

final report

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Sustainable Grazing on Saline Lands

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Sustainable Grazing on Saline Lands



Sustainable Grazing on Saline Lands (SGSL)



Dryland salinity is recognised as one of the major risks to agriculture and the natural environment in the high to medium rainfall zones of Australia. Forty-one per cent of the nation's woolgrowers indicate they already have land affected by dryland salinity* and it is estimated that many other landscapes used for wool production are under increased risk.

Grazing is one of the few activities that can make productive and profitable use of saline land, and also reduce the negative impacts on the environment, and on property owners and managers. The SGSL sub-program is helping woolgrowers better understand and manage their saline land through a range of activities.

These SGSL activities and projects are achieving:

1. Improved production and profit from grazing saline land;
2. Better environmental outcomes from saline land; and
3. More pride for producers who are proactively changing their management systems to tackle saline land on their properties.

SGSL is the largest of the seven sub-programs in Land Water & Wool, managing \$15.3 million in research and capacity building over five years. SGSL receives additional financial and in-kind support from Meat & Livestock Australia, the Cooperative Research Centre for Plant-based Management of Dryland Salinity, CSIRO and State agencies in Western Australia, South Australia, Victoria, Tasmania and New South Wales.

Alongside the five national research projects, SGSL also uniquely supports 120 local producer network demonstration sites in partnership with woolgrower groups across WA, SA, Victoria, Tasmania and NSW.

Sub-Program Coordinator

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*Land, Water & Wool Best Practice Survey 2003

Land, Water & Wool Sustainable Grazing on Saline Lands sub-program partners include:



Sustainable Grazing on Saline Lands (SGSL)



SGSL National Research Projects

SGSL has five national research projects across southern Australia. These projects are developing strong scientific evidence regarding ways to establish and maintain productive and sustainable saltland pasture systems.

PROFITABLE AND SUSTAINABLE GRAZING ON SALINE LAND IN WESTERN AUSTRALIA

Project: UWA29 Location: Western Australia

Project Leader

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Overview

The focus of *Profitable and sustainable grazing on saline land in WA* is to evaluate the gains in animal production, water management and biodiversity in saltbush-based pastures as a result of the introduction of new plant species and better management systems. The sites are located in the WA wheatbelt near Tammin and Yealering.

OPTIMISING THE SALT LAND PASTURE SYSTEM FOR PRACTICAL AND PROFITABLE USE

Project: UWA33 Location: Western Australia

Project Leader

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Overview

Optimising the saltland pasture system for practical and profitable use concentrates on the practical implementation and optimisation of saltbush and understorey systems to provide the most effective inputs into livestock production systems.

Sustainable Grazing on Saline Lands (SGSL)



The focus is on whole farming systems, aiming to lower water tables and boost production from a wasted resource while at the same time increasing profitability. Several sites are located in the WA wheatbelt, with a further site at Grong Grong in southern NSW.

PRODUCTIVE AND SUSTAINABLE SALT-TOLERANT PASTURES FOR SOUTH AUSTRALIA

Project: UWA30 Location: South Australia

Project Leader

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Overview

Saltland pastures in the upper south east of SA are largely dominated by puccinellia. The project *Productive and sustainable salt-tolerant pastures for South Australia* focuses on improving the productivity of puccinellia and other complementary saltland pastures through grazing management, fertiliser strategies and different species mixtures.

The research sites are located near Mt Charles in the Upper South East. Early evidence is emerging of substantial improvements in the pastures leading to high confidence of animal production benefits.

PRODUCTIVE AND SUSTAINABLE SALT-TOLERANT PASTURES FOR VICTORIA

Project: UWA30 Location: Victoria

Project Leader

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Sustainable Grazing on Saline Lands (SGSL)



Overview

Closely aligned with the South Australian project, *Productive and sustainable salt-tolerant pastures for Victoria* focuses on improving the productivity of saltland pastures. The primary focus is on the high rainfall, tall wheat grass-based pastures used on moderately saline land in Victoria with additional effort directed towards legume improvement, weed management and different pasture species options. The site is located at Dunkeld in the Western District of Victoria.

The first season's results have been very promising – despite it being one of the wettest winters in about 10 years, some clovers have shown production of almost 10 tonnes of dry matter per hectare, which is equivalent to district standards from pasture on non-saline ground.

WATER SOIL AND SALT MOVEMENT FROM SUSTAINABLE SALT-TOLERANT PASTURES

Project: UWA32 Location: New South Wales

Project Leader

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Overview

The focus of the project *Water, soil and salt movement from sustainable salt-tolerant pastures* is on the movement of water soil, salt and nutrients from saline discharge sites to waterways, and the impact on these flows by productive saltland pastures. The main research sites are located near Young in the Upper Lachlan catchment and Manildra in the Macquarie catchment.

Sustainable Grazing on Saline Lands (SGSL)



Producer Network Projects

In addition to its National Research Projects, SGSL is encouraging and assisting producer groups across Australia to undertake their own, local research.

SGSL is currently supporting 120 local producer projects nationally over the five years of the program after which time the results of the projects will be collected and made available to woolgrowers throughout the country.

WA GROWER NETWORK PROJECT

The WA grower network is chaired by Fionnuala Hannon and is supporting nearly 70 grower sites.

For further information relating to grower network projects in WA please contact:

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 Department of Agriculture WA
 T 08 9892 8408
 E jhardy@agric.wa.gov.au



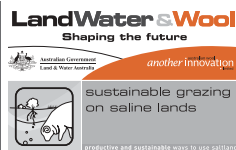
| PROJECT TITLE | GROUP NAME | LOCATION |
|--|--|-------------|
| Establishment of salt-tolerant species | Mingenew Irwin Group | Mingenew |
| Maximising perennial grass production on L2 saline land | Liebe Group | Wubin |
| Integrating perennial and annual pasture research into a saltland grazing system | Fitzgerald Biosphere Group | Fitzgerald |
| Raised bed establishment of pastures and crops on saline land | Evergreen Group | Badgingarra |
| Extend balansa persistence through sustainable grazing | West Arthur LCDC | Darkan |
| Water use of lucerne and saltbush | Tin Dog Creek Catchment Group | Dowerin |
| Production and pasture quality of NyPa Forage™ grass <i>Distichlis spicata</i> | Facey Group | Wickepin |
| Increase productivity and reduce water tables on saline land | Moora-Miling Pasture Improvement Group (2 sites) | Moora |
| Finishing prime lambs in autumn on saltland | Yerecoin-Plawanning LCDC | Yerecoin |
| Saltland pasture research in Mukinbudin | Ningham Farm Focus Group (2 sites) | Mukinbudin |

Sustainable Grazing on Saline Lands (SGSL)



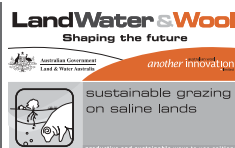
| PROJECT TITLE | GROUP NAME | LOCATION |
|--|---|----------------|
| Integrating saline pastures into future farming systems | WANTFA Farming Systems | Meckering |
| Sub-tropical grasses on South Coast sandplain | Jerdacuttup Grazing Group | Jerdacuttup |
| Establishment and plant persistence in a saline affected area | Ballidu Woolpro Group | Ballidu |
| Establishing salt-tolerant grasses on salt scald | West Gillingarra Koojan LCDC | Gillingarra |
| Trial and demonstration of saltland pastures | Yilgarn LCDC | Southern Cross |
| Establishing perennial pastures on saline land | Yeelanna Catchment Group | Trayning |
| Pasture establishment and management on saline soils | Gorge Rock Salties (3 sites) | Corrigin |
| Do cattle have a place in the wheatbelt? | South Trayning Catchment Group | Trayning |
| Establishing perennial pastures on saline land | Morawa Farm Improvement Group | Morawa |
| Regrowth and graze saline land | Koorda LCDC | Koorda |
| Environmental changes to revegetated saline land | Hamilla Hill Catchment Group | Cranbrook |
| Effects of acacia saligna on mildly saline land | Hamilla Hill Catchment Group | Cranbrook |
| Establishment of rotational grazing systems on saltland | Tambellup Noongar Land Association | Tambellup |
| Productive use of saline land in Forest Hill | Upper Hay Sub-catchment group | Mt Barker |
| Trial of salt-tolerant pastures | Lake Matilda Sub-catchment group | Mt Barker |
| Nutritional value of saltland pastures | Range Road Catchment Group | Pingrup |
| Manipulation of soil ameliorates and fertilisers to optimise production of saline land | Lake Toolbrunup Catchment group (2 sites) | Tambellup |
| Increasing livestock production using saltbush and supplements | Nairibin Saltland Enhancement Group | Dumbleyung |
| Phase farming on valley floors | Facey Group | Wickepin |
| Boosting propagation and productivity of saltbush | South Yoting Catchment Group Inc. | Quairading |
| Kunjin Woolpro Group | Kunjin Woolpro Group | Corrigin |
| Dwarlaking to Avon – riverline saltland grazing | Bulyee Catchment Group | Corrigin |
| Jubuk-Kunjin-Wogerlin Alliance – saltland cereals and grazing | Jubuk-Wogerlin Alliance | Corrigin |
| Kurrenkutten Lakes sustainable saltland forage and pasture | Kurrenkutten Lakes | Corrigin |

Sustainable Grazing on Saline Lands (SGSL)



| PROJECT TITLE | GROUP NAME | LOCATION |
|--|--|-------------------|
| Bullaring Valley saline clay-flats forage and pastures | Bullaring Valley Flatties | Corrigin |
| CCCG saltbush productivity on saline land trail | Conallan Creek Catchment Group | Quairading |
| Linking biodiversity to saline land productivity | Narogin LCDC/Normans Lake Catchment Group | Narogin |
| Profitable grazing whilst alleviating salinity | Morbinning Catchment Group | Morbinning |
| Continual verses mixed grazing of lucerne | Yerapin Catchment Group | Bruce Rock |
| Use of spinner drain to control surface waterlogging | East Woop Woop | Boyup Brook |
| Achieving profitable grazing off saline land through forage shrubs, perennial grasses and balansa clover | Jinkas Hill LCDC | Badgebup |
| Reduce watertables by increasing saltland production | Cunderdin Hill West Catchment Group | Cunderdin |
| Pindellup DIY saltland to clover grazing trial | Pindellup Catchment Group | Tambellup |
| Tie Line salt grazing trial | Murdong Pools | Broomehill |
| Upper Slab Hut holistic grazing | Upper Slab Hut Catchment Group | Tambellup |
| Incorporating raised beds and perennial pastures on saline area | Camel Lake Sub-Catchment Group | Tambellup |
| Evaluate perennial pastures for saline land in West Cranbrook (600 mm) | Kojonup LCDC – Ryans Brook Catchment | Kojonup/Cranbrook |
| Stocking rate trial on puccinellia and tall wheat grass and sub tropicals (grasses) | Katanning Creek Catchment | Katanning |
| Improvement of sodic subsoil for pasture | Beaufort Flats (Sodic soils project) | Woodaniling |
| Sustainable perennial pastures in the Mullewa Shire | Woogoondy Farm Improvement group | Mullewa |
| Perennial pasture species and production trial | Beaufort Flats (perennials) | Woodaniling |
| Establish grazing on salt scalds using cambered beds | Gorge Rock Salties | Corrigin |
| Rehabilitation of pastures on degraded flats | Beaufort Flats | Woodaniling |
| Establishment of perennial salt-tolerant species in low rainfall areas | Ravensthorpe Agricultural Initiative Network | Ravensthorpe |
| Saltbush density effects on understorey growth | South Yarding Catchment Group | Bruce Rock |
| Evaluate saline pasture production in Kojonup | Kojonup LCDC – Lower 54 Creek Catchment | Kojonup |

Sustainable Grazing on Saline Lands (SGSL)



| PROJECT TITLE | GROUP NAME | LOCATION |
|---|----------------------------------|-------------|
| Establishing perennials to prevent waterlogging and salinity | Koojan-Gillingarra LCDC | Gillingarra |
| Amelioration of saline lands with feed mill by-products (oat husks) | Wagin LCDC | Wagin |
| Linking biodiversity and raised beds on saline land | Solomon Yulgan Catchment Group | Bolgart |
| Compare effects of raised bed techniques | Tambellup LCDC | Tambellup |
| Extending saline land green feed production | Narrogin LCDC | Narrogin |
| Comparing the effects of liming on saltland pastures | Hommajelly Creek Catchment Group | Quairading |
| Annual and perennial productivity pasture species for Wandering | Wandering Productivity Group | Wandering |
| Reclaiming saline valley floor in 300 – 350 mm rainfall zone | Woodabulling Catchment Group | Yealering |

SA GROWER NETWORK PROJECT

The SA grower network committee is chaired by Bruce Munday and is supporting 15 grower sites.

For further information relating to Producer Network projects in SA please contact:

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Rural Solutions SA

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| PROJECT TITLE | GROUP NAME | LOCATION |
|--|--|-----------------|
| Weed management to improve production from grazing puccinellia | Coorong and District Soil Conservation Board Bunbury, Upper South East | Coorong |
| Grazing management of tall wheatgrass and fertilizer responses in saltland grasses | Kingston Salinity Group Kingston, Upper South East | Kingston |
| Comparison of pasture production and feed quality from puccinellia and tall wheatgrass with different applications of conventional and alternative fertilisers | Mt Charles Farm Management Group Mt Charles, Upper South East | Mt Charles |
| The nutritional requirements for livestock production grazing saltland pastures | Saltland PPP Group Mt Charles, Upper South East | Mt Charles |
| Rotational grazing and efficient fertilizing of puccinellia and tall wheatgrass to optimise productivity | Kangaroo Island Soil Conservation Board Murray's Lagoon, Kangaroo Island | Kangaroo Island |

Sustainable Grazing on Saline Lands (SGSL)



| PROJECT TITLE | GROUP NAME | LOCATION |
|---|---|-----------------|
| The practical application of raised beds in grazing systems | Kangaroo Island Soil Conservation Board Kangaroo Island | Kangaroo Island |
| Establishment techniques for saltbush, puccinellia and balansa clover | Tumby Bay Agricultural Bureau Tumby Bay, Eyre Peninsula | Tumby Bay |
| Establishment and evaluation of pasture between narrow spaced rows of existing stands of saltbush | Wadikee Agricultural Bureau Kimba, Eyre Peninsula | Kimba |
| Modifying existing saltbush stands to establish inter-row pasture species | Waddikee/Balumbah Catchment Salinity Management Group Waddikee, Eyre Peninsula | Waddikee |
| Establishment and evaluation of pasture between wide spaced rows of existing stands of saltbush | Northern Stokes Landcare Group Ungarra, Eyre Peninsula | Ungarra |
| Establishment and management of saltbush and pasture on a jumbled land system | Kapinnie Landcare Group Kapinnie, Eyre Peninsula | Kapinnie |
| Improved pasture and livestock production on saline land | Southern Yorke Peninsula Alkaline Soils Group Minlaton, Yorke Peninsula | Minlaton |
| Making the most of strawberry clover on saltland – improving pasture productivity on saline seepage areas | Tungkillo Landcare Group Mount Lofty Ranges | Tungkillo |
| Economic analysis of established grazing systems on saline land | Hummocks Soil Conservation Board Clare | Clare |
| The economics of renovating samphire paddocks with puccinellia pasture | Tumby Bay Agricultural Bureau Eyre Peninsula | Tumby Bay |

VICTORIA AND TASMANIA SUSTAINABLE GRAZING FROM SALINE LAND GROWER NETWORK PROJECTS

The Victorian grower network committee is chaired by Christine Forster and is supporting 16 grower sites.

For further information relating to Producer Network projects in Victoria and Tasmania please contact:

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 E trevor.pollard@dpi.vic.gov.au



Sustainable Grazing on Saline Lands (SGSL)



| PROJECT TITLE | GROUP NAME | LOCATION |
|--|---|----------------------|
| Quantifying salinity discharge treatment impacts in the WY Catchment – Pittong site. | Woody Yallock Catchment Group Inc. Group 1 | Pittong/ Ballarat |
| 'Spiny Rush' control demonstration site – Pittong site | Woody Yallock Catchment Group Inc. Group 1 | Pittong/ Ballarat |
| Quantifying salinity discharge treatment impacts in the WY Catchment – Mt. Mercer site | Woody Yallock Catchment Group Inc. Group 3 | Mt Mercer/ Ballarat |
| Comparison of lucerne and salt-tolerant pasture species on saline land | Jallukar Landcare Group | Ararat |
| Saline pasture systems for profit: cell grazing vs set stocking. | ARMAG Group | Kerang |
| Bengworden salinity pasture trial | Bengworden Landcare Group | Barinsdale |
| Evaluating pasture species suitable for saline land in the Whiteheads Creek Catchment | Whiteheads Creek | Seymour |
| Investigating environmental and agricultural benefits of grazing salt tolerant vegetation. | Murdeduke | Winchelsea |
| Agronomic/grazing potential/ water table benefits of growing saltbush on saline land | Bairnsdale Bestwool Group | Barinsdale |
| Implementing saline pasture species results from test-plots to grazing trials | Yarram Salinity Group | Yarram |
| Assessing productive options for saline land in South Eastern Tasmania | Little Swanport Catchment Management Implementation Committee | Little Swanport, Tas |
| Wetland restoration and rotational grazing in high salinity area | Northeast Coast Landcare Group | Bridport, Tas |
| Cross bred sheep weight gains on saline tolerant pasture and fodder species | Upper Derwent Valley Landcare Network | Hamilton, Tas |
| Saltbush vs normal grazing productivity differences in sheep and goats | Hindmarsh Landcare Network | Hindmarsh |
| Investigation of tall wheat grass management techniques on saline land and collation of objective data | Hamilton Landcare Group | Hamilton |
| Raising salt bush productivity on saline sites | Sheep Pen Creek Landcare Group | Caniambo |

Sustainable Grazing on Saline Lands (SGSL)



NSW SUSTAINABLE GRAZING FROM SALINE LAND GROWER NETWORK PROJECTS

The NSW grower network committee is chaired by John Powell and is supporting 25 grower sites. These are strongly focussed in central NSW (where most salinity expression is evident), but are distributed from Inverell in the north to Albury in the south. The sites are predominantly investigating the suite of saltland options available for the rehabilitation of saline land, and the associated establishment and management questions.

For further information relating to Producer Network projects in NSW please contact:

Luke Beange

NSW Department of Primary Industries

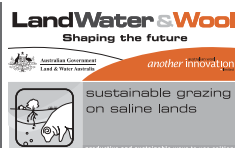
T 02 6881 1294

E luke.beange@agric.nsw.gov.au



| PROJECT TITLE | GROUP NAME | LOCATION |
|--|--|------------------|
| Fescue trial & rehabilitation | Arthurville | Wellington |
| Improve grazing efficiencies on sodic saline country | Bellata Sustainable Farming Group | Bellata |
| Licking salty wounds | Boorowa Regional Catchment Committee | Boorowa |
| Identify productive persistent salt tolerant pastures | Cranbury | Cudal |
| CWNSW SFN species trials & coordination (seven sites) | Central West NSW Sustainable Farmers Network | Central West NSW |
| Economic benefits of grazing management on severe saline lands | Derriwong-Ootha | Condobolin |
| Options for saline land – saltbush/pasture establishment | Grong Grong | Narrandera |
| Deep rooted perennial herbs for salinity control | Gundagai Group | Gundagai |
| Managing salt affected land for increased productivity | Gundaroo | Yass |
| Saline site establishment | Mid Macquarie | Wellington |
| Revegetating extremely salty scalds | Narangarie Valley | Dunedoo |
| Pasture cropping and its use in reducing salinity | Tallawang | Gulgong |
| Evaluation of vegetatively-established native grasses | West Hume | Albury |
| Can grazing management rehabilitate a saline site? | Bannockburn | Inverell |

Sustainable Grazing on Saline Lands (SGSL)



| PROJECT TITLE | GROUP NAME | LOCATION |
|---|---------------|-----------------------------------|
| Sustainable grazing – addressing dryland salinity | Keajura | Wagga |
| Salt pasture systems for Fullerton | Fullerton | Crookwell |
| Alley farming and grazing on saline soil | Coomoo Coomoo | Spring Ridge, Liverpool Plains |
| Combating salinity with best management tall wheat grass | Manilla | Tamworth |
| Can grazing management alone reduce salinity on Inverell basalts? | Nullamanna | Inverell |

FURTHER INFORMATION

SGSL has a number of emerging information products and guides containing further information on dryland salinity, the program and its projects which are either free or available for purchase.

These include:

- **Saltland Pastures in Australia: A Practical Guide** (Product number PR 030 563)
- **Productive Solutions to Salinity Management** (Product number PX 030 508)
- **SGSL Projects and Products** (Product number PF 030 608)
- **Insights – Case studies on how farmers are successfully managing saltland for profit and sustainability** (Product Code: PK 040 658)
- **The Sustainable Grazing Lands Producer Network in WA – Growers and Researchers working together to turn the tide** (Product number PF 040 801)
- SGSL section of the Land, Water & Wool website: www.landwaterwool.gov.au

To order our publications, contact CanPrint, freecall 1800 776 616 or use the order form in the Further Information section on page XX.

Other resources

A two-day EDGenetwork™ course *Making a Profit from Saline Land* has also been developed by Meat & Livestock Australia with input from SGSL. For further information regarding the course, visit the website www.edgenetwork.com.au

SGSL Producer Network and National Research Site information is regularly published in the salinity research and management journals *Focus on Salt* and *SALT Magazine*. To subscribe, visit the CRC for Plant-based Management of Dryland Salinity website www.crcsalinity.com

On-line links:

CRC for Plant-based Management of Dryland Salinity
Australia's National Dryland Salinity Program
CSIRO Livestock Industries

www.crcsalinity.com
www.ndsp.gov.au
www.csiro.au/livestock

Land Water & Wool: program management report



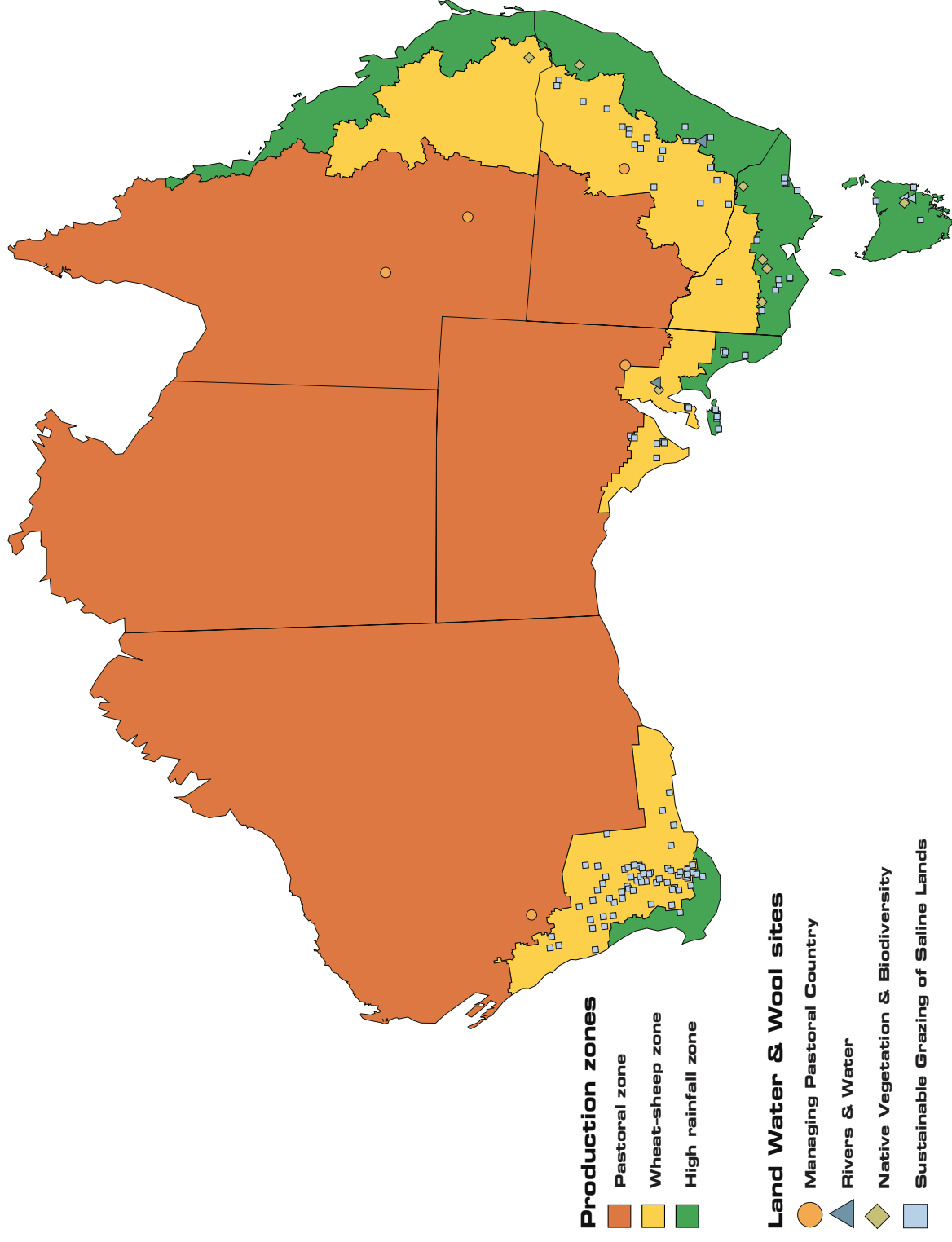
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Land Water & Wool Trial Sites



Land, Water & Wool: program management report

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Disclaimer:

The information contained in this publication is intended for general use, to assist public knowledge and discussion and to help improve the sustainable management of land, water and vegetation. It includes general statements based on scientific research. Readers are advised and need to be aware that this information may be incomplete or unsuitable for use in specific situations. Before taking any action or decision based on the information in this publication, readers should seek expert professional, scientific and technical advice.

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Preface

Land, Water & Wool is a 5½-year research and development (R&D) joint venture between Land & Water Australia (LWA) and Australian Wool Innovation Limited (AWI), with substantial support from a range of other R&D organisations and agencies. The program concluded in March 2007.

The Land Water & Wool Final Report brings together findings and implications from the research.

The 'Program Management Report' has been largely prepared as a report for the program's major funding organisations – LWA and AWI – as well as the Federal Government, which provides significant funding for research to AWI and LWA; and other key partners who invested in the program

A separate document, 'Managing for Sustainable Production', has been developed to target practitioners – leading farmers, farm consultants and advisers, State-based Catchment Management Authorities (CMAs) and natural resource management (NRM) bodies. It is designed to highlight the findings of Land, Water & Wool research and demonstration work, as well as provide pointers on how to get the more detailed information arising from the Land, Water & Wool sub-programs (delivery products, tools, etc).

Acknowledgements

This report has been prepared by Mike Wagg and Andrew Lawson of LWA and Russell Pattinson of Miracle Dog Pty Ltd.

The content for this report draws heavily on a number of other reports, including:

- the Revised Land, Water & Wool Business Plan (2005) prepared Miracle Dog Pty Ltd;
- the 'Land, Water & Wool: managing for sustainable production' report prepared by a consortium headed by Peter Day of Peter R. Day Resource Strategies;

- the Land, Water & Wool Evaluation Reports – at the program and sub-program level prepared by Dr Jeff Coutts of Coutts J & R Pty Ltd; and
- the ex poste cost-benefit analysis prepared by Peter Chudleigh and Sarah Simpson of Agtrans Research.

Most importantly, this report would not have been possible without the professional and dedicated management provided by sub-program co-ordinators and LWA and AWI staff spanning the five years of the program:

- Professor Jann Williams (Native Vegetation & Biodiversity)
- Dr Siwan Lovett (Rivers & Water Quality)
- Dr Warren Mason (Sustainable Grazing on Saline Lands)
- Dr Barry White (Managing Climate Variability and Managing Pastoral Country – 2001 – 2004)
- Dr Rohan Nelson (Managing Climate Variability – 2004 to 2005)
- Mr Peter Hanrahan (Delivery)
- Mr Andrew Lawson (LWA and Managing Pastoral Country 2004 – 2006)
- Mr Russell Pattinson (Future Woolscales)
- Mr Kim Mitchell, Ms Jane Thomas and the team at Currie Communications (Communication)
- Mr Mike Wagg (LWA – LWW Program Manager (2004 – 2007)
- Ms Anwen Lovett (LWA – LWW Program Manager (2001 – 2004)
- Ms Catherine Viljoen (LWA)
- Ms Fleur Flannery (formerly LWA)
- Ms Sandy Brogan (LWA)
- Ms Lu Hogan (AWI)
- Ms Renelle Jeffrey (AWI)

The program has received considerable guidance from the Sustainable Wool Advisory Group members – Tom Dunbabin, James Street, Michael Lloyd, Richard Weatherly, Mary Goodacre, Andrew Southwell, Will Crozier, Peter Day, Andrew Nicholson, Wal Merriman, Marcus Arthur).

