Land Water & Wool:
managing for sustainable profit

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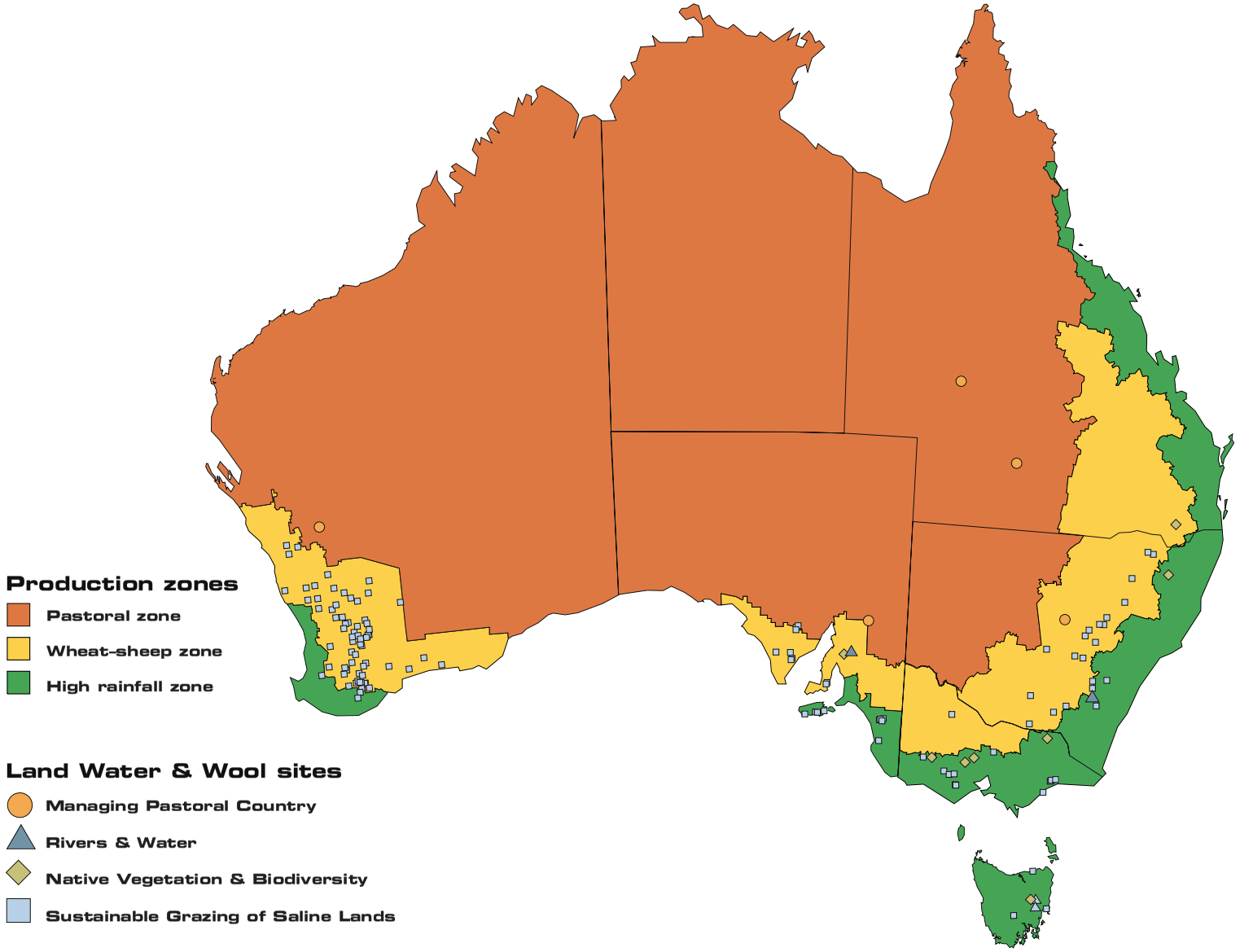

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Preface

Ian Rogan
Wool Production General Manager, Australian Wool Innovation

Land, Water & Wool has tackled topics that are at the heart of profitable and sustainable land management for wool production in Australia.

Sustainable profit

Land, Water & Wool (LWW) is the wool industry's nation-wide program to develop better ways of management for more profit and a healthier environment.

LWW is an industry-driven environmental program. It has asked questions that woolgrowers want answered, has researched them in a way that suits industry, and is delivering the answers in a language understood by woolgrowers and natural resource managers alike.

Woolgrowers across Australia have participated in trials with environmental, social and economic researchers. LWW has challenged scientists to explore complex issues and to generate practical, hands-on advice. It is helping woolgrowers run environmentally sustainable businesses for sustainable profit.

Significance

With $19.89 million of industry money invested over five years, LWW is the wool industry's most significant investment ever in natural resource management (NRM) research and development.

It has tackled topics that are at the heart of profitable and sustainable land management for wool production in Australia:

- living with dryland salinity;
- sustaining native vegetation and biodiversity;
- managing our waterways and floodplains;
- maintaining the rangelands used for pastoral production;
- developing tools to help woolgrowers manage our variable climate; and
- exploring what the industry's future could be in the next 25 years.

The investment in the LWW program has resulted in a benefit-to-cost ratio estimated at 3.9 to 1. The present value of benefits to date is $87.3 million, with half from productivity gains and half from environmental improvements. The program is generating productivity gains through changes in grazing and pasture management strategies and the ready involvement of woolgrowers has resulted in prompt adoption. It has already influenced some NRM policies and will no doubt continue to do so in the future.

Partners

- Land & Water Australia: managed the program, helped in its initial design, secured access to top environmental researchers and contributed knowledge from more than a decade of environmental research and its management.
- Australian Wool Innovation Ltd (AWI): the major funder, investing $19.89 million of the industry's research levies over 5½ years.
- Meat & Livestock Australia: a major co-funder ($1.5 million) of the salinity work and other individual projects.
- The Cooperative Research Centre for Plant Based Management of Dryland Salinity: a major supporter and co-investor.
- Australian Government: a major investor in both AWI and Land & Water Australia and in national, regional and on-farm NRM programs.

LWW was backed by state primary industries and environment departments, CSIRO, universities and regional natural resource management (catchment) bodies. With MLA and the CRC, they added another $19.91 million as well as generous access to staff and research facilities.

Governance

LWW was managed by a dedicated group of staff and advisers with guidance from woolgrowers through the Sustainable Wool Advisory Group (SWAG).

I thank everyone involved with this tremendous program and commend its findings to anyone interested in the future of the wool industry and the environment of Australia. This report is a celebration of the program and the efforts of the many Australian woolgrowers who are committed to an environmentally sustainable future.

Report outline

Information in 'Land, Water & Wool: managing for sustainable profit' is presented in five ways:

1. **Executive summary** – highlighting the main findings from the program. This presents the major messages and indicates the type of information contained within the report.
2. **Overview** – pulling together information from throughout the program and across all regions. It presents the key principles to sustainable grazing management and general information about how sheep can remain a productive element of future Australian landscapes.
3. **Woolgrower perspectives** – letting woolgrowers and researchers tell their stories about the issues they manage and how they go about it. Regional case studies are used to show how information from Land, Water & Wool is applied in the Pastoral, Wheat-Sheep and High Rainfall Zones.
4. **Research summaries** – highlighting the key research findings and their application, as well as directing readers to the main reports or management guides now available. The information is presented under sub-program titles dealing with themes of saltlands, native vegetation, rivers, pastoral, climate and future scenarios.
5. **Product directory** – a listing of all the documents produced by the entire Land, Water & Wool program (indexed by region, research theme and its intended use) is available at www.landwaterwool.gov.au. The on-line directory includes a snapshot, along with a summary of the information it presents and a PDF of the product.

This format aims to help different audiences find the type of information that most suits their needs. For example, if you want:

- A quick picture of Land, Water & Wool
  – go to the Executive summary (page 6)
- Generic information about managing sheep in Australian landscapes
  – go to the Overview (page 10)
- Practical stories and an understanding of woolgrowers
  – go to Woolgrower perspectives (page 22)
- Specific technical information or management suggestions
  – go to Research summaries (page 35)
- Access to more information
  – go to the Product Directory at www.landwaterwool.gov.au

Land, Water & Wool online

Navigate from the Land, Water & Wool home page (www.landwaterwool.gov.au) to the Product Directory to see all the products developed by the program.

Whether you are after information on the management of saline lands, native pastures, riparian areas, pastoral country, climate variability or potential key influences on the future of the wool industry, you will find it there, sorted in groups of general information, fact sheets, case studies and guidelines.

Executive summary

"Farmers have a strong affinity and care for the land they manage. Securing the conservation values required to sustain our agricultural landscapes will require programs that are sympathetic to farmers' sense of place."

– Tom Dunbabin
Woolgrower
Tasmania

Woolgrowers can make a valuable contribution to the sustainable management of Australian landscapes.

This is the central finding of research by scientists and woolgrowers working together in the Land, Water & Wool (LWW) program. Their research has established that, by applying LWW recommendations:

- sheep grazing can help maintain and enhance the biodiversity of native pastures;
- sheep can make it profitable to rehabilitate damaged or degrading landscapes, such as saline scalds; and
- revegetation can benefit production (sheltering sheep and pastures) and the environment (providing shade and habitat for aquatic and terrestrial fauna).

These benefits rely on controlling the timing, duration, intensity and frequency of grazing to ensure it works with the environment. Grazing native, saltland and riparian pastures in this manner can be profitable, especially in terms of annual cash flows. In the Wheat-Sheep Zone, it fits well as a component of a mixed farming system.

Improvements such as fencing and water supplies require significant capital that may take years to recoup. LWW shows that the benefits from these improvements can flow to the wider community as well as woolgrowers, which supports the case for resource management grants to assist with the capital costs.

LWW has developed ways to help woolgrowers in different regions better manage the variability of Australia's climate. It has released a wide range of products to help them identify where changes in land use and management can yield economic, environmental and social benefits. Regional natural resource management bodies around Australia can use these products to help woolgrowers improve both their enterprise and the environment in which it exists.

Thanks to LWW research, woolgrowers are now better positioned for the future and able to continue adopting sustainable management practices. This will make an enduring contribution to their farms, to regional landscapes and communities, and to the nation.

A 'sense of place'

LWW is an industry program. Woolgrowers have been partners in steering its research, contributing knowledge and interpreting its findings. This has enabled LWW to tap into the strong connection that woolgrowers have with their land, their keen interest in the environment and their 'sense of place'. The work highlights the importance of understanding, and building on, the pride that woolgrowers feel for their land.

These feelings are strong motivators for many woolgrowers and can be harnessed by all who want to see Australia retain sustainable agricultural industries like wool production as a core component of future landscapes.

LWW aims to help build the awareness and knowledge of people within the wool industry to understand and implement practices for the sustainable management of the natural resources on which it depends.

About Land, Water & Wool

Land, Water & Wool has been an investment of almost $40 million by Australian Wool Innovation ($19.89 million) and a wide range of collaborators ($19.91 million). The Cooperative Research Centre for Plant Based Management of Dryland Salinity and Meat & Livestock Australia have been major partners, along with State agencies and other research institutions.

The program has been managed by Land & Water Australia.
LWW has aimed to provide the Australian wool industry with the knowledge, tools and enthusiasm to minimise its environmental impact while enhancing productivity, and to enable it to position itself as the world's most sustainable producer of premium natural wool.

Key findings

Across the board

Land, Water & Wool shows the importance of:

- An eye for the country – Understanding the bio-physical processes at play.
- An eye for the vegetation – Knowing the species present, their abundance and growth stage.
- An eye for the climate – Knowing how a season is unfolding and, where possible, assessing the likelihood of rain in coming months.
- An eye for the livestock – Managing the timing, intensity, duration and frequency of grazing to maintain the pasture base.

Strategic approaches to grazing management may require changes to capital improvements such as fencing and stock water. Their use can generate a wide range of benefits, including:

- increased productivity;
- improved 'whole-of-farm' performance;
- enhanced local and catchment environments;
- additional habitats and native fauna populations (including beneficial insects and birds); and
- pride and social well-being.

These on and off-farm benefits show that woolgrowers and other natural resource managers have a lot to gain by working together.

Sustainable Grazing on Saline Lands

- The nature of dryland salinity (and how to manage it) varies with the degree of salinity and waterlogging, soil type and climate. Waterlogging compounds the impact of salinity. Sites should be assessed individually to select appropriate species and establishment techniques.
- The best sites to rehabilitate are those with 'mid-range' salinity and waterlogging. Lower risk, productive solutions are generally now available for half Australia's saline lands.
- Payback periods vary, but saltland pastures can be productive and profitable. The lower the cost of establishment and the higher the value of the end use of pastures, the better the returns on investment.
- Individual saline areas tend to cover larger areas in the west of Australia, compared with many scattered, smaller patches in the east.
- Pride is a motivator for woolgrowers wanting to restore land to vigour and productivity.

"The area was one of the worst salt scalds on the property. Now, we have a pasture base that is going along very nicely."

Peter Simpson, NSW, commenting on a saline site that has now been grazed at 8.9 DSE/ha and has cut 1.8 tonnes/ha of hay

"The real value of the project is that it focuses your attention on your resource and the productivity of your land. That is imperative to the long-term viability of grazing."

– Mac Drysdale
Woolgrower
Queensland

Native Vegetation & Biodiversity

- Strategic grazing of native pastures can boost their biodiversity and profitability. Managing stock with a focus on maintaining native pastures is the key to both a better environment and increased profit. It can increase the diversity and cover of native perennial grasses, reducing erosion, and providing a broader range of habitats for other species and a more reliable feed base in drought.
- Fertilisers can reduce the diversity and number of native plants. Any productivity increase needs to be compared to the benefits those fertilisers could generate if applied to highly productive areas.
- Having trees in the landscape (including shelterbelts and exotic plant species) will benefit sheep health and performance, and further enhance biodiversity.
- Having a diverse range of management within and between properties creates more diversity in habitats and overall regional biodiversity.

Rivers & Water Quality

- Infrastructure (like fencing and stock water) is the essential first step to enable strategic grazing management. When planned in a 'whole farm' context, new fences can serve several purposes and offset their costs.
- Rehabilitation of riparian land can repay the outlay through improved pasture growth, better feed utilisation, disease control, and shelter for lambs and sheep off-shears.
- Native riparian vegetation leads to better water quality and healthier streams. It shades waters, lowering their temperature and benefiting aquatic life, as well as reducing the sediment load of streams.
- Active gully erosion reduces productivity and degrades water quality, but it can be managed profitably. Revegetation options range from higher-cost, more-reliable methods, such as seedlings or long-stem tubestock (which, in some trials, have been better at withstanding grazing by native herbivores) to direct seeding.

Managing Pastoral Country

- Understanding the inherent vulnerability of individual properties to drought, monitoring the status of feed and setting 'trigger points' (dates by which seasonal stocking decisions must be made) can help pastoralists survive drought.
- For decision support tools to be of most use to pastoralists they need to include current and historic information on vegetation condition, seasonal conditions (including seasonal risk assessments) and stocking rates.
- The growth stage of some plants (e.g. Mitchell Grass) is important to stocking decisions. New growth ('green pick') should be given time to build strong root systems before being grazed.

Managing Climate

Variability

- The Southern Oscillation Index (SOI) system provides the most easily interpreted and useful seasonal risk assessments for most regions of Australia, except Western Australia.
- For many regions, seasonal risk assessments can now be made with confidence at certain times of the year, if the SOI is behaving in certain ways. At other times of the year or if the SOI is not exhibiting specified behaviour, seasonal risk assessments will be unreliable. Knowing when and where SOI-based assessments are valid is a significant advance.
- Seasonal risk assessments can be coupled with historical rainfall and pasture data to predict pasture growth in many regions at particular times of the year. This is more useful to farm planning than merely predicting rainfall, as it can be factored into decisions about stocking rates.

"I learnt that if you have not got the rain you cannot afford to sit around and wait. You have to make decisions based on the feed you have now and account for how long that is going to have to last until the chance of getting good rain is more than 80% again."

– Robert Mitchell
Woolgrower
Western Australia

Future Woolscapes

- Ongoing pressure from competing fibres (and changing global demands for food) will probably require more than incremental gains in wool production. It may result in changes to the structure of Australia's wool industry and relocation as woolgrowers find it hard to compete with food-producers for arable lands.
- The sustainable use of natural resources is likely to be increasingly important, along with the need to demonstrate minimal impact on the environment and attention to animal welfare and occupational health and safety.
- Further changes in wool processing can be expected and frontier technologies may provide unprecedented opportunities in wool production and its end uses.

Overview of findings

"No-one has asked me before what I want to know about. That's the great thing about this project – it is looking at things I want answers to."

– Malcolm Schaefer
Woolgrower,
Kangaroo Island

Woolgrowers – stewards of our land

Woolgrowers are the custodians of a large proportion of Australia's natural resources. Australia's 37,000 woolgrowers manage 85 million hectares of land – around 12% of the continent. Their desire to manage their land for economic, social and environmental benefits is an essential ingredient for a sustainable future.

Woolgrowers know their environment is important to the long-term viability of their enterprise, to their freedom to operate and to the image of their product. There is a strong drive to pass it on to the next generation in as good, if not better, condition.

