The Economic Value of Improving Pasture Production on Saltland in Southern Australia

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A Report of the Economics Theme
Sustainable Grazing on Saline Land Program
Land Water & Wool

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Summary

The cause of dryland salinity and the impact on the environment and agricultural productivity of agricultural land is well documented. A significant proportion of agricultural land in Australia is degraded as a result of dryland salinity and the land at risk of degradation from rising water tables is even greater. Much of the area of land affected by salinity cannot be reclaimed profitably and may have adverse consequences for neighbouring properties, reserves and waterways. Introducing production systems that are adapted to waterlogged and saline soils is likely to be the only feasible management option for these areas. Only salt land pasture is likely to be profitable at the scale required to provide a management option for the majority of land affected by salinity.

The Sustainable Grazing for Saline Land (SGSL) initiative was developed with a number of partner organisations throughout southern Australia to identify and promote profitable grazing systems on otherwise unproductive land. Six key issues were identified and research was conducted across five sites in the four southern mainland states of Australia. The broad issues researched were: salt and water movement, pasture performance, animal performance, biodiversity, additional pasture species and systems economics. Results for each research site were published in separate reports.

This paper reports the findings of the Economics Theme. The main aims of the Economics Theme were:

1. To provide assessments of the economic value of forage produce from salt-tolerant perennial pastures at each of the SGSL research sites;
2. To identify the economic constraints to the adoption of saltland pastures;
3. Understand the factors affecting the profitability of saltland pasture systems;
4. Provide estimates of the value of additional pasture supply from saltbush to identify potential areas of future research and development;
5. To update whole-farm models for each of the southern states with the latest production data for saltland pastures and livestock systems.

Mathematical programming provides a very useful method of analysis for assessing the profitability of new grazing systems and pasture species. A large number of production options can be described, in addition to the resources constraints confronting farmers. This capacity enables the whole farming system to be represented, including the interrelatedness of production enterprises, such as rotational influences on crop and pasture production and input levels. For these reasons mathematical programming models were applied to the economic analysis of SGSL data.

MIDAS is a suite of models that have been developed for a number of different regions of Western Australia, south-west Victoria and the slopes of New South Wales. MIDAS was the model of choice in for these analyses.

There were four study regions as part of this project, based in the local of research sites of the SGSL Program. These were south west Victoria, Upper South East of South Australia, the

Central Wheatbelt of Western Australia and the Central West Slopes of NSW. The analyses for each region examined the benefits of introducing improved pasture species and applying different management treatments to saltland. The effect of changing production assumptions and commodity prices on the profitability of saltland pasture were estimated. The factors examined were: pasture growth, pasture quality, wool and meat prices, area of saltland, cost of establishment, type of sheep enterprise and the presence of lucerne.

Introducing improved pasture species to salt affected land to increase the feed value for livestock is profitable across a broad range of environments, production conditions and commodity price assumptions, according the results of this study.

The extent to which farmers can achieve the increases in profit suggested by this study will depend critically on their ability to manage the livestock enterprise to achieve the production levels assumed. Pasture quality and growth were shown to have a major effect on the profitability of improved pastures. Maintaining pasture quality of perennial species requires good grazing management, as long periods of deferment will lead to substantial reductions in feed value. The models used in this study typically selected high stocking rates to increase farm profit when improved pastures on saltland were introduced. This was accompanied by increases in the amount of supplementary feeding in some cases.

It was generally the case that higher farm profit was achieved by increasing the intensity of production. This has potential implications for adoption of improved saltland pastures and consequently for extension; namely that factors that may limit the ability of farmers to increase intensity of production need to be understood and addressed if widespread adoption is likely to occur.

Introduction

Clearing of land for agriculture in Australia has been a significant factor in driving regional development since European settlement. This development has produced a range of negative impacts on the natural environment. One such problem is rising water tables and the consequent transport of stored salts to the soil surface. The cause of dryland salinity and the impact on the environment and agricultural productivity of agricultural land is well documented (see Coram *et al*, 2001, Keighery, 2000 and Kingwell *et al*, 2003). A significant proportion of agricultural land in Australia is degraded as a result of dryland salinity and the land at risk of degradation from rising water tables is even greater (Anon, 2001)

Broadly speaking, dryland salinity may be managed in three ways: prevention by reducing the drainage of water past the root zone of plants, remediation or reclamation by removing saline discharge and salts that have accumulated at or near the soil surface, and adaption which involves introducing a production system that is able to cope with the high level of salt and/or water (Pannell, 2001).