In addition, the program recognises the contribution of the woolgrowers who have hosted research and demonstration sites, along with the professional staff from our partner organisations, without whom the program could not have been carried out.

Executive Summary

Land, Water & Wool is an ambitious research and development program spanning 5½ years that sought to examine key natural resource issues faced by woolgrowers in a commercial context. It has generated new information to help bridge the current gaps between natural resource management (NRM) and woolgrowing practices.

The program has provided the Australian wool industry with enhanced knowledge and tools to better understand and minimise its environmental impacts, while at the same time enhancing or maintaining productivity and profitability.

Before this program, the wool industry's R&D investment in NRM was fairly limited. Now, the Australian wool industry is recognised as a significant player in the identification and implementation of more sustainable farming practices.

Key highlights include:

- The program included 10 sub-programs (see Figure 1) and was managed by Land & Water Australia (LWA) staff. Land, Water & Wool was involved in around 35 research projects across all Australian States.
- The total budget for Land, Water & Wool was an investment of \$19.89 million from Australian Wool Innovation (including interest accrued).
- The Land, Water & Wool investment attracted an additional \$19.91 million worth of funds, including a cash contribution from Meat and Livestock Australia (\$1.5 million), several other smaller cash contributions (totalling about \$67,000) and \$18.34 million of in-kind contributions from 37 agencies and organisations across Australia. LWA made a large in-kind contribution by making more than 10 years of previous research findings (expenditure in excess of \$20 million) available to Land, Water & Wool.

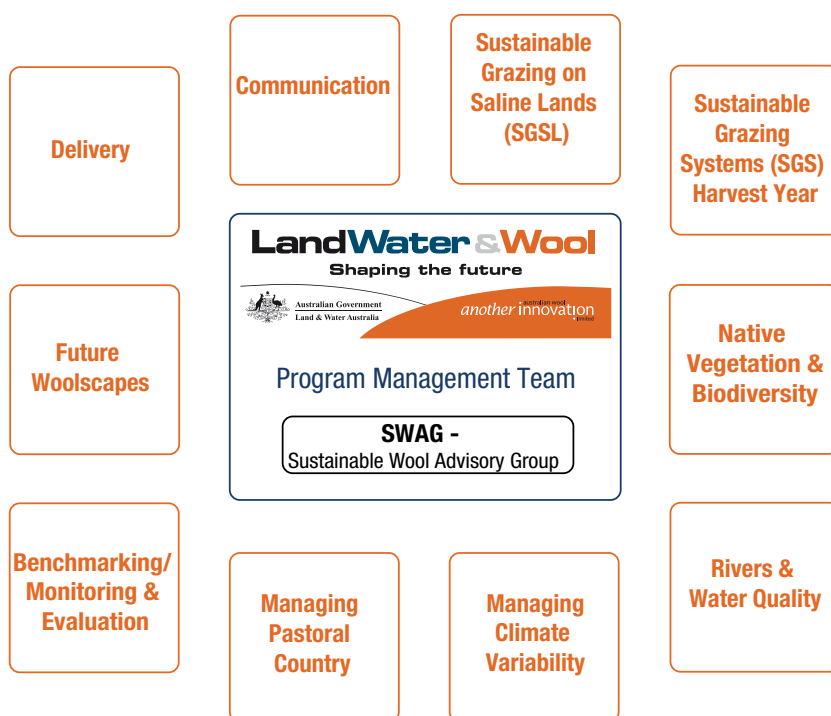


Figure 1: Land, Water & Wool program structure.

- The program was guided by the Sustainable Wool Advisory Group (SWAG), made up primarily of leading woolgrowers and other experts.
- Land, Water & Wool is believed to be the first environmental research project to put such a high emphasis on producing results in a commercial woolgrowing context. It showed that improvements in the quality of a farm's natural resources can be made while also improving productivity and profit. Careful grazing of sheep can actually help the environment in some situations.
- An ex poste cost-benefit analysis (CBA) of Land, Water & Wool estimated that the program had delivered results leading to improvements in woolgrowing productivity in the order of \$87.3 million (compared to the target of \$104 million established before the program began).
- The benefit-cost ratio across the program was calculated as 3.9, compared to the *ex ante* target of 5.5:1. The internal rate of return was 26%.
- Other more generalised benefits identified from the program included:
 - Improvement in the industry's capacity to negotiate, respond to and manage potential future regulation due to improved on-farm assessment tools and woolgrowers' enhanced knowledge.
 - Contribution to maintenance of demand or improved demand for wool in the long term through the development, adoption and publicity of sustainable wool-production practices.
 - Measured, significant increase in the industry's capacity for involvement in NRM and R&D generally – more than 4,220 woolgrowers have been directly involved in some type of LWW activity.
 - Publicity of the important role that the wool industry plays in land management, and of the need to involve woolgrowers to achieve public policy objectives for NRM (e.g. in meeting catchment targets for nutrient loads and biodiversity).
 - Contribution of increased knowledge to the enhanced design and effective delivery of future incentives and payments for ecosystem services and resource stewardship provided by woolgrowers.
 - Development of lessons and networks for future improved management of joint ventures.
 - Possible contribution to improvements in future AWI NRM programs by identifying priorities for further investment and encouraging woolgrowers to be more receptive to NRM initiatives.
 - Raised awareness in the wider community (including government and politicians) of the wool industry's strategies and activities to sustainably manage natural resources and its capability to perform a stewardship role.
- An evaluation of the program has shown that more than 3,190 woolgrowers adopted one or more tools, management approaches or practices as a direct result of their engagement with the program or from the tools, guides and information produced by the program. The target set at the beginning of the program was 2,000.

- The program has unearthed some key findings that will significantly alter the way in which woolgrowing is perceived from an environmental management and productivity perspective. These include:
 - sheep can assist in the sustainable management of Australian landscapes;
 - adoption of new practices is heavily influenced by social as well as economic issues;
 - participatory research involving woolgrowers increases the relevance of research and the likely level of adoption;
 - woolgrowers are well placed to help NRM bodies implement their strategies and meet targets;
 - the community expects the industry to protect the natural resource base;
 - industry-funded research into natural resource management helps woolgrowers influence the agenda in relation to policy decisions;
 - the community benefits significantly from the work woolgrowers undertake on their properties.
- Importantly, Land, Water & Wool identified new practices to manage crucial natural resources (saline land, rivers and waterways, native pastures and bushland, pastoral areas) that can lead to significant economic, environmental and social (personal and community) gains.

- The program has also had an impact on other related activities, such as:
 - LWW outcomes have influenced the environmental module in the AWI/MLA Making More from Sheep Best Practice Manual and more generally across AWI's NRM strategy;
 - the Future Woolscales project has had a strong influence on AWI's On Farm Strategic Plan;
 - SGSL has contributed to aspects of the new Future Farm Industry's CRC;
 - AWI's Wool Pathways Environmental Stewardship and Evergraze projects;
 - the Native Vegetation & Biodiversity sub-program was instrumental to the federally funded Victorian initiative Green Graze; and
 - work undertaken within the Rivers & Water Quality sub-program has underpinned the establishment of an on-farm grants program for gully stabilisation by at least one CMA.

The conclusion of the Land, Water & Wool program should not be viewed as an end point, but as a sound base for the wool industry's ongoing commitment to environmental stewardship. The program identified opportunities for further investment, many of which are already being acted on by AWI.

Introduction

Context

Australia is the driest inhabited continent on Earth, its soils are ancient and it has a highly variable climate. As a result, the impact of farming practices on Australia's natural resources can be significant. Australia's 37,000 woolgrowers run more than 100 million sheep across 85 million hectares of land – more than 12% of the continent – and so are the custodians of a significant proportion of Australia's natural resources.

The series of reports from National Land & Water Resources Audit (2001, 2002a, 2002b) assessed some of the environmental challenges facing the landscape:

Salinity

- Large tracts of Australia (some estimate as much as 5.7 million hectares) are at risk or are affected by dryland salinity. There has been significant loss of production and biodiversity on the salt-affected lands.
- Salinity affects towns and transport systems: almost 20,000 km of major roads are now at risk, with a projection of 67,400 km by 2050. As well, 631,000 hectares of remnant native vegetation are at risk with a projection of around two million hectares by 2050.

Water quality

- About one-third of the rivers assessed are so degraded that they are unlikely to recover in the medium term and almost 40% will require significant intervention to achieve recovery.
- Of 70 river basins assessed, 61% were found to be excessive in major nutrients (nitrogen and phosphorus).
- Of 67 river basins assessed, 61% were found to have major turbidity (dirtiness of water).
- Salt is transported through the landscape by water – affecting water quality and placing the health of up to 41,300 km of streams and lake perimeters at risk by 2050.

Native vegetation

- The clearance and modification of native vegetation is the major contributor to biodiversity loss in Australia. It is the single most important cause of salinity and is among the most important contributors to greenhouse gas emissions.
- Many ecological communities are now restricted in extent and often highly dependent on private land for their continued existence.

Biodiversity

- Australia has lost at least 22 mammal species since European settlement. More than 354 animal and 1,241 plant species are listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*.

Costs

A report commissioned by LWA for the National Farmers Federation and the Australian Conservation Foundation in 2000, 'Repairing the Country', presented cost estimates of land and water degradation to Australia (see Table 1).

Given the modified nature of the Australian landscape, coupled with the vast area managed by Australian woolgrowers (an estimated 85 million hectares), the case for investment in NRM by the wool industry was evident.

Support from woolgrowers for such an investment was also anticipated. This was confirmed early in the program when the attitudes and current practices of woolgrowers were clarified by the Land, Water & Wool Benchmarking Survey conducted in 2002. In brief, the survey found that:

- woolgrowers believed they were custodians of the land, with 90% considering NRM a key component of their whole farm enterprise;
- 91% of woolgrowers reported that they were either doing something about NRM now or had taken some action already;
- woolgrowers who have already undertaken NRM changes in the past were more likely to adopt changes in the future; and
- 93% of woolgrowers were confident about their knowledge of NRM but almost half would like to have had more information or support to help them manage it on their farm.

Table 1: Cost estimates of land and water degradation from Repairing the Country (2000).

| Form of degradation | Estimate (\$m/year) |
|-----------------------------------|---------------------|
| Salinity | 270 |
| Acid soils | 300 |
| Sodic soils or structural decline | 200 |
| Erosion | 80 |
| Irrigation salinity | 65 |
| Water quality | 450 |
| Total | 1,365 |

Background

In June 2001, Australian Wool Innovation Pty Ltd (AWI) and Land & Water Australia (LWA) agreed in principle to partner the development of an extensive natural resource management program for the wool industry.

The program, which became known as Land, Water & Wool, was designed to provide the Australian wool industry with the knowledge and tools to understand and minimise its environmental impacts; enhance productivity and profit; and enable the industry to position itself as the world's most sustainable producer of premium natural wool.

The original Business Plan was developed and adopted in October 2001. A revised plan was prepared in 2004/05 to better reflect the lessons learnt over the initial three years of the program. However, the general thrust of the program remained intact.

The plan for Land, Water & Wool was unique and ambitious. As emphasised in the Business Plan, it was important that expectations were kept realistic in relation to what could be achieved through a five-year investment to address an issue that has been building over the past century and more. Consequently, it was never expected that significant change in the state of natural resources on-farm would be evident when the program concluded. However, it was expected that the framework for future change should be well established and that the benefits from the program would continue to accrue over coming years.

Seven key NRM issues were included in the program research. These did not cover issues affecting woolgrowers, e.g. weeds, acid soils and pests, that came within the brief of other AWI programs.

Land, Water & Wool Mission

The expressed Mission of the Land, Water & Wool program was:

To provide the Australian wool industry with the knowledge, tools and enthusiasm to minimise its environmental impact while enhancing productivity, and to position itself as the world's most sustainable grower of premium natural wool.

Objectives

The overall objective for Land, Water & Wool was to provide a realistic, comprehensive and commercially focused approach to the delivery of enhanced NRM practices to Australian woolgrowers. The objectives were:

Objective 1: To identify key NRM issues from woolgrowers' perspectives and understand their perceptions, needs, priorities and practices.

Objective 2: To increase woolgrower awareness of and motivation to tackle NRM issues.

Objective 3: To provide woolgrowers with the knowledge and practical tools to address key NRM issues, including productive and profitable solutions to the management of:

- saline and potentially saline lands;
- rivers, streams and watering points;
- native vegetation, including grasslands and grazing systems;
- on-farm biodiversity;
- climate seasonal risk assessment; and
- long-term scenarios for future wool production systems.

Objective 4: To increase the capacity of woolgrowers to apply NRM innovations within their commercial enterprise.

Objective 5: To position the wool industry to reduce its environmental impact and to provide it with an opportunity to use environmental performance as a strategic marketing asset if it so chooses.

Guiding principles

Land, Water & Wool took into account previous studies that had identified the factors that make R&D programs successful. For example, a National Land & Water Resources Audit report on the capacity of farmers to implement change (2002c) provided guidance on the factors that are important in farmers changing practices.

Recognition of a resource degradation problem is a necessary but, rarely, a sufficient condition for the adoption of sustainable natural resource management practices. Whether farmers change their land management in response to this recognition depends on many interrelated factors. These factors include:

- *the characteristics of the natural resource management practices;*
- *farmer beliefs about the environment and practices to protect the environment;*
- *financial capacity of farm businesses to invest in natural resource protection;*
- *management skill of land managers;*
- *support for environmentally friendly behaviour from peers and social networks; and*
- *individual differences between landholders.*

Farmers do not all learn about sustainable practices in the same manner. Styles of farmer learning vary from reliance on a few key informants to the use of a wide range of personal and impersonal sources. No one delivery system will be appropriate for all farmers. Dissemination of local knowledge will remain a key feature of any successful training program.

The ability of Land, Water & Wool to provide woolgrower capacity and motivation at a local level was recognised as a key to its success. As a result, the Land, Water & Wool Business Plan adopted some Guiding Principles to focus the modus operandi of the program. These were:

- focus on enhanced productivity, profitability and sustainability for woolgrowers;
- have direct involvement of woolgrowers throughout the life of the project;
- build on existing NRM initiatives rather than ‘reinventing wheels’;
- integrate biophysical issues (land, water, vegetation) with social (capacity, self-esteem) and economic issues for woolgrowers; and
- provide hands-on, interactive and innovative communication products and activities.

Sandy Sharman (USQ) and Sussan Ley Parliamentary Secretary to the Minister for Agriculture Fisheries & Forestry, at the launch of the Environmental Toolkit for Traprock woolgrowers near Stanthorpe in April 2006. The toolkit was produced under LWW’s project in the Traprock district. (Photo: Amelia Radford, QMDC).



Deliverables

The program sought to deliver a series of outputs which could be applied by woolgrowers. Through adoption of these outputs, the program could start to deliver a range of outcomes to woolgrowers, while recognising that a five-year program would be too short to see large-scale, on-ground practice change.

Outputs

- Woolgrower NRM issues, needs and priorities identified.
- A comprehensive understanding of woolgrower practices and perspectives (attitudes).
- Knowledge products (e.g. guides, fact sheets, case studies) emanating from each of the sub-programs, including products intended to increase motivation and to increase the assessment capabilities of woolgrowers contemplating practice change.
- Increased capacity of woolgrowers associated with sub-programs regarding increased knowledge and management options, where to find relevant information, capacity to assess profitability and access industry and government support mechanisms (e.g. woolgrower networks, government incentives).
- Development of effective mechanisms for delivery to woolgrowers of these knowledge products, management options, and information on costs and benefits and other desirable physical and social outcomes.
- High level of involvement of woolgrowers associated with each sub-program.
- Demand for various products from the program.
- Commencement of a comprehensive database of objective measures of natural resources at the farm level.
- Demonstration to the broader community that appropriate knowledge and management options are available and knowledge delivery mechanisms are in place.
- Identification of future wool production system needs, policy options and research priorities.

Outcomes

- A wool industry identified and respected as taking a proactive approach to NRM.
- The groundwork for measurable change in woolgrower NRM priorities and practices (Note: the 5½-year Land, Water & Wool program is relatively short in relation to NRM change. Consequently, it is not expected that significant on ground change will be evident when the program has concluded. However, the framework for future change in this regard should be well established).
- Woolgrowers demonstrating an increased:
 - awareness of NRM issues;
 - understanding of their importance and implications for the industry; and
 - motivation to address the issues.
- More than 2,000 woolgrowers applying NRM innovations (covering salinity, waterway and native vegetation management, pastoral land use, biodiversity and climate forecasts) with a further 4,000 directly contacted through Land, Water & Wool.
- An *ex ante* cost-benefit analysis estimated that the program should deliver (conservatively) \$58 million in improved productivity to woolgrowers and \$46 million in enhanced environmental benefits (at an overall benefit-cost ratio of 5.5:1).
- Additional (difficult to quantify and value) future benefits, including increased land values, reduced regulation, potential market premiums and market access, improved access to capital, increased community support and increased woolgrower pride.

The performance of the program in achieving these Outputs and Outcomes is detailed in Section 3.

Program structure

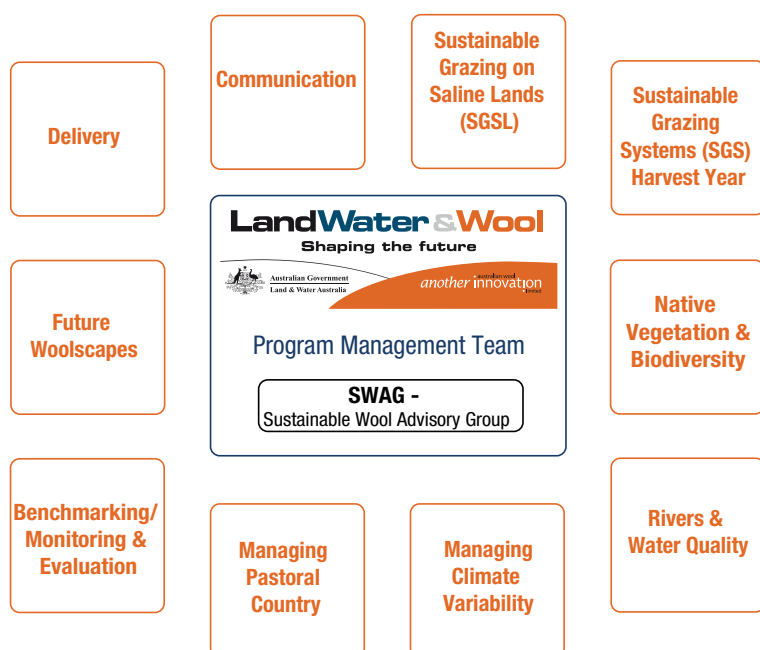
Land, Water & Wool was managed by LWA on behalf of the partners. Major elements of the management arrangements were:

- LWA appointed a Program Manager (Anwen Lovett, followed by Mike Wagg) when the program began.
- Primary program management rested with this position, supported by a Program Co-ordinator (Russell Pattinson) and a Program Officer (Catherine Viljoen and subsequently Andrew Lawson), who worked closely with the relevant AWI Program Manager (Lu Hogan) and Project Officer (Renelle Jeffrey).
- A Sustainable Wool Advisory Group (SWAG) was established to provide regular advice to the program. SWAG played a crucial role in providing ‘farmer-focused’ guidance and strategic advice.
- A single contract was established between AWI and LWA, setting out payments against agreed milestones. Land, Water & Wool also provided AWI with a comprehensive Annual Report each March.

- Land, Water & Wool appointed Sub-program Co-ordinators for each element of the Program:
 - Sustainable Grazing on Saline Lands (SGSL)
 - Native Vegetation & Biodiversity
 - Rivers & Water Quality
 - Managing Climate Variability
 - Managing Pastoral Country
 - Future Woolscapes
 - Sustainable Grazing Systems (SGS) Harvest Year (contribution)
 - Benchmarking
 - Delivery
 - Communication
- For all Land, Water & Wool research commissioned, a Co-investment Form submitted to AWI detailed any third-party funding and intellectual property (IP) rights.
- Principles for the management of new IP were agreed to in contracts between AWI and LWA, including ownership, access and exploitation of IP. The guiding principle was to ensure that there were no impediments in the use of and access to IP for woolgrowers.
- A Risk Management Plan was prepared in the early part of the program. Risks for both AWI and LWA were identified.
- A Monitoring and Evaluation Plan was established early in the program. This was reviewed and comprehensively revised in 2004/05.
- A Corporate Service Agreement was established between AWI and LWA.
- A single Communication and Delivery Strategy was adopted (although most adoption activities were managed at the sub-program level).
- Consistent and strong branding was developed early in the program to increase its profile and recognition
- A strategy was developed toward the end of the program to ensure that the transition from Land, Water & Wool to AWI’s new NRM strategy was as seamless as possible and well managed.

The program was made up of 10 individual sub-programs – shown in Figure 1.

Figure 1: Land, Water & Wool program structure.



Budget

The original budget for Land, Water & Wool was an investment of \$19.35 million from AWI. Interest accrued over the period (\$542,569) brought AWI's total contribution to approximately \$19.89 million.

With this core funding, Land, Water & Wool was able to leverage further contributions amounting to about \$19.91 million, including a cash contribution from MLA of \$1.5 million to SGSL, several other smaller cash contributions totalling about \$67,000 and numerous in-kind contributions from agencies and organisations across Australia amounting to a further \$18.34 million (made up of about \$17.65 million for the original phase of Land, Water & Wool up to March 2007 and \$689,000 for the Additional Activities component, to be undertaken post-March 2007).

A detailed budget is shown in Appendix 1 and a full list of in-kind contributions can be found in the Co-investment Chart in Appendix 5. Finally, and importantly, LWA made an equally large in-kind contribution when it made available to Land, Water & Wool detailed information from more than 10 years of previous research.

During the course of the program there were some minor changes to the budget allocation. These are reflected in Table 2 and include savings from the Future Woolscales, Climate, Pastoral and Monitoring & Evaluation activities.

Mid-way through the program, interest monies and savings accrued to that time were reinvested into a mid-program expansion of the Delivery component of Land, Water & Wool, including the Future Woolscales extension project, web-based delivery of the River Guides, the 'Drafting Gate' climate information and decision-support tool, and the Advocates project.

At the end of the program, an amount of \$992,623 remained unspent. The business plan has been amended to allow these funds to be invested into 'Additional Activities' over the next 18 months, including support for additional data collection where projects in the SGSL and Native Vegetation and Biodiversity sub-programs have been delayed by drought.

Unspent funds were also directed to the development of a SGSL synthesis product that could not be completed within the timeframe of LWW. Communication, product delivery and briefings for key policy makers will also be continued, to maximise return from the LWW investment. These activities will also be covered by the 'Additional Activities' component.

Table 2: Original versus Final Budget for Land, Water & Wool, \$'000s. (These budgetary figures are estimated final as of February 2007. Audited accounts for the program can be obtained from AWI and MLA).

| | Final | Original | Co-investment |
|--|----------------|----------------|----------------|
| Sub-program Expenditure | \$'000s | \$'000s | \$'000s |
| Set-up Program | 189 | 204 | |
| SGS Harvest Year | 300 | 300 | |
| Climate | 764 | 850 | 988 |
| Future Woolscales | 421 | 680 | |
| Pastoral | 524 | 818 | 648 |
| Rivers | 1,509 | 1,400 | 1,866 |
| Salinity | 8,905 | 9,160 | 11,534* |
| Vegetation | 2,466 | 2,483 | 2,613 |
| Portfolio: | | | |
| Communications | 2,368 | 2,710 | |
| Delivery | 579 | 0 | |
| M&E (including benchmarking) | 501 | 710 | |
| Management | 1,940 | 1,536 | |
| Total | 20,466 | 20,851 | 17,649 |
| Income | | | |
| AWI Set-up | 200 | 200 | |
| AWI LWW | 19,150 | 19,150 | |
| MLA | 1,500 | 1,500 | |
| Interest | 543 | | |
| Publications Royalties SGSL | 3 | | |
| External Sponsorships – SGSL Photo Competition | 28 | | |
| CRC contributions | 30 | | |
| Other | 7 | | |
| Total | 21,460 | 20,850 | |
| Variance | 993 | | |
| Additional Activities | 993 | 0 | 689 |

* Doesn't include \$1.5 m in cash contribution from MLA shown as Income

Key insights

1. Sheep can assist in the sustainable management of Australian landscapes

Land Water & Wool research demonstrated that while the woolgrowing industry (along with all agriculture) has previously been associated with some negative impacts on the environment, it is now becoming apparent that:

- Through strategic grazing management sheep can enhance biodiversity and ecosystem services in the landscape in some situations, especially the abundance and diversity of native grassland plants, without compromising productivity.
- Sheep can make it commercially viable to rehabilitate degraded or degrading land. There are many instances where improved productivity and better natural resource management can occur at the same time.

As a result of Land, Water & Wool, the place of sheep in NRM has been re-appraised.

Woody Yallock Catchment Group members in a rehabilitated saltland site.

Photo: Yuri ??????



2. The community expects woolgrowers to protect the natural resources on their farms

One of Land, Water & Wool's sub-programs, Future Woolsapes, examined likely changes in production, technology and markets, and drew up four possible scenarios of the future based on emerging trends and issues. Good land management was a key factor in all the scenarios. Land, Water & Wool has also strengthened the understanding of woolgrowers that the natural resource base underpins their enterprise and must be managed well for future profit, and their sense of purpose and pride. It has provided a range of assessment tools that woolgrowers can use to check whether they are achieving their objectives and constantly improving (adapting) their management.

3. The community benefits significantly from the work growers undertake on their properties

Land, Water & Wool has shown there are wide community benefits from the investments made by woolgrowers in a range of areas. These include:

- enhanced water quality off-farm through better management of riparian areas and water courses reducing soil erosion;
- increased biodiversity through the provision of diverse habitat, better grazing management and appropriate management of native pastures and bushland; and
- increased amenity value from the improved management of remnant native vegetation and the rehabilitation of saline areas.

Efforts such as these are sometimes cash flow negative, as the specific benefits cannot always be captured on-farm.

4. Industry-funded research into natural resource management helps woolgrowers influence the agenda in relation to policy decisions

It was not an aim of Land, Water & Wool to develop policy, however, several projects did generate new knowledge that could be used to assist the public policy debate about NRM. These range from new approaches to incentives for NRM and insights on native vegetation legislation, through to informing the debate about the level of public versus private investment in, and benefit from, improved land management.

5. Sociological factors are critically important to woolgrowers in assessing practice change

Land, Water & Wool has tapped into the strong association that woolgrowers have with their land; their connection to the environment and the importance of their 'sense of place'. This finding can, if applied appropriately, significantly modify the way in which agricultural research is conducted, farm extension delivered and farm policy applied. Asking a woolgrower to change the way they manage their resource base is akin to asking them to alter their self-perception. An understanding of what motivates individual woolgrowers is critical. Land, Water & Wool has reinforced that they are not driven by financial factors alone.

6. Participatory research involving woolgrowers increases the relevance of research and the likely level of adoption

Land, Water & Wool has clearly demonstrated that woolgrowers are hungry for new knowledge that allows them to improve their production and their 'place'. It has been clearly shown that when woolgrowers are involved from the beginning of a research and development program they are not only far better placed to take up research findings but, more importantly, add enormous value to the way in which the research is conducted. Researchers have also found the direct relationship with farmers both unique and rewarding. This is reflected in the sentiment that success should be measured in terms of experience gained as well as the result itself.

7. Woolgrowers are well placed to assist natural resource management bodies implement their strategies

There are many ways in which management practices on wool properties can contribute to the achievement of natural resource management (NRM) agencies' catchment targets, without harming the farm business. Land, Water & Wool has helped stakeholders better understand the commitment of woolgrowers and their industry to sustainable management. This is critical as the importance of regional NRM bodies rises and their need to engage effectively with farmers increases.