A 2002 survey showed that 90% of woolgrowers think natural resource management is important and have adopted sustainable management practices. It showed that dryland salinity affected 40% of all woolgrowers, 78% had waterways (rivers or creeks) on their properties and 77% had areas of native vegetation. It also found:

- 70% of those affected by salinity had introduced practices to improve the land;
- 55% of those with waterways had adopted practices to improve water quality; and
- 55% of those with native vegetation were using improved management practices.

The woolgrowing industry faces big environmental challenges – including dryland salinity and the protection of waterways and native vegetation – within a variable climate.

One of the main challenges facing woolgrowers who want to achieve economic returns with good environmental performance is how to get information on sustainable wool production techniques that is relevant, reliable, easy to apply – and in plain English. That's what Land, Water & Wool is all about.

New knowledge for sustainability

Investment through Land, Water & Wool has put the Australian wool industry at the world forefront of knowledge for sustainable grazing land management.

Driven by woolgrowers across Australia, LWW has generated new knowledge, built on existing understanding, and developed practical tools and advice for on-farm management. It has worked with State and regional resource management agencies to share information and ideas that have led to the adoption of new approaches to land management.

The findings presented in this report emphasise profitable production and sound environmental management in areas of native vegetation (including native pastures), pastoral rangelands, rivers and saltlands. It highlights ways that woolgrowers can make more money while improving the environment.

Bringing scientists, woolgrowers and a range of agencies together, LWW has built on their knowledge and understanding, and is using it to promote improved management and to influence and inform natural resource management policies.

LWW has helped other stakeholders (such as regional catchment management agencies) to better understand woolgrowers and their industry, and the industry's commitment to sustainable management.

The environment – an ongoing priority

Australian woolgrowers have a strong affinity with their land and a deep pride in how they care for it.

They often adopt measures that seem hard to justify on a strictly financial basis but which improve the property and leave it in a healthier state. Taking riparian land out of production or investing in fencing to isolate and manage a salt scald are examples of activities often driven more by a duty of care than by short-term profit.

Most woolgrowers are keenly aware that the regulation of animal welfare and natural resource management – water, soil, vegetation, wildlife and heritage – is becoming stricter and more intrusive. The wool industry wants to ensure high voluntary standards of resource management as a way of minimising external interference. The findings of the LWW research are helping woolgrowers to achieve this goal.

A focus on nature pays off

The LWW project, Farm Businesses and Biodiversity, showed that focusing inputs on the more productive parts of a property, while managing less productive areas with more emphasis on the health of native pastures, can lift overall profitability. It considered three grazing options for hill country:

- deferred grazing (removing stock to allow native grasses to set seed over summer);
- intensive rotational grazing; and
- targeting nutrient deficiencies (strategic use of fertilisers).

The costs of additional fencing and water were often in the vicinity of $60/ha, with annual profits rising by $10,000-$60,000. Financial modelling indicated it would take 7-12 years for the investment to break even.

Strategic Grazing: Manipulating grazing pressure (the timing, frequency, duration and intensity of grazing) to maintain a desired pasture base. Good improvements (fences and water) are needed, along with an eye for the land, its vegetative cover, seasonal conditions and stocking rates. It also requires the ability to control pests and competing herbivores.

The industry is also grappling with what the future holds. One of Land, Water & Wool's exciting projects, Future Woolscapes, asked woolgrowers and technical experts to suggest likely changes in technology, markets and industry structure, and to draw up four possible scenarios for the future based on emerging trends and issues. Good land management featured in all the scenarios.

Some scenarios suggest that over the next 25 years the wool industry might contract, specialise or relocate (e.g. to less arable lands in the High Rainfall or Wheat-Sheep Zones). If so, production from the lands that have been the focus of LWW's research (e.g. native and saltland pastures) will become even more significant.

Could this be the future?

One of four alternative futures developed in Future Woolscapes considered what would happen if:

- there were few restrictions on society and industry; and
- wool was primarily used for apparel.

Fast forward to the year 2030. Under this scenario, fences have been replaced by Kelpie Transponders, small devices fitted to sheep which emit a barking sound when they approach the paddock's boundary.

In the city, a customer has returned some wool-fibre underwear after finding its thermal indicators, which measure and adjust next-to-skin humidity, don't appear to be operating.

In this world, consumers are king, and health and environmental issues are of critical importance to them. Governments play a limited role in people's lives, having been held responsible for a number of environmental disasters some years before. Farmers operate in a totally deregulated industry. Wool as a finished product is primarily used for apparel and is marketed based on its 'human health and wellness' properties.

In response to market pressures, a group of specialist woolgrowers have introduced their own environmental accreditation scheme. They deal directly with their key customers, who manufacture in China and sell globally.

These woolgrowers invest heavily in on-farm technology (such as virtual fencing, gene mapping, genetic defleecing and non-aqueous scouring), and work with their partners to develop apparel products designed to meet the wellbeing requirements of their target consumers. These woolgrowers are carving out their own niche and fiercely protecting it.

A new wool export – knowledge

Driven by woolgrowers' needs and wishes, the research carried out in LWW has given the Australian wool industry a special advantage – the ability to improve returns while enhancing the way it looks after natural resources such as land, water and vegetation; all under the menace of a changing climate.

Just as wool led the world in developing new textile technologies in the 1960s and '70s, it now leads in developing sustainable grazing management practices.

Up to half the world could be hit by drought under greenhouse pressures, according to the UK's Hadley Centre for Climate Change. By mid-century much of the world could face hotter, drier, more erratic climate conditions – and the challenge of producing twice as much food from less land with less water. This will generate huge demand for knowledge.

The type of knowledge produced by Land, Water & Wool offers a real competitive edge for Australian producers and exporters. It could lead to a new export from the wool industry: knowledge and technology. Knowledge is already earning the Australian mining sector $2.5 billion a year and could prove similarly profitable for woolgrowers.

Sheep – part of a sustainable landscape

Land, Water & Wool's main finding is that, with good management, sheep can be an integral part of a sustainable landscape. They can even help promote nature conservation.

Woolgrowers manage a significant part of the native pastures that remain across Australia and can play a lead role in their maintenance by grazing them in a manner compatible with conservation.

In saltlands, sheep offer one of the few economic options for private landowners to manage a major threat to our landscapes. With good management, sheep are a way to generate an economic return from degraded land while restoring it to health and productivity.

- Research in South Australia and related work in Victoria found that the strategic management of pastures that include native grasses (e.g. planned or rotational grazing according to plant growth rates) could significantly increase sheep production (e.g. from 2.3 to 4.2 DSE/ha) while promoting native perennial grasses. This reduced the area of bare ground, and the risk of erosion and increased water infiltration into the soil. These findings apply to more than two million hectares in the two States.
- Research in the Tasmanian Midlands found that well-managed sheep properties combined profitability with a high diversity of native plants, including a number of threatened species (e.g. the Grassland Paper Daisy and Grassland Cupflower). One of the properties involved recorded the highest number of vascular plant species ever found in the region and was among the richest sites on Earth in terms of soil invertebrates. Strategic grazing management, based on the biology of the pastures and stock, is a key to this success.
- Native woodland birds are prospering in areas of south-east Queensland and northern NSW grazing country. In parts of the Northern NSW Tablelands that were previously extensively cleared but have since been revegetated by woolgrowers, native and introduced tree species have led to increased numbers of insect-eating birds, including native woodland species that are still declining in other areas. In the Traprock region of south-east Queensland, surveys found that many ground-feeding woodland birds co-exist with stock, although they have disappeared from similar woodlands in more heavily cleared areas.
- Having sheep in a farming system can make it profitable to reclaim saline lands. Saltland pastures are one of the few productive uses that can be made of saline areas and offer an alternative, or adjunct, to drainage. Salt affects 2.5 million hectares in Australia, including productive and natural landscapes, and is forecast to spread to as much as 16 million hectares. Saltland pastures can make almost half that area productive and lower the watertable. This is expected to reduce run-off

Paper Daisies thriving in a grazed pasture.

Biodiversity:
The variety of life at all levels, from genes to species and ecosystems. It applies to all terrestrial, marine and aquatic life-forms.

Grazing hill country can be profitable and sustainable.

Monitoring pastures is fundamental to strategic grazing management.

"Woolgrowers with hill country can improve profits by 10% and avoid bare hills, erosion and weed problems in winter."

– Jim Moll
Researcher

and the movement of salt to surface water, and to increase the bulk and diversity of native plant species.

- Woolgrowers in the NSW Tablelands have revegetated waterways to improve water quality and provide shelter for stock (especially lambs and off-shears). The vegetation stabilises stream banks, shades the streams (lowering water temperatures to the benefit of in-stream life), and provides habitat and food for birds and other native fauna, as well as reducing stock losses from extreme weather.
- Research in Tasmania, southern Queensland and northern NSW has shown that having a range of grazing management strategies over different vegetation types resulted in a more diverse environment, with higher numbers of native species. Different trees, shrubs and grasses fare differently under alternative grazing systems. The variation in the distribution and abundance of plant species supports different insect and animal populations.

A condition score for the environment

How do you know if your native vegetation or waterway is healthy? 'Quickchecks' (see www.landwaterwool.gov.au) provides the tools to measure the condition of pastures, soils, woody vegetation, birds, productivity and waterways. Its checklists and monitoring tables are easy to use and take away the guesswork. Woolgrowers can use Quickchecks to work out the condition of native vegetation, biodiversity and river health on their farm and choose management options that maintain or improve that condition to meet their goals for the property.

Strategic grazing management

The saying 'It's not what you do, it's how you do it' certainly applies to livestock grazing. Poorly managed stock can quickly degrade natural resources, sometimes irreversibly. However, Land, Water & Wool research found that smart management by woolgrowers can not only prevent the degradation of natural resources but also improve their quality – and make money at the same time.

Whether they are managing saltland pasture, riparian land or native pastures in the high rainfall or pastoral country, successful woolgrowers have several things in common:

- a well-thought out property plan fitted to the farming system and land capability;
- well-placed fencing and watering points that serve multiple needs; and
- a good fit between the grazing of less arable lands and other activities on the property.

LWW has showed the importance of:

- An eye for the country – Understanding the physical characteristics and processes at work, and the way in which sheep interact with them, is vital. This may vary from understanding the unique mix of salt, waterlogging and soil texture in a site to appreciating the preferential grazing habits of sheep and how they affect specific plants at different stages of growth. It's about understanding how any natural system operates.

- An eye for the vegetation – Every manager is continually observing their land, but having data on it takes away some of the guesswork and emotion. It can help replace blind optimism with a rational plan. Everyone is busy, so the trick is to work out the minimum information needed for critical decisions and go from there. There is a range of tools available in different regions, including satellite imagery and models of pasture growth.
- An eye for the climate – Historical records are a handy tool to help judge how a season is unfolding. They can now be enhanced with seasonal risk assessments (or seasonal forecasts). Land, Water & Wool research has found a strong link between the Southern Oscillation Index (SOI) and rainfall at certain times of the year for many pastoral wool-growing regions (except Western Australia). If, during those times, the SOI shows particular traits, the likelihood (or probability) of receiving above or below average rainfall can be predicted, and converted into the likelihood of more or less pasture on the property – which helps with stocking decisions.
- An eye for the livestock – Using climate predictions, historical records and pasture growth models, graziers are better able to set 'trigger points' for major decisions, such as buying or selling sheep. They can plan stocking rates and the duration, timing and frequency of grazing with greater confidence that their pasture base will be maintained. Examples of strategic grazing include 'crash grazing' a block to control weeds while they are palatable and before they flower, resting a paddock to enable a good seed-set or the revitalisation of native grasses and their root systems, and making use of feed before its nutritional value is lost.

Trigger point:
The date beyond which a critical management decision (e.g. to buy or sell sheep) should not be delayed. It can be identified by examining pasture growth and rainfall records (and using pasture growth models). An example is determining the date beyond which additional pasture growth is unlikely and setting that as the time to assess the number of stock the feed on hand can carry through the next season – and so whether to sell or buy stock.

Gullies eat holes in profit

Gully erosion is common in many areas, especially where sodic subsoils are easily eroded:

- Gullies reduce the amount of productive land available, especially in lower areas where deep soils and retained moisture support better pastures, for longer.
- Large gullies limit access to paddocks, make mustering more difficult and are a risk to stock and farm workers.
- Water in creeks and farm dams is degraded by the sediment and nutrients generated by gully erosion. This can reduce water intake by sheep.
- The accumulation of sediment can fill dams and streams, leading to more frequent and widespread flooding, as well as harming wetlands.
- The extension of an eroding gully may threaten important farm assets such as roads, culverts and bridges.

Active gullying erodes productive land and adds sediments to waterways.

Planning gully rehabilitation in a whole-property context can provide opportunities to increase productivity and the ease of farm management, through fencing (e.g. to permit rotational grazing or to align with land class boundaries), or establishing new dams.

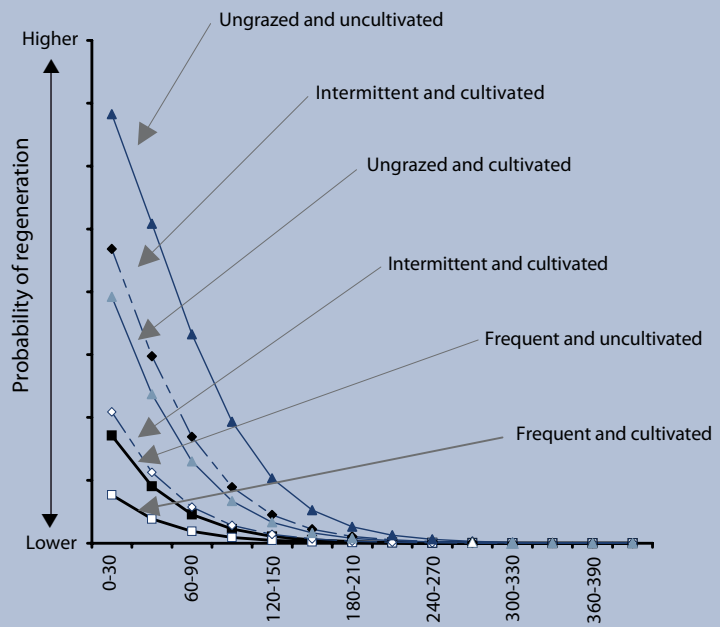
The benefits for neighbours, the catchment and stream ecology may justify a community grant.

Rehabilitation of riparian lands benefits the environment and can make property management easier.

Bringing back trees

Research in Victoria has shown that the natural regeneration of native trees is most likely to occur where the site is:

- close to mature, seed-producing trees (e.g. within 100-200 metres);
- not ploughed or high in nutrients; and
- not grazed or rarely grazed.



Creating healthier landscapes

Rehabilitating damaged land serves local environmental goals, farm production objectives and personal drivers, such as pride and enjoyment. It can be risky and expensive – but there are ways to reduce the cost and uncertainty.

The first and cheapest step may be to introduce elements of strategic management to grazing practices. However, that may require new fences, watering points or tracks – and they need to work for the site to be rehabilitated and for the rest of the property. It pays to look at both perspectives in a whole-farm plan. It is also useful to consider where the best 'bang for the buck' will come from, whether the goal is increased production, a healthier environment or both.

With saltland pastures, start with sites that are mid-range in terms of salinity, where there are good prospects for success and clear gains to be made. With rivers, a rapid appraisal of stream condition can help decide where the best environmental gains may be made or where the biggest erosion threats are. Land, Water & Wool has developed a tool for that purpose; see page 64 for more information.

In some cases, just introducing additional fencing and strategic management may be sufficient to stimulate the spread of existing plants, but if rehabilitation involves establishing new pasture plants or trees, then plant selection is crucial. Plants must match the site's characteristics and land preparation may be required, e.g. before sites get waterlogged by seasonal rains.

If sowing seed, pre-treatments can improve germination rates, while (in some trials) long-stemmed tubestocks have stood up better to grazing pressure from native herbivores.

It is important to assess the risks of any new species 'escaping' to become environmental weeds and to ensure their establishment isn't going to harm existing native plants. In some States, it's an offence to harm native vegetation without authorisation, even if done in the course of rehabilitation.

Prospering with sheep

Introducing new management practices can lead to higher profits but can also involve up-front investments. How do you assess the relative costs and benefits?

From a financial perspective, establishment, operating and maintenance costs may be considered on the basis of annual operating expenditure and income (e.g. per hectare) and as a capital investment (e.g. the time to break-even or recover costs). Other business and management aspects should also be considered, such as improved drought resilience or ease of mustering. Then there are environmental factors to consider, both positive (e.g. increased native habitat) and negative (e.g. the risk of introduced plants becoming environmental weeds).

Land, Water & Wool has developed ways to reduce the costs and risks of introducing new practices. It has also highlighted factors to consider when evaluating them. The 'Checklist' on the following page provides more information.

Having a mix of annual and perennial saltland pastures can boost profits.

Changing markets

LWW's Future Woolscapes projects highlight the advances in technology that are most likely to affect global textile markets and on-farm management:

- Totally new textiles and fibres will emerge, along with dramatic improvements in existing synthetics. Technology will also change the form and end uses of wool.
- Some consumers may continue to prefer a 'natural fibre' with environmental credentials and so help 'eco-friendly wool' to retain its share of the market.
- High-value niche markets will continue to emerge, but the industry will need strong and visionary leadership to manage the value chain and position wool to its advantage.

