Getting cold and prickly on saltland extension

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Abstract. This paper reflects on the methods, outcomes and learnings from an institutionally-driven analysis that aims to determine whether and where to further invest in saltland pastures from an economic and environmental perspective. The analysis showed that following a five year proactive and targeted extension strategy operating on the south coast region resulted in a 5 per cent increase in the area of adoption of saltland pastures. In this example an additional economic value to the region is $11.6 million over a 18 year period.

Introduction

Since 2002, saltland management research and extension activity has increased considerably in Western Australia, particularly through the Sustainable Grazing on Saline Lands (SGSL) program and the additional partners involved with the Cooperative Research Centre for Plant Based Management of Dryland Salinity, the Department of Agriculture and Food of WA (DAFWA), the WA Chemistry Centre and the Saltland Pastures Association Inc. The SGSL research reported important economic and environmental benefits from saltland pastures which prompted DAFWA to undertake this analysis. DAFWA sought this information to help guide decisions on future investment.

Summary of method

Three key tools have been used in the analysis process:

- Land Monitor with the saltland capability which allowed proofing of the remote sensed spatial data enabling some financial return estimates to be calculated on the total areas of the various classes of saltland across the agricultural regions. This specifically entailed comparative analysis across whole farm systems between the total costs of continuing to crop below break-even areas with the total benefits of changing to perennial based grazing options where salinity has been identified as a hazard (yield constraint). In this way the more severely saline areas of land are more easily delineated and the recommendations are for these to be set-aside from grazing use and revegetated primarily for the ecosystem services.
- Whole farm analysis derivatives of the Model of an Integrated Dryland Agricultural System (MIDAS) were used as part of the SGSL research in WA. From this it was concluded that the increased profits, $40 to $174 per hectare (Table 1), resulted from better management of saltland including the introduction of improved saltland pasture species. The improved pastures on the moderately saline soils are saltbush and/or good quality understory of perennial and annual pasture species of grasses and legumes. This whole farm analysis incorporated these saltland pasture options with known spatial data of land with moderate salinity hazard and was used as a tool for prioritising extension investment at a regional and state level. It provides a basis for decision-making on where in the landscape and how much to invest for improving economic returns on farms.

  Running this analysis process, in an interactive manner, has already resulted in some initial prioritisation on the south coast of WA. In this region the Pallinup North Stirling and Gillamii area would have high rates of economic return on investment of future extension resources to improve management of saline land. Coincidently the area also scores highly when the environmental asset considerations are applied using the Salinity Investment Framework analysis.

- Salinity Investment Framework (SIF) is a process to create a robust methodology for prioritised, targeted investment across asset classes to protect highly-valued assets threatened by dryland salinity. SIF uses a decision-making process for assigning public funds which is open, transparent, accountable, transferable and in particular, cost-effective. As a result drawing from the SIF analysis enabled consideration to be given to the requirements for investing in adaptation management techniques that both protect private and public assets (land, water resources, biodiversity, and rural infrastructure) and provide ecosystem services.

  Accordingly the exercise of mapping salinity using Land Monitor salinity classes integrated with the results of the SIF assessments greatly enhanced the prioritisation process for future investment. These SIF assessments were based on salinity's current and forecast impact on the land, water resources, biodiversity, and rural infrastructure.

Results

Valuing saltland pasture

The economic analysis used MIDAS which is a steady-state, whole-farm, mathematical programming optimization model that describes the physical, biological and managerial aspects of a typical broadacre cropping and livestock farming system in the four regions of Western Australia (O'Connell et al. 2006). These studies have estimated the net benefits of saltland in different zones of the WA agricultural region. All studies have shown that there are potential economic benefits to farmers from improving saltland pasture. However profitability has been shown to depend on a number of critical factors. The most important factor has consistently been shown to be pasture quality. Where pasture quality is not maintained the benefits of saltand decline dramatically with a significant impact on profitability. MIDAS modeling identifies site selection, establishment and the management as critical factors for the profitability of saltland (Bathgate et al. 2007).

Estimates of the value of saltland pasture based on several key studies (Bathgate et al, 2007) are positive assuming cereal prices of around $200 per ton. In the example in Table 1 these prices were scaled up by 40 per cent to reflect current cereal prices. As supplementary feeding with grain is used as an alternative to saltland pastures grain price also influences profitability. A key result of this analysis concluded that the value of saltland pasture increases by 20 per cent for every 25 per cent increase in grain prices.

Table 1. Effect of grain prices on value of saltland pasture in the three rainfall zones

Region	Benefit ($/ha) (with cereals at $200/t)	Benefit ($/ha) using 2008 prices (cereals $280/t)
Low rainfall <400mm	40	56
Medium rainfall (400-600mm)	60	98
High rainfall (>600mm)	105	174

Issues to consider

- The area of land in each category of saltland, where a category is defined by the crop yield is important because this affects the production forgone when saltland pasture is established, and therefore the net benefit of saltland pasture.
- As expected grain prices have a big influence on the profitability of saltland pasture future price outlooks will influence judgments about the merits of saltland pasture.
- Although establishment costs in different (sub) regions may vary depending on infrastructure required they have a relatively small influence on the net benefits. They can however, have a large influence on level of adoption achieved.