SGSL Photo Competition

In late 2005, SGSL conducted a photo competition on the theme of 'Pride in Saltland Management'. The competition allowed people involved in the restoration of saltland to highlight their achievements in a positive and public way, as well as helping SGSL to build a bank of images to use in the promotion of better saltland management. The competition was managed by Currie Communications, which oversaw the deliberations of a competition steering committee, managed the cataloguing of photos and sought sponsors. The five competition categories ('Farmers in Action', 'Science in Saltland', 'Productive Saltland Pastures', 'Before & After' and 'Saltland Humour') attracted 400 entries. Fifteen winners shared \$30,000 in prize money. A travelling exhibition at numerous natural resource management conferences and field days further promoted the work of SGSL across the country.



Department of Agriculture Technical Officer Meir Altman downloading a data logger attached to a continuous water level recorder. The loggers are notoriously fickle - we often lose the data - which may explain the "prayer like attitude"!

Photo: Dr Ed Barrett-Lennard

Key findings

Dedicated research sites and farm-based demonstration trials within the Land, Water & Wool project have produced an array of new information and tools to help woolgrowers better manage their resource base and their stock – and better understand the interaction between the two. Financial, environmental and social (personal and community) benefits have been identified as a result of new management techniques for saline soil, riparian areas, native vegetation; enhancing biodiversity and Australia's pastoral areas.

Detailed findings of relevance to woolgrowers, farm advisers and agency personnel can be found in the report, *Land, Water & Wool: Managing for Sustainable Production*. That report also provides links to research reports and management tools that have been developed or refined during the course of the Land, Water & Wool project.

For the purposes of this report, which is more focused on program management, an overview of the key findings from a management, environmental and social perspective is provided. Full lists of all Land, Water & Wool projects, products and publications can also be found in the appendices to this report.

Sustainable Grazing on Saline Lands

Dryland salinity affects nearly 8,000 woolgrowing properties across Australia and negatively affects production capacity, land values and farmer pride. While grazing has been known as one of the few activities that can make rehabilitation of saline land productive and profitable, it has not been actively pursued because:

- it can be costly;
- failures are common (e.g. due to the wrong selection of pasture species, sowing techniques);
- sites vary significantly due to the interaction between the amount of salt and extent of waterlogging; and
- saline areas can be difficult to manage, especially in relation to grazing.

Land, Water & Wool has now identified new productive options for salt-affected land in Australia. The cost effectiveness of such rehabilitation is not universal, as it depends on the area affected and how badly saline it is. Some saline land is just too hostile for productive pasture options (although some of this land can be grazed using volunteer species). However, the new information should give woolgrowers greater confidence in tackling the issue and provide significant financial, environmental and personal benefits.

Management

- To appropriately tackle dryland salinity, woolgrowers must first identify and make an assessment (degree of salinity and waterlogging) of saline and potentially saline areas.
- These areas will need to be managed differently to other parts of the farm, so isolating them (usually requiring fencing) is the first step and, in some circumstances, the only management intervention required.
- Sites of mid-range salinity should have the highest priority. They have a greater likelihood of success than highly saline sites, but a lower opportunity cost than less-saline sites, where crops such as barley (the most salt-tolerant cereal crop) may still be an option.

Media Tour

As well as targeting communication activities at farmers and their advisers, Land, Water & Wool wanted the general community to be aware of the significant effort going into natural resource management research on wool properties. A media tour for influential journalists was conducted through research sites in western Victoria to help achieve this aim.

Journalists representing media such as *The Australian*, ABC television news, ABC Radio, *The Age*, Rural Press and *The Weekly Times* gained an in-depth insight into the wool industry's current and future research into natural resource management. Each step of the tour was led by the appropriate Program Manager and involved farmers and research staff working in the program. The CEOs of AWI and LWA also attended.

Media coverage from the tour included:

- articles in the general news section of *The Australian* and *The Age*;
- two national news stories on ABC-TV;
- extensive coverage on the ABC *Rural Report* and *Country Hour*; and
- woolgrower participants featuring in *The Weekly Times* 'Farm Business Awards' series for good management.



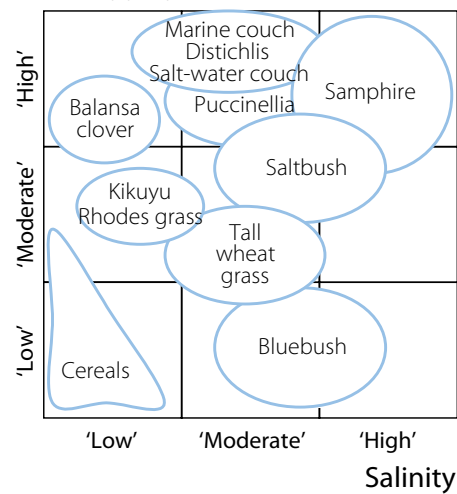
- Research has helped to determine a matrix of species suitability versus site conditions. The matrix, in conjunction with professional agronomic advice, can help provide a high level of success for much of the salt-affected land in Australia. In some cases, such as for balansa clover (an important legume for low-salinity sites) specific levels of salt tolerance in relation to germination have been determined.
- Woolgrowers can now get advice from their agronomist or LWW research reports on making decisions about how to establish saltland pastures – trying to balance between the high-cost but more-reliable options, such as sowing nursery-raised seedlings, versus the cheaper but less-reliable options, such as direct seeding.
- Grazing management techniques for new and established pastures have been refined to enhance productivity and pasture life span.

Production and financial benefits

Returns and benefits from saltland pastures vary greatly from farm to farm, but have now been well documented.

- The major advantage from an improved saltland pasture is the value of the extra feed to the livestock enterprise from these previously unproductive or less-productive areas. This feed is often available out of season, providing additional value – salty sites often stay wet longer, allowing green feed and more cover later into the season. Saltland pastures may also let woolgrowers rest non-saline land, resulting in higher autumn/winter production from other parts of the farm.

Waterlogging



Indicative chart of species suitability for salinity and waterlogging.

- The cost of establishing productive saltland pastures varied from around \$70/ha to more than \$700/ha across a selection of the Land, Water & Wool sites, with an average of \$277/ha. The time to 'break even' ranges from three to more than 20 years. This huge range results from the number of different options suited to different sites. Decision-support products and expertise have been developed within the program to help match the best option to the site.
- Whole-farm modelling in the southern WA wheatbelt shows that saltland pastures can yield around \$4,000 a year extra on a 2,000-hectare farm. This is equivalent to \$80/ha of saltland pasture, based on revegetating 50 ha of moderately saline land. As the area revegetated widened to include mildly and severely affected saltland (115 ha in total) the average profit of saltland pasture decreased to \$40/ha.
- Table 3 provides other examples from studies in Victoria.

Table 3: Site results for saltland pasture establishment.

| | Hamilton | Bairnsdale | Seymour |
|------------------------------|------------------|-------------|------------------|
| Treatment | Tall Wheat Grass | Saltbush | Tall Wheat Grass |
| Pasture establishment cost | \$398/ha | \$1,042/ha | \$571/ha |
| Carrying capacity unimproved | 2.5 dse/ha | 1.2 dse/ha | 2.5 des/ha |
| Carrying capacity improved | 15.5 dse/ha | 14.6 dse/ha | 15.5 dse/ha |
| Gross margin unimproved | \$1/ha | -\$26/ha | \$111/ha |
| Gross margin improved | \$143/ha | \$285/ha | \$301/ha |
| Payback period | 4.6 years | 5.2 years | 3.6 years |

Environmental benefits

The establishment of pastures on previous salty land provides significant environmental benefits.

- While salt run-off from the site may initially increase due to soil disturbance associated with establishing the pasture, over time the amount of salt leaving the site and entering other soil or waterways will most likely reduce. NSW trials showed that improved perennial pastures on saline discharge areas used significantly more water than unimproved pastures. As a result, significantly less saline water ran off to add to stream salinity (although the salt content may be higher due to lower flows).
- A vigorous pasture will use more water from the soil profile, helping to lower watertables and reduce run-off. Lower watertables can reduce the spread of salt over more of the farm and may allow the site to be rehabilitated to its full potential production.
- Biodiversity studies have demonstrated significant increases in the amount and diversity of species (especially microbes and insects) associated with rehabilitated saltland pastures compared to salt scalds. This is thought to be largely a result of increased ground cover resulting in a modified environment with higher organic matter.

This owner of this land was concerned about this saline creek system on his property. Department of Agriculture, Hydrologist, Arjin Ryder takes conductivity readings with an EM38 to determine a plan of action to tackle the problem with a trial of different treatments according to soil type and salinity.

Photo: Lynn Heppell



Social and personal benefits

Personal satisfaction from meeting the salinity challenge, and being recognised as a good land manager by other farmers and the community, are both potent drivers of actions to rehabilitate saline land and rewards for doing so. Especially where areas are small, pride may be sufficient motivation to undertake improvement. As the area increases, commercial considerations start to be the main driver, but personal satisfaction is still seen as a large part of the benefit.

Separate to the pride or satisfaction of the owner, visual amenity has also been identified as a social benefit of rehabilitating saline land. In most areas, saline land is seen as a highly negative characteristic that affects property values. This is driven by a combination of productivity and visual amenity factors. On smaller properties, visual amenity makes up a higher proportion of the value due to the impact of lifestyle purchasers.

One of the highlights identified by woolgrowers belonging to an SGSL network group was that they no longer felt isolated in dealing with their salinity problem. The group environment built confidence and capacity in dealing with saline land, breaking down the feeling of isolation.

New tools and information

Research during the SGSL sub-program developed or refined a range of new tools and information packages to assist woolgrowers address saline land. These include:

- Insights: Case studies on how farmers are successfully managing saltland for profit and sustainability’;
- ‘Saltland Scorings and Solutions – for areas with rainfall of 400-600 mm in WA’;
- ‘Saltland Pastures in Australia: a practical guide’
- ‘Sustainable Grazing on Saline Lands – Productive solutions for salinity management’;
- ‘Land, Water & Wool: Sustainable grazing on saline lands – Making more from your saline land’; and
- ‘SALTdeck’

Native Vegetation & Biodiversity

Most Australian woolgrowers have native vegetation on their land and play a key role in its care and management. Native pastures occupy large areas of many properties. Because of their even (though usually low) production levels, they are highly valued by many fine woolgrowers and produce high tensile strength wool. Their low input and maintenance costs also make them an appealing proposition to many woolgrowers.

Because of past clearing patterns, areas with native vegetation in southern and eastern Australia are often less fertile and potentially less arable. As such, they need to be carefully managed so as to not degrade them. These areas provide many benefits to wool production and the farm enterprise, such as shade and shelter for stock, beneficial insects and timber, as well as recreational and aesthetic values. Native vegetation also provides important habitat for native animals, such as birds, bats and mammals. These animals can play a role in the predation of pasture and sheep pests, as well as being an intrinsic part of the Australian landscape.

As a result of Land, Water & Wool, far more targeted information is now available to help woolgrowers make practical decisions about how to manage native pastures and bushland in the context of a profitable wool enterprise.

Management

- Past thinking was to identify conservation areas and then lock them up. Current thinking is that remnant vegetation and other conservation areas need to be fenced off, but certainly not forgotten. These areas are simply 'special paddocks' that are managed primarily for their conservation value, but should still be seen as part of the total farm feed supply.
- Where possible, land management changes should seek to integrate resource protection strategies with production-focused strategies so as to reduce the marginal costs of any changes.
- A fence that is constructed primarily to protect some remnant or newly planted vegetation, can, if carefully planned, increase subdivision

and therefore increase grazing management and pasture utilisation options across the property.

- Conservation benefits can be achieved in areas that are primarily managed for production.
- Perennial native grasses will persist for many years if grazed correctly. They are low input, resistant to drought, frost tolerant and many are vigorous and highly palatable to sheep – making them ideal for the production of fine, sound wool.
- Research has shown that strategic grazing of perennial native grasses, based on the amount of feed available and the growth stage of the grass, is most effective in increasing productivity and maintaining the plant base.
- In Victoria, deferred grazing and intensive rotational grazing strategies on hill country were most likely to result in extra profits (after an initial capital investment of about \$30/ha returns generated up to an extra \$27/ha/year.) and to have the most favourable impact on the condition of native vegetation, regardless of current stocking rates.
- While native pastures respond well to fertiliser there is a trade off in that native species richness is reduced.
- The approaches identified in Land, Water & Wool have the potential to be applied across two million hectares of central Victoria and a further 8.5 million hectares of south-eastern Australia (in NSW, SA, south-east Queensland and Tasmania). This is more than one-tenth of the area grazed by sheep.

Production and financial benefits

Land, Water & Wool and previous studies identified that woolgrowers are getting benefits from native vegetation in many ways, including:

- Increased stocking rates through strategic grazing management of native pastures. In South Australia, moving to strategic grazing of perennial native grasses increased pasture production and decreased the amount of bare ground, enabling a large increase in stocking rate. For example, on the main experimental site, the stocking rate rose from 2.3 to 4.2 DSE/ha. In Victoria, a trial found that there was the potential for a 10% increase in profit from intensive rotational grazing of native pasture on hill country.

- Shelter for stock during adverse weather conditions significantly reduced stock losses during lambing and off-shears. Work in New England estimated that over a 20-year period the net present value of contour plantings was \$113/ha.
- Higher bird density as a result of shelter meant fewer insect pests of both pastures and sheep.
- More resilience to drought, as native pasture produces some feed even in the driest of years.
- Native pastures are the best options for perennial pastures in soils of low inherent fertility, providing feed balance throughout the year.
- A source of timber, posts and other bush products.
- A potential increase in property value (especially in areas close to major centres) due to recreational and aesthetic benefits.

Many instances of productivity benefits were also identified by Land, Water & Wool in the management of woody native remnant vegetation or establishing shelter belts.

- A Victorian trial found that carefully positioned shelter trees could result in increased returns of \$1/DSE/yr (or \$6.50/ha/yr) from improved shade, shelter and reduced losses.
- In NSW, a potential increase of 11% in profit was achieved at one site from increased lambing percentage following an investment in shelter via native vegetation.
- Also in NSW, it was found that establishing shelter belts by encouraging natural regeneration could deliver benefits to sheep performance and pasture growth worth an extra \$10/ha/year after 15 years or when the trees were fully established and providing shelter.
- In Victoria, the increased production from applying optimal nutrients on a property's most productive paddocks has the potential to more than offset the costs of managing 15% of the area for native vegetation and biodiversity.

- Greater sub-divisional fencing to assist with native vegetation conservation allows for more strategic grazing management.

In some cases, the costs of managing woody vegetation or revegetation may outweigh the benefits that can be captured on-farm. It is for this reason that incentives for farmers to manage these areas are warranted. In most States there are schemes that assist and encourage landholders to provide habitat for native plants and animals on their property.

Environmental benefits

Improved management of native vegetation, pastures or bushland, can bring significant environmental benefits to both the farmer and the broader community. Some examples include:

- Woolgrowers already provide important habitat for a range of threatened plant and animal species across south-eastern Australia. Where a diversity of native plants and habitats is retained, this provides the food and shelter needed to maintain local wildlife populations. Diverse management practices also encourage a diversity of native plants and animals.
- Irrespective of the choice of production system used, any woolgrowing property can make a worthwhile contribution to nature conservation.
- Scattered paddock trees play an important role as habitat, food, shelter and 'stepping stones' for many birds and bats.
- Woody vegetation provides the potential to store carbon, an ecosystem service for which there may, one day, be a payment.
- Shelter belts and native remnant vegetation reduce wind speed, helping to prevent soil erosion.
- Strategic grazing of native pastures allows for increased ground cover over summer/autumn, increasing soil moisture retention and reducing erosion risk.

Social and personal benefits

Like rivers, areas of native vegetation and their associated fauna are often 'special' places on a farm. They have been shown to have significance to woolgrowers and many associated benefits to the community, such as:

- improved visual amenity value to the landholder and the wider community;
- critical importance in farmers' 'sense of place'; and
- help to meet regional targets for salinity, tree cover and biodiversity.

New tools and information

Research undertaken during the Native Vegetation & Biodiversity sub-program has developed or refined a range of new tools and information packages to assist woolgrowers manage such areas. These include:

- 'Insights Case Studies on woolgrowers successfully managing native vegetation and biodiversity';
- 'Managing Tasmanian Native Pastures – a Technical Guide for Graziers';
- 'Quickchecks Manual'; and
- a range of extension fact sheets.

Dog collars

Land, Water & Wool used innovative approaches to get its project findings out to woolgrowers and their advisers. One such example was the 'dog collar brochure' from the Victorian Native Vegetation project. By providing a free dog collar, branded 'BARK UP THE RIGHT TREE



visit landwaterwool.gov.au, woolgrowers were encouraged to examine a range of management practices, including various grazing, fertiliser and revegetation strategies for central Victorian hill country. The brochure had a significant impact, with more than 1,600 being distributed through Elders and Landmark offices.

Rivers & Water Quality

Three-quarters of all woolgrowing properties have frontage to a waterway, whether a river, a stream or an intermittent creek. Sheep need high-quality water to thrive and the pastures alongside waterways (riparian lands) are often highly productive with good-quality feed.

Waterways can also pose a range of management problems, such as insecure boundaries and periodic floods, with the risk of stock losses. Like remnant vegetation, waterways also tend to be 'special' places on the farm, with woolgrowers recognising and caring about the unique biodiversity found there. As a result, woolgrowers have strong financial, environmental and social reasons for better understanding and managing the waterways and riparian land on their farms.

Management

The case for good management of waterways and riparian lands is well established in research and catchment management agencies, however, little of the available scientific information had been translated to meet the practical needs of the wool industry. Land, Water & Wool has undertaken research and tailored practical information for woolgrowers, within the context of commercial farms, so that both profit and environmental goals can be achieved by improving the on-farm management of rivers and water quality.

- Waterways are unique areas on a farm and therefore need to be managed in a unique way as part of a whole-property plan.
- Grazing management is probably the most important single factor influencing the condition and productivity of riparian pastures and native riparian vegetation. This means controlling stock access to riparian areas and the stream or creek itself.

- Control does not necessarily mean exclusion, but it does open the way for riparian pastures to be grazed to optimise the seasonal availability of green feed, to improve pasture composition, growth and utilisation, and to improve parasite control. Land, Water & Wool research has helped determine the timing and intensity of grazing to best match the feed available from other parts of the farm and animal demand (e.g. to lift lamb weights or finish stock for sale).
- Fencing and providing alternative water sources for stock are the first steps in rehabilitation.
- Removing sheep for a period may be all that is needed to promote natural regeneration, as was found to be the case at some Land, Water & Wool sites in Tasmania. In other areas deliberate replanting is necessary.
- Direct seeding is much cheaper than planting tube stock, but is very dependent on good site preparation and the season, as was evident at a NSW site.
- Control of weeds and of grazing by feral or native animals may also be required.
- Follow-up management is always important and, in general, it is best to tackle a short length of the waterway at a time.

The key message is that improved management of riparian pastures and native vegetation can provide benefits to both profit and the environment.

Production and financial benefits

The Rivers & Water Quality sub-program successfully applied, and added to, more than a decade of riparian research. Key production and financial benefits included:

- There are many riparian fencing schemes that will help to defray the capital costs. These are well documented in Land, Water & Wool publications. However, controlling stock access by fencing can be a costly exercise and the net financial benefits may be negative.
- Such a cost should be amortised across the property as it provides ‘another paddock’ that can be strategically grazed at key times of the year when other areas require resting (via strategic grazing and resting of pastures to maintain productive species and increase feed production). Sub-dividing productive riparian pastures to improve feed utilisation and for disease control can help defray fencing costs, as at the NSW site.
- Uncontrolled stock access to rivers which form property boundaries can make disease control difficult.
- Improved stock shade and shelter from native riparian vegetation can increase feed production, wool growth and survival rates (especially lambs and adults off shears).
- Rotational grazing rather than set stocking can be used to maintain ground cover and prevent soil erosion, and to improve pasture production and feed utilisation in all regions, from the high rainfall to the semi-arid.
- Higher livestock performance and product quality improvements (from cleaner water, lowered death rate, less vegetable matter or soil in wool).
- Reduction in mustering and livestock inspection times, reduced risk of losing stock during floods and from bogging.

Environmental benefits

Enhanced management of rivers, gullies and other water courses can also deliver significant environmental benefits to farmers and to the broader community. These include:

- As noted above, control of stock access to waterways to maintain ground cover and reduce erosion or to promote natural regeneration of native plants is a crucial first start. Different regeneration and replanting methods have been demonstrated and costed, as have methods for the control of weeds in riparian areas. Maintaining or rehabilitating native riparian vegetation is essential to provide natural inputs that drive stream life, to provide shade that reduces water temperature and light levels thereby preventing excessive growth of in-stream plants including toxic algae, and to strengthen stream banks and prevent or reduce their erosion.
- Land, Water & Wool quantified the impact of gully erosion. Eroded gullies can reduce the amount of productive land, limit access to paddocks, make it difficult to muster stock, degrade water quality through sediment and nutrient runoff, and pose a risk to the safety of stock and farm staff.

- Researchers found that in one 50 millimetre rainfall event, 60 tonnes of suspended sediment, 15 megalitres of discharge (water flow), 20 kilograms of phosphorous and 75 kilograms of nitrogen ran out of a single farm gully in hours. The cumulative effect of this sort of event across a catchment significantly reduces downstream water quality to all users. Many catchment authorities have identified a reduction in sediment load in rivers as a priority, and are making funding available for on-farm works. Land, Water & Wool fact sheets will assist woolgrowers to decide the most cost-effective way to stabilise and repair gullies, and to manage in-stream wetlands on their property.
- Other environmental benefits include:
 - water quality improvements through fencing off gullies and other waterways and ensuing sediment and nutrient trapping;
 - water quality improvement by restricting stock access to streambanks and waterways;
 - biodiversity enhancement from improved vegetation management, including natural regeneration and enhanced plantings in some cases;
 - increased carbon sequestration from natural and enhanced vegetation; and
 - progress towards meeting catchment targets.

Social and personal benefits

Rivers are often seen as special places on a farm. The Rivers & Water Quality sub-program found them to be critical to a woolgrower's well being. They:

- are important to farmers' 'sense of place';
- improve the visual amenity of the property – both for farmers and the wider community;
- help to meet catchment targets for salinity, water quality and tree cover/biodiversity; and
- provide the motivation for people to change their management of these parts of the farm.

New tools and information

Research during the Rivers & Water Quality sub-program has developed or refined a range of new tools and information packages to assist woolgrowers manage these areas. These include:

- 'Insights: case studies on how woolgrowers are successfully managing rivers, streams and creeks on wool properties';
- 'Managing rivers, creeks and streams – a woolgrower's guide';
- 'Wool Industry River Management Guide: High Rainfall Zone';
- 'Wool Industry River Management Guide: Sheep/Wheat Zone';
- 'Rapid Appraisal of Riparian Condition Technical Guideline for Tasmania / SA / NSW';
- 'Managing gullies on wool producing farms';
- 'Managing in-stream wetlands on wool producing farms';
- 'Is my waterway in good condition?';
- Community guides to river and riparian management for NSW Tablelands, SA Burra region and Tasmania;
- Oral history of 10 woolgrowers in Tasmania; and
- Interactive website providing summaries of all publications and easy access to information.

Richard Weathly explaining catchment planning on the Hopkins River at 'Connewarren', Mortlake, Victoria.



Managing Pastoral Country & Climate Variability

The Pastoral Zone has about 1,700 woolgrowers (6% of the Australian total), who produce 12% of the national clip (by value) on 40% of the area in which the Australian wool industry operates. The Pastoral Zone was served by two Land, Water & Wool sub-programs – Managing Pastoral Country and Managing Climate Variability.

The overwhelming management issue that drives sustainable resource use in the rangelands is matching stocking rates to available and foreseeable feed reserves. The concept is easy to state, but in practice is very difficult to implement because of a range of confounding pressures, including:

- the enormous area of pastoral properties (e.g. Western Australian average: 189,000 ha), combined with a relative scarcity of labour, makes it difficult for a manager to know the condition of pastures across the whole property;
- non-domestic grazers (e.g. kangaroos, feral goats and rabbits) must be factored into the pressure on the available and foreseeable feed reserves;
- a highly variable climate that affects a manager's ability to judge the foreseeable feed reserves;
- the lack of effective and user-friendly monitoring techniques with which to assess land condition; and
- the lack of objective data on emerging management systems.

The effects of mismanagement of stocking rates are more critical in the rangelands than in higher rainfall areas, because low productivity per hectare makes amelioration unviable. There are few (if any) opportunities to fertilise and re-sow a depleted pasture. The low rainfall means that natural recovery is uneconomically slow. As with all agricultural producers, pastoralists face increasing scrutiny in relation to their management of their natural resources.

Management benefits

Land, Water & Wool projects have investigated a range of tools and techniques for managers to add to their decision-making 'kit bag'. For example:

- Satellite imagery was investigated as a possible technique to deal with the issue of 'seeing' the whole property in a timely fashion and as a way of monitoring the effects of rabbit control undertaken some years previously (or it could be applied to other feral animals and weeds). In addition, land assessment techniques were developed and a commonly used pasture index scrutinised for validity. While the technology still needs significant investment and refinement before it could be used in a decision-making capacity, many woolgrowers found it of significant interest.
- A new way of looking at pastoral properties' susceptibility to drought through the consideration of property attributes, carrying capacity and seasonal conditions was developed. AWI is currently considering how the outcomes from this project could be applied in its ongoing pastoral strategy.
- Stocking rates are obviously affected by seasonal conditions. Until recently, woolgrowers in most parts of Australia made limited use of seasonal risk assessments in their management decisions because of a lack of understanding of the tools, a lack of accuracy and the difficulty of converting seasonal risk assessments into local information that can be used in farm management (e.g. for estimating pasture growth). The Managing Climate Variability sub-program set out to make seasonal risk assessment more reliable for grazing enterprises. It found that the Southern Oscillation Index (SOI) provides the most easily interpreted and useful seasonal climate and pasture growth forecasts for most regions of Australia, except WA. For the woolgrowing pastoral zones of Queensland, NSW and South Australia, the time of year, forecast period and SOI phase for which SOIs provide useful information have been determined, which will enable pastoralists to make more confident seasonal risk assessments (see Table 4).

Land, Water & Wool research findings have been incorporated into State agency extension programs, including:

- NSW Department of Primary Industries' Tactical Grazing Management extension program aimed at western division landholders;
- Queensland Department of Primary Industries & Fisheries' (QDPI&F) Grazing Land Management (GLM) and Stocktake courses aimed at western Queensland pastoralists; and
- WA's Department of Agriculture & Food's Integrated Range Development extension program in WA's southern rangelands.

Production and financial benefits

Projects also helped to identify the financial impact of decision making in the pastoral zone, including:

- A project in Queensland used the ABCD land condition framework developed for land assessment in the Queensland rangelands to examine declining land condition, from an economic perspective, specifically for Mitchell grass. The area of Mitchell grass in 'A' Condition (the highest grade) had declined from 80% in the 1970s to less than 5% in 2005. In four central western Queensland shires alone, the lost value of sheep and cattle production resulting from this decline is estimated to be \$5.7 million a year. If current trends continued, then a further \$10.4 million a year decline in value would occur amounting to more than one-third of the gross margin value of production. The Mitchell grass project is working on better understanding the relationship between drought, fire, grazing management and Mitchell grass regeneration, as well as developing management guidelines for graziers.
- A comparison of various seasonal forecasts in different grazing systems indicated that the use of seasonal forecasting to make estimates about the prospects of pasture growth and feed availability in the coming season could be worth 60¢/ha – or \$17,000 to a typical Queensland pastoral property – and as much as \$1.40/ha. This included reducing the losses caused by degradation of resources and better prospects of high incomes in good years.

