of vegetation types with varying levels of productivity. Most areas have shallow, acid low fertility soils where maintenance of ground cover and productivity is difficult. Clearing of steeper, shallow soil areas has reduced ground cover, allowing erosion, loss of nutrients and recharge, contributing to salinity in the local landscape and in rivers within the Murray-Darling system. The need to treat these more skeletal soils differently from other areas has only been recently recognised (e.g. Simpson and Langford 1996). Current projects are investigating the effects of fertiliser and lime on botanical change, production, ground cover, runoff and water quality on such soils.

CATCHMENTS AND WATER

The big picture[2]

Runoff water is scarce in Australia. In the Murray-Darling Basin Some 86% of the land area contributes virtually no runoff to the rivers except during floods. The high rainfall rangelands of the southeast (rainfall greater than 800 mm) yield less than 125 mm/year runoff which by world standards is very low. About 46% of the runoff that does occur in the Basin is contributed by only 3 rivers - the Upper Murray, Murrumbidgee and Goulburn-Broken Rivers, which rise in the NSW and Victorian high country.

Water resources of the Murray-Darling Basin are both meagre and precarious. Small changes in water balance components may have considerable implications in terms of water yield, water quality and the reliability of supply. This is particularly the case along the western fall of the Great Dividing Range where rainfall is between 500-700 mm/year, and runoff is low (25–50 mm/year), intermittent, highly seasonal, and most of the land area is under some form of agricultural production.

Land use impacts

The most far-reaching change that has occurred in the vegetation since European settlement of Australia has been the replacement of plant communities that were capable of transpiring water throughout the year, with annual-behaving crop and pasture species. Under the impact of clearing, grazing, fertiliser application and the introduction of exotic pasture species, simple mixtures of short-growing plants that grow mainly in winter and spring have displaced the original complex, summer-active, tall growing indigenous communities (Figure 2). This has resulted in subtle but important changes in the hydrology of landscapes. The impacts can be summarised as:
Removal of trees – reduced direct evaporation; more rainfall reaches the ground

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[2] Statistics for this section were obtained from the State of Environment Advisory Council (1996) and Crabb (1997).

Loss of summer-active species – soils remain wet through summer; reduced N demand; higher rates of recharge and NO_3^- leaching in autumn and winter
Ingress of annual species – reduced opportunity for recruitment by summer-growing plants; increased competition and water use in spring, further favouring winter-growing rather than summer-growing species.

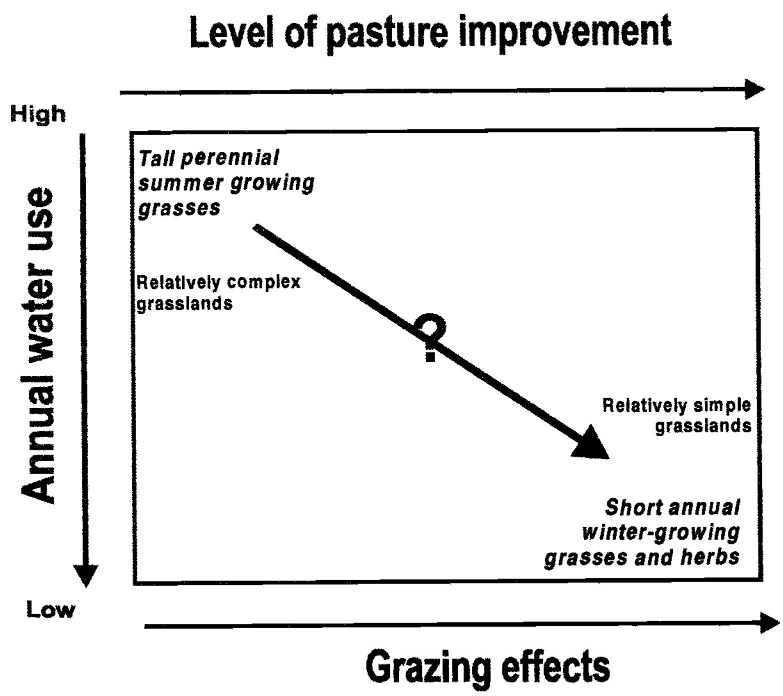

Figure 2. Effects of clearing and grazing on grassland composition and water use.