Due to fierce competition from other fibres, woolgrowers face a continued cost-price squeeze (running at 2% or more a year). In the main, they will have to offset that squeeze through increased productivity, quickly adopting new technologies and smarter on-farm management. Off farm, there may be opportunities to explore the development of more profitable markets for wool (such as novel end-uses like cosmetics and electronics) and other new income streams, such as environmental services or the marketing of land management skills.

Having a better understanding of these risks and opportunities will alert woolgrowers and the industry to:

- changing markets and consumer demands (e.g. for environmental credentials);
- emerging technologies (both in competing textiles and new uses for wool); and
- production options (e.g. multi-purpose or specialised wools).

Checklist – assessing the benefits

Topics to consider when contemplating a change in management.

Productivity

- Pasture production: can be measured in terms of dry matter, seasonal availability and nutritional value, e.g. saltland pastures often provide feed in autumn when other pasture is scarce (making it more valuable) and provide high levels of vitamin E to sheep.
- Stock performance: measurable through stocking rates, weight gain, wool production and stock health. For example, the salt from saltland pastures can increase the efficiency of wool production by up to 30% (dietary salt at 7% of dry matter intake can lift wool production by 12%) and improved stock health can reduce parasite loads and the need for drenching.
- Stock shelter: windbreaks and shade can enhance stock growth rates and reduce losses, particularly in off-shears and lambs.

Whole-farm performance

- Added value: for example, autumn saltland pastures may be available for finishing high-value prime lambs.
- Improved resilience: areas of native or saltland pasture, a 'riparian paddock' and even some native plants (like mulga) can be treated as a 'living haystack' to provide a forage reserve.
- Increased capital value: in some regions, improving the natural assets (e.g. waterways) of a property will increase its market value.
- Ease of management: fencing and laneways may be installed for strategic grazing management or to protect environmental assets, but they can also reduce labour requirements and make stock mustering easier, safer and quicker.

Environment

- Enhanced biodiversity: more species and larger populations of plants, amphibians, reptiles, birds, marsupials and invertebrates can play a role in maintaining ecosystems or naturally controlling on-farm pests.
- Improved water quality and in-stream biodiversity: this can result from improved riparian management, better ground cover, lowered watertables and reduced saline run-off.
- Reduced salinity or soil erosion: in both extent and severity.
- Risk management: better management of potentially invasive plants.

Social wellbeing

- Renewed pride and confidence at personal, community and industry levels.
- Good neighbours: improved natural resource management can provide benefits to neighbours and the community, and present new opportunities to enhance local relationships.
- Enhanced capacity: at personal, community and industry levels, e.g. the ability to become part of regional natural resource management programs, attracting increased assistance for on-farm works and influencing government policies.

Invertebrates: All animals without a spinal column. They include all worms, insects, mites, spiders and snails.

Climate change and risk management

Australian woolgrowers have always dealt with a variable climate and its associated droughts and floods. Climate change scenarios suggest this variability will increase.

More frequent or longer droughts will change the economics of primary industries. Producers will need more sophisticated or robust risk management plans to remain financially secure. These may include larger cash reserves, more off-farm income and the ability to wind down costs or use forward pricing.

Increased understanding and appropriate use of seasonal risk assessments will help woolgrowers deal with climate variability and the associated challenges. The tools developed through Land, Water & Wool will help woolgrowers in many regions to make better livestock and pasture management decisions.

Managing drought

Many LWW projects were undertaken in dry or drought conditions.

Although 'managing drought' was not a research theme, LWW trials have highlighted key aspects of drought management:

- assess feed availability;
- consider the prospects of receiving effective rainfall (via historical records or seasonal risk assessments);
- make decisions early about the stock that may be carried through using available or brought-in feed;
- monitor pastures and manage retained stock to ensure adequate ground cover is maintained in open paddocks and that pastures (both native and improved) are not degraded.

CASE STUDY: Greg and Jane Kellock, SA

For South Australian woolgrowers Greg and Jane Kellock, changing their grazing management through the LWW Rivers project has already had a range of benefits on their family's 10,049 ha pastoral properties near Burra.

As part of the project, livestock are being grazed according to pasture growth rates, with emphasis on an adequate rest periods to allow the perennial plants to recover.

According to Greg, despite the continuing dry conditions, the land's productivity and health has significantly improved, with lambing percentages doubling, along with an increase in ground cover and the perennial grass population.

"Our plan for these properties is a plan for our sustainable future. We want to be able to improve our property and do it in a way that is good for our profits, management, the environment, and to encourage others to look at planned grazing and hopefully benefit from it."

Capital outlays

Strategic grazing management may call for new or additional infrastructure and the costs can vary widely.

As an example, establishing saltland pastures in trial plots can cost between $70 and $700/ha. The 'profit' from their grazing depends on the quality and quantity of additional pasture produced and the use to which it is put (e.g. finishing prime lambs versus maintaining older Merino ewes). Considering differing capital costs, different production shifts and different uses of the pastures, payback periods (the time taken to break even on the investment) can range from three to 20 years.

Woolgrowers can spread the costs of new infrastructure by meeting multiple goals from the one improvement but, given the uncertainties around the industry's future, big capital outlays to better manage saltland, rivers or native pastures can be a daunting prospect. An option is to share the costs with outside groups by meeting community or government natural resource management goals as well as farm goals and accessing land management grants.

Community partnerships

Improved natural resource management can generate sustainable production, renew pride and confidence, and benefit the wider community. It can lower watertables, improve water quality, promote biodiversity and improve the appearance of the landscape.

Many State agencies, regional natural resource management bodies, and the Australian Government (e.g. through the Natural Heritage Trust, the National Landcare Programme and the National Action Plan for Salinity and Water Quality) are ready to help woolgrowers redevelop their properties for sustainability – not only with financial assistance but also with advice on design, species selection and management.

Land, Water & Wool, and its information products and grower networks, makes it easier for these other stakeholders to work with the wool industry and to establish local partnerships. The program has developed a virtual ute-load of tools, information and guidelines for woolgrowers, regional natural resource management bodies, State agencies and producer organisations.

Some researchers and natural resource managers (e.g. Landcare co-ordinators and catchment management officers) have very good knowledge of how the environment functions but little direct contact or experience of the wool industry, its particular needs and the benefits it offers to landscape management. LWW gives them a chance to appreciate the challenges from a woolgrower's viewpoint and to work more closely with woolgrowers in tackling natural resource issues.

LWW's collaborative projects have generated new knowledge and relationships – often changing the perspectives of researchers and giving them a better insight into how the environment works and the role of sheep in it. It has given NRM workers a clearer appreciation of woolgrowers and enhanced their ability to provide the sort of services and assistance required.

These relationships will help the wool industry make the most of the opportunities that will emerge in the future.

Stakeholders will be key players in promoting the use of LWW products for enhanced land management. For example, the Western Australian Government has developed a new extension program for climate variability based on LWW activity. Western Australia and other States are also updating salinity management Fact Sheets and other products based on information from LWW.

Similarly, the South Australia Murray Darling NRM Board is adopting materials from the program and will use them in assessing and promoting the better management of rivers. In Victoria, the Goulburn Broken and North Central CMAs (with help from Australian Government funding) are incorporating Land, Water & Wool vegetation and biodiversity information into 'Green Graze', a new project for graziers.

Pride in Saltland Management: Photography Competition

The pride some woolgrowers feel in seeing their land recover from salinity was highlighted in Land, Water & Wool's saltland photography competition.

Public recognition of a good effort can be an important reward to landholders so the LWW Sustainable Grazing on Saline Lands (SGSL) sub-program held a photographic competition, to let woolgrowers show each other and the public what they had achieved. 'Pride in Saltland Management' attracted $30,000 in sponsorship and resulted in a travelling exhibition of entries in its five categories:

- Farmers in action;
- Science in saltland;
- Productive saltland pastures;
- Before & After; and
- Saltland humour.

The success of the Pride in Saltland Management photo competition was phenomenal, according to SGSL Coordinator, Warren Mason.

"Probably more than any other event or product, the photos that were entered from across the country capture the adversity, the determination and the pride associated with turning unproductive land into something that inspires a photo – and then taking an even bolder step by entering that photo into the public arena," he said.

"It's always great to see how the travelling photo exhibition draws a crowd whenever it is displayed."

The salinity program's section of the LWW website includes other winning entries. Go to www.landwaterwool.gov.au.

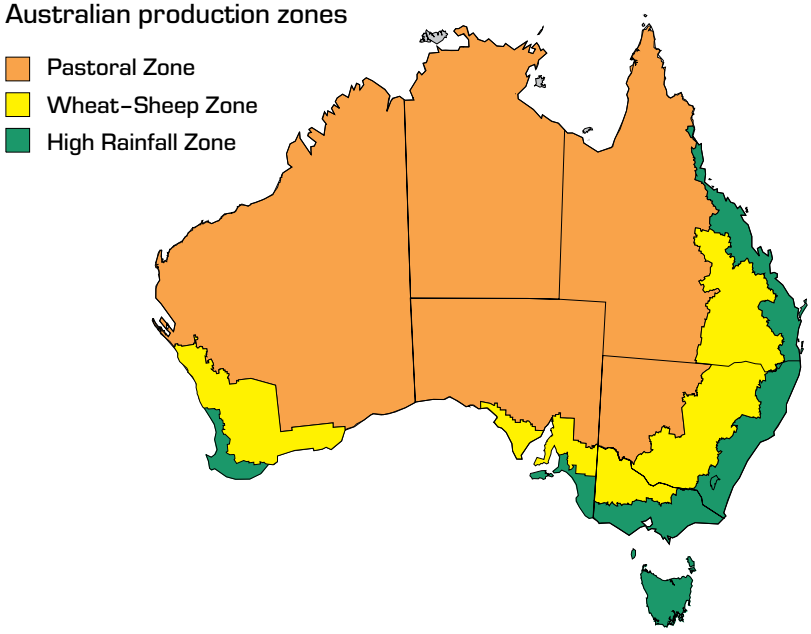
Left: The national winner.

Below: Victoria's winner.

Left: The humour category showed the lighter side of a serious story.

Woolgrower perspectives

Australian production zones



Sustainable wool production has to 'make sense' to woolgrowers operating in their own unique environment, on land they know well, take pride in and feel deeply about. It also must work for the wool industry as a whole.

One of Land, Water & Wool's main aims has been to develop solutions that work locally. It has also brought woolgrowers from different regions into contact to share ideas and experiences on what does and doesn't work. This approach has allowed woolgrowers to build on local knowledge, while sharing their ideas and experiences with counterparts across the region and across the continent. It is a good example of an industry helping itself to develop new production models.

This chapter shows how woolgrowers in different regions are applying the knowledge they have gained through LWW. It highlights:

- how common challenges are being met and managed in different regions;
- the attitudes and values of woolgrowers in different production zones, and the importance of 'pride, connection and place' to them; and
- examples of woolgrowers using the type of approaches pioneered through LWW and the reasoning behind their decisions to do so.

People & place

Woolgrowers say their 'sense of place' is what gives them the motivation and commitment to improve environmental management.

Resource management programs seeking to manage landscape in new ways can sometimes run up against this 'sense of place' – and occasionally even challenge the identity of landholders who have lived there a long time.

Land, Water & Wool research has revealed that care is needed to ensure the 'new' landscape is also one that landholders connect with, and can draw their strength and identity from.

"How people think and feel about something relates to how they behave in relation to it," says Grace Pretty, a LWW researcher. She identifies three aspects of a person's 'sense of place' which influence how woolgrowers think, feel and behave regarding their properties:

- Place identity: who I – and others – think I am is partly defined by where I live.
- Place attachment: how I feel is influenced by where I am; some places are special.
- Place dependence: I need to be where I am to do the work I love.

Place identity, attachment and dependence were independent of age, but older woolgrowers were more likely to have an ecological focus as well as economics or product quality. Using a 'photo-voice' method (where landholders photograph and describe their properties' characteristics) the research also identified a correlation between a strong place attachment and concerns about diversity and ecological management.

"We all have a sense of belonging to our farms. It's hard to put a value on it, because it is so personal; but it is real."

Michael Lloyd
Woolgrower
Western Australia

CASE STUDY: Tom and Cynthia Dunbabin, Tasmania

Tom Dunbabin chaired a group advising Land, Water & Wool. He and his wife, Cynthia, won the 15th Australian Government's McKell Medal for excellence in natural resource management. Their thoughts highlight the importance of invoking producers' strong 'sense of place' when engaged in change.

"Farmers have a very strong sense of place, built on generations of land management. Partnerships with them that are respectful of this strong sense of place are an essential precursor to developing an understanding of their goals and practices. In some locations, this may require a fundamental shift in the relationship between landowners and natural resource management bodies.

The regional NRM framework across Australia has delivered a multitude of strategies and action plans, but unless they are implemented through a process that engages with the farmers they will come to naught.

"An approach of 'professionals' telling farmers what environmental management changes need to be made, threatening them with regulations and offering incentives will not achieve the required changes.

"Farmers are being told to change their place. Instead, we need programs that strengthen their passion for their land and promote responsibility for positive actions.

"Farmers have a strong affinity and care for the land they manage. Their sense of place is a fundamental core value for them that can be harnessed to meet the environmental challenges facing agricultural land management.

"To secure the conservation values required to sustain our agricultural landscapes will require programs that are sympathetic to, and compatible with, farmers' sense of place, and which are staffed by individuals with the skills to engage them."

John and Jill Neal, Queensland, value their riparian areas as special places to enjoy.

Two of the Pride in Saltland photo competition's humour section entries.

Five Ps

To make sure its research outcomes work at the local as well as national level, Land, Water & Wool uses the 'five Ps' – factors that affect almost every major decision woolgrowers make. These were developed in LWW's Rivers sub-program.

- Profit: the need for a return (in an environmental, social and economic sense).
- Proof: solid, real-life evidence to underpin decision making.
- People: the importance of establishing and maintaining relationships.
- Place: taking one's place, with all its spiritual and cultural values, into account alongside technical knowledge.
- Promise: a commitment to listen, empathise, deliver, think about legacy and celebrate people's involvement in natural resource management.

Rivers Coordinator, Siwan Lovett, says the Five Ps recognise the importance of considering the biophysical, economic, social and environmental together, rather than as separate parts of a puzzle.

"This demystifies a lot of the jargon used in natural resources management and places the individual at the centre of the issue, rather than on the periphery."

The following stories about woolgrowers in the different climatic zones of Australia illustrate how individuals are meeting the challenges of sustainable grazing in their particular setting – applying new insights gained through LWW and at the same time bringing new life to the Australian landscape.

The pastoral sheep country is dry country with an often erratic rainfall. Wool production is mainly underpinned by native vegetation. Besides their sheep, pastoral woolgrowers also manage vast areas of Australia's native biodiversity on some of the biggest properties in the world. They use virtually no fertilisers and few chemicals – production relies on water and native pastures.

The land and its vegetation are often resilient through harsh seasons, but it is important to maintain them during drought and not to push the country beyond the point from which it can recover.

Pastoralists pay special attention to:

- monitoring the condition of vegetation;
- making timely decisions about stocking (and feral animal control); and
- watching how the season unfolds.

These skills are keys to a successful grazing business – and the Pastoral Zone has many families who have employed them for several generations.

Management decisions, such as de-stocking, are often difficult and can be an emotive mix of care for the land, care for the stock, uncertainty about rain and the need to maintain an income stream.

Any technology that helps make such decisions is an asset. Providing those technologies has been one of LWW's goals.

Highlights

Land, Water & Wool has helped pastoralists with:

- Monitoring vegetation – see Managing Pastoral Country (page 66) for information on the ABCD pasture condition guide and a trial of remote sensing.
- Decisions support tools – see Managing Pastoral Country (page 66) for information on critical decisions on stocking rates and tactical grazing.
- Seasonal risk assessment – see Managing Climate Variability (page 72) for several examples.

"In 1926 'Landor' was carrying 50,000 sheep and 5,000 cattle. It was (the owner's) ambition that it should carry 80,000 sheep. During 1936, only 260 points (66 mm) of rain was recorded and sheep began to die. Every year the rain was more spasmodic and each year stock losses grew. In 1938, only 13,225 sheep were left. The drought dragged on and in 1942 all that remained of the flock was 6,220 sheep. Never again did Landor carry such numbers."

– Alec Holm
LWW Researcher
(quoting from
McDonald 1991)

CASE STUDY: David and Carol Warwick, SA

When David Warwick left school, he needed no career adviser to tell him what to do next: he just wanted to go back to 'Holowiliena', the family station on the plains over the hills east of Hawker, in South Australia's Flinders Ranges.

"The land is my hobby and my work," he said. "I've no desire to move into something else."

David took over from his father in 1973 and in 1980, when the family partnership dissolved, he took up the 40,000 ha 'Holowiliena South'. He inherited a legacy of small paddocks from his father – in a region where 'small' is 25 square kilometres. That's about half the usual paddock size for a local station and has given him much greater flexibility in how he manages the land. His father also built central watering points into his cut-down paddocks, allowing stock to utilise the entire paddock instead of just the area within walking distance of the trough.

Within this infrastructure, David makes a point of grazing conservatively. He runs smaller mobs than usual so that he can better manage grazing pressure. When available feed is threatened with being flogged out – as it has been repeatedly in the past decade of dry seasons – he begins rapidly to off-load stock.

"I believe the land is our livelihood. I hate to see degraded country," he said.

"When it does rain after a dry spell, I don't just bring stock back in to knock down the feed. I like to see the feed get away a bit. If you're stocked right up, you don't have feed in reserve for when it starts to get dry again."