Table 4: Usefulness of the SOI to pastoral zone woolgrowers.

| Pastoral Zone | Useful period | Comment of usefulness* |
|--------------------|---------------------------|---|
| NSW | Late winter-spring period | Useful. Can contribute to important tactical decisions regarding livestock sales or purchases, and in-crop management. |
| Western Queensland | November to March | Useful for forecasting rainfall and pasture growth during November to March, using a two-stage forecasting system that includes sea surface temperatures |
| SA | June to November | Useful for three-month forecasts of rainfall and pasture growth between June and November. |
| WA | None | Not useful. Seasonal rainfall forecasts using the SOI are generally unreliable, except for summer rainfall when the SOI is strongly positive or negative. |

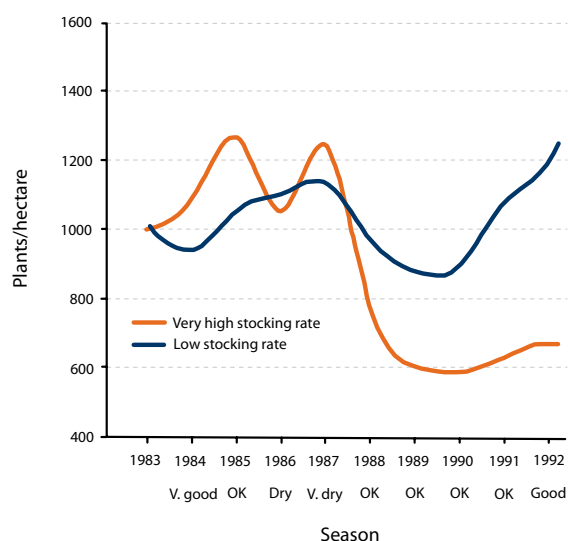
** The usefulness of the SOI is phase dependent and lead times can vary. For detail on the use of the SOI in seasonal risk assessments see the climate products in Appendix 3.*

- In Queensland, a Land Condition Framework project developed an economics module through trial and amendment of Breedewe and SheepDyn software for the mulga and Mitchell grass regions. Relationships between land condition, stocking rate, carrying capacity and production were based on consultations with research and extension officers, a literature review and the principles and substantiated information developed for the GLM workshops. A system was established to ensure woolgrowers can access the economics module via QDPI&F staff if they wish to assess alternative scenarios to those already developed for GLM.

Janelle Park updating the website for the Queensland Managing Climate Viability project.



Figure 3: Survival of cotton bush in the WA rangelands after drought in 1987 (Holm, 2006)



Environmental benefits

The WA Managing Pastoral Country sub-program project (AMH3) emphasised the fragile nature of natural resources in the pastoral zone. Poor management decisions leading up to and during drought can have permanent effects on the resource base, such that it never again recovers, even when 'good' seasons return (see Figure 3).

One of the components necessary to prevent future degradation is an alert system based on climatic understanding, ecosystem response and resource monitoring that provides a warning before damage occurs, rather than a retrospective analysis after the event (McKeon *et al.*, 2004). The aim of Managing Pastoral Country sub-program projects was to investigate tools that could provide warnings and prompts to encourage vigilant observation and timely decisions on appropriate stocking rates.

- In the WA project this was done through a methodical process of risk assessment of a property's inherent vulnerability to drought, combined with a systematic means to follow

up the season until a critical date beyond which no further rainfall could reasonably be expected (typically between mid-August to early September for the WA southern rangelands). The result provides a comparatively objective analysis of risk that can counter-balance the stress and subjectivity of making a decision about pre-drought de-stocking.

- Queensland researchers offered advice on drought and post-drought management of Mitchell grass tussocks to avoid the debilitating effects of dieback. Perennial plants, such as Mitchell grass, are essential to ecosystem function in the rangelands.
- The Land Condition Framework project in Queensland made use of the strong and approximately linear correlation between basal area of perennial grasses and pasture productivity in improving the 'ABCD' monitoring system used to assess rangeland condition in Queensland. The new framework can be used by pastoralists and extension staff to track changes in pasture condition over the long term.

Personal and social benefits

At either end of the continent, woolgrowers involved with Land, Water & Wool projects expressed the desire for tools and technologies that would inject a greater degree of objectivity into decision making on stocking rates.

- The Managing Climate Variability sub-program fine-tuned the Southern Oscillation Index (SOI) by refining the months, places and phases in which it could add value to a pastoralist's decision. Many woolgrowers said that using seasonal risk assessments gave them insights to their local climate's variability that rainfall records and human memory could not provide.
- In the Managing Pastoral Country sub-program, the WA and NSW projects emphasised pre-drought preparedness and the setting of trigger dates by which decisions about stocking must be made.
- Where SOI reliability is low, historical rainfall records can be used in the development of trigger points. Objectivity and setting actions against key dates remove some of the stress of decision-making and give the manager some feeling of control in an otherwise uncertain environment.

New tools and information

Research during the Managing Pastoral Country and Managing Climate Variability sub-programs has developed or refined a range of new tools and information packages to assist woolgrowers manage such areas. These include:

- 'Insights – Case studies on how woolgrowers are successfully managing pastoral country for profit and sustainability';
- 'Betting on Rain – a Guide to Seasonal Forecasting in Western NSW';
- 'Climate Risk Seasonal Outlook – Pocket Guide for Wool Producers in the Pastoral Rangelands of SA';
- 'Drafting Gate' – On-line information and decision-support tool;
- 'Critical Decisions on Stocking Rate' – instruction & decision support manual;
- 'ABCD Pasture Condition Guide for Mulga & Mitchell grass regions';
- 'Mitchell Grass Recovery – Drought Information Kit'; and
- 'Mulga as a feed source' – fact sheet.

Future Woolscapes

Future Woolscapes, the scenario planning component of Land, Water & Wool, closely examined some key long-term issues (such as climate change, the emergence of new technologies, pressure from competitive fibres and land use, changing consumer preferences, etc) to explore the trends and patterns evident around us today, and to look at how they may shape the wool industry over the next 25 years.

It has developed a range of key outputs, primarily for wool industry organisations (such as AWI), but which also have applicability to a range of other enterprises. These include:

- A set of commissioned expert reports on specific issues that may (or may not) affect the world and the wool industry in the future.
- Four totally different wool industry scenarios (written as short stories) set in the year 2030.
- Indicators that may be employed via a scanning process to identify if any of these scenarios are emerging.
- Detailed implications and possible R&D strategies for the wool industry to consider.

While the Future Woolscapes program did not aim to develop any management recommendations or financial, environmental or social impacts, the use of scenario planning showed many common and important themes in these areas. The background research papers for the Future Woolscapes sub-program (see Appendix 3) outline a number of possible areas for research and development investment.

Issues identified by the sub-program that could be considered by woolgrowers and the industry in their long-term strategic planning included:

Management

Farm management approaches will possibly alter, with greater focus on:

- animal welfare;
- an ability to track fibre through the processing to final product;
- a likely move to further agricultural specialisation, including a possible significant relocation of wool production;
- further increase in scale of the enterprise; and
- increased focus on business skills.

Production and financial challenges

The economics of woolgrowing will likely alter, requiring:

- significant productivity and quality improvements (\$/ha) as the terms of trade for wool continue to reduce; the growth in synthetic fibre production remains unabated; and price competition remains fierce; and
- harnessing the opportunities created by new technologies.

Environmental challenges

The Future Woolscapes sub-program identified that sustainable resource use was a consistent and growing theme in all scenarios.

- Environmental considerations may be driven by government regulation or consumer demands – or both. This may well be further compounded by climate change.
- Consistent with the findings of Land, Water & Wool, sheep may be well positioned to be an important element in sustainable and profitable land use (cropping rotations; less arable areas).

Social issues

Significant implications from a social perspective are also evident – both in rural Australia and globally. Some considerations include:

- an increased need for labour-saving technology as labour availability becomes tighter and manual labour less appealing; and
- changing consumer markets are likely to be far more focused on value, health consciousness, individuality, immediateness, well being, confidence and comfort.

The program generated significant interest within AWI and across the industry, as well as among woolgrower groups. As an addition to industry workshops, a woolgrower session on thinking about the future of the industry run along scenario planning lines proved to be a stimulating activity, especially for younger woolgrowers. Woolgrowers involved in the Future Woolscapes forum (tasked with the scenario development), along with those that had a presentation, found the exercise improved their confidence that the industry is thinking in terms of long-term opportunities and risks.

New tools and information

Research during the Future Woolscapes sub-program has developed or refined a range of new tools and information packages to assist woolgrowers manage such areas. These include:

- 'Future Woolscapes – Summary of Commissioned Research Papers'
- 'Future Woolscapes – What might the world and the wool industry look like in 2030? – Brief Summary'

I feel strongly that the Future Woolscapes outcomes have real value for planning by many entities in the wool industry to individual woolgrower businesses; to consultants/advisers; to AWI; to agribusiness suppliers; to government departments; to stud merino breeder organisations; and to others.

The outcomes are helping form some views that I will take into the new strategic planning process that AWI will initiate shortly. For example, Future Woolscapes has contributed to a firming of my support for ongoing investment on behalf of woolgrowers in NRM R&D and demonstrating the complementarity between wool production and excellent environmental stewardship. It has also strengthened my commitment to the development of an industry-wide framework for accounting for on-farm environmental, animal welfare and chemical use issues – for use by those woolgrowers who see it as important to their management and by those in supply chains which demand such information.

Ian Rogan, General Manager, Wool Production, AWI, August 2006

Evaluation

This chapter summarises the monitoring and evaluation data from the Land, Water & Wool program and its sub-programs to provide an overview of how it performed against its objectives. The details behind this summary can be obtained from the full individual sub-program evaluation reports (Coutts, 2006a-d & 2007) and the cost-benefit analysis report (Agtrans, 2007).

As stated earlier, the program was directed at increasing woolgrowers' awareness of, and motivation and capacity to tackle, NRM issues. It also aimed to position the wool industry to reduce its environmental impact and to provide it with an opportunity to use environmental performance as a strategic marketing asset if it so chooses.

The evaluations have shown the Land Water and Wool program has been highly successful in addressing its objectives and realising its outcomes.

Highlights

- From a total investment of \$19.89 million from AWI, a further \$19.91 million was leveraged (MLA and others) to be directed at increasing sheep and woolgrowers' awareness of, motivation and capacity to tackle NRM issues.
- The estimate of the benefit-cost ratio for Land, Water & Wool investment is 3.9 to 1, with an internal rate of return of 26%. The present value of benefits was \$87.3 million, made up of \$43 million in productivity benefits and \$44.3 million in environmental benefits. When the additional \$22.8 million (present value) in partner funds are included, the benefit-cost ratio becomes 3.5 to 1, with a total present value of \$156 million generated.
- Table 5 shows the numbers of wool industry members who were involved in the Land, Water & Wool sub-programs.
- More than 4,220 woolgrowers directly took part in trials or attended training activities.

Advocates target NRM Agencies

Regional natural resource management agencies, such as Catchment Management Authorities, are key stakeholders in agriculture and the environment. The Advocates project targeted these agencies to show how wool production can assist in the sustainable management of Australian landscapes. Consultants with strong networks among natural resource management (NRM) bodies were trained in the range of Land, Water & Wool management products. They then identified particular products that addressed aspects of Regional Catchment Strategies and targeted specific agency personnel for extension. The approach focused on how Land, Water & Wool could help them to engage woolgrowers in making progress towards regional NRM targets in a mutually beneficial way. The consultants considered this approach to have been both innovative and highly effective.

Table 5: Growers 'touched' by Land Wool & Water activities and information.

| Area of investment | Involved field/ technical officers | Cooperating (host) woolgrowers | + woolgrowers engaged in activities | + woolgrowers receiving information | Total woolgrowers reached at some level | Estimated number who made one or more practice changes to date |
|--------------------|------------------------------------|--------------------------------|-------------------------------------|-------------------------------------|---|--|
| SGSL | 150 | 150 | 1,700 | 5,200 | 7,050 | 1,200 |
| Rivers | 70 | 20 | 410 | 1,600 | 2,030 | 300 |
| Native Vegetation | 300 | 70 | 930 | 8,400 | 9,400 | 1,000 |
| Climate | 80 | 20 | 480 | 1,270 | 1,770 | 350 |
| Pastoral | 20 | 20 | 160 | 1,500 | 1,680 | 160 |
| Future Woolscapes | 10 | 10 | 250 | 1,000 | 1,260 | 180 |
| Total program | 630 | 290 | 3,930 | 18,970* | 23,190* | 3,190** |

May be overlaps between sub-programs.

*** Based on estimates from survey data and/or proportioned – 50% close engaged; 5% receiving information.*

- The most important benefits from the program in a quantitative sense are productivity improvements due to changes in grazing strategies and pasture management, and water quality and biodiversity improvements.
- There are likely to be many unvalued benefits, such as increased amenity value to woolgrowers and the community, and increased pride by woolgrowers due to a sense of 'managing the resource well'.
- It is estimated that more than 3,190 woolgrowers adopted one or more tools, management approaches or practices by the end of the program as a direct result of their involvement. This compares to a target of more than 2,000 woolgrowers.
- Some 250 different knowledge products have been produced, with around 30,000 individual copies ordered from the product distribution centre. More than 70 media releases have been developed, with items appearing in around 90 TV, print or radio outlets, as well as a range of direct mail farmer magazines.

The tables on the following two pages summarise the achievements of the Land, Water & Wool program against its expected outcomes and outputs from Land, Water & Wool Business Plan.

Evidence of the impact of the sub-program activities is outlined in the following sections. These are: Sustainable Grazing on Saline Lands (SGSL); Native Vegetation & Biodiversity; Rivers & Water Quality; Climate; Pastoral; Futures; SGS Harvest Year and Benchmarking.

The more generalised outcomes from the program that cannot be attributed to any specific sub-program include:

- improvement in the industry's capacity to negotiate, respond to and manage potential future regulation, due to improved on-farm assessment tools;
- enhanced knowledge of woolgrower best management practices and how they are improving;
- contribution to maintaining or improving demand for wool in the long term through development and adoption of sustainable production practices;
- contribution to the enhanced design and effective delivery of incentives and payments for future ecosystem services and land stewardship;
- development of lessons and networks for future improved management of joint ventures;
- possible contributions to improvements in future NRM programs of AWI by identifying priorities for further investment and encouraging woolgrowers to be more receptive to future NRM initiatives; and
- raised awareness in the wider community (including government and politicians) of the wool industry's strategies and activities to sustainably manage natural resources and its capability of performing a stewardship role.

SGSL Producer Networks

In tandem with the four major scientific research projects, SGSL supported 120 woolgrower demonstration sites across southern Australia. The sites were selected by State-based steering committees made up of woolgrowers and agency staff, with executive support from the local State agency. Key criteria were that the applicant was part of a local natural resource management or production group, and the demonstration would trial an issue of interest to that group. An average of \$20,000 was allocated to each site – about half for on-ground works and half for field days, publicity, product development, support activities and site characterisation.

Strengths:

- A simple, farmer-friendly application process.
- Producer-driven and participatory – this approach delivered a strong set of projects that demonstrated and promoted farm practice change.
- The group nature of projects meant that the 120 demonstrations could be accessed by more than 1,700 group members.
- It created an extension network through which could be delivered other information about saltland management and SGSL research results.

Lessons for next time:

- For many sites, the quality and quantity of data was less than was hoped for. In hindsight, expecting farmers to do detailed monitoring was perhaps optimistic.
- It is always a difficult question of balance to know ahead of time how much emphasis to put on site characterisation.
- For some sites, more technical and facilitation support could have been helpful.



Outcomes

| Expected Outcome | Achievement |
|--|---|
| A wool industry identified and respected as taking a proactive approach to NRM. | Land, Water & Wool has contributed strongly to the wool industry being identified and respected for its NRM work, as demonstrated by the policy and perceptions survey (Agtrans, 2007) and the informed persons' survey for SGSL. |
| The groundwork for measurable change in woolgrower NRM priorities and practices (Note: the five-year Land, Water & Wool program is relatively short in relation to NRM change. Consequently, it is not expected that significant on-ground change will be evident when the program has concluded. However, the framework for future change in this regard should be well established). | The progress demonstrated through sub-program evaluations and the associated cost-benefit analyses has shown that increased attention to NRM priorities and practice has been embedded in a critical mass of woolgrowers with a momentum for further gains. The collated information has also provided a comprehensive benchmark to measure ongoing change. |
| Woolgrowers demonstrating an increased: awareness of NRM issues; understanding of their importance and implications for the industry; and motivation to address the issues. | There is overwhelming evidence emerging from the sub-program evaluations that most of the 4,220 woolgrowers who were closely engaged with the program increased their knowledge, capacity and motivation in addressing NRM issues on their properties. |
| More than 2,000 woolgrowers applying NRM innovations (covering salinity, waterway and native vegetation management, pastoral land use, biodiversity and climate forecasts) with a further 4,000 directly contacted through Land, Water & Wool. | It is estimated that more than 3,190 sheep- and wool-growers have applied one or more NRM practices as a direct result of involvement in Land, Water & Wool activities over the life of the program, with a further 1,720 directly involved in Land, Water & Wool activities and up to 19,000 accessing information about Land, Water & Wool programs. |
| An <i>ex ante</i> cost-benefit analysis estimated that the program should deliver (very conservatively) \$58 million in improved productivity to woolgrowers and \$46 million in enhanced environmental benefits (at an overall benefit-cost ratio of 5.5:1). | The investment in Land, Water & Wool has resulted in a benefit-to-cost ratio estimated at 3.9 to 1, and an internal rate of return of 26%. The present value of benefits was \$87.3 million, made up of \$43 million in productivity benefits and \$44.3 million in environmental benefits. |
| Additional (difficult to quantify and value) future benefits which may include increased land values, reduced regulation, potential market premiums and market access, improved access to capital, increased community support and increased woolgrower pride. | The cost-benefit analysis concluded that there were likely to be many unvalued benefits, such as increased amenity value to woolgrowers and the community, and increased pride by woolgrowers due to a sense of 'managing the resource well'. |

Outputs

| Expected Output | Achievement |
|--|--|
| Woolgrower NRM issues, needs and priorities identified. | Woolgrowers' needs and priorities were established by the comprehensive benchmarking survey undertaken at the beginning of the program. This market research involved a telephone survey of 1,500 woolgrowers and 30 in-depth interviews. |
| A comprehensive understanding of woolgrower practices and perspectives (attitudes). | Woolgrowers' practices and perspectives were established by the benchmarking survey undertaken at the beginning of the program. |
| Knowledge products (e.g. guides, fact sheets, case studies) emanating from each of the sub-programs, including products intended to increase motivation and to increase assessment capabilities of woolgrowers contemplating practice change. | Around 250 different knowledge products have been generated across the program (Appendices 3 and 4). There is a focus on clear information, guidelines, assessment tools and case studies to motivate woolgrowers and assist them in pursuing further assistance. |
| Increased capacity of woolgrowers associated with sub-programs regarding increased knowledge and management options, where to find relevant information, capacity to assess profitability and access industry and government support mechanisms (e.g. woolgrower networks, government incentives). | About 4,220 sheep and woolgrowers were closely engaged with sub-programs, including new woolgrower networks, with evaluations showing that most had gained awareness and knowledge. It is estimated that approximately 3,190 have already made one or more changes. |
| Development of effective mechanisms for delivery to woolgrowers of these knowledge products, management options, and information on costs and benefits and on other desirable physical and social outcomes. | Communication strategies operated at a program and sub-program level. This included the commissioning of an externally managed communication strategy to stakeholders; appointment of an experienced rural extension expert to manage the Delivery of Land, Water & Wool products; and an innovative advocates program which proactively introduced Land, Water & Wool products to their target audiences. |
| High level of involvement of woolgrowers associated with each sub-program. | The Land, Water & Wool sub-programs directly involved 4,220 sheep- and woolgrowers, with 1,850 directly involved in SGSL networks. |
| Demand for various products from the program. | Around 30,000 individual products have been sent out with ~70% of these having been ordered directly from the distributor. Website visits have averaged around 680 unique users per month |
| Commencement of a comprehensive database of objective measures of natural resources at the farm level. | Two databases were developed – one for the SGSL National Research sites and one for the SGSL woolgrower network. Other sub-program projects populated their own databases as required. |
| Demonstration to the broader community that appropriate knowledge and management options are available and knowledge delivery mechanisms are in place. | More than 70 media releases have been developed with items appearing in around 90 TV print or radio outlets, as well as a range of direct mail farmer magazines |
| Identification of future wool production system needs, policy options and research priorities. | The Future Woolscapes sub-program explored key future issues such as climate change, technology developments, competitors, regulatory pressure and consumer needs, and developed four differing scenarios in a 25-year timeframe. For each scenario, an array of R&D and policy needs was identified. These have been examined in depth by AWI. |

SGSL was the largest of the sub-programs. Through a combination of national research sites and the development of an extensive network of woolgrowers in regions that have salinised (or high risk) land, existing information was reviewed and repackaged, new research conducted and local demonstrations undertaken.

Land Wool & Water provided a total budget of \$12,017,903, including a proportion of program overheads for SGSL. Based on a conservative estimate of the profitability gains likely and the area that may be planted to saltland pastures over the next 10 years, the investment in SGSL is considered to have provided benefits with a present value of \$24.6 million. The investment is estimated to provide a benefit-cost ratio of 2.1 to 1 and an internal rate of return of about 11.8%. (Agtrans, 2007)

Most host farmers reported high satisfaction with results on their sites. Almost all group members associated with the trial sites in the different regions were very positive about their involvement and the achievements. Many reported having developed an increased confidence, ability and desire to more effectively manage their saline land.

Ninety per cent of informed persons surveyed from across the participating States rated the core activities of the sub-program as effective to very effective in terms of both exploring practical options for the management of saline land and in promoting networking and information sharing. These 'informed persons' were drawn from a non-random group within wool industry and NRM networks to provide a sounding board for Land, Water & Wool evaluations.

Key new knowledge outcomes from the project have included:

- a greater awareness and integration of options for salt-affected land;
- improved understanding of how to establish and manage saltland pasture systems;
- greater confidence by many farmers to tackle salt-affected land, with their subsequent attitudes toward saltland having changed from wasteland to potential profitability; and
- an increased desire to improve salt-affected areas and show others that it can be profitable.

To date, an estimated 1,200 woolgrowers have made some practice change as a direct result of SGSL activities. The types of documented changes included fencing out saline areas and planting more salt-tolerant trees, shrubs and pastures.

The main identified potential impact from the sub-program's outputs was the future profits from increased productivity, as well as the improved environmental and social condition. An Ararat woolgrower said: "There was no grazing from the saline site. We are now able to graze the treated site, there is no evidence of salt and the production allows high stocking (25 dse/ha) for short rotational grazing. A very beneficial outcome."

Respondents to an extensive Informed Persons Survey rated the 'triple bottom line' benefits from the sub-program highly (see table below).

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through ongoing extension activities.

| | |
|---|-------|
| Involvement field/ technical officers | 150 |
| Cooperating (host) woolgrowers | 150 |
| + woolgrowers engaged in activities | 1,700 |
| + woolgrowers receiving information | 5,200 |
| Total woolgrowers reached at some level | 7,050 |

The details underpinning this summary can be sourced from two reports: 'Evaluation Report for the Sustainable Grazing on Saline Land Sub-program' (Coutts, 2006a) and 'Ex post Benefit Cost Analysis for the Land, Water & Wool Program' (Agtrans, 2007).

| Economic | Environmental | Social | [Agtrans, 2007] |
|---|---|---|-----------------|
| Increased adoption of saltland pastures. | Reduced spread of salinity and protection of associated remnant vegetation. | Renewed pride and satisfaction. | |
| Lower cost of establishment. | Reduced soil erosion and salt export. | Enhanced amenity value for both woolgrowers and the remainder of the community. | |
| Less risk in establishment. | Improved water quality in waterways. | Increased individual and community capacity to manage saline land. | |
| Productivity increases. | Revegetation of otherwise very low value habitat. | | |
| Higher DSE/ha with improved saltland pastures. | Improved biodiversity of flora and associated fauna in some regions. | | |
| Higher gross margins on whole farm basis. | Rehabilitation of degraded land. | | |
| Water quality impact on livestock performance. | | | |
| Positive biodiversity impact on pests and diseases. | | | |

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through ongoing extension activities.

| | |
|---|-------|
| Involved field/ technical officers | 300 |
| Cooperating (host) woolgrowers | 70 |
| + woolgrowers engaged in activities | 930 |
| + woolgrowers receiving information | 8,400 |
| Total woolgrowers reached at some level | 9,400 |

The details underpinning this summary can be sourced from two reports: 'Evaluation Report for the Native Vegetation & Biodiversity Sub-program of Land, Water & Wool'; (Coutts, 2006b); and 'Ex poste Benefit Cost Analysis for the Land, Water & Wool Program' (Agtrans, 2007).

The Native Vegetation & Biodiversity sub-program aimed to develop, test and promote options for integrating wool production, and the protection, management and restoration of native vegetation and its associated biodiversity in the High Rainfall and Wheat-Sheep Zones.

The sub-program objectives were about creating the science and knowledge behind a set of guidelines, best management practice, monitoring tools and policy approaches that could be used to encourage, promote and assist the adoption of improved management approaches for native vegetation and biodiversity. The sub-program sought to achieve its objectives through five R&D projects based in Tasmania, South Australia, Victoria, NSW and Queensland.

Total funds from Land, Water & Wool were \$3,039,549, including a proportion of program overheads. The Land, Water & Wool investment's Present Value is estimated at \$24 million, with an estimated benefit-cost ratio is 6.3 to 1 and internal rate of return of 45% (Agtrans, 2007).

Evaluation activities showed that there was a wide degree of interest in native vegetation and biodiversity work from woolgrowers across the projects. The level of positive response increased over the life of the projects. There was much interest in the economics of native vegetation and biodiversity as it affected productivity and profitability and the use of local grounded data was seen as important in supporting change in management practice.

The suite of projects produced a significant amount of new knowledge and guidelines about combining profitability with management for positive native vegetation and biodiversity outcomes.

Surveys and feedback sheets indicated that there was a high level increased understanding, knowledge, skills and interest in native pastures, biodiversity and related management approaches among those woolgrowers who were closely engaged with the project or who attended one or more of its activities.

Extension and advisory personnel involved in activities also reported increases in their knowledge and willingness to incorporate learnings into their extension programs.

It is estimated that close to 1,000 woolgrowers made changes as a result of project activities and information by the end of the project. The knowledge, experiences and tools developed have the potential to support much broader ongoing management practice change as they are taken forward into broader extension programs into the future. Recorded practice changes included: the fencing of native bushland; sub-dividing paddocks; use of rotational grazing; tree planting; and more informed strategic control of timber.

Potential impacts that could result from the outputs of this sub-program are shown in the table below.

| Economic | Environmental | Social [Agtrans, 2007] |
|---|---|--|
| Pasture productivity improvements. | Ecological value of improved biodiversity. | Improved visual amenity value to the landholder and to the wider community. |
| Improved growth rates and reduced death rates of livestock due to shade and shelter. | Reduced salinity risk. | Greater sense of satisfaction among woolgrowers for 'doing the right thing' for the environment. |
| Pollination and improved pest control from beneficial insects, birds and bats that use native bushland and revegetation as habitat. | Improved water quality due to reduced runoff of sediment and trapping of nutrients etc. | Increased capacity to manage native vegetation in the future. |
| Fencing, watering and planting costs, and opportunity cost of reduced stocking rates in some cases. | Increased carbon sequestration due to enhanced vegetation growth | Contributes to a woolgrower's 'sense of place' |
| Reduced input costs associated with fertiliser/chemical use and the cost and maintenance of sown pastures. | | |
| Increased production of fine wool from native pastures that obtains a price premium | | |

The Rivers & Water Quality sub-program aimed to assist woolgrowers to better manage their rivers and riparian areas for both sustainability and productivity goals through:

- practical methods for improved river management and water quality demonstrated by leading woolgrowers;
- evaluation of improved methods for stock management in riparian zones; and
- development of river and riparian land management guidelines and other communication products, in close collaboration with leading woolgrowers.

Land Wool & Water provided a total budget of \$3,061,496, including a proportion of program overheads. The Present Value of the Land, Water & Wool investment is estimated at \$15 million, providing a benefit-cost ratio of 6.1 to 1 and an internal rate of return of 45% (Agtrans, 2007).

The sub-program established three regional projects (in the mid-north region of South Australia (Burra), NSW tablelands (Bookham) and the Tasmanian midlands (Ross)) and was focused mainly on the sheep wheat (300-600 mm) and high rainfall (>600 mm) parts of Australia. The research concentrated on practical waterway management problems that had been identified by woolgrowers.

Issues examined included:

- grazing management;
- fencing and watering options;
- revegetation techniques;
- weed management; and
- 'best bet' approaches for dealing with gully erosion.

Each of the three regional projects worked directly with a group of local woolgrowers to develop solutions to these issues within the context of a commercial wool enterprise. Each was co-ordinated by a local person who was well

known and trusted by woolgrowers and who could provide local skills and knowledge to the woolgrowers long after completion of the Land, Water & Wool investment.