The sensitivity analysis associated with MIDAS encourages practitioners and funders to debate a set of adoption targets for a given area based on the physical, biological (enterprise mix) and managerial aspects of the farms in the target area and in the light of externalities such as farm commodity prices and costs associated with supplementary feeding livestock.

Valuing extension

The benefits from a 5 year saltland pastures adoption project begin after the project has finished with the benefit cost ratio (BCR) resulting for each region being positive. Table 2 represents a modest BCR for the south coast region.

Table 2. Benefit cost ratio example using estimated areas of moderate salinity hazard taken from the medium rainfall zone of the South Coast of WA

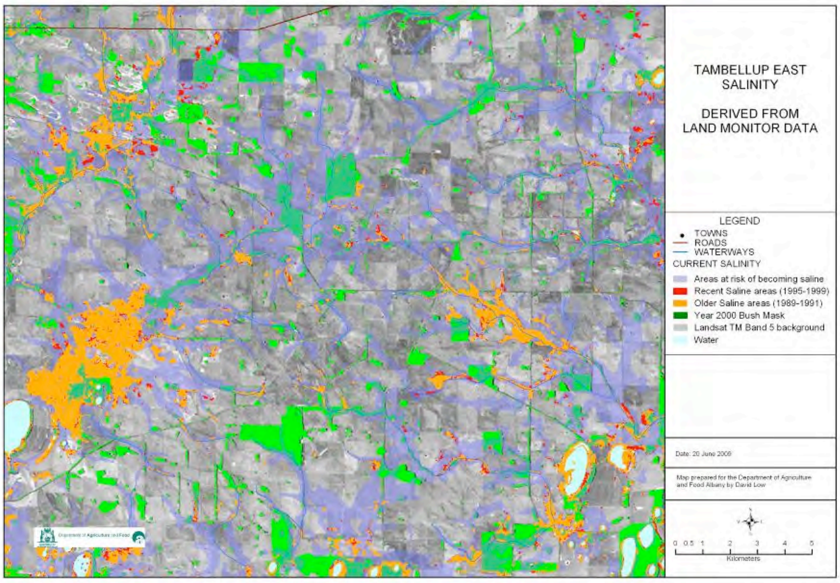
Adoption – Medium rainfall in the South Coast region of WA		
Adoption measures	With targeted project completed in 2013	Without targeted project
Adoption Commence	2014	2000
Adoption peak	2022	2032
Benefits curtailed	2032	2032
Per hectare benefits	$100	$100
Potential area hectares	459,647	459,647
Area of adoption	68,947	45,966
% Adoption	15%	10%
Benefit Cost Ratio		8.2
Net Present Value		$11,590,621
Internal Rate of Return		14%

Spatial distribution of salinity

Land Monitor (McFarlane et al. 2004) provides highly accurate digital elevation models (DEMs; with accuracy to within one or two metres in elevation) combined with mapped and monitored changes in the area of salt-affected land from 1988. Land Monitor also allows for predicted areas with a hazard of future salinity and has provided a process for distribution of this information to the end-users and the community (Figure 1). The one metre Area of Height Above Valley Floor (AHAVF) from Land Monitor has been used to determine the upper limit of 'moderate hazard' of future saltland and is a potential indicator for fence location for grazing management.

The focus on moderate hazard land is a direct result of the conclusion drawn from the SGSL research and economic analysis (Bathgate et al. 2007) where the largest increase in farm profit consistently comes from establishing saltland pasture on moderately affected saline soils. That is, land too saline to produce profitable annual pastures by themselves, but not so saline as to severely impact on production from the saltland pasture systems. Selection of moderate hazard land for saltland pastures is a profitable system. Paddock confirmation can be achieved by using the standardizing techniques for describing the level of salinity in soils in Australia (Bennett and Barrett-Lennard 2008) that is for 'Moderate Hazard' the sub-surface soil salinity is in the 4-8 dS/m ECe range and is also reflected by the growth of key indicator plant species that grow on the site.

Figure 1. A map of the Land Monitor product used for communicating with end-users and the community.



This example is from the eastern portion of the Tambellup Shire, a priority area for the south coast and central to a community driven saltland adoption initiative underway