Drought, rabbits and grasshoppers have been constant features of life for David and Carol Warwick and their two daughters, Christina and Fiona. The inadvertent release of rabbit calicivirus in 1996 was "a godsend for us" on the plains. It was less effective in the hills, but it gave the Warwicks the break they needed to get on top of the rabbits through warren ripping.

David has been ripping since 1986 and even though they have been battling a run of poor seasons he is sure the effort is paying off. "We can see the regeneration of bushes and trees where there was none before."

CASE STUDY: Drysdale family, Qld

The Drysdale family has grown wool at Augathella in Queensland for five generations. Along the way, they have faced many challenges .

One of the most recent and potentially dramatic has been a seemingly unexplained decline in Mitchell grass pastures, the basis of livestock production for a lot of southern and central Queensland.

The Drysdales have been keen to be involved in a research project on this important plant community, which covers 330,000 square kilometres.

The research, funded by Meat & Livestock Australia with assistance from Land, Water & Wool, sorted out how drought, stock management, disease and plant life cycles interact, providing pastoralists with a better understanding of how to manage this valuable resource.

"The value of this project is that it focuses your attention on your resource and the productivity of your land. It's an important honing of your skills that is imperative to the long-term viability of grazing," Mac Drysdale said.

Over the years, the Drysdales have made a number of changes to the management of 'Perola Park' in an effort to remain sustainable. One of the most apparent is a change in the breeding of the sheep flock. The century-old Merino base flock is now being infused with the meatier South African Dohne (a South African Merino), with the aim of producing crossbred ewes that will turn off a fast-maturing prime lamb.

"Being in an arid region, the quick maturing physiology of the Dohne will enable us to turn off a lamb without stressing the grazing system," Mac said.

Flock selection has been based on 20 years of objective measurement, resulting in a 30% increase in lambing percentage, a two-micron reduction of wool fineness and significantly lower need for jetting sheep.

"We started selecting for fly resistance 15 years ago and we have not had to jet sheep for a decade or dip sheep for three years now," he said.

The Drysdales have taken several other important steps to ensure the maximum value is gained from their stock, including gaining accredited organic status to supply their lamb to the domestic market. It took them three years to gain Perola Park's certified organic status but they had been working towards minimal chemical input on the sheep for many years. The value of clean, healthy and resilient rangelands also adds to the bottom line for an organic operation.

"Following successive dry years, an increase in the variability of the seasons and the decline of Mitchell grass, we believe the key to our future is in knowing as much as possible about our grazing system, running fewer stock and value adding," Mac said.

CASE STUDY: Melissa Rebbeck

Melissa Rebbeck, a climate researcher involved in a Land, Water & Wool project in South Australia said one of the most rewarding aspects of the project was hearing from woolgrowers that they would consider changing the timing of important decisions to fit around the time that climate forecasts are useful.

"It was great to see our research being utilised!" she said.

Melissa and her team looked at the value to pastoralists of using the Southern Oscillation Index (SOI) in their management decisions. They found that in much of the South Australian rangelands, the SOI was of use for three-month forecasts of rainfall and pasture growth between June and November. They then developed a pocket guide for woolgrowers called 'Climate Risk Seasonal Outlook', which takes producers through the steps for determining whether the SOI can provide useful information in any particular year.

"Most of our research is 'applied' and, as we're probably the best people to talk about our own research, contact with woolgrowers was essential. Pastoral leases cover nearly a third of South Australia – so the task of delivering research is extremely challenging. However, it was also very rewarding," Melissa said.

"The South Australian Climate project was one of my favourites. The interaction with the other researchers from across Australia has also been excellent for each of us, resulting in improved research and delivery to woolgrowers, as well as professional contacts and on-going friendships.

"The Seasonal Climate Forecast review committee, established by LWW, was invaluable for all the researchers involved. These things have created a legacy for me that will assist with my delivery of climate research now and into the future."

Wheat-Sheep Zone

Australia's Wheat-Sheep Zone receives moderate rainfall and is largely cleared of native vegetation, although important stands remain and the less arable lands will often support significant native biodiversity. Dryland salinity occurs in many regions – over large areas in the west of Australia and with smaller outbreaks in the east (which affect more people). Past farming practices have left their mark in many locations, creating a legacy that invites rehabilitation, sometimes on a 'landscape' scale.

Sheep play a central role in the Australian mixed farming system. They spread the financial risk compared to a single commodity enterprise and help in the management of diseases, pest and weeds, as well as introducing and recycling nutrients.

In some farming systems, livestock are part of a higher input approach, using fertilisers and chemicals to get the optimum production from the best quality soils. In others, they complement it – precision agriculture may apply on arable lands with strategic (low-input) grazing on less arable parts of the property.

Land, Water & Wool has shown that many less-arable lands (be they saline flats, 'rougher' country with native grasses, rocky hilltops or riparian lands) can be productive while maintaining or improving the natural environment and fit well into mixed farming systems. It has also demonstrated the benefits of rehabilitation through revegetation and better management of waterways and native bush.

Highlights

Land, Water & Wool has helped mixed farmers with:

- Sustaining profits from native pastures – see Native Vegetation & Biodiversity (page 46) for information on strategic grazing management.
- Riparian management – see Rivers & Water Quality (page 56) for information on river management guidelines and wetland management.
- Saltland pastures – see Sustainable Grazing on Saline Lands (page 36) for more information on plant selection, establishment and management.

Multiple benefits can come from saltland rehabilitation. 'Before' and 'after' photographs from Boorowa, NSW.

CASE STUDY: Chris Heinjus, SA

Adopting planned grazing has regenerated native grass pastures and significantly boosted stocking rates for Brinkworth woolgrower Chris Heinjus.

Chris owns a 1,420 ha farm in South Australia's mid-north, running a self-replacing Merino flock of 2,400 ewes, with an average rainfall of 400 mm. The 400 ha of arable country are sown to opportunity crops, depending on the seasonal conditions.

During 2000, Chris received some Natural Heritage Trust funding and subdivided three paddocks into 12 paddocks. Since then, the 1200 ha of hill country has been fenced into 25 paddocks varying in size from 6 ha to 166 ha. More than seven kilometres of piping has also been installed. Where possible, the fencing has been carried out according to aspect, with north and south-facing slopes separated, which Chris said has been a huge benefit.

Previously, the shaded southern slopes were under-grazed and covered by a huge thatch of wild oats. Once the wild oats were removed by grazing, the perennial grasses have gradually re-appeared.

Chris runs two large mobs of 1,200 ewes and employs a planned grazing system based on plant growth rates and rainfall. Rest periods range from 30 days during periods of peak pasture growth to 120 days in late summer. Typical grazing periods range from 1–2 days to a maximum of 10 days in the larger paddocks. The pastures in each paddock are visually monitored before and after the sheep graze the paddock.

Chris aims to use no more than half the available feed in a grazing event. His observations show that leaving at least 5 cm of pasture height provides sufficient leaf material for the grass to recover and regrow.

Since making the change, Chris has seen an improvement in the land's condition, including reduced bare ground and increased perennial and annual grass populations. Stocking rates have increased from an average of 1–1.5 to 3–4 DSE/ha. The smaller paddocks have achieved a higher stocking rate due to more even pasture utilisation.

Chris has also made several changes to his farm's yearly production calendar. Spring shearing and autumn lambing have been shifted to a June shearing and an August lambing to better match peak pasture growth with the ewe's peak nutritional requirements. As a result, the average lambing percentage has increased from 78% to 100%. A drift move is employed at lambing and Chris has not had any problems with mismothering.

The change in shearing time has also affected wool productivity. Average staple strength has increased from 28 to 44 Newtons per kilotex and mid-point breaks have been reduced. Ewes are supplemented with cottonseed meal or copra from the end of December through to the season break. This helps ensure a ewe body condition score of 3 at joining.

A grazing chart is now an important tool. The chart allows Chris to plan the paddock moves more than three months ahead and incorporate critical times such as holidays or shearing and lambing.

CASE STUDY: Jeff and Marilyn Tink, WA

Looking over the neighbour's fence was the inspiration for Jeff and Marilyn Tink to tackle the emerging creek-line salinity that was threatening to extend into their cropping country. On their neighbour's property healthy trees flourished in the flat creek area further downstream while the same area on their own property showed bare salt scalds and dying trees. While they could still grow barley on the adjoining paddock, the area they were cropping was getting smaller and yields were declining.

On their property 'Mountlea', north of Ravensthorpe, 1,500 ha of annual cropping represents 80% of their enterprise. Another 300 ha is allocated for sheep, mainly a wool-producing Merino flock.

In 2004, as part of the SGSL project, three areas were identified for different treatments: lucerne on a fresher site, tall wheat grass on poorer soil and saltbush on the saline areas. A total of 15 ha of tall wheat grass was sown where barley would not grow. They ripped and mounded the worst-affected country, sowing saltbush seed as well as planting 2,000 saltbush seedlings by hand.

In September, when the weather warmed up, they used a small disc seeder and press wheels to sow an Evergreen saltland mix that included tall wheat grass, puccinellia, panic, setaria and Rhodes grass varieties between the mounds. Away from the creek line, oil Mallees and other salt-tolerant trees were planted.

The Evergreen mix was sown into dry soil and didn't receive another rain that year. The Rhodes, setaria and panic grasses survived and in late winter 2006 were the only Evergreen salt mix species growing. For any future planting, Marilyn said, they would have separate plantings of tall wheat grass and puccinellia early in the season, followed by subtropicals on a spring rain.

In 2005, the tall wheat grass paddock was tickled up and Balansa clover and Mongul and Santorini medic also sown. The tall wheat grass was the dominating species at the end of 2006.

Since planting the area, the Tinks have fenced the site into three paddocks to manage the lucerne, tall wheat grass and saltland perennials separately. They have rotationally grazed the lucerne and tall wheat grass paddocks and, because it is near their feedlot, they envisage it as a part of a management strategy valuable in turning off finished sheep.

Excluding livestock from the salt-affected area for an extended period has allowed blue bush to regenerate on the scalds and the Tinks have been amazed at the way the landscape has changed. The absence of stock on the salt planting and the practice of rotational grazing on the lucerne paddocks has encouraged the regeneration of other native grass species.

Marilyn Tink inspects new growth in the saltland on Mountlea.

CASE STUDY: Stephen Pereira, NSW

Grazing and cropping farmer Stephen Pereira can hardly believe the abundance of growth of salt-tolerant pastures on a trial site on his property, 'Spring Vale', near Grenfell in Central West NSW.

The project explored better use of land that is showing the effects of salinity. In the Pereiras' case it was scalding. The 11 ha trial plot is now home to a productive pasture mix of grasses and legumes that Stephen has cut for hay and grazed with Merino wethers.

"Last spring (2005) the growth was so thick, you could hardly walk through the trial site," Stephen said. "My dad jokingly refers to the site as 'the orchard' because the growth was so vigorous. We cut it for hay and baled 35 tonnes, which was a fantastic result given the ground had previously been more or less unproductive, especially in a pasture sense."

The trial site pasture mix includes tall wheat grass, puccinella, phalaris, fescue, prairie grass, Balansa and strawberry clovers, chicory and lucerne. It was conventionally sown and is opportunistically grazed by sheep (mostly wethers) at up to 50 dry sheep/ha. It is now one of the property's most productive paddocks.

Spring Vale is a 400 ha, fourth-generation property of undulating to creek flat country. The average rainfall is 625 millimetres but the previous two years had been exceptionally dry, making the vigorous saltland pasture growth at the trial site even more critical to the grazing component of the enterprise.

Spring Vale is home to a self-replacing Merino flock of sheep (adult micron is 20.5) and a cropping program of winter cereals including wheat, oats and canola. Lucerne is also grown as a valuable source of feed for the sheep. Cereal crop yields are typically 3–4 tonnes/ha and the cropping program involves minimum or no tillage techniques.

Poor seasonal conditions in 2005 delayed work on the trial plot, but the various salt-tolerant species are now well established. Stephen is so impressed by the growth and productiveness, he has already decided that the site will not be cropped again and he plans to introduce a similar pasture mix to other water flow lines on the property.

The renovation of the scalded areas of land is timely as Stephen also made a conscious decision four years ago to implement whole farm change to ensure the land's long-term future. As part of his new approach, he recently completed installing a new stock watering system that will allow him to fence off creek lines and waterways (for future renovation).

Bores have been sunk to allow water to be pumped to tanks. The stand pipes are fixed in a position so that they can service several paddocks. This allows Stephen greater flexibility in his stock and pasture management, and he will soon be investigating the introduction of cell grazing.

Jessica Pereira looks over a salt-scalded paddock near the SGSL trial site.

High Rainfall Zone

For a long time, much of Australia's High Rainfall Zone was grazing land but changes in technology, markets and land use have introduced cropping and irrigated production.

Grazing is based on both introduced pastures (often with fertiliser inputs) and native pastures. Many regions still boast significant native vegetation – ranging from grand trees within paddocks to remnants on hills and rivers, and extensive tracts of largely intact vegetation. Special efforts can be needed to prevent soil erosion and to optimise the value of rivers and streams.

Managers in these regions share traits with those of the Pastoral Zone (e.g. keeping a sharp eye on the condition of native pastures) and the Wheat-Sheep Zone (e.g. managing production with the aid of fertilisers, herbicides and veterinary chemicals).

Highlights

Land, Water & Wool has helped high rainfall graziers:

- Better manage streams and gullies – see Rivers & Water Quality for River Management Guidelines (page 56) and gully management information.
- Sustain productive native pastures – see Native Vegetation & Biodiversity (page 46) for information from the Tasmanian Grazing Guidelines and NSW Fact Sheets.
- Make better use of native bushland – see Native Vegetation & Biodiversity (page 46) for information from the Queensland and NSW projects.
- Plant and improve saltland pastures – see Sustainable Grazing on Saline Lands (page 36) for information on the interaction between salinity and waterlogging, pasture establishment and management.

Environmental 'health check' for woolgrowers

Woolgrowers in South-East Queensland can now perform an on-line 'health check' of their natural resources using a new web-based environmental management toolkit. Woolgrowers from the Traprock Wool Association and Land, Water & Wool researchers developed the toolkit by drawing on economic, ecological and social research previously undertaken in the region.

The information helps woolgrowers, collectively or individually, to monitor their farm's environmental performance (e.g. pasture and habitat condition) and compare their property to regional benchmarks. The aim is to highlight trends – especially where land condition improves following changes in management – and improve the skills of woolgrowers in assessing their farm management and production.

Project leader Geoff Cockfield said the toolkit allowed a new set of land planning and management tools to be applied to wool enterprises for more sustainable production.

"Traprock Wool Association is encouraging woolgrowers to consider grazing management practices that result in sustained or increased on-farm production while also achieving improved natural resource condition," he said.

Woolgrowers across Australia can access the toolkit to see how it assesses the condition of natural resources on-farm – soils, pastures, woody vegetation, water quality and biodiversity. The toolkit can be viewed at www.traprockwool.com. It can be adapted to local conditions, enabling woolgrowers to fine-tune their management for property and regional benefits.

CASE STUDY: Brendon Lunney, NSW

When Brendon Lunney bought 'Bogolara', a 1,627 ha property near Yass, NSW, he noticed newly formed gullies eating up valuable land.

"There's no doubt that gully erosion is getting worse in this area. I can't clearly state how much worse it's become but I'm absolutely certain it's not getting better," Brendon said.

Over the past five years, Brendon, a CSIRO research team, Kevin Schofield (manager of Bogolara), other woolgrowers and local catchment management staff have developed a much better understanding of the impact gully erosion has on the loss of land and water quality. Run-off, water quality and turbidity data have been measured. The results show that as much as 60 tonnes of sediment are being released through the gully in a single rainfall event.

Most of the sediment comes from the gully walls and this scouring will continue to loosen and carry away fresh, unprotected soil as long as the flow continues. The erosion will recur unless the gullies are stabilised or the lowered gully floor reaches a new equilibrium. A range of treatment options are being tested, including a dam at the head of the gully, side contour banks and revegetation.

The key message is that preventing gully erosion is much cheaper and easier than trying to cure it. Gullies can form quickly, sometimes during a single rainfall event, so maintaining a complete ground cover and minimising overgrazing, soil compaction and physical damage to the soil surface are important preventative measures. Stopping gully erosion once it has begun is much more difficult. Land, Water & Wool guidelines are available to help woolgrowers tackle this problem.

A dam built at the head of a gully as part of treatments being tested on the site.

A gully on Bogolara before sheep were fenced out and treatments applied.

Field monitoring equipment in a gully.

CASE STUDY: Lindsay and Biz Nicolson, Tasmania

Biz Nicolson says that sometimes we think special places are somewhere else – great cities, remote wilderness, places we long to visit.

"But special places are as much about the commonplace as the rare, about the everyday as much as the endangered, and about the ordinary as much as the spectacular," she said.

"It's about the detail and accumulation held together by what places mean to us.

"Special places are about the rich tapestry of our lives. A tapestry that maps our sense of history, our sense of pride and our sense of place; and our rivers hold each person's map together. A meandering thread through each person's life, weaving together the edges of each tapestry, making all of these journeys fit together.

"The work we have done through Land, Water & Wool has reminded us that every place is special, distinctive and worth appreciating. Woolgrowing is not just a business; it's also an emotional connection with the landscape."

Lindsay and Biz Nicolson at Buffalo Brook, their special place.