Much of the area of land affected by salinity cannot be reclaimed profitably (Coles *et al*., 1999), and may have adverse consequences for neighbouring properties, reserves and waterways. Introducing production systems that are adapted to waterlogged and saline soils is likely to be the only feasible management option for these areas.

A number of studies have reviewed the alternative uses of saline land. Options include energy generation, mineral extraction, aquaculture, forestry, horticulture and salt tolerant pastures for grazing. However only salt land pasture is likely to be profitable at the scale required to provide a management option for the majority of land affected by salinity.

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In addition, themes that were common to all sites were identified and theme projects formed. The main aim of the themes was to ensure consistency of data collection and analysis across sites where possible and provide data interpretation between sites to determine the extent to which the viability of saltland pasture is affected by the different production environments.

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Method

Farm modelling

Mathematical programming provides a very useful method of analysis for assessing the profitability of new grazing systems and pasture species. A large number of production options can be described, in addition to the resources constraints confronting farmers. This capacity enables the whole farming system to be represented, including the interrelatedness of production enterprises, such as rotational influences on crop and pasture production and input levels.

Detailed representation of the production relationships of farms makes explicit assumptions used in the analysis making them more accessible. Making the assumptions explicit enables the influence of these assumptions on the model results easier to examine. This is in contrast to many analyses undertaken using simpler approaches such as budgeting or gross margins, where many assumptions are implied.

Most importantly however, using a detailed model will provide a more realistic assessment of the impact of new technologies or changes in management on farm profit. Non-linear production relationships will often result in non-linear profit responses to changes in the farming system. This implies that the gross margin of an enterprise will often change as enterprise mix is altered. This change can be difficult to estimate using simpler methods of analysis.

For these reasons mathematical programming models were applied to the economic analysis of SGSL data.

Description of study regions

South West Victoria

Location
The trial site in this region was located near Dunkeld which is around 250 km west of Melbourne and 100 km from both the eastern and western boundaries of the designated study region. The northern and southern boundaries were determined by the 550mm and 750mm annual rainfall isohyets respectively. Reserves and major tracts of native vegetation have been excised from the map (Figure 1).

Climate
The climate can be broadly described as Mediterranean, with a cool wet growing season, where rainfall exceeds evapotranspiration and warm relatively dry summers. The study region has annual rainfall of between 550 and 650 mm, 80% of which falls in the growing season (Table 1). The break of the season is typically around late March and season finish is in early

December. Whilst summer rain is a small proportion of the total the variability is low compared with other regions of southern agricultural areas

Soils

A basalt plain is the dominant land form in the study region. Within this plain there are areas of shallow, underdeveloped soils that are infertile, while others have developed over a longer period and are more fertile supporting high levels of production. Consecutive lava flows have also interrupted drainage lines, so much of the plain is poorly drained and subject to water logging and inundation. In some areas salinity levels also limit the production of many agricultural plants species.

Sedimentary soils formed by marine deposition make up a smaller proportion of the region, . These are older soils and typically low in fertility with a sandy top soil and heavier subsoil. Old lake beds contain heavy clay soils included cracking clays. These are often sodic and poorly drained.

Main Enterprises

Sheep meat and wool is the dominant enterprise. Livestock are grazed on productive mixed pastures of mixed perennial and annual species. Sheep farmers often sow a small proportion of the farm to crop for feed grain. Dairy and beef enterprises are important to regional economies but only a minor in terms of total area in the study region shown in Figure 1. Cropping, horticulture, forestry and viticulture are also minor enterprises.

Table 1: Comparative production and climate characteristics of study regions

	SW Vic	Upper SE SA	Central Wheatbelt	Central West NSW
Annual RF (mm)	700	450	350	600
Growing season RF (%)	80%	70%	80%	50%
Summer RF variability	moderate	moderate	Extreme	Mod – High
Crop area (%)	<10%	<10%	50-60%	<50%
Ave stocking rate (est.)	11-13	6-7	4-5	8-10
Season break	Late March	Early May	Early May	Early April
Season finish	Early Dec	Early Nov	Early Oct	Late Nov

Upper South East of SA

Location

The study region is part of the Upper South East of South Australia. It is about 200 km from Adelaide and bounded in the east by the towns of Keith and Naracoorte and the coast in the west. The region lies south of the 450 mm annual rainfall isohyet and just to the north of the 650 mm rainfall isohyet (Figure 2).