Current catchment research at Wagga Wagga has provided evidence that infiltration rates are higher for pastures dominated by exotic species, particularly where pasture sowing has increased soil surface roughness. However, there is no evidence that this increased infiltration is matched by increased rates of water use. Overall, clearing and agricultural land use practices have modified several water balance components concurrently – direct evaporation from tree foliage has declined; infiltration has increased at the expense of runoff; and for pastures consisting of annual-behaving, winter-growing species, water use has declined in summer. Inevitably, deep drainage must increase. In saline environments, this means the risk of salt mobilisation, increased salt in washoff and consequent dryland salinity.

Land use options

Large areas of grazed pastures in southern Australia still contain an appreciable proportion of native grasses (Pearson *et al.* 1997). These are a valuable resource, particularly from a catchment water use/protection context, and there is considerable scope to increase their productivity while enhancing catchment protection and biodiversity qualities. Tree planting also has a role. However, trees have two impacts – direct canopy evaporation reduces effective rainfall, while increased water use dries the soil. In combination, this may reduce catchment water yield, which may ultimately be detrimental. Grasslands also dry the soil, which may reduce deep drainage, but not at the expense of effective rainfall. If pastures need to be sown, there is evidence that summer-active species are more in-tune with the hydrologic balance of the landscape than summer dormant perennials (Johnston *et al.* 1999). However, in many landscapes, it may be difficult to overcome the normal trend towards winter-growing species.

SOCIO ECONOMIC FACTORS

There is clear recognition that catchment degradation problems, including loss of ground cover (and associated increases in turbidity and nutrient movement), increasing acidity, salinity and weed and pest invasion are here to stay. Unfortunately, agricultural productivity and resource stability can often be in conflict. For example, increasing stocking rate to achieve productivity goals may reduce ground cover (causing increased runoff and erosion) and available green leaf (minimising water use). Therefore, integrated on-farm and off-farm practices and policies which recognise these conflicts need to be developed to achieve long-term solutions.

Unfortunately, the group of landholders in the high rainfall grazing industry have the highest average age in Australia, and have the lowest net farm income. Over 70% of these grazing properties are structurally non-viable without off-farm income, and diversification options are limited. It has been estimated that less than one third of grazing properties achieve disposable farm income of $45,000 per year – this is the minimum estimated income required to maintain investment for both maintaining the farm business and for environmental protection (Barr and Ridges 1998; Clarke *et al.* 1998).

Progressive urbanisation and increasing subdivision limit restructuring opportunities. It is unlikely that with an ageing population under financial pressure, on-farm investment into resource management will ever be adopted without substantial incentives. In addition, increasing regulation will most likely harden landholder attitudes against integrated resource management for overcoming multi degradation issues.

Nationally, a recent study of land and environmental degradation has estimated that remedial costs are over $50 billion, and that this is beyond the capacity of the farm sector, which only had a net profit of approximately $4 billion last year (Australian Financial Review, May 13-14 2000). Where the economics of degradation are beyond commercial reality, redirection of land use will have to be considered, particularly where the downstream effects are economically and technically positive. Appropriate management policies may include limited grazing to maintain native species, encouragement of tree vegetation and, for some areas, retirement from agriculture. However, such solutions may conflict with the economic and social goals of individual landholders and local communities. Integrated solutions are required to address complex degradation issues. These may include revegetation for salinity and carbon credits, nutrient recycling and conservation trusts and agreements. However, much more needs to be done if we are to have a significant impact on resource issues in the 21st Century.

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