Buffalo Brook, before and after rehabilitation.

CASE STUDY: Peter Simpson, NSW

Saline farmland has been given a new lease of life following a two-year trial on the 5,870 ha holding, 'Banoon'. The site now has a well-established, salt-tolerant pasture base that is providing manager, Peter Simpson, with grazing and hay-making potential.

The property, 30 kilometres south-west of Barraba in Northern NSW, is split among several blocks. The average rainfall is 700-750 millimetres and the property is some 900 metres above sea level, on the headwaters of the Manilla River.

Banoon runs an extensive sheep and cattle operation, with a cropping program of winter cereals (oats and barley) and dryland lucerne.

"The area was one of the worst salt scalds on the property, with a very hard setting surface. However, as a result of the trial, we now have a pasture base that is going along very nicely," Peter said.

The production from the site has included controlled cattle grazing (at a rate of 8.9 DSE/ha) and hay making. The hay was made into large square bales with a total of 1.8 tonnes/ha cut.

The site's research manager and district agronomist with the NSW DPI at Manilla, Lester McCormick, is also impressed with the pasture growth to date.

"The trial is showing very promising results, especially considering the condition of the ground pre-trial where there was no perennial grass growing and forage crops were failing due to the salinity," Lester said.

"The fact there is now pasture growing is a major outcome. We are still hoping to establish other legumes on the site if the seasonal conditions allow it this year."

Saline scalds – an indication of dryland salinity – have become more prevalent in the Manilla catchment in recent years. While relatively small at present, scalding is predicted to make significant contributions to the salt load of the Murray-Darling River system in the future, according to Lester.

Banoon manager Peter Simpson and NSW DPI Salinity Advisory Officer Lachlan Rowling inspect autumn pasture growth at Banoon.

Research summaries

"It was just a black, saline area and would not grow anything. To see the comparison is unbelievable. It's above my wildest dreams."

– Alan 'Bluey' Smith
Woolgrower
Mt Mercer, Victoria

Sustainable Grazing on Saline Lands

Setting the scene

Wool production is one of the few economic activities that can be used to rehabilitate saline land. Saltland pastures can be highly profitable, but their practical and financial success depends on site characteristics and sound management.

Many parts of the Australian continent are naturally salty, especially in the south. Soils contain large stores of salt (ranging from a few hundred kilograms to several hundred tonnes per hectare) built up over geological time, mainly from salt blown in from the sea, some of which finds it way into surface waterways and groundwater.

The clearing of catchments changed the way that rainfall flows through the landscape. In some places, this has mobilised salt and led to outbreaks of dryland (or secondary) salinity. Woolgrowers may have areas of waterlogged and/or salty land on their land (discharge zones) or they may be managing a recharge zone where extra water entering the soil causes salinity down slope and affects downstream neighbours.

The causes and problems associated with dryland salinity have been known in Australia for decades, but it was only when scientists realised Australia had 16 million hectares at risk that a co-ordinated research effort was begun to find viable solutions. The initial work aimed to reduce recharge, while less effort was put into using and rehabilitating salt-affected land.

In 2001, there was much talk of the benefits of sowing and grazing saltland pastures but little hard information and no co-ordinated extension effort. Land, Water & Wool's Sustainable Grazing on Saline Lands (SGSL) research changed all that, building on the work of others such as the Saltland Pastures Association and in collaboration with the CRC for Plant Based Solutions to Dryland Salinity and Meat and Livestock Australia (MLA).

By 2006, a network of 1,200 producers were running saltland pasture and grazing trials and coming up with new, practical information about establishing pastures and getting them to persist under the hostile conditions of salt scalds.

The issues

Dryland salinity affects 2.5 million hectares of Australia and is continuing to spread. Nearly 8,000 woolgrowers report salinity on their properties, sometimes as a single zone or band (e.g. along a valley floor), sometimes as patches scattered around the farm. About 1.2 million hectares on woolgrowing properties are affected by salt, of which about a fifth has been sown to saltland pasture.

Land affected by dryland salinity is seen as having lost, or is losing, its productivity and much of its commercial value. It looks bad and often poses an environmental threat to remaining native vegetation, wetlands and waterways. It also threatens infrastructure like building foundations and roads.

Grazing is one of the few activities that can make productive and profitable use of saline land and so potentially reduce the negative impacts on the environment.

Although saltland pastures offer a good solution, they haven't previously been widely adopted because:

- rehabilitating salt-affected areas can be costly, especially fencing small, irregularly shaped areas;
- failures occur, due to the wrong selection of pasture species, sowing techniques and timing;
- saline sites can be difficult to manage and there has been a lack of knowledge about when and how to graze them;
- woolgrowers lack confidence that saltland pastures will persist if grazed; and
- salt-affected land is discouraging and it can take some time before landholders are willing to give affected lands another go.

Key points found by a survey of Western Australian farmers were:

- the greatest barrier to improved management of salt-affected land is that areas are too small or patchy to be easily managed;
- stopping the spread of salinity and maintaining the productive capacity of the land are the strongest motivators for landholders; and
- good planning and preparation are the keys to successfully establishing saltland pastures.

What LWW found

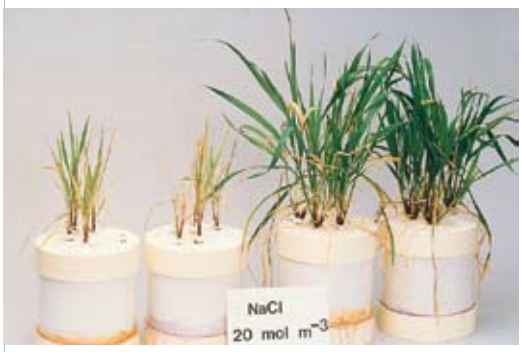
Salinity problems vary widely

- Salt-affected land is highly variable across Australia because of the interaction of the amount of salt, the extent of waterlogging, different soil types and climate. Waterlogging compounds the effects of salt and a waterlogged site will have poorer production than a free-draining site of equal salinity. Waterlogged clay soils with high salt are the most difficult to manage.
- Salinity in Western Australia and South Australia often covers large areas of an individual property. In the east, salt-affected areas are often smaller but may have more impact on rivers and downstream water users.
- In a Mediterranean climate (Western Australia), most plant water demand occurs in late spring and summer. Complementary engineering solutions (e.g. raised beds, shallow drains or diversion banks) may be needed to deal with the excess water available in winter, especially in clay soils. Capillary rise in clay soils means that pasture species that cannot tolerate waterlogging should not be used unless the watertable is at least 1.5 metres deep.

Capillary action: The movement of water above the water-table through pores in the soil, due to the strong surface tension between water molecules and soil particles.

There are productive options

- Within this huge variation, LWW has identified productive options for about half the salt-affected land in Australia.
- Although improvements can be made to all saltlands, 'mid-range' salinity sites are the best place for farmers to make a start on saltland management.
  - Less salty and/or less waterlogged sites are 'easier' to manage for saltland pastures, but have a higher opportunity cost as pastures are generally less profitable than barley crops – the most salt-tolerant of the cereal crops – that may still be sown on such land.
  - The most salty and/or waterlogged sites have no opportunity cost, but the risk of failure is higher. Even if successfully established, saltland pastures in these more hostile environments are not very



These plants were grown in a 4% seawater solution. Those on the right were aerated; those on the left were in simulated waterlogging.

productive, although they may reduce problems such as erosion.

- Novel ways to establish saltland pastures are being devised, including seed coatings that deter ants, the use of smoke to enhance germination, seed-priming to shorten germination time, and dressings to reduce plant stress from salt.
- Researchers are continuing to test other native and introduced plants for their usefulness in saltland pastures. It has been shown that some plants that tolerate waterlogging – such as Balansa clovers – are sensitive to salt, while others can cope with salt but not saturated soil. The characteristics of the individual site are crucial for correct plant selection.
- It is important to distinguish between profit per hectare of salted land and the contribution that saltland pasture can make to whole farm profit (e.g. by providing green feed over summer or covering an autumn feed gap). In some cases, the direct profit per hectare from establishing saltland pasture may be small (e.g. growing barley may seem a better option for sites with low salt), but when the total benefits to farm enterprises are considered, saltland pastures may be preferred.

There are a range of measures used in salinity. These tables give a guide to what they mean.

Site salt level	Measured salt concentration – EC in dS/m
Low salinity site	0 – 10
Mid-range salinity	10 – 30
Highly saline site	Above 30
Seawater	55

Adapted from Saltland pastures in Australia *by E.G. Barrett-Lennard*

To convert to EC in decisiemens/metre (dS/m)	Multiply by
Parts per million (ppm or milligrams/litre)	0.0017
Percentage of seawater salinity	0.55
Microsiemens/cm (uS/cm)	0.001
Millisiemenns/m (mS/m)	0.01
Millimolar concentration (mM/litre)	0.1

Money can be made from saltland pastures

- The cost of establishing productive saltland pastures varied from $73 to more than $700/ha across a selection of the LWW trial sites, with an average of $277/ha. The time to 'break even' ranges from three to more than 20 years. Per hectare establishment costs, and therefore payback periods, can be reduced when rehabilitating larger areas and incorporating the change with other property improvements. Woolgrowers can now get advice on the best balance between the high-cost but more reliable methods – such as sowing nursery-raised seedlings – and cheaper but less-reliable methods like direct seeding.
- Careful site preparation, species selection and sowing with viable seed are essential for good early establishment, especially in seasons of below-average rainfall; of the LWW sites in NSW, just over half achieved satisfactory establishment of saltland pasture at the first attempt.
- Returns and benefits from saltland pastures vary greatly from farm to farm. They include:
  - the value of the extra feed to the livestock enterprise;
  - this feed is often extra-valuable because it is out of season – salty sites often stay wet longer and perennials can hold their canopy when annuals aren't available;
  - grazing saltland pastures lets the woolgrower rest other land, resulting in higher autumn/winter production from good pastures;
  - sheep grow more wool per unit of feed ingested with a bit of salt in their diet;
  - saltbush has a high vitamin E content, reducing the need for supplements;
  - lower watertables reduce the spread of salt over more of the farm and may allow the site to be rehabilitated to its full potential production; and
  - saltland pastures look better than bare scalds.

- Whole-farm modelling in the southern Western Australia wheatbelt shows that saltland pastures can yield around $4,000 a year extra on a 2,000 ha 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.
- Overall, the revegetation of saline land in the low to medium rainfall zone of south-west Australia offers benefits to producers in the form of livestock profits and a healthier environment. Social benefits include more attractive country and easier livestock management.
- In a South Australian case, saltland pastures were used as pioneers for the subsequent introduction of other pasture plants; they drew down the watertable sufficiently to grow lucerne. In one case, this approach turned a 725 ha property from unviable (losses of $62/ha/year under its existing system) to highly profitable (profit of $77/ha/year). Another farm increased profit at full equity from $8 to $147/ha/year, mainly from cropping options on the rest of the farm when the sheep were grazing the saltland.
- In a Victorian case, a grower who sowed tall wheat grass gained an internal rate of return of 21% for a 10-year pasture life and covered the cost in five years.
- In NSW, net returns from establishing saltland pastures (saltbush) were around $85/ha in the Cowra region. This was considered not sufficiently profitable to ensure widespread adoption. The value of saltbush largely depends on keeping down the establishment costs. In the lower rainfall zones of NSW, saltbush offers valuable drought management options to producers. The profitability of prime lamb production has increased the value of introducing saltbush in western NSW.
- Saltland pastures offer environmental benefits. A vigorous pasture will use more water from the soil profile, helping to lower watertables and reduce run-off. NSW trials showed that improved perennial pastures on saline discharge areas use significantly more water than unimproved pastures, leading to a reduction in runoff. Over time, this should lead to significantly less salt leaving the site to add to stream salinity.

Saltbush is a good source of vitamin E which is important to stock health and can improve the shelf life and colour of meat. Deficiencies in vitamin E result in muscle damage and even death. Vitamin E levels are low in dry feed – an estimated one million sheep a year receive a supplement in Western Australia alone.

The efficiency of converting feed into wool can be increased when sodium chloride is added to the diet, e.g. by consuming saltbush.

Summary of results from some sites in Victoria

Case Study	Treatment	Carrying Capacity Unimproved	Carrying Capacity Improved	Pasture Establishment Costs per ha	Fences & Water Establishment Costs per ha
Hamilton: 40 ha	Tall wheat grass	2.5 DSE/ha	15.5 DSE/ha	$398	$67
Bairnsdale: 16 ha	Saltbush	1.2 DSE/ha	14.6 DSE/ha	$1,042	$224
Seymour: 8 ha	Tall wheat grass	2.5 DSE/ha	15.5 DSE/ha	$571	$250

Case Study	Net Present Value 10 years	Net Present Value 20 years	Internal Rate of Return 10 years	Internal Rate of Return 20 years	Payback Period (Years)
Hamilton	$13,718	$32,440	19.0%	22.7%	4.6
Bairnsdale	$6,255	$16,076	15.7%	19.7%	5.2
Seymour	$3,873	$7,279	29.6%	31.8%	3.6

Saltland management information in demand

- Land, Water & Wool has identified pride as an important motivator behind farmers' decisions to invest in saltland management.
- Two markets have emerged for saltland management information:
  - Woolgrowers with large amounts of saline land on their properties – mostly in Western and South Australia. For these farmers, the productivity and profitability of saltland pastures is the main consideration as there is considerable scope for them to contribute to whole farm income. Amenity and environmental health are important, but are not the main drivers for adoption.
  - Woolgrowers with small patches of saline land. Nationally, 54% of farmers with saline land have less than 20 ha; in NSW and Victoria, 51% have less than 10 ha. For woolgrowers with small areas, there is less scope for saltland pastures to generate much profit. Amenity value, personal pride in management and potential for environmental improvements tend to be the major drivers of adoption, with finance an important but secondary consideration.

CASE STUDY: Andrew Southwell, NSW

Andrew Southwell, from Rye Park, NSW, now has about 120 ha across two properties under a saltland system.

"We have recorded what all our paddocks carry over a 12-month period and surprisingly the saltland carries 11 DSE/ha/year on average, while the improved pastures carry only 8 DSE/ha/year!" he said. " We have learned it is essential to get onto the saltland before you lose too much topsoil from erosion.

"Salt-tolerant pastures actually generate more profit on our properties than improved pastures on the good land because the sowing costs per hectare are about the same, but the carrying capacity of the saltland is higher."

Andrew said the saltland was essentially an underground irrigation system during dry summers and autumns. "It is now an integral part of our rotational grazing system".

Assessing the pros and cons of saltland management

LWW research has shown that pastures can be established on salt-affected land and will persist under profitable grazing. It has provided new information about:

- the various saltland pasture species which best suit different conditions;
- establishment techniques and costs;
- grazing management to get the most from these pastures and ensure their persistence; and
- long-term financial returns from investment in saltland pasture, allowing woolgrowers to choose the best option for their situation.

However, getting into saltland rehabilitation isn't straightforward. There are pros and cons to assess. Issues to consider when planning the management of salt-affected land are:

What if nothing is done?

- Past experience of the site, and mapping its extent and response to seasonal conditions (rainfall), will help determine whether the salinity is stable or likely to expand.
- If the site remains bare, is it an erosion risk (slope), a source of salt in runoff or of weeds, a danger to stock or an eyesore on the farm?

What are the causes?

- Can you identify the recharge area that is affecting your salty land? Sometimes this will be on your farm (often higher in the landscape); in other situations it may be many kilometres away.
- Can you influence the recharge, for example by planting trees or productive deep-rooted pasture (e.g. lucerne) or through simple engineering such as a contour bank?

What is needed to attack the problem?

- It is usually necessary to control stock access to the salt-affected site, so some type of fencing and possibly stock water will be required. This needs to fit into the whole farm plan.
- In many cases, fencing off to prevent stock access to a salty site is the cheapest option.

What production value can be expected?

Consider:

- data on dry matter production, digestibility and energy/protein value of different types of saltland plants suited to your area;
- seasonal feed availability from saltland (autumn feed is generally 10 times more valuable than spring feed) and how this fits into grazing/spelling other paddocks;
- nutritional value (e.g. salt improves the efficiency of wool production and some saltland pastures provide high levels of vitamin E);
- stock performance – weight gain, wool production and health on different pasture types; and
- the potential to use saltland to provide stock shelter and shade with salt-tolerant wind-breaks.

What will be the effect on profit?

- Well-managed saltland pastures can lift wool enterprise profit at least 10%, e.g. by covering an autumn feed drought or enabling more early winter growth on spelled paddocks.
- Saltland pasture can provide new market opportunities, e.g. finishing off prime lambs on autumn feed.
- There is potential for improved resilience when saltland pasture allows longer resting of other paddocks or is used as a drought reserve to reduce the risk from maintaining breeding numbers.

How can costs be managed?

- Work out the establishment and maintenance costs (fencing and water, seed, fertiliser, sowing) and whether you can meet them from within the farm budget or will need external assistance, e.g. from grants for fencing that also provides environmental benefits.
- Annual operating costs for saltland pasture are usually low but the payback period may be several years.
- Consider the change in land value with and without 'fixing' salt-affected areas.
- Find out if there are sources of financial help. Many local schemes provide funds for capital investments that yield environmental benefits.