Climate

The climate of the Upper South East is broadly similar to south west Victoria. Winter is wet and cool while summers are hot. However this region has lower annual rainfall compared to SW Victoria (Table 1), with a later season break in early May and an earlier finish, in early November. This limits production levels and livestock carrying capacities of farms are therefore lower. Average daily maximum temperatures are 2-3 degrees warmer all year round. The variability of rainfall, as measured by the Bureau of Meteorology index, is slight higher compared to SW Victoria between December to April.

Soils

Soils are predominately sandy overlying clay and a limestone that slopes gently westward. They are typically low in natural fertility and were only cleared within the past 60 years when trace elements were identified as a major factor limiting productivity. Drainage of these soils was generally limited by the slight gradient to the coast and a series of dune systems that run parallel to the coast. Large areas of land are subject to waterlogging and dryland salinity, although the majority of affected land has low salinity. In recent times a network of drainage canals was constructed, but large areas of land remain affected by high water tables.

Main enterprises

Wool production is the dominant enterprise in the region, while beef and dairy production is the focus for a minority of businesses. Intensive cropping is practiced in some areas. Horticulture is a major enterprise in terms of value, particularly wine grape production.

Pastures consist and a mix of perennial and annual species. Lucerne is typically grown on the deeper soils while other perennial species such as tall whet grass is recommended for the shallow soils less affected by waterlogging and salinity.

Central Wheatbelt of WA

Location

This study region is part of the Central Wheatbelt just over 100 km east of Perth. It is comprised of the Corrigin, Quairading and Dowerin Shires. The 350 mm rainfall isohyet runs through the centre of the regions.

Climate

The Central Wheatbelt of WA has a broadly similar climate to the regions in SA and Victoria. However the average annual rainfall is lower (Table 1) and less than 20% of this falls outside the growing season. Rainfall over the summer is also much more variable compared to the Upper South East of SA and SW Victoria. The summer maximum daily temperature during summer is over 30 degrees celsius on average which is around 10 degrees higher compared to south western Victoria. The growing season is also much shorter compared to study regions in the east (Table 1).

Soils

There is a large variation in soils of the region. They have been developing on an ancient landscape, resulting in highly weathered, highly leached, infertile, coarse textured soils with poor structure. Heavier more fertile soils have developed in lower parts of the dissected landscape. Farms are heterogenous in terms of the mix of soils, with eight main land management units described for the typical farm for the region.

Main enterprises

Mixed crop-livestock farms make up the majority of farm businesses. The average crop area is between 50-60% although this is varies significantly depending on the mix of soils on each farm and farmer preference. The major crops grown in the region include wheat, barley, lupins and canola. Sheep are the dominant livestock which are grazed mainly on annual pasture, although a small area of perennial species are grown. Wool production makes up the majority of the sheep enterprise, by value of production, although prime lamb production has increased in recent years as a result of improved prices.

Central West Slopes of New South Wales

Location

The Central West slopes is around 250 km from the NSW coast It covers the western slopes of the Lachlan and Macquarie River catchments. It is bounded by the 700 mm rainfall isohyet and the 400 metre altitude contour. Boorowa lies in the south of the region while Wellington lies in the north.

Climate

The region has a temperate climate with average annual rainfall of around 600mm. Rainfall is spread evenly throughout the year although it is slightly summer dominant in the north and slightly winter dominant in the south. Rainfall is more variable in the warmer months compared to the SA and Victorian study regions (Table 1), where storms develop along low pressure troughs fed by moist tropical air. Winter rainfall is less variable and typically precedes frontal systems that develop to the south of the continent. The Central West Slopes has a relatively long growing season compared to the SA and WA regions, typically starting in early Arpil and finishing in November (Table 1).

Soils

The region is comprised of complex geological formations that have had a marked influence on the formation of the soils. The soils are largely derived from the bedrock material that is predominantly granitic with some sedimentary parent material. Volcanic intrusions are interspersed within the older more weathered material, leading to a broad range of soils with differing characteristics, from weak, naturally acidic and sodic soils to more robust, fertile soils. The region is typically undulating and on many properties slope of the land has a significant influence on land use.