Another aspect to the regional projects was the development of Rapid Appraisal of Riparian Condition (RARC) techniques specific to the local environment. These RARCs were supported by training for local catchment management and industry extension officers so that the skill base would remain in the local region after the Land, Water & Wool program finished. A range of fact sheets and guides have also been developed that are specific to woolgrowers in each of the three regions.

A fourth project ran at the national level and developed two comprehensive Wool Industry River Management Guides, one for the Wheat-Sheep Zone and one for High Rainfall Zone. All these products are in hard copy and web-based formats, with an interactive site enabling easy access to 'bits' of the guides for use by CMA, BestWool, State agency staff or facilitators wishing to run local field days and workshops (a train the trainer approach). Case studies have been used extensively in both the regional and national projects so that recommended management practices can be 'brought to life' through woolgrower experiences.

Documented examples of practice change include a noticeable increase in interest in improving the condition of the Macquarie River in Tasmania with significant lengths of river frontage fenced.

It is estimated that more than 300 woolgrowers have already made some changes to date in relation to the sub-program activities. Potential impacts from the outputs of this sub-program are shown in the table below.

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through ongoing extension activities.

| | |
|---|-------|
| Involved field/technical officers | 70 |
| Cooperating (host) woolgrowers | 20 |
| + woolgrowers engaged in activities | 410 |
| + woolgrowers receiving information | 1,600 |
| Total woolgrowers reached at some level | 2,030 |

The details underpinning this summary can be sourced from the 'Cost-Benefit Analysis for Land Wool & Water' (Agtrans, 2007) and individual project reports from the sub-program.

| Economic | Environmental | Social | [Agtrans, 2007] |
|---|----------------------------|--|-----------------|
| Private benefits including improved grazing, shelter, livestock performance and product quality, and reduced mustering costs. | Water quality improvement. | Enhanced amenity value for both woolgrowers and the remainder of the community. | |
| Private costs including capital and maintenance costs of intervention. | Biodiversity enhancement. | Increased individual and community capacity to manage riparian areas. | |
| | Carbon sequestration. | Greater sense of satisfaction among woolgrowers for 'doing the right thing' for the environment. | |

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through on going extension activities.

| | |
|---|-------|
| Involved field/ technical officers | 20 |
| Cooperating (host) woolgrowers | 20 |
| + woolgrowers engaged in activities | 160 |
| + woolgrowers receiving information | 1,500 |
| Total woolgrowers reached at some level | 1,680 |

The details underpinning this summary can be sourced from two reports: 'Evaluation Report for the Managing Pastoral Country Sub-program of Land, Water & Wool' (Coutts, 2006c); and 'Ex poste Benefit Cost Analysis for the Land, Water & Wool Program' (Agtrans, 2007).

The Managing Pastoral Country sub-program commissioned and tested five innovative projects to provide simple 'best bet tools' that Pastoral Zone woolgrowers could readily use for more effective monitoring and management of grazing. The projects focused on both enhanced profitability and sustainability and included a review of the needs of the Pastoral Zone woolgrowing industry.

Land Wool & Water provided total funds of \$627,420, including a proportion of program overheads. The present value of the Land, Water & Wool investment is estimated at \$1.2 million, providing a benefit-cost ratio of 1.5 to 1, and an internal rate of return of 8.7%. (Agtrans, 2007)

The five projects were based in Western NSW, the WA and SA Pastoral Zones, and the Mulga and Mitchell grass regions of Queensland. Many of the tools and products developed in one region had relevance across the other.

There have been very positive reactions to the range of outputs from those involved in developing, testing or reviewing the products. However, there is a recognition that further development and testing is needed before all products are fully usable by woolgrowers.

A project review identified a large amount of new (or newly packaged) knowledge that emerged as a result of these projects. Testing of some products with woolgrowers (stocking rate tools; assessing land conditions) provided participating woolgrowers with increased understanding and confidence in decision making in these areas. Because of the nature of the projects, measurement of gains in knowledge and aspirations from the wider stakeholder groups was not measured.

The sub-program review identified a large number of (potential) practical uses for the sub-program projects' outputs by woolgrowers. These include:

- undertaking assessments to better match animal numbers to feed supply;
- being more systematic in alerting themselves to decisions and their timing in the face of drought;
- assessing and actively managing Mitchell grass recovery;
- using more effective information to assess feed supply and land condition across properties; and
- better assessing their own land condition.

Broad adoption of practice change was not expected in the project's time frame, however, there were examples of some participating woolgrowers making changes. There was also some evidence of researchers changing focus to more practical applications and commercial companies expressed an interest in using some outputs. The integration of some project results into workshop programs such as Grazing Land Management and the Stocktake courses have the potential to make the results of the sub-program available to a number of woolgrowers over the next few years.

There is some evidence that the tools and outputs of these projects have the potential to provide environmental management and associated economic benefits on many of the 1,700 properties across the Pastoral Zone. Potential impacts that could result from the outputs of this sub-program are shown in the table below.

| Economic | Environmental | Social | [Agtrans, 2007] |
|--|---|---|-----------------|
| Maintenance of productive capacity and an increase in long-term average profitability per property from improved stocking rate and grazing pressure decision making. | Reduced land degradation including soil erosion potential from use of more effective stocking rate decision aids. | Reduced anxiety in managing uncertainty in pastoral management. | |
| | Improved biodiversity. | Enhanced personal capacity of woolgrowers in managing stocking rates and grazing pressures. | |
| | Improved water quality in some waterways. | | |

The Managing Climate Variability sub-program sought to rapidly increase woolgrower awareness and use of seasonal risk assessments, initially in priority pastoral regions, contributing to sustainable grazing management through the development of enhanced decision-making tools and demonstrating these tools to woolgrowers.

Land Wool & Water provided total funds of \$909,305, including a proportion of program overheads. The present value of the Land, Water & Wool investment is estimated at \$5 million, providing a benefit-cost ratio of 4.2 to 1 and an internal rate of return of 20%. (Agrtrans, 2007)

The sub-program focused on the application of publicly available seasonal climate forecast information and climate risk assessment for pastoralists. It also sought to lay the foundation for future consideration of new systems as they become available.

The sub-program used four delivery projects based in the pastoral areas – the southern rangeland of South Australia, western NSW, the southern zone of Western Australia and Queensland. Each project was about developing and promoting improved information and tools to enable woolgrowers to more effectively use seasonal forecasting, so as to make decisions about stocking rates and related matters.

Different approaches were taken in each project:

- Queensland focused on Internet delivery;
- South Australia developed a pocket guide;
- NSW used workshops and a booklet; and
- Western Australia integrated information with other related initiatives.

There were positive reactions to the projects' activities across the regions, as shown by:

- responses by case study woolgrowers and others who tested the pocket guide in SA;
- the 80% satisfaction rate by woolgrowers who attended the SA workshops;
- a newsletter survey that produced a high positive rating (88%) for the value of the project in western NSW;
- the increased information seeking in related topics in the southern zone of WA (feedback from Department of Agriculture WA); and
- the positive reactions by some woolgrowers to the website and electronic workshops in Queensland.

It is estimated that at least 350 woolgrowers had made practice changes by the end of the project. The knowledge, experiences and tools developed have the potential to support much broader ongoing practice change among the 1,700 woolgrowers in the Pastoral Zone as they are taken forward into broader extension programs into the future.

Potential impacts that could result from the outputs of this sub-program include the increased ability of woolgrowers to maximise profits and minimise losses through an improved understanding and use of effective risk assessment.

These benefits are included in the summary of Triple Bottom Line benefits included in the following table.

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through ongoing extension activities.

| | |
|---|-------|
| Involved field/ technical officers | 80 |
| Cooperating (host) woolgrowers | 20 |
| + woolgrowers engaged in activities | 480 |
| + woolgrowers receiving information | 1,270 |
| Total woolgrowers reached at some level | 1,770 |

The details underpinning this summary can be sourced from two reports: 'Evaluation Report for the Managing Climate Variability Sub-program of Land, Water & Wool' (Coutts, 2006d) and 'Ex post Benefit Cost Analysis for the Land, Water & Wool Program' (Agrtrans, 2007).

| Economic | Environmental | Social |
|--|---|--|
| Increase in long-term average profitability per property from use of climate information (including seasonal climate forecasts) and their applications in decision making. | Reduced land degradation potential from use of risk assessment (e.g. early warning drought aids) through adjustments of feed budgets and grazing pressures. | Reduced anxiety in managing variable climatic conditions. |
| | | Enhanced personal capacity of woolgrowers in managing climatic and grazing pressure risks. |

[Agrtrans, 2007]

The number of woolgrowers and technical field officers engaged at different levels of the project. Many more woolgrowers will benefit from tools and guidelines developed through ongoing extension activities.

| | |
|---|-------|
| Involved field/technical officers | 10 |
| Cooperating (host) woolgrowers | 10 |
| + woolgrowers engaged in activities | 250 |
| + woolgrowers receiving information | 1,000 |
| Total woolgrowers reached at some level | 1,260 |

The Future Woolscales sub-program of Land, Water & Wool was a scenario-planning exercise. It was deliberately 'blue sky' research and covered more than just natural resource management issues.

The sub-program was designed to:

- identify and analyse the key global and industry issues likely to affect the wool industry over the next 25 years;
- develop a range of alternative scenarios; and
- identify and prioritise their strategic implications for the wool industry, especially as it relates to research, development and policy.

Land Wool & Water provided total funds for the project of \$561,218, including a proportion of program overheads. The sub-program's key benefits include a more robust research program for the wool industry and improved directions for industry policy and strategy, potentially resulting in a more profitable and sustainable wool industry meeting community, government and consumer demands. There was no benefit cost analysis undertaken for this sub-program (Agtrans, 2007).

- The Future Woolscales project delivered on the key outputs sought, especially:
 - a set of commissioned 'expert' reports on specific issues that may (or may not) affect the world and the wool industry; and
 - four totally different wool industry scenarios and a listing of research, development and policy implications that arise.
- The members of the Future Woolscales National Forum rated the sub-program as a worthwhile activity that had a high personal impact, but they were unsure what impact it would have on the industry (depending on AWI and LWA's use of the findings).
- Following a comprehensive review of the AWI Strategic Plan, senior managers have regularly used the outcomes of Future Woolscales during their Strategic Plan revision (2007-2012). This has included presentations and part facilitation of their planning sessions.
- Presentations on the outcomes of Future Woolscales have been made to a range of audiences, such as woolgrower groups, conferences and young farmers. These have included WA (1), SA (1), NSW (3), Victoria (2), Tasmania (1). Feedback has generally been positive, but it did vary.

Potential impacts that could result from the outputs of this sub-program are shown in the table below.

| Economic | Environmental | Social [Agtrans, 2007] |
|---|---|--|
| A future research agenda that is robust given the range of futures considered (leading to potential efficiencies in R&D resource allocation). | Reduced environmental impact of the industry, due to preparedness for future issues arising in this area. | A more robust and responsive industry with a greater capacity to prepare for change, leading to increased social and economic stability for industry members |
| More astute alignment of strategic policies with potential future impacts. | Potential for the industry to be more proactive and thus quickly and more effectively address future issues, such as action by lobby groups and/or increased regulation | |
| Optimal development of and access to future markets. | | |

SGS Harvest Year

The five-year Sustainable Grazing Systems (SGS) program addressed declining pasture productivity and sustainability in high rainfall regions by bringing researchers, woolgrowers and extension agents into a partnership to tackle the key production and sustainability issues.

As well as demonstrably increasing the profitability and sustainability of participants, SGS assembled the first nationally credible datasets of proven information (relationships, interactions and trade-offs) between water, nutrients, pasture, animals, biodiversity and economics that provide the basis for the development of improved information, tools and products for woolgrowers.

The Harvest Year concept was based on woolgrowers working with researchers to interpret the results and experiences from SGS, and to develop products for delivery to woolgrowers (Final Report, 2002). The one-year SGS Harvest Year project established Harvest Teams that reviewed the findings of the SGS project, developing practical products to assist woolgrowers attain the dual goals of productivity and sustainability.

Given the nature of the project, there was no cost-benefit analysis done for SGS harvest. The total investment was \$300,000.

Linking the Land, Water & Wool program to the SGS Harvest Year aimed to tap into the substantial knowledge base established during SGS and tailor its outcomes for immediate application to the Land, Water & Wool program.

This contribution from Land, Water & Wool resulted in Harvest Year activities, as a whole, being geared significantly towards Land, Water & Wool program needs. It is reported that having Land, Water & Wool funding made it easier to put together some MLA Tips & Tools addressing NRM issues in line with the needs of Land, Water & Wool. Specific examples included:

- The development of four EDGEnetwork courses, including Profiting from Saline Land and Managing Living Systems (because Biodiversity was not seen as a suitable title) – developed only as a result of the link to Land, Water & Wool.
- The inclusion of a chapter called Biodiversity in Grazing Systems in the flagship publication, Towards Sustainable Grazing: the professional producers guide was at least partly due to the Land, Water & Wool connection.

Benchmarking

In late 2001 and early 2002, a significant market research project was undertaken to provide Land & Water Australia (LWA) and Australian Wool Innovation Limited (AWI) with benchmark information to assist in the development of the Land Water and Wool program.

The data collected through the research established baseline measures for key performance indicators in five Land Water and Wool sub-programs and provided insight into the attitudes and behaviour of Australian woolgrowers towards natural resource management. It also explored their needs for additional information and support.

The methodology used consisted of six group discussions and 1,500 computer-assisted

telephone interviews with woolgrowers shearing at least 750 sheep in the past 12 months and 30 in-depth interviews with industry opinion leaders.

The information captured helped to refine elements of the Land Water and Wool Program and was also used to publicise woolgrowers' current attitudes to NRM and the practices they employed.

It was intended to repeat the benchmarking survey at the program's conclusion to assess changes to woolgrowers' attitudes and practices. This was not done due to technical concerns as to how well such research would be able to measure change at that broad scale. Instead, other monitoring and evaluation techniques were employed at the sub-program level.

Policy considerations

Although Land, Water & Wool did not aim to develop policy, many of its projects generated results that have refined our understanding of the management of natural resources on farms. As a result, the program is in a position to contribute data and knowledge to public policy discussions. Some of these issues are discussed below.

Understanding the policy environment

“To really influence policy it is necessary to have a clear understanding of the political climate, the stakeholders, the main players and, often, the historical context” (Victorian Native Vegetation project). As an example, Victorian researchers analysed the potential of their research to inform the policy arena of the Victorian Department of Primary Industries (DPI). The researchers noted that the research on native vegetation was unlikely to have an impact on the DPI unless it was able to attach itself to a “more high profile issue such as soil or animal health”. This observation enabled the researchers to more carefully consider the relevance of the research to soils and animal health.

Implications: Undertake a detailed analysis of the policy arenas LWA and AWI want to influence, to better understand the drivers within those arenas. The policy report from the Victorian Native Vegetation project provides an example of how to proceed in this regard.

Become an informed participant in the debate

There are numerous opportunities for the wool industry to provide input into the policy arena backed up by credible research results. Six policy initiatives have been identified that Land, Water & Wool research could have a positive influence on:

- the Rural Lands Stewardship Initiative (Vic.);
- market-based instruments for natural resource management;
- programs under the State departments of primary industries and agriculture (e.g. the Victorian DPI's programs under the 'Healthy Soils for Australian Farms' program, managed by LWA);
- environmental management systems;

- programs managed by the Catchment Management Authorities (CMAs); and
- extension programs, e.g. BestWool (State agencies in collaboration with AWI) and Land for Wildlife (Vic.)

The program has already had an impact on other related activities, such as:

- LWW outcomes have influenced the environmental module in AWI/MLA's Making More from Sheep Best Practice Manual and, more generally, across AWI's NRM strategy;
- the Future Woolscales project has had a strong influence on AWI's On Farm Strategic Plan;
- SGSL was a significant contributor to the development of plans for the Future Farm Industries CRC;
- the AWI projects Wool Pathways Environmental Stewardship and Evergraze;
- the Native Vegetation & Biodiversity sub-program influence was instrumental to the federally funded Victorian initiative Green Graze; and
- the Rivers & Water Quality sub-program influenced at least one CMA to establish an on-farm grants program for gully rehabilitation to assist in meeting its targets for sediment and nutrient loads in rivers.

Implications: Land, Water & Wool provides LWA and AWI with an opportunity to be pro-active in policy debates about natural resource issues.

Modest improvements over large areas

Most government programs for funding on-ground works focus on the radical change of small areas of high conservation value. For example, incentives are offered for exclusion of grazing in relatively small remnants of woodland. Land, Water & Wool research modelled the biodiversity gains of deferred summer grazing of native pastures, rotational grazing of native pastures and revegetation through natural regeneration on hill country in southern Australia. The researchers concluded that the strategies would result in small improvements in native vegetation quality. However, when the effect is aggregated over large areas of a catchment,

the result is significant, especially when the soil health and water quality effects are included. Furthermore, these strategies are relatively low cost to both the landholder and the public funding body in terms of outlay and lost income.

Implications: Provide public funders and policy makers with examples of potentially low-cost, extensively applied management practices, to augment high-impact/small area/high-cost approaches.

Nearly commercial vs non-commercial

Land, Water & Wool research agrees with the findings of other commentators who contend that: “The greatest public benefit per dollar of public funding will often come from supporting environmentally beneficial land uses that are nearly but not quite commercially competitive with existing land uses. For these land uses the amount of public funding necessary to be allocated will be relatively low, compared to land uses with no commercial return creating high demands for public funding” (Victorian Native Vegetation project).

An example of a nearly commercial land use is “putting in infrastructure to remove constant stock access to waterways”. Another is retaining or replanting native riparian vegetation that provides both windbreak shelter for sheep and shade to reduce stream water temperature.

Implications: Direct research towards activities that are close to being economically competitive, as these are the activities that are likely to be adopted by landholders and that efficiently use public funds.

Broadening the mix of incentives

Land, Water & Wool research highlights the opportunity for policy makers and incentive funders (e.g. CMAs), armed with research findings, to realign priorities for incentive payments in line with research. “For example, landholders are currently given incentives to establish perennial pastures (lucerne, phalaris). Are incentives available for the sustainable management of native grasslands through practices such as rotational or deferred grazing?”

Implications: Using research results, challenge incentive designers to think broadly about the types of incentives that should be offered to landholders, including incentives for changed grazing practices on native pastures and natural regeneration as an alternative to replanting.

Biodiversity – the narrow vs broad focus

Even in substantially similar landscapes, individual landholders practise differing management regimes – some favour set stocking, some favour rotational grazing, and there are a myriad of permutations in between. Land, Water & Wool research in Tasmania confirmed that different management regimes on farms result in different arrays of species and different manifestations of biodiversity. Collectively, the mosaic of different management regimes across a whole region or catchment can contribute to an increase in biodiversity at the landscape scale; that increase would not have occurred if all landholders practised exactly the same management regime.

Implications: Ensure that policy makers are thinking about biodiversity in all its manifestations across broad areas, not merely the biodiversity of a particular small site of interest.

Land, Water & Wool researchers and SWAG members inspecting pasture growth during tough seasonal conditions at one of the Native Vegetation and Biodiversity trial sites in Tasmania's Midlands.

Photo: Kim Mitchell.



More trees don't automatically mean more biodiversity

Research in the Traprock country of Queensland confirmed that thick regrowth in grassy box woodlands of south-east Queensland was of lower biodiversity *and* production value than more open woodland areas. This would suggest that there are both production and biodiversity benefits that could result from strategic clearing. In more open woodland country, there was a positive relationship between the amount of tree and under-storey cover and the diversity of native animals.

Implications: Provide policy makers with research to underpin legislation and policy that provides more flexible responses to the management of native vegetation rather than blanket prohibitions.

Inform the debate on environmental targets

By using economic models based on data from 14 wool properties, it was found that up to 15% of the land area of hill country farms in Victoria could be revegetated for environmental benefits without a significant effect on farm profitability. This is useful information to bring to the debate on the proportion of the landscape that needs to be revegetated for environmental reasons. Some CMAs have 30% of their area as a target

for revegetation, which this research suggests is unlikely to be economic.

Implications: Economic modelling can be used to better inform the debate on who bears the costs and who receives the benefits of improved environmental management.

Sociological issues – a challenge for extension programs

Researchers in the Queensland Traprock project investigated the close link between woolgrowers' sense of identity and the farm environment in which they live and work. They theorised that asking landholders to change the physical nature of the farms is akin to asking them to change their self-perception. Such a change is likely to be resisted. Therefore, natural resource officers need to understand and work with the psychology of 'sense of place', otherwise they may find themselves frustrated by lack of response from landholders. On the other hand, sense of place (sometimes described as pride) often explained the willingness of farmers to adopt practices that may not be clearly to their economic advantage.

Implications: Recognise the need to understand how different motivating factors influence adoption.

Strengthen the NRM aspects of production-focused extension programs

Extension programs that are focused on production often provide an operational way of implementing other research findings because of their access to a large number of farmers. However, these programs tend to have a narrow focus on production issues and may exclude synergies with natural resource management.

Implications: Use Land Water & Wool research to provide additional benefits to production-focused extension programs.

Land, Water & Wool Oral Histories

In Tasmania, Land, Water & Wool talked to 23 woolgrowers selected as a broad representation of people involved in woolgrowing and caring for the land and rivers in their regions. We have been privileged that these people have shared their history, told us what motivates them to work in the wool industry and spoken about their ideas for the future of their farms. The woolgrowers in these stories reflect the very essence of their social and biophysical landscape with lightness and honesty, reminding us that woolgrowing is not just a business, it is also an emotional connection with the landscape. The full collection of stories entitled 'Reflections of Tasmanian Wool Growers' are on a CD with 'Managing rivers and streams in Tasmania: A Woolgrowers Guide'.

"No orchestra in the world can match the sounds of the bush at the base of the Teirs at sunrise. Some people see it and feel it and some don't. I can't explain it, you can only know if you have experienced it for yourself. My whole senses change, I just get this feeling, I feel it in every part of my body, it is not describable. I can't explain it to you; I just wish that all my friends could have been there. I can't explain to you how I feel because there are no words to explain or describe it. The words just aren't there." Sue Rapley

Bring a whole farm context to environment-focused extension programs

The converse of the item above is that 'industry' research (such as research sponsored by AWI) can help focus the attention of policy makers and program designers on how environmental policy can realistically be implemented in the context of the whole farm. For example, deferring summer grazing on hill country requires consideration of where the sheep will graze over summer and how that affects the operation of the whole farm.

Implications: Environment-focused extension programs need to present/consider their advice in the context of the whole farm.

Better links between research and policy

Experience within the program has shown that there are significant barriers of time, resources, and political and institutional drivers that affect the ability for research to access the policy arena and inform policy debates. Looking for ways to address this should be mutually beneficial.

Implications: Existing networks could be used to actively inform policy development. This is especially relevant to networks where AWI collaborates with policy-making departments (e.g. BestWool, where AWI collaborates with the Victorian DPI).

Quantification of environmental benefits

Land, Water & Wool researchers highlighted PlainsTender as an example of an incentive program that establishes a 'market' for environmental services by paying landholders for those services. A key to this type of program is the ability to quantify the environmental benefits (e.g. biodiversity benefits) being paid for. Land, Water & Wool research was able to help quantify the amount of biodiversity gain that could be achieved through the application of the strategies investigated in that project (deferred summer grazing, rotational grazing and regeneration on hill country in Victoria).

Implications: Support research that attempts to quantify environmental benefits.

Sustainable production as a marketing tool

Incentives are used by Governments where markets fail to deliver important environmental outcomes and where those outcomes have benefits that outweigh their costs. However, the disadvantages of government investment include high administration costs and sometimes perverse outcomes. Theoretically, there is a lower risk of these outcomes if markets are able to give proper signals to woolgrowers via price premiums. It goes without saying that significant price premiums in the marketplace have a powerful effect on production systems.

Implications: The potential exists to use research products from the program as an input to develop a market advantage based on the environmental credentials of wool production.

Disjunct in extension programs

The Land Water & Wool Advocates project highlighted confusion in some States on the issue of responsibility for extension programs that gather and synthesise the latest research and package it for delivery to end users (such as farmers). In some States, extension services are said to have declined, perhaps with the expectation that these services will be re-developed by the regional NRM boards. However, the regional NRM boards are not necessarily in a position to develop those services.

Implications: AWI and LWA have a clear interest in ensuring that there is a conduit for research into the extension arena and may be able to play a role in assisting the State agencies and regional NRM bodies to develop strategy on their respective responsibilities in this regard. Additionally, they can play a role in ensuring consistency across States, as the wool industry operates across most States. For example, by managing projects in four States, the Land Water & Wool Managing Climate Variability sub-program found that climate information could be more easily extended via the Internet in Queensland than South Australia. The Queensland Government had facilitated the development of adequate broadband technologies in Queensland into the pastoral zone. AWI could play a role in lobbying for consistent access to these types of technologies on environmental grounds.

Introduction

While Land, Water & Wool was designed as a research and development program with specific objectives, most research projects have identified new questions for further investigation. As a result, each of the Land, Water & Wool sub-programs has identified areas of work for possible future research. These have been included in this report as they are potential opportunities that could be investigated under the AWI NRM strategy or picked up by other research investors with common interests.

A small number of projects have also been extended under the management of Land & Water Australia, mainly where additional data collection was seen as being necessary to allow valid conclusions to be drawn and often as a result of drought conditions having affected projects during the course of the program. Where this has occurred (described below), it has been funded by savings made and interest accrued during Land, Water & Wool.



SGSL WA researchers Sally Phelan and Matt Wilmot weigh sheep in an experiment that compares rotational grazing with set stocking of sheep grazing saltbush. It shows the latest technology with saltbush in the background.

Photo: Dr Hayley Norman

Sustainable Grazing on Saline Lands

Three Sustainable Grazing on Saline Lands (SGSL) sub-program research projects were extended so that additional data could be collected to improve the quality of analysis. Both the Western Australian projects and the NSW project received additional funding for up to 18 months, as each project has been affected by the drought, resulting in delayed site characterisation and treatment effects.

Towards the end of Land, Water & Wool, a business case (Kiri-ganai Research, 2006) was prepared for additional funding for management of saline land, with the intention of it becoming a major component of the Future Farm Industry's Cooperative Research Centre. New R&D activities were spelt out in the business case and are briefly summarised below:

- SGSL provided information on site selection and establishment for salt-tolerant pasture species. New research could investigate the effect of agronomic treatments and grazing management on the productivity and persistence of saltland pasture.
- identify the best species and stock classes to maximise farm profits and environmental gain from utilising saline pasture;
- test a range of novel halophytic shrub species for productivity and persistence in saline areas and identify and select lines of 'oldman' saltbush for higher nutritive value;
- further quantify the environmental impact of saline land rehabilitation by measuring changes in key environmental variables in response to the treatments outlined above;
- provide additional support to the woolgrower and extension network developed in SGSL in order to capitalise on the initial investment and provide an extension pathway for the results of the new research described above; and
- invest in further development of tools, products and training opportunities to help farmers determine the options for saline land, site characterisation and consequent species selection, and establishing and managing saltland pastures for improved performance.

In addition to these areas of work, a common need was identified across most research projects for a greater selection of higher performance salt and waterlogging-tolerant legumes.



Farmer Chris Walton standing in adjoining SGSL research plots on his property. In the photo on the left, the first plot (unimproved) is an unmodified area of saltland. The photo on the right is of Chris standing in a plot that was revegetated in 2005 with saltbush seedlings and annual legumes

Photos: Dr Hayley Norman & Matt Wilmott

Native Vegetation & Biodiversity

Grazing trials in two projects in the Native Vegetation & Biodiversity sub-program have been extended to improve the robustness of the findings. They are the parts of the Traprock project in south-east Queensland and the Tasmanian Midlands project.

A few of the projects in this sub-program commented on the role of fire regimes in the landscape as an area of potential work from both the point of view of initiating regeneration of native plants and, at the other extreme, controlling regrowth. In some instances, the use of fire could also have production benefits, but the extent of this relationship needs to be tested.

Other areas for investigation include:

- continue studying the impact of accelerated rotational grazing on natural resources and profitability;
- extending our understanding of ‘sense of place’ as a barrier or motivator for management changes;
- quantifying the ecosystem services provided by native vegetation on and off-farm;
- unravelling the relationship between grazing regimes, climate, and shrub and tree establishment;
- further exploring the interactions between grazing, fertiliser use and tree cover on species abundance and composition; and
- examining the possible biodiversity and production benefits of different locations of regrowth strips or patches in landscapes.