CASE STUDY: Rodney & Sharon Drage, WA

Graziers Rodney & Sharon Drage, from the Upper Hay River in Western Australia, have rehabilitated a previously salt-affected and waterlogged area of their 550 mm rainfall farm. Rodney considers that his farm is now carrying 200-300 more sheep than was previously possible, with no supplementary feed likely to be needed until April, where feeding would normally have begun in February.

The watertable has been lowered by an estimated 10-20 centimetres in just 18 months. The site's aesthetic appeal has greatly improved, with less surface water lying about and good stands of perennial pastures including Rhodes grass and Setaria, as well as saltbush thriving on areas of previously bare salt.

Rodney Drage about to seed an Evergreen mix.

What are the benefits for the environment?

- Potential to slow, halt or reverse the loss of productive land and native vegetation to salinity.
- Improved water quality, and stream and wetland health, through lowered watertables and less salt and sediment in run-off from saline lands.
- Enhanced biodiversity from mixed plant species in saltland pastures and the invertebrates, birds and reptiles that use them for food and/or habitat.
- The wider beneficial roles rehabilitated sites play (such as providing habitat for the predators of pasture pests, and corridors for the movement of species between native vegetation patches).
- Better management of environmental risks, such as the spread of unmanaged saline pastures as environmental weeds.
- Reduced erosion of bare, scalded land.

Biodiversity and biomass increased in a trial site at Yearling, WA.

	Unimproved saltland	Saltbush & sown under-storey
Biomass (kg DM/ha)	1,403	7,729
Native plant species present	1	3
Exotic plant species present	10	15

And the social benefits?

- Renewed pride and confidence at personal, community and industry levels.
- Achievement of a range of personal and family aspirations about the place they farm, and why and how they do it.
- Individual woolgrowers, and the industry, contributing to catchment goals.

An example of financial benefits

This detailed example of potential effects of establishing sown saltland pastures is drawn from two farms on the NSW Southern Tablelands, and shows the key factors affecting financial returns. Both sowed saline areas (using internal funds) rather than grazing the existing volunteer pasture. The financial results varied considerably, as shown below.

Key results from analysis comparing sown with volunteer saline pastures.

	Farm A	Farm B
Stocking rate	13 DSE/ha	7 DSE/ha
Investment period	10 years	10 years
Year of peak debt	1st year	1st year
Year investment is paid back	4th year	5th year
NPV/ha sown pasture on saline areas	$1,373	$577
NPV/ha volunteer pasture on saline areas	$753	$653
Change in NPV from investment (saline areas only)	82%	-12%
Change in NPV from investment (whole enterprise)	15%	4%

The analysis is over a 10-year period and indicates that sown saltland pasture is clearly the best option for Farm A, but the result on Farm B is not as clear cut. On Farm B, the lower return from sowing pasture and its longer payback period make it less attractive.

The main reason for these different results is the conservative stocking rate used by Farm B. This woolgrower also considered that changes in grazing management alone could result in improved species composition, productivity and environmental benefits from the volunteer pasture.

The financial performance of an investment in sowing saltland pasture is sensitive to the establishment cost, stocking rates and the value of the stock products (i.e. wool or meat). However, for Farm A, sown saltland pasture has the potential to transform a poor performing area of the property, at present contributing very little to whole farm profit, into an important component of total farm productivity.

What can be done by woolgrowers

Understand the site

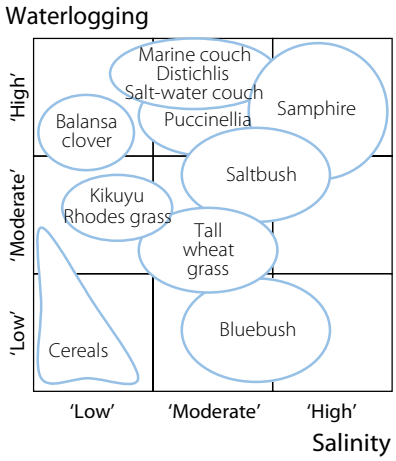
Choosing the best solution for managing salty land depends on the salinity of the soil, the depth to groundwater, the degree of waterlogging (which compounds the effect of salt) and soil texture (clays are harder to deal with than sands). Climate (temperature, rainfall and evaporation) is also important.

Different sites will yield different returns on the investment. Sites with moderate salt levels (and those at risk of becoming saline) offer better and more reliable returns. On this basis, around half the saline land in Western Australia is suitable for saltland pastures that will be profitable in the long term.

Look for native plants already on the site and protect them from disturbance. They may be the cheapest source of new plants for the site.

Pick the right plants

Different plant species perform better in different combinations of salinity and waterlogging (depth to the watertable). Select ones that best suit your site and fit your farm management.



Indicative chart of species suitability for salinity and waterlogging.

Start 'em right

Establishing fences and stock waters in the right place is the first step and can lead to better groundcover on its own if coloniser plants are already present.

Wet sites can be sown when they are driest (e.g. in late summer or autumn) but drainage may still be needed. Consider forming the site (e.g. with raised or cambered beds) if there is sufficient topsoil and it can be done in summer before sowing. The minimum disturbance required to ensure seed placement for germination may be the best approach on scalds with little topsoil.

CASE STUDY: Phil & Caroline Smith, WA

Phil and Caroline Smith farm a 1,880 ha (1,400 ha arable) property at Bonnie Rock – a very low rainfall area at the edge of farming country on the far edge of Western Australia's eastern wheatbelt. A 33 ha area at the top of a drainage line started to cause problems after a neighbour cleared some land upslope.

It had been deteriorating for about 10 years with very poor lupin growth and even triticale not yielding well. Floods in 1999 (450 mm in three days) made the area bare and a saline scald developed further with sheep camping on the moist ground. Phil and Caroline reckoned that if it was allowed to go unchecked, the bare, salt-affected area would progressively creep up the slope and the salt could also affect areas downslope.

The area was fenced and planted to saltbush seedlings with other native species volunteering. Groundcover is now complete and sheep are allowed to graze it in conjunction with the surrounding crop stubble. Another area of about 10 ha developing on the farm is destined for the same treatment.

Evapotranspiration (which is proportional to leaf cover) will lower watertables in summer but drainage or diversion banks to stop water flowing onto saline areas may be needed in winter. Any disturbance of the surface soil can lead to a temporary increase in the amount of salt leaving the site.

Some plants (e.g. many saltbushes) have better germination rates if seeds are 'pre-treated' (e.g. removing parts of the old flowers) or primed with water, gibberellic acid, kinetin and/or salicylic acid. Fertilisers and soil ameliorants can help to speed early establishment and growth.

Apply the three key restoration criteria:

1. Identify the severity of the salinity and whether waterlogging is a problem.
2. Match drainage treatment and plant selection to the site.
3. Assess the likely costs and benefits before proceeding.

Design the area so it can be managed as a grazing unit, accounting for plant selection, access to water, drainage, alley alignment, equipment, etc.

CASE STUDY: Tony York, WA

To illustrate the grazing potential of saltland, Tony York gives the example of a 150 ha paddock he bought about 10 years ago.

"There was about 8 ha of arable land, and the rest salt, and in pretty bad shape. Initially we grazed about 50 dry sheep on the area for about three months each year. Since then it has been revegetated with bluebush and saltbush and we run 300 lambing ewes in there over a four-month period each year. Not a bad effort for land that many would consider useless.

"Of course, not all paddocks are as good as this one, (but) we feel that saltland is very beneficial to our farming enterprise.

"The whole grazing operation is more productive and we can spell some of the arable land at the break of the season, putting sheep on the saltland to allow pastures on the arable land to get away.

"We are certainly not afraid of buying saltland, because, well managed, it can be a valuable asset."

Manage saltland sites strategically

Grazing should be delayed until plants are fully established and provide at least 70% groundcover. Grazing pressure and waterlogging interact to affect the survival of saltland pastures. Monitor groundcover, vegetation composition, growth stage and vigour (for pastures and weeds) – and vary the timing, frequency, intensity and duration of grazing accordingly.

Strategic management of persistent, high yielding saline pastures can lower watertables, maximise the availability of useful 'out-of-season' (e.g. autumn) feed, optimise pasture survival and minimise weeds.

Saltbush-based pastures that also contain under-storey plants offer the best scope for stock weight gains in parts of Western Australia. Establish larger perennials first, then under-storey species – or introduce cheap energy supplements to stock rations.

In South Australia, Victoria and NSW, where saltbush and under-storey is rarely the best option, the perennial salt-tolerant grasses are a better bet in locations where they will grow. This requires a different process for establishment and grazing management.

What can be done by NRM managers

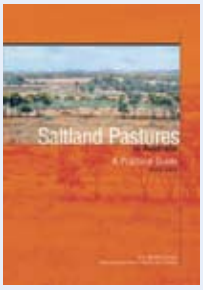
Sustainable Grazing on Saline Lands has established grower networks and trial sites around Australia. Regional NRM bodies and State agencies may find them useful groups to support as they continue to develop and promote measures to address a common environmental issue.

Woolgrowers will need ongoing assistance with on-ground programs if the adoption of new techniques is to continue. Assistance will be needed with grants for fencing and pasture establishment, and Land, Water & Wool information products could be made available to woolgrowers as part of incentive packages.

More information

- SALTdeck – Plant identification cards for saltlands

- Saltland Pastures in Australia – a Practical Guide



- The SGSL in NSW DVD – Productive and Sustainable Ways to Use Saltland

- Insights: Case studies on how farmers are successfully managing saltland for profit and sustainability

Further salinity products will be produced as a result of collaboration with other institutions. Visit www.crcsalinity.com to view them as they become available.

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Sustainable Grazing on Saline Lands section of the website.

"Blocks and treelines cater for different livestock and wildlife needs. We have saved thousands of dollars worth of stock each time we use the blocks for sheep off-shears. In other words, we have paid for every tree we will ever plant."

– James Street
'Blaxland'
Armidale, NSW

Native Vegetation & Biodiversity

Setting the scene

Three out of every four Australian woolgrowers have native vegetation on their land. They play a key role it its care and management.

Native pastures and bushland occupy large areas of many properties and underpin the fine wool industry in several regions. Native vegetation provides many benefits to wool production and the farm enterprise, such as feed, shade and shelter for stock, beneficial insects and timber, as well as recreational and aesthetic values.

Results from a national benchmarking survey showed that 68% of woolgrowers with native vegetation on their farm believe it is useful for production, with the main benefits being shelter (40%) and feed for stock (36%). Perennial native grasses will persist for many years if grazed correctly. They are low input, resistant to drought and frost tolerant. Many are vigorous and highly palatable. Research has shown that native grasses can provide a valuable quantity and quality of pasture for wool production, in some cases rivalling that of introduced species.

The issues

The Australian community expects that the continent's unique flora and fauna will be protected by land holders as well as governments.

Sustainable management of native vegetation on-farm is essential to achieving this aim. Many woolgrowers consider that retaining native habitats is an important part of their farming system. However, until recently little useful information has been available to help woolgrowers make practical decisions about how to manage native pastures and bushland in the context of a profitable wool enterprise.

Land, Water & Wool has made a start at filling that gap and measuring the economic, social and environmental benefits at the farm and catchment scale.

What LWW found

Biodiversity boosts the bottom line

Many woolgrowers are already generating a profit while enhancing biodiversity on their properties. They do this through:

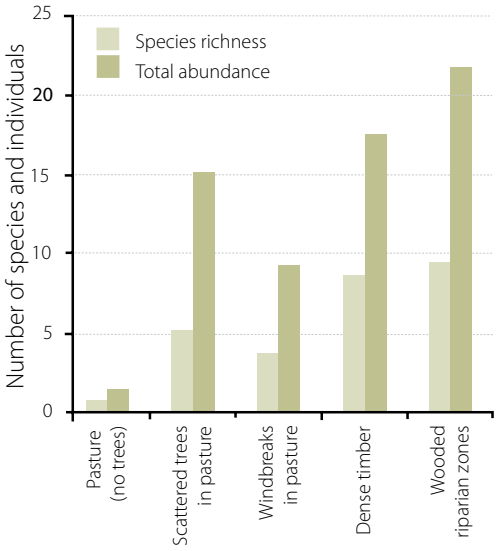
- choosing an appropriate grazing system;
- monitoring native pastures;
- retaining native vegetation and establishing shelterbelts; and
- protecting riparian zones and creating wetlands.

Increasing on-farm biodiversity by maintaining native vegetation can enhance productivity and add income to farm businesses. For example, Land, Water & Wool found that native pastures on hill country in the mid-North of South Australia require few inputs but can carry more than 4 DSE/ha through the year. Shelterbelts of native vegetation in cleared country on the New England Tablelands improved profit by $11/ha at one site from an improved lambing percentage.

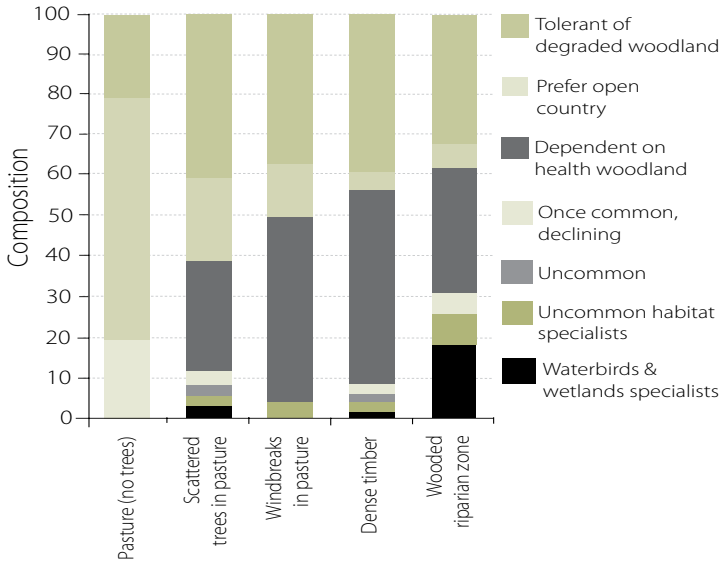
Woolgrowers are getting benefits from existing and regenerated or replanted native vegetation in the following ways:

Productivity increases bring rewards

- Increased stocking rates and improved lambing percentages on native pastures through strategic grazing management.
- Shelter for stock during adverse weather conditions, significantly reducing stock losses during lambing and off-shears.
- Reduced pest insect numbers (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.
- Lower input costs compared to sown pastures and (in some cases) a lower financial risk profile for the farm as a result.



The average number of bird species and individuals in different habitats on New England wool properties. Censuses were conducted for 20 minutes in 1.2 ha plots.



Bird species composition in different habitats on New England wool properties. Species are classified in seven groups based on Geoff Barrett's pioneering work in the Armidale region.

A 1999 survey identified 20 species of woodland bird destined for extinction in the NSW wheat/sheep belt. Land, Water & Wool research found 10 of those species on New England wool properties. With few conservation reserves in the developed parts of New England, bird conservation will be largely dependent on graziers.

- Protection of land from wind and water erosion through more extensive groundcover.
- Increased feed utilisation of native and introduced pastures as a result of strategic grazing regimes (these match the season and the vegetation growth patterns/rates of different pasture types).
- Increased production from soils of low inherent fertility.
- Increased property value due to recreational and aesthetic benefits.
- A source of timber, posts and other bush products.

The environment wins

- Diversity of native plants and habitats is retained, providing the foods and shelter needed to maintain local wildlife populations.
- More desirable wildlife are retained on the farm.
- Potential to store carbon, an ecosystem service for which there may, one day, be a payment.
- Surface runoff is filtered and sediments removed, so water quality is improved on farm and for downstream users.
- Recharge of watertables is reduced because of greater water use by native perennial grasses than by annual pasture species (especially if they are summer-active and managed to maintain green leaf over summer). This reduces the risk of salinity.
- Reduced risk of soil loss by wind or water erosion.

CASE STUDY: Tony Gall, NSW

Tony Gall says a lot of the success of his fine wool is due to the native species across the country – Microlaena in particular – so "you have got to treasure them".

The native species are adapted to the cool climate and high altitude on the Northern Tablelands. Over-grazing and over-fertilising these species creates a risk of reducing their balance. Their ability to grow high tensile-strength, bright, stylish superfine wools in this cooler climate New England region should not be under-estimated.

"My most important message is that we must learn to appreciate the environment," Tony said. "We are so lucky, but we must aim to leave the country in better shape than we inherited it. We are only caretakers and we can always do better."

Strategic management is the key

Strategic management relies on sound observation and knowledge of the vegetation being grazed – the species present, their condition, life cycles, pattern of growth and feed production – and the ability to change stock numbers in response to the pasture and seasonal conditions.

There is no one 'right way' to manage sheep grazing native pastures, but the research has shown that well-planned, strategic management (such as rotational grazing) can boost both economic and environmental benefits.

The strategy must reflect local conditions. For example, on the New England Tablelands an unfertilised improved pasture is likely to be re-invaded by useful native grass species, but in Victoria the invaders are more likely to be low-fertility weeds such as onion grass and bent grass. Land, Water & Wool research in Victoria and South Australia has shown that where native grasses already exist they can benefit from changes in grazing management that also improve groundcover and production. Native pastures are generally only found in non-arable areas in the southern States.

What LWW found – Wheat-Sheep Zone

In the mid-north of South Australia, strategic grazing of perennial native grasses, based on the amount of feed available and its growth stage, has expanded the cover of perennial grasses and of vegetation overall (decreasing the amount of bare ground). This enabled a large increase in stocking rate. The expansion in groundcover also resulted in greater infiltration of rainwater and less run-off and erosion.