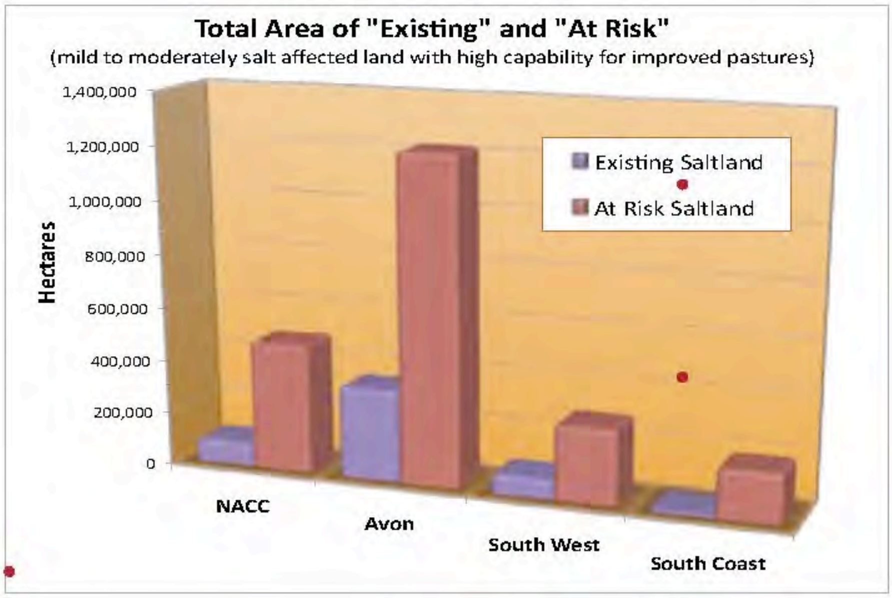
Land Monitor data analysis excluded remnant vegetation from farmland and all reserves and public estate with the aim to only measure saltland on existing cleared farmland (Table 3).

Table 3. A statewide summary of the agricultural based Salinity Investment Framework (SIF 2003). Defined by subtraction of total shire area and area of hazard.

Asset Class SW Total area 26,511,000 hectares Agricultural land 18, 790,000 hectares		
	Current salinity (1996)	Hazard Area (<2.0 m class)
Shires agricultural land ha (%)	1,047,000 (5.6%)	5,428,000 (29%)
Agricultural land ha	821,000 (4.4%)	4,408,000 (23%)

The total area of saltland capable of supporting profitable saltland pastures in WA has been calculated to be 20 per cent of current moderately affected (ECe range of 4-8 dS/m) saltland that has the potential to be improved for profitable grazing as well as the total salinity hazard area. However due to the variability of saltland at a paddock scale it often does not fit this 20:80 rule however at the catchment scale the rule will apply and can be a good guide for making on-ground fencing decisions. Land monitor has been interpreted such that where the moderately saline hazard area is not treated with saltland management practices the soil salinity will progressively get worse and eventually become too saline for profitable grazing.

Figure 2. Summary of Land Monitor assessments of total current and hazard (risk) saltland areas and their distribution across the four regions in South West of WA



Valuing ecosystem services

Impacts of salinity include the loss of topsoil, deterioration of soil due to lowered organic matter and increased sodicity of clay (leading to gully erosion), exacerbation of flooding from soils with high water tables, deterioration of roads, buildings, fences, and town infrastructure and salinisation of water resources (Bowman and Ruprecht 2000). Based on these, (George et al. 2004) concluded that, with predicted two to four-fold increase in area of wheatbelt land with shallow watertables, there will be at least a two-fold increase in flood flows. In addition 50 percent of groundwater bores in the wheatbelt of WA have extreme acidity (Lillicrap and George 2009) posing a significant threat to plant cover and subsequent down stream water bodies.

Therefore saltland revegetation offers a significant and vital contribution to the protection of the 50 per cent of the 1922 taxa unique to the WA wheatbelt that has been identified and classed as threatened by the Salinity Action Plan (SAP) biological survey of wheatbelt valley floors and wetlands (Keighery 2000). As a result the SIF analysis has identified some high priority salt affected areas as significant assets with several key natural saline lake systems in the wheatbelt being specifically named. In addition roads, railways and 38 key rural towns are significantly being impacted by salinity (George et al. 2005).

Saltland pastures and revegetation have an important role for the large scale improvement of saltland conditions (on-site) and for subsequent delay or abatement of further downstream degradation processes (George et al. 2004). This is a strong case for increasing vegetative cover in the broad valley floors of the wheatbelt.

Conclusions

- MIDAS analysis suggests that a targeted, sustained investment in an extension program over a five year duration with a modest level of adoption spread over eighteen years will result in a Benefit Cost Ratio of 8.2 and a Net Present Value of $11,590,000. This example was applied to the areas of moderate salinity hazard of the medium rainfall zone (400 – 600mm) on the south coast of WA.
- Land Monitor data in conjunction with local knowledge on saltland capability is an effective tool for identifying and prioritising geographic areas for investment in extension where positive economic and environmental outcomes can be achieved. For example the process of integrating the whole farm analysis data where saltland options were included with the spatial data on the south coast region identified the Gillamii/Pallinup North Stirling sub-region as a priority. The community in this area have responded proactively and have instigated a new three year extension project.
- When the land identified as having the potential to become moderately salt affected is fully realised, the cost to the grain industry is estimated at $425 million per annum.

Conversely the rewards of adopting grazing systems on this land where the salinity hazard is fully realised are estimated at $236 million per annum for the WA agriculture sector.

The establishment of perennial based systems on land with salinity hazard contributes positively to the environment as well. The fencing and management requirements also provide an opportunity for a saltland set-aside program to be introduced on the highly affected saline soils of low productivity which deliver only modest gains in profit at best, when saltland pastures are introduced to them.

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