Rivers & Water Quality

Riparian land research from Land, Water & Wool has shown that grazing management is probably the single-most important factor influencing the condition and productivity of riparian pastures and woody vegetation. Improved riparian land management does not necessarily mean excluding the area from the overall farming system. Practical ways of addressing key river management issues have been identified, although some of the long-term consequences of such management interventions are yet to be quantified.

One of the areas of concern for woolgrowers in relation to long-term management that requires further investigation is how best to control weeds and pests in riparian areas, as well as monitoring the long-term impact of improved riparian management on biophysical and ecological parameters.

Establishment of the extent to which the individual property manager, or the community as a whole, receives the benefit from management interventions has significant implications for cost sharing.

Managing Pastoral Country

The Managing Pastoral Country sub-program focused on the development of tools for more effective management and monitoring of grazing in the arid zone. A review of the Managing Pastoral Country sub-program (Watson and Trelor, 2006) was conducted in February 2006. As a part of the review, recommendations for future research opportunities were identified as:

- Review the Forage Square method of pasture assessment to test aspects of alternative grazing systems under different rangeland conditions.
- Investigate synergistic application of the stocking rate benchmarking system explored in the Land, Water & Wool NSW project with the decision support approach developed in the WA project.
- Test the Critical Decisions on Stocking Rate tool with a larger number of pastoralists, combined with a social study of how pastoralists make the decision contemplated by the technique. This tool requires further investment to develop it as a piece of interactive software. Bearing in mind the small market among woolgrowers, exploring its applicability to the northern beef industry may help create a potential market that would justify such an investment.
- A scoping exercise to determine the requirements for the increased uptake of satellite technology, including training needs and ongoing support, would provide a sound basis for further research and extension into what is potentially an extremely valuable decision-making aid. Investigating how these requirements relate to the Pastures from Space program would be worthwhile. The use of this technology in conjunction with the other decision-support tools developed in Land, Water & Wool is another potential area of investigation.

Managing Climate Variability

High climate variability on a range of timescales, such as between seasons, years and decades, poses a great challenge for woolgrowers. Many scientists believe that this familiar variability is now overlaid by anthropogenic climate change, which further exacerbates the risk of difficult seasons and the associated potential for land degradation. This supports the need for the continued provision of seasonal risk assessment information, not just within the pastoral zone, as was the focus for Land, Water & Wool, but across all woolgrowing areas. The Map Arranger capability developed within Land, Water & Wool provides a good platform to allow ongoing improvement of seasonal risk assessment systems, such as the composite El Nino Southern Oscillation (ENSO) and the composite El Nino Southern Oscillation - Pacific Decadal Oscillation (ENSO-PDO) system developed in the project.

With some 1,200 woolgrowers and their advisers having experience of regionally specific and nationally relevant products developed within the program, the opportunity exists for co-investment on a range of newsletter, e-mail report systems and workshop-based training to build confidence and experience in the use of climate information in decision making on sheep properties.

The Land, Water & Wool Managing Climate Variability sub-program developed strong links with the national Managing Climate Variability (MCV) collaborative program of the Research and Development Corporations, managed by Land & Water Australia. MCV is broadening the focus of its climate R&D from seasonal climate variability to also address adaptation to climate change from an industry and science perspective. A new focus is emerging on seasonal forecasting built on global climate models, aimed at improving the probability associated with seasonal risk for specific geographic areas and further developing applications for farmers and NRM managers to make decisions in response to climate risk. The underlying theme is about building capacity in risk management and providing the technology and tools for farmers to make strategic, resilient decisions. Further investment by the wool industry is probably best done through MCV.

Future Woolscapes

This sub-program identified many potential research and development priorities within each scenario. These are far too numerous to list in this report. However, one of the final activities of the Future Woolscapes project was to assess the existing AWI Strategic Plan. A series of considerations arose from this review and are being considered by AWI as it reviews its Strategic Plan, including:

- With an expected increased scrutiny on production systems from consumers and society, the ability to track fibre and demonstrate the degree of environmental sustainability and welfare will be critical.
- While the industry has a significant animal health portfolio (especially a strategy to replace mulesing), there may be other animal welfare areas that AWI may wish to consider.
- The industry should review whether its risk management protocols for animal welfare, environmental issues and unexpected events are satisfactory.
- As incremental gain across the industry may not be sufficient to avoid significant restructuring and disruption the industry, via AWI, may wish to consider whether a larger allocation of budget into riskier 'blue sky' research is warranted, given the potential need for paradigm change across the pipeline.
- Harnessing the opportunities created by new technologies will be vital to find 'paradigm' change solutions to current production and processing impediments (parasites, harvesting, sheep health and bio-security, genetic progress). Is there sufficient investment being made in such high-risk/high-reward areas?
- There is a strong need to make woolgrowing 'easier'. Developing labour-saving technology and taking a greater focus on the concept of an 'easy care' sheep seem rich areas for investment. A project specifically examining alternatives to traditional fencing may be another area warranting investment.
- In addition, there may be a worthwhile investment in examining 'biopharm' opportunities from sheep. For example, obtaining a better understanding the specific function of the rumen, thereby allowing improved matching of nutritional needs to the type of production sought (wool, meat or both). Intensive examination of the rumen may also help identify ways to reduce methane production or even new applications of 'rumen products' (such as human medicine).
- As all four scenarios identified a potential relocation of wool production to less arable areas, is there sufficient knowledge about enhancing productivity and quality in non-arable, hostile (e.g. saline) or low-input (native pasture) areas?
- With the likelihood that the scale of the enterprise, its ownership structure and the skills of farmers will continue to alter significantly, the industry may like to consider what could be done to create an environment that is attractive to new capital investment (land ownership, technology, product ownership down pipeline, infrastructure).
- Alternatives to current wool scouring could be examined again to identify improved methods.
- Given the expected focus on 'health and well being' by future consumers, the industry, via AWI, might consider partnering with leading medical institutes to identify whether wool products have 'healthy' attributes.
- There is not currently a group that is continually looking at future opportunities (a fore-sighting group). It is suggested that such a focus may unearth useful areas for new investment and be valuable insurance in relation to risk management.

Management and delivery

Land, Water & Wool was a significant investment in both research and people over a 5½-year period. Throughout the course of the program, many lessons were learnt that could have application for other long, large and multi-partner programs.

A process to capture these 'lessons' for program management and delivery was undertaken toward the conclusion of the program. The major lessons are listed below:

- The **planning phase** of any program is absolutely critical in ensuring success. The emphasis needs to be on clearly aligning the program activities with SMART (Specific, Measurable, Achievable, Realistic and Time-bound) objectives. Strong project management disciplines with trained and experienced practitioners in place at the start of the program is essential.
- Project, sub-program and program **evaluation needs to be built in** at the planning stage. Retro-fitting evaluation is time consuming, more difficult to agree on and may result in lost opportunities for the gathering of good evaluation data. The use of an established evaluation framework, such as Bennett's Hierarchy, is helpful. Early determination of key evaluation questions, aligned to the objectives, along with providing templates for the collection of relevant monitoring information, is beneficial. Specific evaluation expertise may need to be brought in for this task.
- **Programs need to be responsive to changing circumstances.** Especially when conducting field research, investors need to acknowledge that things may not always go to plan and that new opportunities may present themselves during the course of the program. Having the flexibility for investors and managers to agree on revisions to program plans as these situations arise is important for success.
- While a significant investment, spending time and money (regular face-to-face meetings and phone conferences) to **develop a management team** approach paid high dividends in terms of program implementation.
- Successful program implementation requires considerable **interest, support and trust from the investors.** The corollary to this is that program management needs to deliver meaningful outputs during the course of the program so that the above mentioned trust is justified.
- A significant amount of research points to **trust between farmers and researchers** as being a major determinant of the successful adoption of new technology (Pannel *et al.*, 2006, Leith, 2006). The participatory research model (with woolgrowers and researchers working side by side) used through Land, Water & Wool was a key factor in developing trust, developing useful outputs and achieving adoption among farmers. This was reinforced by the use of a woolgrower advisory group (SWAG) throughout the program.
- In addition, the use of **farmer demonstration sites** to support research sites and provide an opportunity for woolgrowers to investigate areas of local interest was a highlight of the program. Comments such as "... no-one has ever asked me before what I want to know about, that's the great thing about this program – it's looking at things I want answers to" typified woolgrower sentiment.
- In hindsight, while the farmer demonstration sites were extremely successful, the expectation that they would do their own measurements was largely not met and it may be better to have **fewer sites, with better technical support** in similar future programs.
- **Strong administrative support** across the whole program is paramount for management, co-ordinators and researchers.
- The ability for sub-program managers to have some **flexibility in relation to the transfer of funds** within their sub-program was important.
- The **speed of decision making** at both the program and sub-program level can be a cause for frustration if it is seen as being too slow, especially if it happens in relation to activities with tight timeframes.
- **External consultants** can add considerable value to the management team, both in terms of expertise and in timeliness of getting things done.
- The **adequacy of timeframes for conducting research** needs to be carefully considered by both investors and researchers. Investors can have unrealistic expectations of what can be achieved and, in a bid to access resources,

it is not uncommon for researchers to “over promise and under deliver”. This essentially reinforces the need for strong project management discipline.

- A recurring theme throughout the program was the social context in which farmers made decisions. This has become very apparent through the participatory research model and the resulting exposure of scientists to farmer experiential knowledge (Leith, 2006). **Understanding the ‘people’ issues** associated with this type of R&D program greatly improves adoption or the understanding of barriers to adoption.
- **Program management needs to be prepared to confront/change/terminate projects** without procrastination where circumstances indicate that objectives will not be met. This is often difficult in agricultural and NRM research, which may be dependent on factors beyond our control, such as the weather.
- A large program such as Land, Water & Wool provides the opportunity to look at innovative approaches and take some risks in trying new ways of doing things. A couple of examples of this are using external consultants with strong networks in a particular target audience (the Land, Water & Wool **Advocates Program** was targeted specifically at agencies such as catchment management authorities; the Rivers & Water Quality sub-program engaged local project co-ordinators already known to and trusted by woolgrowers) to tailor program results for a specific identified need and gaining sponsorship for program activities such as the **SGSL Photo Competition**.

- A strong investment in **communications and delivery support** provides good results in adherence to communication guidelines and protocols, ensures that stakeholder groups are targeted according to their needs and can provide media training to program staff.
- A clear **exit and handover strategy** needs to be put in place with consideration at the individual project, sub-program and whole-of-program level, to ensure that stakeholder aspirations are managed and that program success does not lead to goal displacement and unrealistic expectations of continued investment.

Land, Water & Wool Communications

Adequate investment in communication resources enabled the Land Water & Wool team to access a large proportion of the target audience in innovative ways. Communication was managed by a professional communications company (Currie Communications) selected through an open and competitive tender. This was augmented by extension advice from experienced agricultural extension consultant, Peter Hanrahan.

Some key activities:

- An overarching communications strategy was developed early in the program and refined throughout.
- Specialist assistance for program, sub-program and project personnel on extension and communication.
- Group and personal training on communication techniques.
- A full range of communication methods, including print media, TV, traditional extension materials, a dedicated website, web-based information, conference participation, sponsorship of farmer champions and an internal e-newsletter.
- Leeway for innovation and creativity from the sub-program and project teams including the ‘Dog collar’ brochure, the Advocates program and the SGSL Photo Competition.
- Emphasis on farmer-friendly publications, such as the Insights Case Study series.
- Proactive pushing of Land, Water & Wool materials and issues into the media (e.g. via the Media Tour).
- Detailed monitoring and reporting of media and web activity.

Appendix 1: Budget

| Expenditure | | | | | | | | | |
|--|------------------|------------------|------------------|------------------|------------------|------------------|----------------|---------------|-------------------|
| Sub-program | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 | 2006/07 | 2007/08 | 2008/09 | Total |
| Set-up Program | 189,390 | | | | | | | | 189,390 |
| SGS Harvest Year | 225,000 | 75,000 | | | | | | | 300,000 |
| Climate* | 21,666 | 286,012 | 150,439 | 172,780 | 140,800 | -7,571 | | | 764,126 |
| Future Woolscapes | 24,690 | 43,431 | 133,911 | 129,015 | 64,697 | 24,962 | | | 420,706 |
| Pastoral | 73,262 | 30,422 | 28,613 | 135,112 | 242,156 | 14,218 | | | 523,783 |
| Rivers | 113,362 | 279,805 | 298,323 | 357,663 | 225,591 | 233,917 | | | 1,508,660 |
| Salinity | 426,388 | 1,815,554 | 2,019,126 | 1,542,120 | 1,892,019 | 1,209,990 | | | 8,905,197 |
| Vegetation | 194,732 | 477,224 | 628,053 | 525,002 | 505,021 | 136,000 | | | 2,466,032 |
| Portfolio: | | | | | | | | | |
| Communications | 164,674 | 469,030 | 730,028 | 282,672 | 445,886 | 275,248 | | | 2,367,538 |
| Delivery | | | | 84,174 | 252,902 | 242,014 | | | 579,090 |
| M&E (including benchmarking) | 104,303 | 45,535 | 15,049 | 37,693 | 41,870 | 256,962 | | | 501,412 |
| Management | 290,718 | 303,794 | 306,857 | 304,087 | 430,529 | 304,373 | | | 1,940,358 |
| Totals | 1,828,185 | 3,825,807 | 4,310,399 | 3,570,318 | 4,241,471 | 2,690,113 | 0 | 0 | 20,466,293 |
| Additional Activities** | | | | | | 262,000 | 700,834 | 29,789 | 992,623 |
| Grand Totals | 1,828,185 | 3,825,807 | 4,310,399 | 3,570,318 | 4,241,471 | 2,952,113 | 700,834 | 29,789 | 21,458,916 |
| Income | | | | | | | | | |
| Source | 2001/02 | 2002/03 | 2003/04 | 2004/05 | 2005/06 | 2006/07 | 2007/08 | 2008/09 | Total |
| AWI Set-up | 200,000 | | | | | | | | 200,000 |
| AWI LWW | 2,800,000 | 2,750,000 | 6,250,000 | 4,350,000 | 2,850,000 | 150,000 | | | 19,150,000 |
| MLA | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | | | | 1,500,000 |
| Interest | 16,332 | 69,550 | 30,033 | 106,048 | 228,597 | 92,009 | | | 542,569 |
| Publications Royalties SGSL | | | | 1,810 | 1,273 | | | | 3,083 |
| External Sponsorships – SGSL Photo Comp | | | | 25,000 | 2,500 | | | | 27,500 |
| CRC contributions | | | 10,000 | | 20,000 | | | | 30,000 |
| Other | | | 6,589 | | | | | | 6,589 |
| Total | 3,316,332 | 3,119,550 | 6,596,622 | 4,782,858 | 3,402,370 | 242,009 | 0 | 0 | 21,459,741 |

* Climate 2006/07 – negative figure represents refund of unspent research funds by Research Organisation.

**Expenditure forecasted for post-March 2007.

Appendix 2: Project list

NOTE: This table does not represent all LWW expenditure; these are projects that have been contracted. Expenditure such as staff costs, LWA service charges, legal fees, communication activities including workshops, printing and publishing, and monitoring and evaluation are not shown in this table, but are included in the budget in Appendix 1.

*R = Research; C = Communications; M&E = Monitoring & Evaluation; M = Management

| Project code | Project Title | Principal Investigator | Organisation | Type of Project* | Total \$ | Co-investment |
|----------------------|---|------------------------|--|------------------|----------|---------------|
| Whole Program | | | | | | |
| AGT15 | LWW Monitoring & Evaluation Review | Dr Peter Chudleigh | Agtrans Research | M&E | 47,064 | |
| AGT27 | Consultancy to conduct the <i>ex poste</i> cost-benefit analysis | Dr Peter Chudleigh | Agtrans Research | M&E | 53,200 | |
| BDA1 | Ex ante cost-benefit analysis of the Sustainable Wool Production Initiative. | Mr David Collins | BDA Group | M&E | 22,000 | |
| COU2 | Assisting the refinement and implementation of evaluation and management plans | Dr Jeff Coutts | Coutts J&R Pty Ltd | M&E | 18,400 | |
| COU4 | Consultancy to provide an overall evaluation report on Land, Water | Dr Jeff Coutts | Coutts J&R Pty Ltd | M&E | 19800 | |
| CUR11 | Communication Implementation Strategy | Mr Kim Mitchell | Currie Communications | C | 851,200 | |
| CUR4 | Media Strategy | Mr Kim Mitchell | Currie Communications | C | 133,685 | |
| CUR6 | Strategic Communication Support | Mr Kim Mitchell | Currie Communications | C | 25,331 | |
| DAN24 | Delivery Project No. 2: Delivery of climate risk management information to woolgrowers in the sheep/wheat and high rainfall zones of Australia. | Dr Helen Fairweather | NSW Department of Primary Industries | C | 40,000 | 20,893 |
| DTE1 | Best Practice Survey for LWW | Ms Pam Watson | Down to Earth Research | M&E | 131,535 | |
| HAN1 | Delivery Coordinator | Mr Peter Hanrahan | Peter Hanrahan Consulting Pty Ltd | C | 247,112 | |
| HAS9 | Development of Recommendations for the Information Requirements and Conduct of a cost-benefit analysis | Mr John Madden | Hassall and Associates Pty Ltd | M&E | 21,950 | |
| INS4 | Tas Advocate | Dr Jann Williams | NRM Insights Pty Ltd | C | 11,000 | |
| MDP1 | Develop a business plan for AWIL to invest in applied natural resources R&D | Mr Russell Pattinson | Miracle Dog Pty Ltd | M | 57,287 | |
| MDP2 | Program Coordinator | Mr Russell Pattinson | Miracle Dog Pty Ltd | M | 401,659 | |
| MDP5 | Coordination of activities to progress the delivery of productive NRM solutions to woolgrowers | Mr Russell Pattinson | Miracle Dog Pty Ltd | C | 68,186 | |
| MDP7 | Delivery Project No. 4: Future Woolscales Delivery Phase | Mr Russell Pattinson | Miracle Dog Pty Ltd | C | 47,811 | |
| MSA1 | Wool Country Management Toolkit | Mr Jim Shovelton | Mike Stephens and Associates Pty Ltd | C | 76,430 | |
| RMG6 | Vic Advocate | Mr Simon McGuinness | RM Consulting Group | C | 42,650 | |
| RPC2 | Benchmarking – Survey Dataset & Design | Dr Warren Mason | RPC Solutions | M&E | 15,920 | |
| RST10 | Development of Final Reports | Mr Peter Day | Peter R. Day Resource Strategies | C | 162,600 | |
| RST9 | SA Advocate | Mr Peter Day | Peter R. Day Resource Strategies Pty Ltd | C | 32,000 | |
| SFA1 | Peer Review of Natural Resource Management Toolkit Materials Designed for Wool Producers | Ms Robbie Sefton | Sefton & Associates Pty Ltd | C | 43,925 | |
| SIW6 | Delivery Project No. 1: Delivery of River Guides | Dr Siwan Lovett | Lovett Clarke Consulting Pty Ltd | C | 28,200 | |
| UNE58 | Delivery Project No. 3: Engagement of Woolgrowers not actively involved in environmental issues | Mr Ian Reeve | University of New England | R | 40,000 | |

Appendix 2: Project list – continued

| | | | | | | |
|---|--|---------------------------------|--|---|---------|---------|
| VBS2 | NSW & Qld Advocate | Mr Mark Gardner | Vanguard Business Services | C | 50,000 | |
| WEB6 | Sustainable Grounds for Wool – an NDSP Salinity Management Initiative for the Wool Industry. Initial Scoping Study | Mr Adrian Webb | WEBBNET Land Resource Services Pty Ltd | M | 15,000 | |
| SGS Harvest Year | | | | | | |
| MLA1 | Sustainable Grazing Systems Harvest Year | Dr Ben Russell | Meat & Livestock Australia | C | 300,000 | |
| Managing Climate Variability sub-program | | | | | | |
| AGE3 | Sub-program Coordinator | Dr Barry White | AGEC Consulting | M | 82,021 | |
| DAN16 | Improved Seasonal Forecasts for Wool Producers in Western New South Wales | Dr Ron Hacker | NSW Agriculture | R | 130,506 | 322,095 |
| DAW41 | Improved Seasonal Forecasts for Wool Producers in the Western Australian Southern Pastoral Zone | Dr Ian Watson | WA Dept of Agriculture | R | 90,000 | 178,447 |
| QNR30 | Improved Climate Forecasts for Wool Producers in Australia's Pastoral Zone – Support Project for Regional Projects | Dr Beverley Henry | Qld Dept of Natural Resources & Mines | R | 155,000 | 120,401 |
| QPI47 | Improved Seasonal Forecasts for Wool Producers in the Queensland Pastoral Zone | Mr David Cobon | Qld Dept of Primary Industries | R | 150,000 | 119,200 |
| SRD4 | Improved Seasonal Forecasts for Wool Producers in the South Australian Pastoral zone | Ms Melissa Rebbeck | SA Research & Development Institute | R | 100,000 | 226,327 |
| UTA13 | Knowing El Nino: The Influences of Climate Perception on Land Management Decisions in Western New South Wales and Queensland | Mr Peat Leith | University of Tasmania | R | 20,024 | 1,000 |
| Future Woolscapes sub-program | | | | | | |
| ACI5 | Scope of the Future Woolscapes sub-program | Mr Greg Martin | ACIL Tasman Pty Ltd | R | 41,800 | |
| CSE25 | The potential impact of climate change on woolgrowing by 2029 | Dr Katherine Harle | CSIRO Sustainable Ecosystems | R | 9,800 | |
| HSA1 | Terms of Trade for Woolgrowing in 2029 Using Modelling Techniques | Mr David Sackett | Holmes Sackett & Associates | R | 8,800 | |
| IFA1 | Project 1: New Technology in 2029 & Project 2: Consumer Preferences in 2029; their Implications for the Wool Industry | Mr Ian Ferguson | Ian Ferguson Associates | R | 12,000 | |
| LOF1 | Review of Future Woolscapes: Stage 1 Implementation Plan | Ms Bronwynne Jones | LookOut Futuring Services | R | 7,000 | |
| LOF2 | Future Woolscapes Scenario Planning | Ms Bronwynne Jones | LookOut Futuring Services | R | 25,625 | |
| MDP4 | Sub-program Coordinator | Mr Russell Pattinson | Miracle Dog Pty Ltd | M | 138,963 | |
| PCI1 | Competitor Trends in 2029 | Ms Bruna Angel | PCI – Fibres & Raw Materials | R | 10,000 | |
| UME69 | Land and Animal Management in 2029 | Ms Linda Hygate | University of Melbourne | R | 9,500 | |
| USY12 | The Potential Impact of Biotechnology in 2029 – The Sheep & Wool Industry | Mr Herman Raadsma | University of Sydney | R | 6,600 | |
| VPI5 | Farming Structures in 2029 | Mr Roger Wilkinson | Vic Dept of Primary Industries | R | 10,000 | |
| Managing Pastoral Country sub-program | | | | | | |
| AGE5 | Sub-program Coordinator | Dr Barry White | AGEC Consulting | M | 24,568 | |
| AMH3 | Informing decisions of pastoral woolgrowers for country and profit | Dr Alec Holm | Alexander Holm & Associates | R | 75,000 | |
| BLE1 | Implementation Plan and Targeted Regional Consultations for Managing Pastoral Country sub-program | Mr Don Blesing | Blesing Strategy | M | 42,368 | |
| CSE27 | Wool producers with remote controls: New tools for whole of property management | Dr Craig James & Mr Gary Bastin | CSIRO Sustainable Ecosystems | R | 74,952 | 66,069 |

Appendix 2: Project list – continued

| | | | | | | |
|--|---|------------------------|--|-----|-----------|-----------|
| DAN23 | Stocking rate decision tool for rangeland pastoralists | Dr Ron Hacker | NSW Dept of Agriculture | R | 9,046 | 55,674 |
| MLA2 (NBP 348) | Mitchell Grass death in Queensland: extent, economic impact and potential for recovery | Mr David Phelps | (Managed by MLA) | R | 100,000 | 370,000 |
| QPI56 | Delivering a land condition framework for grazing land management education | Dr Terry Beutel | Qld Dept of Primary Industries | R | 75,000 | 155,765 |
| RDP1 | Survey of Bestprac groups to identify promising natural resource management practices for the Managing Pastoral Country sub-program | Mr David Heinjus | Rural Directions Pty Ltd | R | 10,000 | |
| URS5 | Review of natural resource management practices for pastoral zone wool producers | Dr Donald Burnside | URS Australia Pty Ltd | R | 10,000 | |
| Rivers & Water Quality sub-program | | | | | | |
| CLW56 | Managing Gully Erosion in the New South Wales Tablelands to Improve Water Quality and Maintain Productive Wool Pastures (NB: This project has reporting requirements concluding near the end of the 2006/07 financial year) | Dr Gary Caitcheon | CSIRO Land and Water | R | 308,000 | 1,333,000 |
| MCB1 | Optimising Wool Production and Profitability in Mid North South Australian Riparian Areas | Dr Kerri Muller | River Murray Catchment Water Management Board | R | 300,000 | 267,489 |
| MCG4 | River Guidelines for Woolgrowers | Dr Phil Price | Mackellar Consulting Pty Ltd | C | 100,000 | |
| PLN1 | Local Communications Co-ordinator – Yass Region | Ms Fleur Flanery | Placing Nature | C | 119,412 | |
| SIW3 | Sub-program Coordinator | Dr Siwan Lovett | Lovett Clarke Consulting Pty Ltd | M | 216,128 | |
| TPI2 | Sustainable Sheep Grazing Systems for Riparian Landscapes | Mr Michael Askey-Doran | Tas Dept of Primary Industries Water & the Environment | R | 249,988 | 265,230 |
| TRS1 | Local Communications Co-ordinator – Tasmania | Mrs Elizabeth Nicolson | Tasmanian Revegetation Services | C | 110,400 | |
| Sustainable Grazing on Saline Lands sub-program | | | | | | |
| AGI1 | Chair of the SGSL Western Australia Coordinating Panel | Dr Fionnuala Frost | AgInsight | C | 86,631 | |
| BOW1 | Review of progress and future options for the SGSL National Network of Experiments (II) | Dr Roger Barlow | R & PA Barlow Pty Ltd | M&E | 14,145 | |
| CFO1 | Chair of the SGSL Victorian Coordinating Panel | Ms Christine Forster | Christine Forster | C | 12,130 | |
| COU3 | Assistance with the development and implementation of evaluation strategies for the Sustainable Grazing on Saline Lands sub-program – Land, Water & Wool | Dr Jeff Coutts | Coutts J&R Pty Ltd | M&E | 40,800 | |
| CUR13 | Managing the Photo Competition: SGSL sub-program | Mr Kim Mitchell | Currie Communications | C | 12,335 | |
| CUR2 | SGSL / NDSP National Communication Coordinator | Mr Kim Mitchell | Currie Communications | C | 50,000 | |
| CUR3 | National Communication Program for the SGSL sub-program | Mr Kim Mitchell | Currie Communications | C | 100,000 | |
| DAN17 | New South Wales Producer Network for the SGSL sub-program | Mr Luke Beange | NSW Dept of Agriculture | R | 384,619 | 675,000 |
| DAW40 | Phase 1 of WA network for participatory R&D for SGSL | Mr Justin Hardy | WA Dept of Agriculture | R | 95,000 | 150,000 |
| DAW42 | Phase II of the WA Network for Participatory Research & Development | Mr Justin Hardy | WA Dept of Agriculture | R | 1,258,980 | 3,215,907 |
| DAW44 | Storage and Retrieval System for SGSL Producer Group Research Data | Mr Greg Beeston | WA Dept of Agriculture | R | 101,115 | 47,000 |