The higher stocking rates translated into greater production and profit. Coupled with a resultant shift in lambing dates, there has also been a rise in lambing percentages (from 78% to 100% in one trial site). Examples include:

- Stocking rate increases: from 1.25 to 3.5 DSE/ha and from 2.3 to 4.2 DSE/ha at two of the sites.
- Increased groundcover (particularly on exposed northern hill faces): spread of perennial grass cover by more than 70%, with bare ground reduced to as little as 5% compared to typical levels of up to 40%.
- Greater profit: using an average gross margin of $20/DSE, the financial benefits have been substantial – up to $38/ha before accounting for costs of additional management.

About 500,000 ha in the mid-north of South Australia are predominantly native pastures used for wool production. They have traditionally been regarded as being of low productivity, with an average stocking rate of 2.5 DSE/ha. These results show that with improved grazing management, productivity and profit can be increased. At the same time, pasture condition and function can be improved.

What LWW found – High Rainfall Zone

Native pastures in the High Rainfall Zone can produce highly valued, fine and superfine wool, so maintaining them in good condition makes economic sense. For example, in Tasmania there are three million sheep, half of which are run on native pastures. Land, Water & Wool research has found that in high rainfall areas the keys to optimising production and biodiversity are:

Match the stocking rate to the carrying capacity

- Stocking rate will need to vary from year to year and from season to season.

Understand the lifecycle of all plant species present

- Allow enough recovery time following grazing to maintain desirable species.
- Strategically graze pastures so that competition and seed production from undesirable species is reduced while desirable species are adequately spelled during seed set.
- In dry times, rest native pastures and move stock to maintain the health of the vegetation.

This project also showed that the interaction of fire management with sheep grazing regime is critical in determining the species composition of both vascular plants and invertebrate animals. Both fire and grazing are necessary to prevent increases in tree cover on those bush runs that have had their tree cover reduced by past management regimes.

"I could see that with the gradual death of remnant (vegetation) on my farm and in the district, we were going to run out of native trees, which would affect production. Loss of timber resources, reduced stock shelter and the spread of salinity were progressing unabated and that's what prompted me to act."

– Peter Waldron
Melville Forest
Victoria
Up to 8% of his previously grazed area is now fenced and revegetated with trees, but the property produces more wool and meat than ever before

Design the system to suit grower objectives

In the hill country of central Victoria, four management strategies for increasing the profit from wool and improving the condition of native vegetation have been identified and modelled. These strategies were aligned with family goals as part of whole farm plans.

The benefits gained from particular management strategies depended on the amount of hill country and current stocking rates on the property.

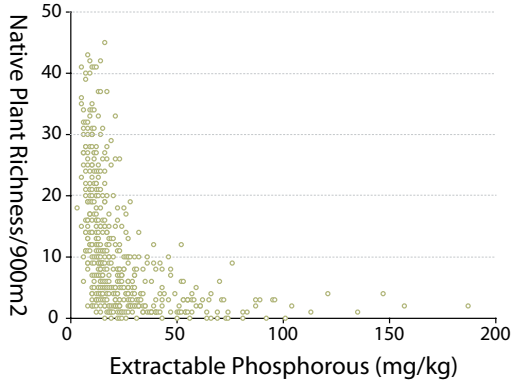
The four strategies were:

- correcting nutrient deficiencies;
- deferred grazing on hill country;
- intensive rotational grazing; and
- establishing shelter-belts.

The 'deferred grazing' and 'intensive rotational grazing' strategies were most likely to result in extra profits and to have the most favourable impact on the condition of native vegetation, regardless of current stocking rates.

Both these strategies require an initial capital investment in fencing and watering points estimated at $30/ha. Using 'deferred grazing' on hill country areas generated the most attractive returns, up to an extra $27/ha/year.

Applying the 'correcting nutrient deficiencies' strategy across 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.



Native plant species richness vs. soil extractable phosphorous in Victorian hill country.

However, the returns vary depending on existing productivity. If stocking rates were high to begin with (10 DSE/ha or more), better nutrient management would generally not improve the stocking rate enough to offset native vegetation management costs. Woolgrowers running lower stocking rates (<8 DSE/ha) found more potential for improvement. This strategy assumes fertiliser is not applied to areas being managed for native vegetation and biodiversity, as phosphorus in particular can result in the loss of native plant species.

There was potential for a 10% increase in profit from intensive rotational grazing of native pasture, and $1/DSE/year (or $6.50/ha/year) from carefully positioned shelter trees. Changes in land management to improve profit and native vegetation condition using these approaches have potential application to two million hectares across central Victoria and a further 8.5 million hectares of south-eastern Australia (in NSW, South Australia and Tasmania).

Take care before intensifying wool production

Clearing, cultivation and sustained use of fertilisers all reduce the biodiversity of native vegetation. Total grazing pressure (domestic stock plus feral and native animals) has a major influence as well. The Land, Water & Wool project on the New England Tablelands collected data from 64 paddocks across 18 farms. It found:

- Naturalised pastures that had been previously sown but were dominated by volunteer native species produced the most wool per hectare (about 19 kg/ha in 2004).
- Although fertiliser was good for production, native species richness was reduced by fertiliser use.

CASE STUDY: Bill Hoffman, SA

Since changing to a planned grazing system using small paddocks, large mobs and long rest periods, Jamestown prime lamb producer, Bill Hoffmann, has been amazed by the improvement in the land and pasture productivity.

According to Bill, who took part in the Land, Water & Wool grazing trial in South Australia's Mid North, the alternative grazing management has increased stocking rates and improved groundcover and native grass populations.

Bill owns a 769 ha property running 1,800 Merino ewes mated to White Suffolk terminal sires and growing wheat, triticale, oats and lucerne. The average rainfall is 480 millimetres.

Traditionally, Bill ran 800 ewes on his 162 ha of hill country from May through to December to coincide with the cropping program. They were then moved onto the stubbles for the summer until the break of the season.

In 1999, he answered an advertisement in the local newspaper for free fencing. Initially, Bill was only going to fence off 5 ha, but with encouragement from the Mid North Grasslands Working Group, he decided to tackle half the hill country area, subdividing 80 ha, from the original two paddocks into nine paddocks. Sheep were combined into one large mob and rotated through the nine paddocks.

The results encouraged Bill to fence the remainder in 2003, resulting in 21 permanent paddocks. He has also subdivided some arable land that was previously used for cropping.

Early on, Bill used five plain wires but now believes three plain electrified wires are sufficient. Temporary electric fencing is also used to make the paddocks smaller, which provides better control over the grazing and more even pasture utilisation. The paddocks are 6–10 ha and, where possible, up to 1,100 ewes will be run in a single mob. Grazing periods are 2–3 days, while rest periods are 60–90 days, depending on the time of year, with a short rest during peak pasture growth in spring and a longer rest period in summer.

Groundcover and native grass populations have increased and the perennial plants are now robust, productive and growing a lot more vigorously. As a result, livestock profitability has improved through a doubling in stocking rates (from 3–4 to 6–8 DSE/ha) despite some tough seasons.

For Bill, this achievement confirms that the principles of planned grazing – using small paddocks, large mobs, a short graze and a long rest period – can be successful in a range of environments. His goal is to continue to increase the perennial pasture content, maintain groundcover at 100% and to get a balance between the annuals and perennial plants, as both have their benefits.

Bill believes the sheep are well adjusted to the rotation: he simply opens a gate and they move quietly through, even with lambs. During the past two years he has averaged more than 100% lambing and this includes 30–40% maiden ewes. The lambs are weaned at shearing in October and moved into lucerne paddocks on the flat country to be finished. Bill aims to have at least 70–80% of the lambs sold by the end of December. The ewes go back into the hill country until the stubbles become available.

According to Bill, an important part of managing a planned grazing system is regular visual assessment to monitor pasture growth. This ensures the stocking rate matches the land's carrying capacity and there is no over-grazing. Involvement with the project and attending several grazing management workshops have helped to improve his pasture assessment skills.

Although Bill admits it can take a while to become proficient at estimating available feed, he says there is always something different to see on the ground. He believes the money he has spent on fencing is a far better long-term investment than money spent on continual fertiliser applications.

Providing stock shelter can boost biodiversity

The Victorian Land, Water & Wool project showed that establishing shelter belts by encouraging natural regeneration can be worth an extra $10/ha/year in sheep performance and pasture growth after 15 years or when the trees are fully established and providing shelter.

The results are sensitive to the area set aside for shelter belts (assuming they are not grazed). For example, if 12% of the area of grazed pasture is set aside, the benefits begin to outweigh the cost of the grazing foregone after about 15 years.

In practice, shelter can usually be provided using less area and these areas can be grazed once the trees are established and beyond grazing height. Public funds to help defray the fencing costs also mean that benefits exceed costs sooner (although there may be establishment and management requirements to qualify for funding). Electric fencing to promote natural regeneration (costing about $80/ha) is much cheaper than replanting with tubestock ($680/ha).

Many woolgrowers in northern NSW have profitable enterprises characterised by high levels of native biodiversity. The methods used to enhance farm profitability as well as native biodiversity include:

- grazing management based on matching the needs of preferred pasture species with those of the sheep, and includes use of phase (cell and rotational) grazing;
- proactive tree management involving native and exotic species, such as protecting and enhancing woody vegetation, developing windbreaks and wildlife corridors, plantation forestry and agroforestry; and
- river and water management, including protecting riparian zones and farm dams and creating and protecting wetlands.

Management that consistently achieves high production per head, high groundcover, high pasture and crop biomass, clean water supplies and 10-30% of the property vegetated with healthy timber and shrubs, has been shown by LWW research to also achieve high levels of native biodiversity.

If pastures and crops are diverse, productive and palatable, such management is also likely to be profitable:

- A potential increase of 11% in profit was achieved at one site from an increased lambing percentage following an investment in shelter from native vegetation.
- When only stocking rate benefits were considered, a 7% increase in farm carrying capacity was sufficient to justify the establishment of windbreaks on all north-south fence lines on a New England farm (in this case, occupying just 12 ha of a 1,000 ha property).
- Other benefits from shelterbelts are increased wool production per animal, higher lambing rates and fewer deaths leading to more sheep available for sale.

In Queensland, research found that retaining or restoring native tree cover of up to 30% over grazed pastures can increase their productivity and species richness. This supports earlier studies that also found 30% native tree cover was beneficial to both profitability and biodiversity. If managed carefully, grazing by sheep can help prevent excessive regrowth of eucalypts and the formation of a tree-based monoculture.

Helping woolgrowers help themselves

In Land, Water & Wool, woolgrowers have worked with researchers to develop practical, cost-effective tools and guidelines designed to integrate native vegetation and biodiversity management into overall farm planning. Web-based interactive environmental assessment methods are now available, as well as a range of guidelines, manuals and fact sheets.

An on-line 'health check' developed by woolgrowers in the Traprock region of Queensland enables woolgrowers collectively or individually to monitor their farms' environmental performance. It records factors such as pasture and habitat condition, and enables them to compare their property against regional benchmarks. This information helps woolgrowers integrate environmental management into their operations and to feed information into regional catchment planning activities.

Being able to demonstrate their environmental credentials to themselves, each other and the market is an important step forward. Woolgrowers can now demonstrate that they are caring for the natural resources under their management.

The LWW project in Tasmania developed a template for a Biodiversity Management Plan which was endorsed by a woolgrower steering committee. They saw this as a useful addition to a whole farm plan/environment management scheme (EMS) and for accreditation purposes.

The plan includes the specific management requirements of the native vegetation communities, species and habitats found on the farm, but also considers the property's production and the needs and goals of the managers. This type of plan could be used by any woolgrower preparing a whole farm property plan.

Diverse management promotes regional biodiversity

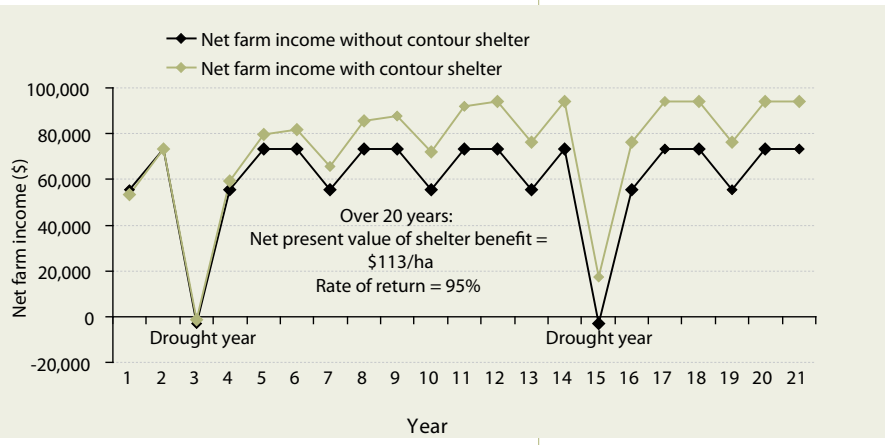
Different species of native plants and animals have different requirements for growth and reproduction, so any one style of grazing management for native pastures is likely to benefit some at the expense of others. It is useful to manage different areas in different ways if total biodiversity is to be maintained.

Management can be based on the needs of rare or threatened species in a particular area, as the more common species are likely to be less specific in their needs and hence able to survive under a wider range of conditions.

There is an important interaction between sheep grazing and the fire regime (season, intensity and duration) which determines the species composition of bushland. The re-introduction of planned burns into areas of native vegetation may help to maintain pasture productivity and eucalypt cover in areas where other tree species are increasing.

"Without monitoring, we don't have an objective way to measure whether we're heading in the right direction with our management. Once we start to get an idea of how our management is affecting these pastures, we can extrapolate these results to other areas of the property."

– Matthew Dunbabin
'Bangor', Dunalley
Tasmania



Contour shelter belts can increase net farm income (Northern Tablelands, NSW).

"Costs associated with protecting remnant woody vegetation are minimal when compared to the biodiversity and stock protection gains that are achieved."

– Colin Seis
'Winona'
Gulgong, NSW

Valuing ourselves and our 'place'

A theme that has emerged throughout the Land, Water & Wool work on native vegetation and biodiversity is how connected woolgrowers and their families feel to 'their place'.

This has been described in terms of people's place identity, place attachment and place dependence. It should not be under-estimated as a key driver for action on-farm to protect and maintain native vegetation and biodiversity.

A Victorian study identified five key personal drivers that influenced how native vegetation is managed by woolgrowers:

- family succession;
- enjoyment of farming;
- overcoming isolation;
- learning about farming; and
- education of children.

Resource management programs aligned to these personal drivers are more likely to be effective. Spiritual, cultural, social, financial and aesthetic factors are all important in shaping the decisions a woolgrower makes, and it is important this is recognised in developing information and tools for the wool industry.

What can be done by woolgrowers

LWW has developed tools to help woolgrowers decide how the native vegetation – both pasture and bush – on their farms can be incorporated into current and long-term management. There is a wide range of products, including web-based toolkits, fact sheets, case studies and detailed technical guides.

LWW has provided many examples of how woolgrowers are already doing this and how they have captured the multiple benefits.

What can be done by NRM managers

- Provide LWW booklets and guidelines to landholders receiving grants to improve the biodiversity of native pastures (e.g. fencing assistance), to help them get the most out of their efforts. (The booklets can be tailored to local needs and local contact details).
- Make use of the Quickchecks manual and include all relevant LWW products on any local 'tools and advice' database.
- Develop programs that take advantage of woolgrowers' sense of place and fit their differing production systems.

"The psychological benefit of a biodiverse farm is important. It's good to be able to look at the flowers or trees for a while when things aren't going right. It's better than taking your frustrations out on the stock or the dogs."

– Rob Adams
'Swallowfield'
Armidale, NSW

More information

- Insights – case studies on how woolgrowers are successfully managing native vegetation and biodiversity for profit and sustainability

- The Tasmanian Native Pasture Guidelines

- How to make money out of grass (SA)

- Farm Business & Biodiversity 'Barking up the right tree' brochure and extension notes

- Quickchecks: Natural Resource Managment Monitoring Tools for Woolgrowers

- Land, Water & Wool Northern Tablelands Project Fact Sheets

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Native Vegetation and Bioversity section of the website

"River and waterway management should be a part of the whole farm ecosystem and not a separate issue. We had noted a rise in the salinity of the river water, so to water the stock efficiently and provide them with clean water, the best thing to do was to shut them away from the river altogether and water them from another source. While the river is not used for stock watering any more, it's a vital ingredient in the property's increase in overall biodiversity."

– Richard and Jenny Weatherly
'Connewarran'
Victoria

Rivers & Water Quality

Riparian land: 'Any land which adjoins, directly influences or is influenced by a body of water'. The body of water could be a creek or stream (even if it flows only occasionally), a river, a lake or a wetland. There is no rule of nature that defines the 'width' of riparian land. The width of interest or concern is largely determined by the particular landscape and by management objectives.

Setting the scene

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.

Waterways can pose a range of management problems such as insecure boundaries and periodic floods, with the risk of stock losses.

Waterways also tend to be 'special' places on the farm, with woolgrowers recognising and caring about the unique biodiversity that can be found there. As a result, woolgrowers have strong financial, environmental and social reasons for understanding and managing the waterways and riparian land on their farm.

The issues

Australia is well known as the driest inhabited continent, with a generally low and highly variable rainfall. It is not surprising that there is increasing competition for surface and groundwater, and concern at the continuing decline in water quality in many rivers.