Main Enterprises

This is a traditional wool growing area where livestock is the dominate enterprise in the mixed enterprise farms of the region. During the mid 1990's the majority of land was under pasture, with around 30% of the total area under crop in the north of the region and less than 10% in the south. There has more recently been a shift toward cropping but more than half of the total agricultural area remains under pasture. Whilst relative prices have an influence on the balance of crop and pasture soil limitations are the dominate factor, thus limiting the extent of the expansion of cropping.

Implications for management

The difference in climate between the regions has important implications for livestock production, particularly in the Central Wheatbelt. Firstly, perennial species are generally less successful in environments with shorter growing seasons and where summer rainfall is low and variability high. Secondly, shorter growing seasons demand that livestock be carried for longer on dry feed. Hence the cost of supplementary feeding is higher or the carrying capacity for livestock is more limited. Optimum stocking rates are therefore be much lower in the Central Wheatbelt and hence the value of saltland pasture is likely to much lower. Farms in the Central West Slopes of NSW on the other hand have higher carrying capacities because there is more uniform annual average rainfall. This provides a longer growing season and enables summer active perennials to thrive. There is a potential trade-off however, as the economic viability of salt tolerant perennials will depend on the extent to which they compete with other perennials such as lucerne. The viability of salt tolerant pasture will depend critically on the extent of utilisation by livestock. This will be affected by the supply of other feed sources and the extent to which they limit stocking rates.

Description of representative farm model

MIDAS is a suite of models that have been developed for a number of different regions of Western Australia (Blennerhasset & Bathgate, 2000; Morrison *et al.*, 1986; Morrison & Young, 1991), south-west Victoria (Thompson & Young, 2000) and the slopes of New South Wales (Bathgate & Hoque, In Progress). A full description of the model can be found in Kingwell and Pannell (1987).

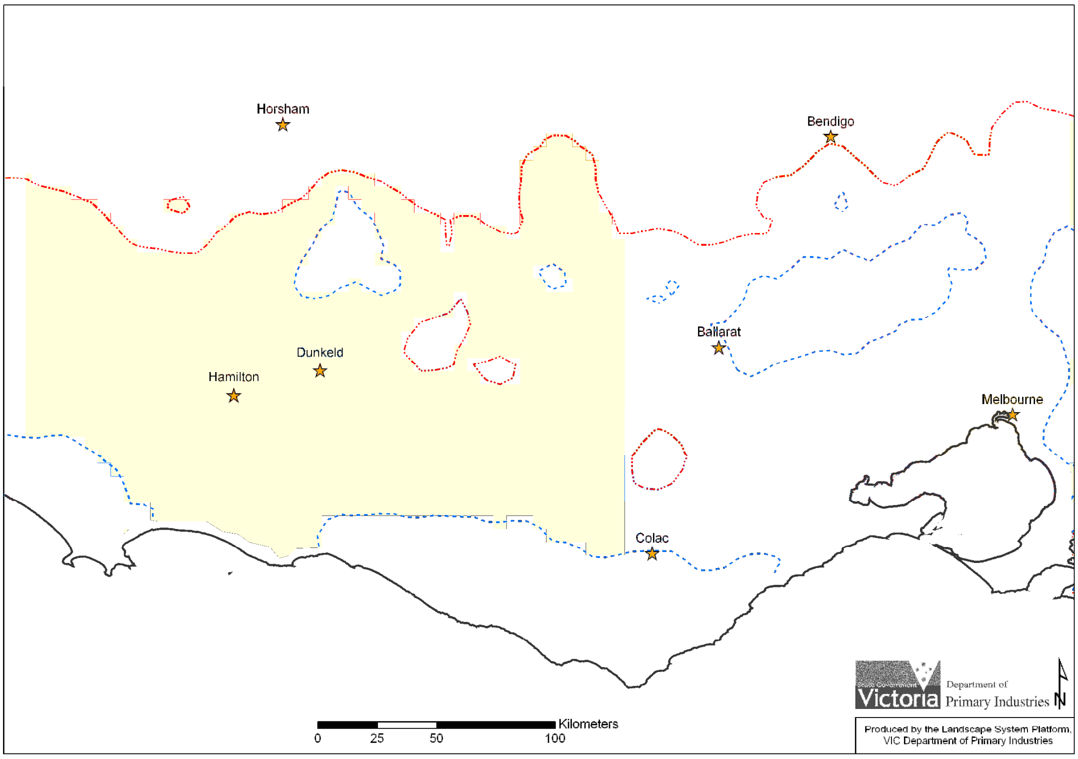

Figure 1: 'Footprint' of the Dunkeld Model for South Western Victoria.