Appendix 2: Project list – continued

| | | | | | | |
|-------|--|-------------------------------|--|-----|---------|-----------|
| DEP14 | SA Producer Network for the SGSL sub-program | Mr Jock McFarlane | SA Dept of Water, Land & Biodiversity Conservation | R | 421,000 | 547,000 |
| HAS7 | Review of progress and future options for the SGSL National Network of Experiments (I) | Mr Ian Rogan | Hassall & Associates Pty Ltd | M&E | 22,329 | |
| LAM1 | Chair of the Sustainable Grazing on Saline Lands Victorian Coordinating Panel of the Land, Water & Wool Program | Mr Ken Lamb | K & C Lamb Pty Ltd | C | 33,860 | |
| MUN2 | Chair of the SGSL SA Coordinating Panel | Dr Bruce Munday | Clear Connections | C | 55,185 | |
| OPT1 | Preparation of case studies where producers have been implementing grazing systems onto saline land | Mr John Powell | Optimal ICM | C | 37,669 | |
| OPT2 | Chair of the SGSL NSW Coordinating Panel | Mr John Powell | Optimal ICM | C | 97,045 | |
| RPC1 | Sub-program Coordinator | Dr Warren Mason | RPC Solutions | M | 836,845 | |
| SAI1 | Development of the suite of SALTdeck cards – SGSL sub-program – Land, Water & Wool | Mr Geoff Sainty | Sainty & Associates Pty Ltd | C | 52,899 | |
| SPC3 | Editing of Saltland Pastures Guide | Ms Jo Curkpatrick | Span Communication | C | 23,400 | |
| UME66 | Red Barren Project | Mr Jonathon Fawcett | University of Melbourne | R | 10,000 | |
| UNE46 | Provision of Database Services for the SGSL Series of Research Projects | Associate Professor Jim Scott | University of New England | R | 85,045 | |
| UNE49 | Database Support for the Research Sites of the SGSL sub-program | Associate Professor Jim Scott | University of New England | R | 100,000 | |
| UWA28 | Fencing of Demonstration Site | Dr David Masters | University of Western Australia (for Salinity CRC) | R | 15,000 | |
| UWA29 | Profitable and sustainable grazing of saline lands in Western Australia – Site 1 | Dr Hayley Norman | University of Western Australia (for Salinity CRC) | R | 841,988 | 706,468 |
| UWA30 | Productive and Sustainable Salt-tolerant Pastures for South Australia and Victoria | Dr Nicholas Edwards | University of Western Australia (for Salinity CRC) | R | 893,623 | 1,929,644 |
| UWA32 | Water, soil and salt movement from sustainable salt-tolerant pastures in New South Wales | Dr Warren King | University of Western Australia (for Salinity CRC) | R | 656,522 | 1,598,062 |
| UWA33 | Optimising the saltland pastures system in Western Australia for profitable use | Dr Ed Barrett-Lennard | University of Western Australia (for Salinity CRC) | | 688,765 | 1,465,030 |
| UWA35 | Improving the establishment of saltbushes (Atriplex spp.) on saltland – preliminary research | Dr Ed Barrett-Lennard | University of Western Australia (for Salinity CRC) | R | 45,000 | 71,180 |
| UWA39 | SGSL Performance & utilisation of saltland pastures – Integrating the information from the SGSL National Research Sites | Dr Colin White | University of Western Australia (for Salinity CRC) | R | 125,000 | 33,827 |
| UWA41 | SGSL Biodiversity Theme – Integrating the information from SGSL national research sites | Dr Warren King | The University of Western Australia | R | 124,377 | 76,274 |
| UWA42 | SGSL Economics of saltland pastures – Integrating the information from the SGSL national research sites | Dr Andrew Bathgate | University of Western Australia (for Salinity CRC) | R | 125,000 | 154,500 |
| UWA43 | What to plant where: effectively positioning plants in saline/waterlogged landscapes (NB: This project has reporting requirements concluding near the end of the 2006/07 financial year) | Dr Sarita Bennett | University of Western Australia (for Salinity CRC) | R | 168,470 | 152,372 |
| UWA44 | SGSL 'Salt & Water Movement from Saltland Pastures' Theme – Integrating the information from the SGSL national research sites | Dr Richie Silberstein | University of Western Australia (for Salinity CRC) | R | 90,133 | 23,804 |
| UWA52 | Reliable establishment of non-traditional perennial pasture species | Dr Phil Nichols | The University of Western Australia | R | 170,000 | 700,449 |
| VPI2 | Victorian Producer Network for the SGSL sub-program | Mr Trevor Pollard | Vic Dept of Primary Industries | R | 430,000 | 237,800 |

Appendix 2: Project list – continued

| Native Vegetation & Biodiversity sub-program | | | | | | |
|--|--|--|---|---|---------|---------|
| DAV39 | Marrying Biodiversity Conservation and Productivity In Wool Production Landscapes | Dr Jim Crosthwaite | Vic Dept of Natural Resources & Environment | R | 642,868 | 638,000 |
| EVC1 | Identification of Incentive Packages and Development of Guidelines to Improve Native Vegetation & Biodiversity Management for Wool Producers | Mr Rodney Safstrom | Environs Consulting Pty Ltd | R | 100,760 | |
| GRS1 | Managing Native Pastures in South Australia for Improved Animal Production and Native Biodiversity | Ms Millie Nicholls | Mid North Grasslands Working Group Inc. | R | 300,000 | 323,640 |
| INS2 | Coordination of Native Vegetation & Biodiversity Guidelines | Professor Jann Williams | NRM Insights | C | 50,250 | |
| RMI10 / INS1 | Sub-program Coordinator | Dr Jann Williams | NRM Insights | M | 198,970 | |
| UNE43 | Profitable, biodiverse, wool production systems for the northern tablelands of NSW | Assoc Prof Nick Reid | University of New England | R | 307,620 | 378,000 |
| USQ5 | Integrating paddock and catchment planning: a woolgrower driven approach to sustainable landscape management | Prof Charlie Zammit | University of Southern Qld | R | 219,901 | 368,250 |
| UTA12 | Biodiversity Conservation Integrated into Sustainable Grazing Systems in Tasmania | Prof Jamie Kirkpatrick | University of Tasmania | R | 397,020 | 905,054 |
| VBS1 | Development of Environmental Monitoring Aids for Woolgrowers – National Component | Mr Mark Gardner | Vanguard Business Services | C | 70,000 | |
| Additional Activities – these projects extend data collection over the next 18 months at sites affected by drought or where additional data will increase the integrity of the results | | | | | | |
| UWA55 | Continuing Data Collection – WA sites | Dr Hayley Norman/ Dr Ed Barrett-Lennard | The University of Western Australia | R | 138,234 | 159,180 |
| UWA56 | Continuing Data Collection – NSW sites | Dr Warren King | The University of Western Australia | R | 123,000 | 496,410 |
| USQ13 | Continuing data collection – Traprock site (USQ5) | Dr Geoff Cockfield | University of Southern Queensland | R | 61,081 | 21,940 |
| UTA18 | Continuing data collection – Tas site (UTA12) | Dr Jamie Kirkpatrick/ Dr Kerry Bridle | University of Tasmania | R | 35,524 | 11,616 |

Appendix 3: Product list

| Product Name | Product Number | Project |
|---|-------------------------------|---------|
| Whole Program | | |
| Best Practice Survey: Natural resource management & Australian woolgrowers | PB030472 | |
| Land Water & Wool: Product Summary | | |
| Land Water & Wool: Project Guide | PK050843 | |
| Land Water & Wool Business Plan | PR010116 | |
| Productive Resource Management for woolgrowers | PB030471 | |
| Shaping the Future: A snapshot of the Australian wool industry's Land Water & Wool natural resource management research and development programme | PR051010 | |
| Managing Climate Variability | | |
| Betting on Rain – a Guide to Seasonal Forecasting in Western NSW | Published by NSW DPI | DAN16 |
| Climate Risk Seasonal Outlook Outlook – Pocket Guide for Wool Producers in the Pastoral Rangelands of SA | Published by SARDI | SRD4 |
| Conversations About Climate: Seasonal Variability and Grazier's Decisions in the Eastern Rangelands | | UTA13 |
| Drafting Gate - On-line information and decision-support tool | | DAN24 |
| Improving seasonal forecast for woolgrowers | PF040736 | |
| Future Woolscales | | |
| Future Woolscales - Scenarios | | |
| Future Woolscales – Summary of Commissioned Research Papers | PB061189 | |
| Future Woolscales – What might the world and the wool industry look like in 2030? | PK061164 | |
| Pastoral | | |
| Enhanced profitability, productivity and positive outcomes for wool producers throughout Australia's pastoral zone | PF050840 | |
| Insights: case studies on how woolgrowers are successfully managing pastoral country for profit and sustainability | PK061226 | |
| Critical Decisions on Stocking Rate – instruction & decision support manual | PX051233 | AMH3 |
| The ABCD Pasture Condition Guide – Mulga lands and Mitchell grasslands (booklet) | Published by Queensland DPI&F | QPI56 |
| Mulga as a feed source (factsheet) | Published by Queensland DPI&F | QPI56 |
| Mitchell Grass Recovery – Drought Information Posters | Published by Queensland DPI&F | MLA2 |
| Rivers & Water Quality | | |
| Are my waterways in good condition? A checklist for assessing river, stream or creek health on farms | PB061114 | |
| Improving water quality to benefit wool production sub-program fact sheet | PF030529 | |
| Insights: case studies on how woolgrowers are successfully managing rivers, streams and creeks on wool properties | PK050950 | |
| Managing gullies on wool producing farms fact sheet | PF061166 | |
| Managing in-stream wetlands on wool-producing farms fact sheet | PF061168 | |
| Managing rivers, creeks and streams – a woolgrowers guide | PX051003 | |
| New South Wales Regional Project – Community Report | | PLN1 |
| Preventing erosion to maximise wool production project fact sheet | PF030530 | |
| Rapid Appraisal of Riparian Condition Technical Guideline for Tasmania | PB061229 | TPI2 |
| Rapid Appraisal of Riparian Condition Technical Guideline for the midnorth of South Australia | PX061155 | |
| Rapid Appraisal of Riparian Condition Technical Guideline for the New South Wales Tablelands | | CLW56 |
| South Australia Regional Project – Community Report | | MCB1 |
| South Australia Regional Project – Fact sheets | | MCB1 |
| Tasmanian Regional Project – Community Report | | TRS1 |
| Tasmania oral histories – Reflections from woolgrowers in the midlands | | |
| Tasmania Postcard Fact Series – Five topics including: managing cumbungi; blue-green algae; unreliable boundaries | | |
| Wool Industry River Management Guide: High rainfall zones including tableland areas | PX050951 | |
| Wool Industry River Management Guide: Sheep/wheat zones | PX050952 | |
| Interactive website with rivers documents broken up into easily accessible sizes | | |

Appendix 3: Product list – continued

| Sustainable Grazing on Saline Lands | | |
|---|---------------------------------|-------|
| Insights: Case studies on how farmers are successfully managing saltland for profit and sustainability | PK040658 | |
| Land, Water & Wool: Sustainable grazing on saline lands – Making more from your Saline Land? | PF030528 | |
| Northern NSW Saltland Pastures Guide | TBC | DAN17 |
| NSW Network DVD | TBC | DAN17 |
| NSW Network Summary | TBC | DAN17 |
| Prospects for Saline Land | Joint venture with Salinity CRC | |
| SA 'Sites' booklet, with supporting posters and case studies | TBC | DEP14 |
| SA Case Studies | | DEP14 |
| SA Fact Sheets (Agency products) | | DEP14 |
| SA Project Poser Sheets | | DEP14 |
| SA Saltland Pastures Guide | TBC | DEP14 |
| SALTdeck | PB061190 | |
| Saltland Pastures in Australia: a practical guide | PR030563 | |
| SGSL National Synthesis Product | TBC | |
| Sustainable Grazing on Saline Lands – Productive solutions for salinity management | PX030508 | |
| Sustainable grazing on saline lands – projects and products | PF030608 | |
| The Sustainable Grazing on Saline Lands (SGSL) Producer Network in WA: Livestock producers and researchers working together to turn the tide | PF040801 | DAW42 |
| The Sustainable Grazing on Saline Lands (SGSL) Producer Network in New South Wales | PF050874 | DAN17 |
| Vic/Tas Agnotes (Agency products) | NA | VPI2 |
| Vic/Tas Network Summary Booklet | TBC | VPI2 |
| WA 'Social' Case Studies | TBC | DAW42 |
| WA 'Technical' Case Studies | TBC | DAW42 |
| WA Farm Notes (Agency product) | NA | DAW42 |
| WA Network Summary of Individual Projects | TBC | DAW42 |
| WA Saltland Scoring & Solutions | TBC | DAW42 |
| Native Vegetation & Biodiversity | | |
| 12 NSW Fact sheets (Pastures; Water quality; Birds; Bats; Arboreal marsupials; Fauna; Woolgrower attitudes; Economics, productivity and environment (x2); 42 management recommendations; 10 production/environment hypotheses tested) | | UNE43 |
| 7 NSW testimonials | | UNE43 |
| Barking up the right tree | PB051020 | DAV39 |
| Effect of vegetation management on woodland communities in the Traprock region | | USQ5 |
| Victorian Extension Note 1: Farm businesses, wool productivity and biodiversity | | DAV39 |
| Victorian Extension Note 2: How can managing hill country be more profitable? | | DAV39 |
| Victorian Extension Note 3: Using natural regeneration to establish shelter on wool properties | | DAV39 |
| Grasses, gums and groundcovers: a field guide to the common native plants of the Northern Agricultural districts of South Australia | | GRS1 |
| Grazing native pastures in Tasmania – managing kangaroo grass pastures | PF050865 | UTA12 |
| Grazing native pastures in Tasmania – managing wallaby grass pastures | PF050868 | UTA12 |
| Grazing native pastures in Tasmania – the best way to manage grassy weeds in native pastures | PF050866 | UTA12 |
| Grazing native pastures in Tasmania – the forage characteristics and qualities of native grasses | PF050867 | UTA12 |
| How to make money out of grass: A farmer's guide to grazing management in the Northern Agricultural Districts of South Australia | | GRS1 |
| Insights: Case studies on how woolgrowers are successfully managing native vegetation and biodiversity for profit and sustainability | PK050949 | |
| Integrating paddock and catchment planning a wool producer approach to sustainable landscape management | PF040731 | USQ5 |

Appendix 3: Product list – continued

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|---|-------------------------------|-------|
| Making more from your native pastures | PF030477 | |
| Managing grazing on native pastures in Tasmania | PF050864 | UTA12 |
| Managing Tasmanian Native Pastures – a Technical Guide for Graziers | PN061152 | UTA12 |
| Our reputation for quality wool in the Northern Midlands rides on the sheep's back – and on the health of our native vegetation | PF030480 | UTA12 |
| Pasture and biodiversity monitoring field guide | | USQ5 |
| People, Sheep and Nature: The Tasmanian Experience | Published by CSIRO Publishing | UTA12 |
| Productive native pastures in the high and medium rainfall zones | PX030509 | |
| Productive resource management for woolgrowers: managing native vegetation and biodiversity | PK040727 | |
| Profitable wool production and improved native vegetation – a healthy marriage in Victoria | PF030478 | DAV39 |
| Property and Sub-catchment planning for sustainable land management | | USQ5 |
| QuickChecks Manual | PX061206 | VBS1 |
| Revealing the secrets for profitable, productive native pastures in the Mid-North | PF040787 | GRS1 |
| Tasmanian Wool – Natural Landscapes, Natural Fibres | PF030527 | UTA12 |
| Traprock website | | USQ5 |
| Vegetation changes following the short-term exclusion of grazing in the Traprock region | | USQ5 |
| Vegetation management, grazing and arthropod assemblages in the Traprock region | | USQ5 |
| What do native vegetation; quality wool and healthy profits have in common in the Northern Tablelands? | PF030479 | UNE43 |
| Wool Production and Biodiversity: A holistic solution for fine wool and healthy profits at 'Lana' | PF050838 | UNE43 |
| Wool Production and Biodiversity: Fine wool, healthy profits and a healthy landscape the ideal equation | PF050837 | UNE43 |
| Wool Production and Biodiversity: Triple bottom line the focus for wool production at 'The Hill' | PF050839 | UNE43 |
| Woolgrowers in the high rainfall and sheep-wheat zone protecting and improving bushland biodiversity on farm | PX030510 | |
| Woolgrowers' psychological engagement with their properties, and implications for the management of biodiversity and sustainability | | USQ5 |

Appendix 4: Publications

Journal articles, conference presentations, scientific books and university theses

(This list does not include products and publications produced by the sub-programs and which appear in Appendix 3 – List of Products)

Whole Program

Wagg, M. & Lawson, A. 2006, 'Land, Water & Wool: An integrated extension program in Natural Resource Management on wool properties', paper presented at the Australasia-Pacific Extension Network (APEN) Conference, Beechworth, Vic., 6-8 March.

Sustainable Grazing on Saline Lands sub-program

Abraham, E.A., Edwards N.J., Hebart, M.L., Hocking Edwards, J. & Craig, A.D. 2006, 'Balansa Clover Improves Wool Production On Saline Pastures', paper presented to the 26th Biennial Conference of the Australian Society for Animal Production, Perth. UWA 30 SA

Abraham, E.A., Hebart, M.L., Edwards, N.J. & Craig, A.D. 2005, 'The Effect of Timing and Rate of Nitrogen Fertiliser on Puccinellia-based Pastures', paper presented to the 46th Annual Conference of the Grassland Society of Southern Australia. UWA 30 SA

Abraham, E.A., Hebart, M.L., Edwards, N.J. & Craig, A.D. 2006, 'Incorporating balansa clover in a puccinellia sward increases pasture and animal production', *Proceedings of "Utilising the asset", 47th Annual Conference of the Grasslands Society of Southern Australia*, Warrnambool, Victoria, p. 119. UWA 30 SA

Barrett-Lennard, E.G. 2003, 'Pastures for saline land', *Agribusiness Sheep Updates*, Perth 12-13 August. UWA 33

Barrett-Lennard, E.G. 2003, 'The interaction between waterlogging and salinity in higher plants: causes, consequences and implications', *Plant and Soil*, vol. 253, pp. 35-54. UWA 33

Barrett-Lennard, E., Dynes, R., Masters, D., Norman, H., Phelan, S., Rintoul A. & Wilmot, M. 2003, 'The saltland pasture revolution – improved profits flow from mixtures', *Proceedings of the State Landcare Conference for Agricultural Sustainability*, Katanning, WA, 7-10 October, pp. 4-8. UWA 33

Barrett-Lennard, E.G., Freudenberger D.O. & Norman H.C. 2005 'Composition, structure and function in saltland ecosystems: parts and blueprints for saltland restoration', *Proceedings of the International Salinity Forum (Managing Saline Soils and Water: Science, Technology and Social Issues): Oral Presentation Abstracts*, Riverside, California, 25-27 April, pp. 37-40. UWA 33

Barrett-Lennard, E.G., George, R.J., Hamilton, G., Norman, H.C. & Masters, D.G. 2005, 'Multi-disciplinary approaches suggest profitable and sustainable farming systems for valley floors at risk of salinity', *Australian Journal of Experimental Agriculture*, vol. 45, pp. 1415-1424. UWA 33

Barrett-Lennard, E.G. Hamilton, G., Norman, H. & Masters, D. 2004, 'Multi-disciplinary approaches suggest profitable and sustainable farming systems for valley floors at risk of salinity', *Salinity Solutions. Proceedings of the Salinity Solutions Conference "Working with Science and Society"*, Bendigo, Victoria, 2-5 August. UWA 33

Barrett-Lennard, E., Mason, W., Hannon, F., Powell, J. & Munday, B. 2005, 'Australia's sustainable grazing on saline lands initiative: creating attitudinal change on a grand scale', *Proceedings of the International Salinity Forum (Managing Saline Soils and Water: Science, Technology and Social Issues)*, Riverside, California, 25-28 April.

Barrett-Lennard, E.G. & Moore, G. (in press), 'Saltland pastures', *Perennial Pastures Guide* (Ed G. Moore). UWA 33

Barrett-Lennard, E.G., Norman, H.C., Willmott, M., Altman, M., Pearce, K., Masters, D.G., Phelan, S. & Silberstein, R. 2005, 'Saltbush pastures: dispelling some myths', *Sheep Updates*. UWA 29 & 33

Bennetts, D., Webb, J., McCaskill, M.R. & Zollinger, R. (in press) 'Dryland Salinity Processes within the Discharge Zone of a Local Groundwater System, Southeastern Australia', submitted to *Hydrogeology Journal* UWA 30 Vic

Crosbie, R.S. & Hughes, J.D. 2006, 'Challenging the paradigm: An example of anthropogenic modification to groundwater discharge causing a saline scald rather than an increase in recharge', paper presented to the 10th Murray-Darling Basin Groundwater Workshop, Canberra. UWA 32

Crosbie, R.S., Hughes, J.D., King, W., Dassanayake, K. & Broadfoot, K. 2006, 'Perennial pastures reduce runoff from saline discharge areas: a case study', paper presented to the 10th Murray-Darling Basin Groundwater Workshop, Canberra. UWA 32

Crosbie, R.S., Wilson, B., Hughes, J.D. & McCulloch, C. (submitted), 'A comparison of the water use of tree belts and pasture in recharge and discharge zones in a saline catchment in the Central West of NSW, Australia', submitted to *Agricultural Water Management*. UWA 32

Dunstan, D., Edwards, N., Craig, A. & Revell D. 2006, 'Grazing balansa clover and puccinellia mixed pastures on saline land', "Ground breaking stuff": *Proceedings of the 13th Australian Society of Agronomy Conference*, Perth. www.regional.org.au/au/asa/2006/poster/pests/4651_dunstand.htm UWA 30 SA

Dynes, R., Henry, D., Norman, H.C. & Masters, D.G. 2003, 'Feeding value – the essential link between pastures and animals', *Agribusiness Sheep Updates*, Perth 12-13 August. UWA 29

Edwards, N.J., Masters, D.G., Barrett-Lennard, E.G., Hebart, M.L., McCaskill, M.R., King, W. McG. & Mason, W. 2004, 'Profitable and sustainable grazing systems for livestock producers with saline land in southern Australia', paper presented to the Salinity Conference, Bendigo.

Edwards, N.J., Fenton, M., Craig, A., McCaskill, M.R., Evans, P. & King, W. McG. 2003, 'Sustainable Grazing on Saline Lands – a new national research program addressing animal production on saline grasslands', paper presented to the Grasslands Society Conference.

Edwards, N.J., Masters, D.G., Barrett-Lennard, E.G., Hebart, M.L., McCaskill, M.R., King, W. McG. & Mason, W. 2005, 'Profitable and sustainable grazing systems for livestock producers with saline land in southern Australia', *Proceedings of the XXth International Grasslands Congress (Grasslands: a global resource)*, Dublin, Ireland & Glasgow, Scotland, July, p. 131.

Appendix 4: Publications – continued

- Edwards, N.J., Masters, D., Barrett-Lennard, E., Hebart, M., McCaskill, M., King, W. & Mason, W. 2005, 'Profitable and sustainable grazing systems for livestock producers with saline land in southern Australia', *Proceedings of the XXth International Grasslands Congress (Grasslands: a global resource)*, Dublin, Ireland & Glasgow, Scotland, July, p. 694. UWA30 SA
- Edwards, N.J., Masters, D., Barrett-Lennard, E., Hebart, M., McCaskill, M., King, W. & Mason, W. 2005, 'Profitable and sustainable grazing systems for livestock producers with saline land in southern Australia', *Proceedings of a Satellite Workshop of the XXth International Grasslands Congress (Pastoral systems in marginal environments)*, Dublin, Ireland & Glasgow, Scotland, July, p. 204. UWA30 SA
- Edwards, N.J., Abraham, E.A., Fenton, M.L., McFarlane, J.D., Craig, A.D. & Hocking Edwards, J.E. 2004, 'Cobalt, selenium and copper responses in sheep grazing saline land in the Upper South East of South Australia', *Animal Production in Australia*, vol. 25, p. 236. UWA30 SA
- Edwards, N.J., Hebart, M.L., Craig, A.D., Abraham, E.A., Hocking Edwards, J.E. & McFarlane, J.D. 2004, 'Applying nitrogen increases pasture and sheep production on puccinellia-based pastures in the SA SGSL grazing experiment', paper presented to the Salinity Conference, Bendigo. UWA 30 SA
- Edwards, N.J., Norman, H.C., Hebart, M.L., Barrett-Lennard, E., McCaskill, M.R., King, W.M. & Mason, W. 2005, 'Australia's Sustainable Grazing on Saline Lands Initiative: a national research program addressing profitable and sustainable use of saline land', *Proceedings of the International Salinity Forum (Managing Saline Soils and Water: Science, Technology, and Social Issues)*, Riverside, California, 25-27 April, p. 159. UWA30 SA
- Edwards, N.J., Norman, H.C., Hebart, M.L., Barrett-Lennard, E.G., McCaskill, M.R., King, W.M. & Mason, W. 2005, 'Sustainable Grazing on Saline Lands: profitable and sustainable grazing systems for livestock producers with saline land in southern Australia', *Proceedings of the 'Horizons in Livestock Sciences: Redesigning Animal Agriculture' Conference*, Gold Coast, Qld, 2-5 October, p. 27. UWA30 SA
- Fenton, M.L., Edwards, N.E., McFarlane, J.D., Craig, A.D., Abraham, E.A. & Hocking Edwards, J.E. 2004, 'Urea applied to puccinellia pastures increases sheep production', *Animal Production in Australia*, vol. 25, p. 241. UWA30 SA
- Fitzpatrick, L., McCaskill, M. & Hebart, M. 2005, 'Viable pastures for saline land: puccinellia and tall wheatgrass', *Proceedings of the 46th Annual Conference of the Grassland Society of Southern Australia*, Warragul (Ed J. Court), p. 119. UWA 30 Vic
- Hardy, J., Collins, J.P., Ryder, A. & Johns, J. 2005, 'Farmer driven innovation – the backbone of the SGSL Producer Network', paper presented to the Ballard Seeds Official Opening, Narrogin WA, November. DAW 42
- Hardy, J., Collins, J.P., Ryder, A. & Johns, J. 2005, 'Farmer driven innovation – an update on the SGSL Producer Network in WA', paper presented to the PUR\$L Conference, Wellington and Cowra NSW, October. DAW 42
- Hardy, J., Collins, J.P., Ryder, A. & Schiller, N. 2005, 'Farmer driven innovation – the backbone of the SGSL Producer Network', paper presented to the State Natural Resource Management Conference, Western Australia, October. DAW 42
- Hardy, J., Collins, J.P., Ryder, A. & Johns, J. 2003, 'The Sustainable Grazing On Saline Lands (SGSL) Producer Network In Western Australia', paper presented to the State Landcare Conference for Agricultural Sustainability, Katanning, WA, 7-10 October 2003. DAW 42
- Hardy, J., Collins, J.P., Ryder, A. & Schiller, N. 2004, 'The Sustainable Grazing On Saline Lands (SGSL) Producer Network farmer case studies', *WA Regional Sheep Up-dates*. DAW 42
- Hardy, J., Collins, J.P., Ryder, A. & Schiller, N. 2004, 'The Sustainable Grazing on Saline Lands (SGSL) Producer Network in WA', paper presented to the Salinity Conference, Bendigo. DAW 42
- Hebart, M.L., Abraham, E.A., Edwards, N.J. & Craig, A.D. 2006, 'Incorporating balansa clover in a puccinellia sward increases pasture and animal production', paper presented to the 26th Biennial Australian Society of Animal Production Conference, Perth. UWA 30 SA
- Hebart, M.L., Edwards, N.J., Abraham, E.A. and Craig, A.D. 2005, 'The biodiversity value of 'improved' and 'unimproved' saline agricultural land and adjacent remnant vegetation in South Australia', *Proceedings of a Satellite Workshop of the XXth International Grasslands Congress (Pastoral systems in marginal environments)*, Dublin, Ireland & Glasgow, Scotland, July, p. 131. UWA30 SA
- Hebart, M.L., Edwards, N.J., Craig, A.D., Abraham, E.A., McFarlane, J.D. & Hocking Edwards, J.E. 2005, 'Urea applied to puccinellia-based pastures increases pasture and sheep production', *Proceedings of the XXth International Grasslands Congress (Grasslands: a global resource)*, Dublin, Ireland & Glasgow, Scotland, July, p. 149. UWA30 SA
- Hebart, M.L., Edwards, N.J., Abraham, E.A. & Craig, A.D. 2005, 'The biodiversity value of 'improved' and 'unimproved' saline agricultural land and adjacent remnant vegetation in South Australia', *Proceedings of the XXth International Grassland Congress ("Grassland: a global resource")*, Dublin, Ireland & Glasgow, July, Scotland. UWA 30 SA
- Hughes, J., Khan, S., Crosbie, R., Helliwell, S. & Michalk, D. 2006, 'The role of surface hydrology in planning salinity mitigation strategies', paper presented to the 10th Murray-Darling Basin Groundwater Workshop, Canberra. UWA 32
- Hughes, J.D., Khan, S., Crosbie, R., Helliwell, S. & Michalk, D. (submitted), 'Runoff and solute mobilisation processes in a semi-arid head water catchment', *Water Resources Research*. UWA 32
- Jenkins, S., Barrett-Lennard, E.G. & Rengel, Z. 2005, 'Ecological zonation of tall wheatgrass and puccinellia caused by the interaction of salinity and waterlogging?', *Proceedings of the International Plant Nutrition Colloquium*, Beijing. UWA 33
- Jenkins, S., Barrett-Lennard, E.G. & Rengel, Z. 2004, 'Ecological zonation of tall wheatgrass and puccinellia caused by salinity and waterlogging gradients', paper presented to the Salinity Conference, Bendigo. UWA 33
- King, W. 2005, 'Sustainable Grazing Systems on Saline Lands – Research in New South Wales', a paper presented to the PUR\$L Conference, Wellington and Cowra NSW, October. UWA 32
- King, W. McG. & Atkins, L. 2005, 'Invertebrate diversity in salinised agricultural landscapes', paper presented at the Australian Entomological Society Conference, Canberra. UWA 32
- King, W. McG. 2006, 'Invertebrate diversity in salinised agricultural landscapes across Australia', paper presented at the Combined Ecological Society of Australia/New Zealand Ecological Society Conference, Wellington, NZ. UWA 32
- Lee, G.J., Semple, W.S., Costello, D., Stringer, D., Sladek, M.A. & Corrigan, J. 2006, 'Diet selection of Merino wethers grazing vegetatively-established grasses for productive revegetation of saline sites in New South Wales', paper presented to the 26th Biennial Conference of the Australian Society of Animal Production, Perth. UWA 32

Appendix 4: Publications – continued

- Lefroy E.C., Flugge F., Avery A. & Hum I. 2005, 'Potential of current perennial plant-based farming systems to deliver salinity management outcomes and improve prospects for native biodiversity: a review', *Australian Journal of Experimental Agriculture*, vol. 45, pp. 1357-1367. UWA 29
- Loch, D.S., Barrett-Lennard, E. & Truong, P. 2003, 'Role of salt tolerant plants for production, prevention of salinity and amenity values', *Salinity under the sun – investing in prevention and rehabilitation of salinity in Australia: Proceedings of the 9th National Conference on Productive Use and Rehabilitation of Saline Land (PURSL)*, Yeppoon, Qld, 29 Sep–2 Oct. UWA33
- Lovett, S. 2006. 'Managing knowledge to improve NRM Outcomes'. Proceedings Vegetation Futures Conference. Greening Australia. Canberra SIW3
- Lovett, S. 2006. 'People, passion and place: broadening our perspectives about river knowledge'; Proceedings Riversymposium . Brisbane SIW3
- Malcolm R McCaskill, M.R., Mavromihalis, J., Zollinger, R. & Kearney, G. 2006, 'Soil analysis and vegetation as indicators of salinity', *Proceedings of the Australian and New Zealand Soil Science Society*. UWA30 Vic
- Malcolm, C.V., Lindley, V.A., O'Leary, J.W., Runciman, H.V. & Barrett-Lennard, E.G. 2003, 'Halophyte and glycophyte salt tolerance at germination and the establishment of halophyte shrubs in saline environments', *Plant and Soil*, vol. 253, pp. 171-185. UWA33
- Marcar, N., Barrett-Lennard, E.G., Dynes, R., Edwards, N.J., King, W.M., McCaskill, M.R. & Mason, W. 2004, 'Profitable And Sustainable Grazing Systems For Livestock Producers With Saline Land In Southern Australia', paper presented to the Salinity Conference, Bendigo.
- Marcar, N., Mason, W., Barrett-Lennard, E.G., Dynes, R., Edwards, N.J., King, W.McG. & Hamilton, G. 2003, 'New Programs To Deliver On Sustainable Production Systems For Salinity Management', paper presented to the PURSL Conference, Yeppoon, Qld, 29 September – 2 October.
- Masters D., Edwards N., Sillence M., Avery A., Revell D. Friend M., Sanford P, Saul G., Beverly C. & Young J. 2006, 'The role of livestock in the management of dryland salinity', *Australian Journal of Experimental Agriculture*, vol. 46, pp. 733-741. UWA 29
- Masters D.G., Benes S.E. & Norman H.C. (in press), 'Biosaline agriculture for forage and livestock production', *Agriculture, Ecosystems and Environment*. UWA 29
- Masters, D.G, Edwards, N.J., Sillence, M., Avery, A., Revell, D.K., Friend, M, Sanford, P., Saul, G., Beverly, C. & Young, J. 2006, 'The role of livestock in the management of salinity', *Australian Journal of Experimental Agriculture*, vol. 46, pp. 733-741 UWA 30 SA
- Masters, D.G. Rintoul, A.J. Dynes, R.A., Pearce K.L. & Norman, H.C. 2005, 'Feed intake and production in sheep fed diets high in sodium and potassium', *Australian Journal of Agricultural Research*, vol. 56, pp. 427-434. UWA 29
- Masters, D.G., Norman, H.C & Dynes, R.A. 2002, 'A mix of plants lifts feed value from saline land', *Farming Ahead*, Kondinnin Group. UWA 29
- Masters, D.G., Norman, H.C. & Barrett-Lennard, E.G. 2005, 'Agricultural systems for saline soil: the potential role of livestock', *Asian-Australasian Journal of Animal Sciences*, vol 18, pp. 296-300. UWA 29
- McCaskill, M. & Borg, D. 2006, 'Pastures for saline areas', *Greener Pastures for south-west Victoria* 2nd Edition (Eds Z. Nie and G. Saul), Victorian Department of Primary Industries, Hamilton, Victoria, pp. 90-98. UWA 30 Vic
- McCaskill, M. (and others) (Submitted) 'Salt-tolerant pastures for temperate southern Australia: 1. Soil and water environment; 2. Biodiversity impacts; 3. Pasture growth and persistence; and 4. Animal production', submitted to *Australian Journal of Experimental Agriculture*. UWA30 Vic
- McCaskill, M.R. & Bennetts, D. 2004, 'First-year production of salt-tolerant pasture in response to salinity and wetness', paper presented to the Salinity Conference, Bendigo. UWA30 Vic
- McCaskill, M.R. & Pollard, T. 2005, 'Summer weight gains from tall wheatgrass and volunteer pastures on saline land', *Proceedings of the 46th Annual Conference of the Grassland Society of Southern Australia*, Warragul (Ed J. Court), p. 124. UWA 30 Vic
- McCaskill, M.R., Pollard, T., Evans, P.M., Mavromihalis, J. & Zollinger, R. 2005, 'Development of saline land technologies for temperate southern Australia', paper presented to the International Salinity Forum, Riverside, California, 25-27 April. UWA 30 Vic
- McCulloch, C., Hughes, J., Crosbie, R. & Mitchell, D. 2006, 'Investigation into the effects of extended dry periods on ground water dynamics and stream salt loads in NSW', paper presented to the 10th Murray-Darling Basin Groundwater Workshop, Canberra. UWA 32
- McFarlane, J., Collins, J.P., Hardy, J. & Ryder, A. 2003, 'Sustainable Grazing on Saline Lands (SGSL) Producer Network in South Australia and Western Australia', paper presented to the PURSL Conference, Yeppoon, Qld, 29 September – 2 October. DAW 42
- Mitchell, D., Crosbie, R., Derham, P., Hughes, J., Bernardi, T., Summerall, G., Littleboy, M., Behane, D., Blasi, M., Lee, C., McCulloch, C., Nies, L., Shoemark, V. & Wilson, B. 2006, 'Key sites for hydrology, salinity and model validation: a local groundwater flow systems perspective', paper presented to the 10th Murray-Darling Basin Groundwater Workshop, Canberra. UWA 32
- Nichols, P.G.H., Albertsen, T.O & McClements, D. 2006, 'Pasture legumes and grasses for saline land', *Proceedings of the 2006 Agribusiness Sheep updates*, Perth (Ed. S.Shaw), pp. 54-55. UWA 29
- Nicolson, B., Flanery, F. & Nicholls, K. 2005. 'River management: bridges we need to cross together'. Proceedings Stream Management Conference. Tasmania. MCB1/PLN1/TRS1
- Norman H.C., Dynes R.A. & Masters D.G. 2005, 'Diversity and variation in nutritive value of plants growing on two saline sites in south-western Australia', *Proceedings of the Satellite Workshop of the XXth International Grasslands Congress (Pastoral systems in marginal environments)*, Dublin, Ireland & Glasgow, Scotland, July. UWA 29
- Norman H., Revell D.K.. & Masters D.G. 2006, 'Animal production from extensive grazing systems – factors contributing to productivity, saltland pastures and incorporating shrubs into systems', *Regional Sheep & Beef Updates*, 25-26 July. UWA 29
- Norman, H.C. Masters, D.G., Dynes, R.A., Henry, D.A. & Lloyd, M.J. 2002, 'Liveweight change and wool growth in young sheep grazing a mixed saltbush and balansa clover based pasture', *Animal Production in Australia*, vol. 24. UWA 29
- Norman, H.C., Dynes, R.A. & Masters, D.G. 2003, 'Botanical diversity within 2 saline ecosystems in south-western Australia', *Proceedings of the 11th Australian Agronomy Conference*, Geelong, Vic. UWA 29
- Norman, H.C. & Masters, D.G (in press) 'Animal production from extensive grazing systems', *Perennial Pastures Guide* (Ed G. Moore). UWA 29

Appendix 4: Publications – continued

Norman, H.C., Barrett-Lennard, E., Dynes, R.A., Masters, D.G., Phelan, S., Wilmot, M.G. & Rintoul, A.J. 2003, 'The saltland pasture revolution – improved profits flow from mixtures', *Proceedings of the State Landcare Conference for Agricultural Sustainability*, Katanning, Western Australia, 7-10 October. UWA 29

Norman, H.C., Dynes, R.A., Rintoul, A.J., Wilmot, M.G. & Masters, D.G. 2004, 'Sheep production from saline land – productivity from old man and river saltbush and the value of grain and straw supplements', *Animal Production in Australia*, vol. 25, p. 289. UWA 33

Norman, H.C., Friend, C., Masters, D.G., Rintoul, A.J., Dynes, R.A. & Williams, I.H. 2004, 'Variation within and between two saltbush species in plant composition and subsequent selection by sheep', *Australian Journal of Agricultural Research*, vol. 55, pp. 1-9. UWA 33

Norman, H.C., Masters, D.G., Wilmot, M.G., Silberstein, R. & Lefroy, T. 2005, 'Sustainable grazing on saline land in Western Australia – multidisciplinary research linking producers and scientists', *Proceedings of the XXth International Grassland Congress ("Grassland: a global resource")*, Dublin, Ireland & Glasgow, Scotland, July. UWA 29

O'Connell, M., Young, J. & Kingwell, R. (submitted) 'The Economic Value of Saltland Pastures in a Mixed Enterprise Farming System in a Heterogeneous Landscape experiencing a Mediterranean Climate', submitted to *Agricultural Systems*. UWA 29

Powell, J. & Beange, L. 2005, 'The Sustainable Grazing on Saline Lands (SGSL) Program in NSW', paper presented to the NSW Grassland Society Conference, July. DAN 17

Rogers, M.E., Craig, A.D., Munns, R.E., Colmer, T.D., Nichols, P.G.H., Malcolm, C.V., Barrett-Lennard, E.G., Brown, A.J., Semple, W.S., Evans, P.M., Cowley, K., Hughes, S.J., Snowball, R., Bennett, S.J., Sweeney, G.C., Dear, B.S. & Ewing, M.A. 2005, 'The potential for developing fodder plants for the salt-affected areas of southern and eastern Australia: an overview', *Australian Journal of Experimental Agriculture*, vol. 45, pp. 301-329. UWA33

Stevens, J.C., Barrett-Lennard, E.G. & K.W. Dixon, K.W. (in press), 'Enhancing the germination of three fodder shrubs (*Atriplex amnicola*, *A. nummularia*, *A. undulata*; Chenopodiaceae): implications for the optimisation of field establishment', *Australian Journal of Agricultural Research*, vol. 57. UWA 33

Thomas D.T., Norman H.C. & Filmer, M. 2006, 'Measuring diet selection accurately', *Farming Ahead*, Kondinnin Group, December. UWA 29

Thomas D.T., Norman H.C., Rintoul, A.J., Wilmot M.G. & Masters D.G. 2005, 'The use of stable carbon isotopes to measure diet selection in sheep grazing saltland pastures', *Proceedings of the 'Horizons in Livestock Sciences: Redesigning Animal Agriculture' Conference*, Gold Coast, Qld, 2-5 October, p. 29. UWA33

Thomas D.T., Rintoul A.J. & Masters D.G. (in press), 'Sheep select combinations of high and low sodium chloride, energy and crude protein feed that improve their diet', *Applied Animal Behaviour Science*. UWA 29

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Wilmot M.G. & Norman H.C. 2006, 'Saltbush biomass in a saline grazing system – use it or lose it', *Animal Production in Australia*, vol. 26. UWA 29

Wilmot, M.G. & Norman, H.C. 2006, 'Saltbush more hardy than many think', *Farming Ahead*, Kondinnin Group, October. UWA 29

Native Vegetation & Biodiversity sub-program

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Appendix 4: Publications – continued

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- Kahn, L., Nicholls, M., Earl, J. & Nicholls, K. 2005, 'Successful research with local farmers to improve native grasslands', Australian case studies of integration in natural resource management: Special Issue of the Australasian Journal of Environmental Management, vol 12, pp. 62-64. GRS1
- Kirkpatrick, J.B. & Bridle, K.L. (in press), *People, Sheep and Nature: The Tasmanian Experience*, CSIRO Publishing, Collingwood. UTA 12
- Kirkpatrick, J.B. 2004, 'Vegetation change in an urban grassy woodland 1974-2000', *Australian Journal of Botany*, vol. 52, pp. 597-608. UTA 12
- Kirkpatrick, J.B., Bridle, K.L., Leonard, S.W.J. & Gilfedder, L. 2005, 'Managing sheep for nature conservation on wool-growing properties – some preliminary observations on the short term impacts of grazing regime changes', *Grassland Conservation and Production – Both Sides of the Fence: Proceedings of the 4th National Native Grasses Conference* (Eds C O'Dwer and S Hamilton), Burra 11-13 October, pp. 100-105. UTA 12
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- MacDonald, M. & Kirkpatrick, J.B. 2003, 'Explaining bird species composition and richness in eucalypt-dominated remnants in subhumid Tasmania', *Journal of Biogeography*, vol. 30, pp. 1415-1426. UTA 12
- Moll, J., Dorrough, J., Crosthwaite, J. & Straker, A. 2005, 'Improving native biodiversity management on wool properties in central Victoria – investment analysis of four strategies', paper presented to a Resource Economics Workshop 'Identifying production and environmental trade-offs at the farm level', organised by the AGSIP project AG13 in partnership with the Australian Agricultural and Resource Economics Society, Rockhampton 28 October. DAV 39
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- Reid, N. & Reseigh, J. 2005, 'How Management Affects Pasture Composition on the Northern Tablelands of NSW', *Grassland Conservation and Production – Both Sides of the Fence: Proceedings of the 4th National Native Grasses Conference* (Eds C O'Dwer and S Hamilton), Burra 11-13 October. UNE 43
- Scott, M. 2004, Evaluation of two methods to assess remnant vegetation as fauna habitat. BSc (Hons) thesis, School of Geography and Environmental Studies, University of Tasmania. UTA 12
- Vercoe, J. 2003, Voluntary conservation on private land: Tasmania's private reserve program: lessons and opportunities. BSc (Hons) thesis, University of Tasmania, Hobart. UTA 12
- Vesk, P.A. & Dorrough, J. (in press), 'Getting trees on farms the easy way? Lessons from a model on eucalypt regeneration in pastures', *Australian Journal of Botany*. DAV 39
- Von Platten, J. (in progress), The reconstruction of historic and prehistoric fire regimes using evidence in tree stumps. PhD thesis, University of Tasmania. UTA 12
- Williams, J.E. (2003) 'Integrating native vegetation and biodiversity management into profitable wool production systems' BUSH magazine, Environment Australia.
- Williams, J.E. 2006, (representing the LWW Native Vegetation & Biodiversity sub-program) 'Today's landholders managing tomorrow's landscapes: the changing face of native vegetation stewardship in Australia's wool industry', paper presented to Veg Futures 06 Conference, Albury, March.
- Williams, J.E., Dorrough, J., Kahn, L., Kirkpatrick, J., Ford, G. & Reid, N. 2005, 'Bringing an ecological perspective to commercial sheep grazing systems in South-Eastern Australia', *Proceedings of the Ecological Society of Australia Conference*, Brisbane. GRS1
- Williams, J.E., Maclean, M. & Reid, N. 2003, 'Going green and staying in the black', *Sustainability and Beyond: Proceedings of the 3rd National Native Grasses Conference* (Eds C. O'Dwyer and S. Hamilton), ILFR, University of Melbourne, pp. 53-61.

Rivers & Water Quality sub-program

- Guy, J. 2004, The floristic significance of River Styles along the upper Macquarie River, Tasmania. BSc (Hons) thesis, School of Geography and Environmental Studies, University of Tasmania. TPI2
- Jones, M. 2004, Plant diversity on sheep-grazed properties in the Northern Midlands, Tasmania, with special attention to bryophytes. BSc (Hons) thesis, School of Geography and Environmental Studies, University of Tasmania. TPI2

Appendix 4: Publications – continued

Managing Pastoral Country sub-program

Bastin, G., James, C. & Brook, A. 2006, 'Wool producers with remote controls: New tools for whole of property management', poster paper presented to 14th Biennial Conference, Australian Rangeland Society, Renmark S.A., 3-7 September. CSE 27

Managing Climate Variability sub-program

Alemseged, Y., Hacker, R.B., Hayman, P.T., Carberry, P.M. & Henry, B.K. 2004, 'Improved seasonal forecasting for wool producers in western NSW', *Proceedings of the 13th Biennial Australian Rangelands Society Conference*, Alice Springs 5-8 July, pp. 241-42. DAN 16 & QNR 30

Carter, J., Bruget, D., Day, K., Hassett, Henry, B.K. & Henry R. (in collaboration with R. Cowley, S. Heidenreich, J. Leys, J. Maconochie, G. McKeon, C. Paull & A. Peacock) 2004, 'AussieGRASS: Australian Grassland and Rangeland Assessment by Spatial Simulation: New developments and applications', a paper presented at the 13th Biennial Australian Rangelands Society Conference, Alice Springs 5-8 July. QNR 30

Cobon, D.H., Bell, K.L., Park, J.N. & Keogh, D.U. (submitted) 'Grazier learning from climate applications activities in western Queensland', *Australian Journal Experimental Agriculture*. QPI 47

Cobon, D.H., Park, J.N. & Bell, K.L. 2004, 'Astrebla mortality in Queensland after the 2002 drought' *Proceedings of the 13th Biennial Australian Rangelands Society Conference*, Alice Springs 5-8 July, pp. 409-410. QPI 47

Cobon, D.H., Park, J.N., Bell, K.L., Watson, I.W., Fletcher, W. & Young, M. 2005, 'Targeted forecasts offer more for pastoralists', a paper presented to the XXth International Grassland Congress ("Grassland: a global resource"), Dublin, Ireland & Glasgow, Scotland, July. QPI 47 & DAW 41

Hacker, R.B., Alemseged, Y., Carberry, P.M. & Smith, W.J. 2006, "Trigger points" for stocking decisions in western NSW', poster paper presented to 14th Biennial Conference, Australian Rangeland Society, Renmark S.A., 3-7 September. DAN 16

Henry, B.K. 2004, 'Management of climate variability in extensive grazing systems', a paper presented at the Australian Bureau of Agricultural and Resource Economics' (ABARE) Outlook 2004 Conference, March. QNR 30

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Keogh, D.U., Bell, K.L., Park, J.N. & Cobon, D.H. 2003, 'Formative evaluation of climate-based decision support information for graziers in western Queensland', *Australian Journal of Experimental Agriculture*, vol. 43, no.5, pp. 233-246. QPI 47

McKeon, G.M., Hall, W.B., Henry, B.K., Stone, G.S. & Watson, I.W. 2004, 'Review of eight major degradation episodes in the history of Australia's rangeland – Can we prevent the ninth?', a paper presented at the 13th Biennial Australian Rangelands Society Conference, Alice Springs 5-8 July. QNR 30 & DAW 41

McKeon, G.M., Hall, W.B., Henry, B.K., Stone, G.S. & Watson, I.W. (Eds) 2004, *Pasture degradation and recovery in Australia's rangelands. Learning from history*. Queensland Department of Natural Resources, Mines and Energy, Brisbane, Australia. QNR 30 & DAW 41

Park, J.N., Cobon, D.H. & Bell, K.L. 2004, 'Evaluating grazer knowledge of seasonal climate forecasting in the Mitchell grasslands of western Queensland', *Proceedings of the 13th Biennial Australian Rangelands Society Conference*, Alice Springs 5-8 July, pp. 275-276. QPI 47

Park, J.N., Cobon, D.H. & Phelps, D.G. 2003, 'Modelling pasture growth in the Mitchell grasslands', *Proceedings of MODSIM 2003: Proceedings of International Congress on Modelling and Simulation*, Townsville, Qld, vol. 2, pp. 519-524. QPI 47

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Watson, I.W. 2004, 'I had the right number of sheep, but the wrong amount of rain', *Proceedings of the 13th Biennial Australian Rangelands Society Conference*, Alice Springs 5-8 July, pp. 291-292. DAW 41

Future Woolsapes sub-program

Pattinson, R. 2006, 'What might the world and the wool industry look like in 2030?', paper presented to Veg Futures 06 Conference, Albury.

Pattinson, R. 2006, 'What might the world and the wool industry look like in 2030 – and what might be the implications?', paper presented to the 14th Biennial Conference, Australian Rangeland Society, Renmark S.A., 3-7 September.

Appendix 5: Co-investment

| Organisations co-investing | TOTAL \$ | Projects | Sub-programs | | | | Salinity | Vegetation |
|--|-----------------|---|--------------|--------------------|-----------|---|----------|------------|
| | | | Climate | Pastoral | Rivers | | | |
| Burra Landcare Group (SA) | 159,249 | MCB1 | | | 159,249 | | | |
| Charles Sturt University | 27,105 | UWA52 | | | | 27,105 | | |
| Chemistry Centre (WA) | 51,420 | DAW42 | | | | 51,420 | | |
| Combined South East Soil Conservation Boards | 152,804 | UWA30 | | | | 152,804 | | |
| CRC for Dryland Salinity | 1,056,704 | UWA29 UWA33 UWA32 UWA30 UWA35 UWA42 UWA43 UWA44 UWA52 | | | | 45,000 250,000 250,000 250,000 53,180 74,200 20,000 6,000 108,324 | | |
| CSIRO Land & Water | 1,350,804 | CLW56 UWA44 | | | 1,333,000 | 17,804 | | |
| CSIRO Livestock Industries | 1,042,722 | UWA33 UWA29 UWA39 | | | | 347,427 661,468 33,827 | | |
| CSIRO Sustainable Ecosystems | 93,897 | CSE27 UWA41 | | 47,719 | | 46,178 | | |
| Farmbiz (DAFF) | 16,000 | SRD4 | 16,000 | | | | | |
| Granite Borders Landcare Association (Qld/NSW) | 43,500 | USQ5 | | | | | 43,500 | |
| Kings Park & Botanical Gardens (Perth, WA) | 80,500 UWA52 | UWA35 | | | 62,500 | 18,000 | | |
| Inglewood Shire Landcare (Qld) | 33,750 | USQ5 | | | | | 33,750 | |
| Meat & Livestock Australia | 260,000 | MLA2 UWA52 | | 100,000 | | 160,000 | | |
| Mid North Grasslands Working Group Inc. (SA) | 285,000 | GRS1 | | | | | 285,000 | |
| NSW Dept of Infrastructure, Planning & Natural Resources | 398,966 | UWA33 DAN17 UWA32 | | | | 15,750 205,000 178,216 | | |
| NSW Dept of Primary Industries | 1,949,878 | DAN16 UWA33 DAN17 UWA32 DAN23 UWA41 UWA42 UWA52 DAN24 | 322,095 | 55,674 | | 82,602 470,000 919,846 30,096 44,700 13,430 | | |
| Qld Dept of Primary Industries & Fisheries | 551,061 | QPI47 QPI56 MLA2 DAN24 | 119,200 | 155,765 270,000 | | | | |
| Qld Dept of Natural Resources & Mines | 120,401 | QNR30 | 120,401 | | | | | |
| Queensland Centre for Climate Applications | 1,000 | UTA13 | 1,000 | | | | | |

Appendix 5: Co-investment – continued

| Organisations co-investing | TOTAL \$ | Projects | Sub-programs | | | | Vegetation |
|--|-------------------|--|------------------|----------------|------------------|---|------------------|
| | | | Climate | Pastoral | Rivers | Salinity | |
| Qld Murray Darling Committee | 133,000 | USQ5 | | | | | 133,000 |
| River Murray Catchment Water Management Board (SA) | 108,240 | MCB1 | | | 108,240 | | |
| SA Dept of Environment & Heritage | 38,640 | GRS1 | | | | | 38,640 |
| SA Department of Primary Industries & Resources | 32,000 | DEP14 | | | | 32,000 | |
| SA Dept of Water, Land & Biodiversity Conservation | 330,542 | DEP14 CSE27 SRD4 | 87,192 | 18,350 | | 225,000 | |
| SA Dept of Water, Land & Biodiversity Conservation/ University of Adelaide | 93,935 | UWA30 | | | | 93,935 | |
| SA Producer Groups & Networks | 290,000 | DEP14 | | | | 290,000 | |
| SA Research & Development Institute | 877,980 | SRD4 UWA30 DAN24 | 123,135 3,362 | | | 751,483 | |
| Tas Dept of Primary Industries, Water & Environment | 815,222 | TPI2 UTA12 | | | 265,230 | | 549,992 |
| Traprock Wool Association (Qld) | 27,500 | USQ5 | | | | | 27,500 |
| University of New England and Southern New England Landcare Coordinating Committee (NSW) | 378,000 | UNE43 | | | | | 378,000 |
| University of Southern Queensland | 130,500 | USQ5 | | | | | 130,500 |
| University of Tasmania | 355,062 | UTA12 | | | | | 355,062 |
| Vic Dept of Natural Resources & Environment | 681,422 | UWA30 | | | | 681,422 | |
| Vic Dept of Primary Industries | 259,728 | VPI2 UWA52 | | | | 237,800 21,928 | |
| Vic Dept of Sustainability & Environment | 638,000 | DAV39 | | | | | 638,000 |
| WA Dept of Agriculture | 3,384,719 | DAW41 UWA33 DAW44 DAW42 DAW40 UWA42 UWA43 UWA52 | 178,447 | | | 769,251 47,000 1,764,887 150,000 35,600 132,372 307,162 | |
| WA Saltland Pastures Association | 1,399,600 | DAW42 | | | | 1,399,600 | |
| TOTAL | 17,648,851 | | 988,363 | 647,508 | 1,865,719 | 11,534,317 | 2,612,944 |
| Plus: | | | | | | | |
| Meat & Livestock Australia – cash contribution to SGSL | 1,500,000 | | | | | 1,500,000 | |
| Additional Activities Co-investment: | 689,146 | | | | | | |
| CRC for Dryland Salinity | | UWA55 | | | | 159,180 | |
| CRC for Dryland Salinity | | UWA56 | | | | 496,410 | |
| University of Southern Queensland | | USQ13 | | | | | 21,940 |
| University of Tasmania | | UTA18 | | | | | 11,616 |

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Abbreviations

AWI – Australian Wool Innovation Limited
CMA – Catchment Management Authority
ENSO – El Nino Southern Oscillation
ENSO – PDO – El Nino Southern Oscillation- Pacific Decadal Oscillation
LWW – Land, Water & Wool
LWA – Land & Water Australia
M&E – Monitoring & Evaluation
NRM – Natural resource management
NSW – New South Wales
SGSL – Sustainable Grazing from Saline Land
SWAG – Sustainable Wool Advisory Group
R&D – Research and development