Those living and working on the land are increasingly being called on to be responsible 'environmental stewards'. Land, Water & Wool has provided woolgrowers with another opportunity to respond to that challenge.

Riparian lands are often highly productive due to their fertile soils and retained moisture, but they are also vulnerable to poor management. Many of the current problems of reduced water quality in rivers, accelerated erosion of stream banks, loss of valuable land to flooding and declining in-stream health can be linked to on-farm management.

By recognising the special characteristics of riparian lands and managing them within the context of a whole farm plan, woolgrowers can lift production and profit. For example:

- Carefully planned seasonal grazing of riparian pastures can improve species composition and feed utilisation while providing a filter

to remove soil and attached nutrients from upslope before they reach the stream.

- Retained or planted native riparian vegetation can provide a valuable windbreak at lambing or for sheep off-shears, while also shading the stream and reducing water temperature and nuisance aquatic plants.

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 on-farm management of rivers and water quality.

What LWW found

Waterway management within a whole farm plan

Riparian pastures can be highly productive and often retain green feed after higher parts of the farm have dried off. They also present special challenges in, for example, optimising grazing management if the stream or creek is unfenced; controlling parasites in wetter areas; preventing disease transmission by roaming animals; and preventing injury to stock and loss of infrastructure during floods.

The woolgrowers involved in LWW have met these challenges by planning the use and management of riparian areas and waterways within their whole farm plan. They have:

- determined the timing and intensity of grazing to best match the feed available from other parts of the farm and meet animal demand (e.g. to lift lamb weights or finish stock for sale);
- sub-divided riparian areas to enable strategic grazing and resting of pastures to maintain productive species and increase feed production; and

"There seems to be more bird life, a greater range of plants in terms of age, species and size, as well as more shelter and shade for stock. It is also a lot better to look at."

– Brendon Lunney
'Bogalara'
NSW

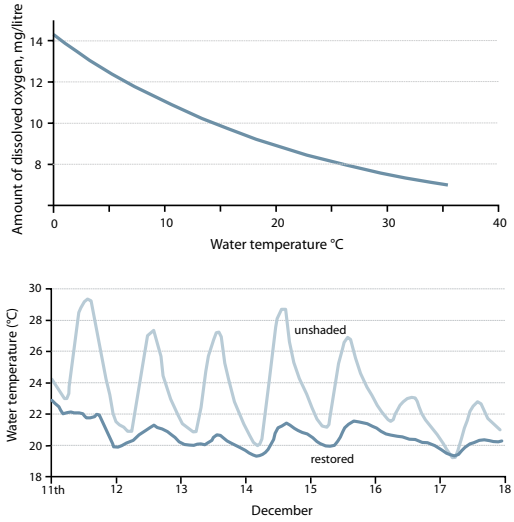
"It is important to recognise that the battle for water quality is generally won or lost in the small creeks, gullies and streams within a catchment. These waterways make up three-quarters of the stream network length and are generally located on farms, so developing guidelines for woolgrowers to better manage them within the context of a commercial operation is vital to maintain water quality for downstream users."

– Phil Price
Researcher

- controlled stock access to maintain groundcover and reduce erosion or to promote natural regeneration of native plants.

Tasmanian woolgrowers have used this planned management to increase pasture and wool production, while also promoting natural regeneration or enabling replanting of native riparian vegetation. In NSW, the focus has been on preventing the formation of gullies, or their stabilisation and rehabilitation. In South Australia, the emphasis has been on optimising the use of riparian pastures and control of invasive, unpalatable weeds.

Colder waters typically contain a higher oxygen concentration than warm waters because the solubility of oxygen increases as temperatures fall. When shade is removed from the stream, water temperatures rise and dissolved oxygen levels fall, making it difficult for in-stream animals and fish to survive.



Source: Davies Petal (2006). River & Riparian Lands Technical Guidelines 5.

Benefits of native riparian vegetation

Providing shelter and shade can significantly boost productivity.

Shelter from cold winds reduces the amount of energy animals require to maintain body temperature, providing more energy for weight gain and wool production. A vegetated strip at least 10 metres wide and 10 metres high will reduce wind speed and provide protection up to 300 metres downwind.

Research in Armidale, NSW, found that wool production in well-stocked plots partially sheltered by a one metre high iron fence was 43% greater than in open plots over a five-year period. Halving the wind speed can reduce heat loss by 20% or more in adult sheep and shelter can make all the difference to lamb survival.

Tree roots reinforce and protect streambanks, reducing erosion and the loss of valuable grazing land. Shade from riparian trees reduces water temperature and light intensity in the stream, which can be vital to healthy in-stream life.

A riparian area that includes native vegetation can also provide firewood, beneficial insects for crop protection and selective timber harvesting for agro-forestry.

Shading helps lower water temperatures and increase oxygen levels.

Fencing and grazing management – the key

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 to the stream or creek itself. Control does not mean exclusion. It opens the way for riparian pastures to be grazed to optimise seasonal availability of green feed, to improve pasture composition, growth and utilisation, and to improve parasite control.

Strategic grazing is likely to provide the best long-term management regime and is preferable to set stocking or allowing the animals to make the decision. Strategic grazing, matched to seasonal pasture growth and with periods of rest, promotes a vigorous and competitive pasture sward that is at lower risk of invasion by unpalatable weeds, minimises soil erosion and provides a filter between the stream and intensive production upslope.

Fencing and reticulated water points can be used to optimise feed utilisation on riparian pastures and make full use of their greater production potential.

Fencing permits the strategic management of riparian areas.

CASE STUDY: John & Sue Holt, SA

When John and Sue Holt took over 'Burn Brae' at Eden Valley in 1976, it had a number of similarly sized paddocks, fenced without regard to the hilly and rocky terrain. All paddocks opened onto the creek for water.

They decided to make the job of mustering both safer and easier with a more efficient paddock layout. They were also interested in improving pasture management by fencing according to land type.

Taking this approach has led them to reorganise their property. Rocky and difficult areas to access are fenced off and left as wildlife reserves and shelter belts. Riparian areas have been rehabilitated, as stock access in the past had led to silting, erosion, bank instability and water quality problems.

Today, these problems are no more and John believes his stock are much healthier having access to clean water.

Other productivity benefits include having shelter for stock, particularly lambing ewes, and easier stock management as a result of a more effective paddock plan. The increase in biodiversity is very rewarding for the Holts, who enjoy seeing birds flourishing along the rehabilitated creeks and dams on their property.

CASE STUDY:
Gill & Ruth Strachan, SA

Gill and Ruth Strachan have been on 'The Gums' (in South Australia's mid-north) for the past 30 years, but it has been hard work to maintain a viable, profitable property during the past 8-10 years of dry conditions.

Although the floodplain country is only a small part of their property, they believe they have a significant responsibility to try to eradicate the pepper trees on it, for the long-term health of the Burra Creek and properties downstream.

They hope landholders upstream from The Gums will not ignore the impact of vigilant weed control.

Gill hopes the LWW project site on the property will highlight what can be achieved through best practice weed control.

"We no longer see these fenced off areas as wasted country. They are a real asset. Some people question the value of trees and revegetation but I can't remember the last time we had any problems with stock during cold snaps and high winds. The benefits of shelter are obvious. It cuts wind velocity and provides a haven for lambing and for shorn sheep."

– Mark Gubbins
'Coolana'
Victoria

Preventing, managing and rehabilitating gullies

Gully erosion reduces the amount of productive land, limits access to paddocks, makes it difficult to muster stock, degrades water quality through sediment and nutrient runoff and poses a risk to the safety of stock and farm staff alike. These are visible signs of a resource management problem.

Land, Water & Wool 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. This would significantly reduce downstream water quality to all users.

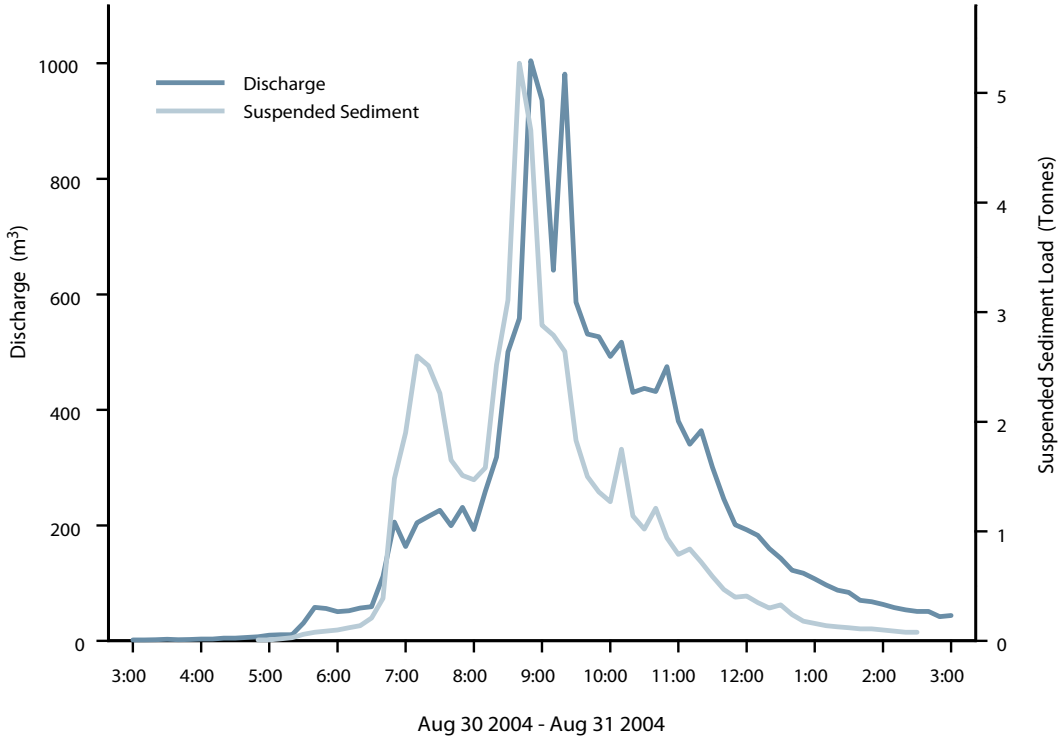
Many catchment authorities have identified reducing sediment load in rivers as a priority, and are making funding available for on-farm works.

The key to preventing gully formation is to maintain a vigorous pasture in areas at risk due to slope, convergence of overland flow and unstructured (often sodic) subsoils.

Where a gully has already formed, a range of stabilisation and rehabilitation options are available. The first step is to determine whether the gully is already stabilising. Many were formed generations ago and natural processes have led to reduction in bank slope and some revegetation. In this case, fencing to control stock access and speed natural revegetation may be all that is needed.

If the gully remains active, steps should be taken to reduce the overland and subsurface flow entering it (e.g. using small banks to redirect overland flow, and replanting along the bank tops), and to stabilise the gully bed (e.g. by constructing a dam at its head).

Sodic soils have high levels of sodium in the layer beneath the top soil. These soils have no cohesive structure and dissolve and crumble easily when wet or when touched — they are called 'dispersive' and dissolve into their constituent clay, silt and sand particles when placed in rainwater.



Water flow (discharge) and sediment load in a small gully during a nine-hour rainfall event at 'Bogolara'. Sediment is mobilised early in a storm.

Rehabilitating riparian land pays off

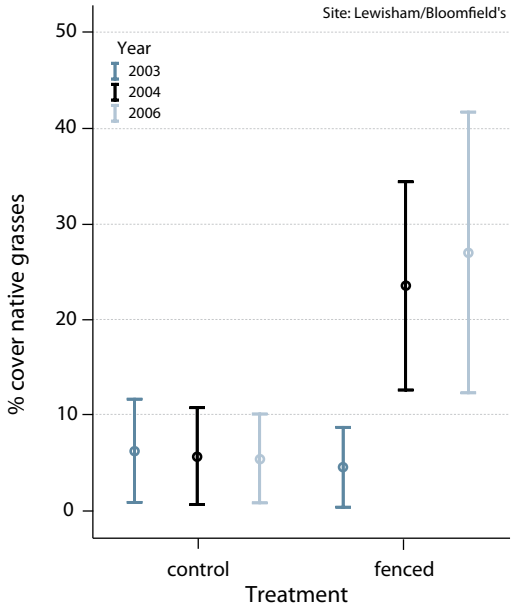
Native vegetation has been lost along many streams, rivers and creeks in woolgrowing areas through over-clearing or unmanaged grazing leading to failure of regeneration. Replacing this to regain the many benefits detailed in this chapter is not always straightforward. Maintaining and enhancing remaining natural riparian vegetation is by far the cheapest option for most woolgrowers.

Fencing and providing alternative water sources for stock are the first steps in rehabilitation. There are many riparian fencing schemes that will help to defray the capital costs. Removing sheep for a period may be all that is needed to promote natural regeneration, as was found at some Land, Water & Wool sites in Tasmania; at other sites, deliberate replanting was necessary.

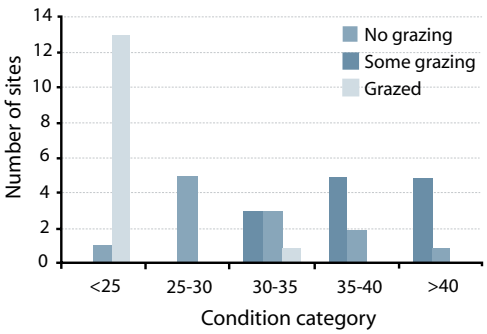
Large or long-stem tubestock plants had a better survival rate at some sites (withstanding the grazing pressure from local possums) but not others. Direct seeding is much cheaper than planting tubestock but is very dependent on good site preparation and the season, as was evident at a NSW site.

Control of weeds and of grazing by feral or native animals may also be required, but this is very site-specific.

Follow-up management is also important and, in general, it is best to tackle a short length of the waterway at a time.



Fencing can improve the cover by native grasses. The graph shows changes in grass cover following fencing. There was a large increase in native grass cover after fencing to control stock. The control plots remained open to grazing and cover did not improve.



Uncontrolled grazing degrades riparian land but strategic grazing can maintain it in good condition. Areas with limited or no grazing had the best (highest scoring) condition.

In-stream wetlands as sediment traps

In-stream wetlands are common in many tableland areas and on some slopes and plains, and appear as reed beds within a stream or creek channel.

In-stream wetlands were a common feature prior to European settlement, and acted to slow the flow of runoff from hilly areas and to absorb this water and then release it slowly over the drier periods. They often formed as water meadows in flat valleys.

With the onset of grazing by domestic stock, many lost their protective cover of vegetation and erosion by water led to the formation of gullies. Some of these channels have become more stable and, with greater input of sediment from surrounding agricultural areas, reed beds are re-forming. The best way to manage these beds is to leave them alone.

The beds trap sediment from upslope that would otherwise continue downstream, reducing water quality for other users. CSIRO research associated with the Land, Water & Wool Rivers project in NSW showed that even at high flows, reed beds can remove up to a third of the sediment. Some may remove as much as 160 tonnes of sediment trapped per linear kilometre of bed, per year. It has been calculated that reed beds in the Jugiong Creek catchment, NSW, hold around two million tonnes of sediment and remove around 75,000 tonnes/year; equivalent to 10% of the total suspended solids load in the Murrumbidgee River at Wagga.

Building relationships

LWW projects showed that trust between researchers, project staff and woolgrowers is fundamentally important for effective natural resources management programs.

The Five Ps (Profit, Proof, People, Place and Promise) were developed as a guiding principle by the LWW Rivers & Water Quality sub-program team and are now in widespread use. They are recognised as bringing together the economic, scientific, environmental and social factors that influence woolgrowers in deciding whether to adopt recommended management practices.

"The trees and revegetation provide a valuable source of off-farm income. They are also instrumental in building biodiversity, controlling salinity and increasing productivity by, for example, providing shelter for stock.

"We also know that the trees and revegetation lift winter pasture dry matter levels by 6-8%. This is paramount to our bottom line, so we have no qualms taking farmland out of production and planting it out to trees and shrubs. We may soon see up to 30% of our property planted out to trees and revegetation."

– Mark Wootten and Eve Kantor Victoria

Fencing out a 'riparian paddock' permits strategic grazing and promotes natural in-stream function.

"Assessing riparian areas in the Mid North of South Australia will be much simpler and accurate thanks to some modifications to the Rapid Appraisal of Riparian Condition (RARC) method. It has more weighting on grasses and shrubs than on trees and canopy cover. Local field officers have been trained in the use of the technique and help is now available to woolgrowers who would like to learn how to assess their riparian areas. It is great to have a monitoring tool designed for our local region."

– Kylie Nicholls
Burra
South Australia

What can be done by woolgrowers

Deciding to rehabilitate riparian lands

When planning to protect or rehabilitate a riparian area, knowing what to do, when, where, and how to do it, is often difficult and requires assistance. Woolgrowers can now get hold of numerous Land, Water & Wool products designed to help them.

- Want to know if your creeks are in good condition? Have a look at 'Are my waterways in good condition? A checklist for assessing river, stream or creek health on farms'.
- After some general information on the principles of riparian management? See 'Managing rivers, creeks and streams – a woolgrower's guide'.
- Need some more specific information on managing gullies or wetlands? Refer to 'Managing gullies on wool producing farms' and 'Managing in-stream wetlands on wool-producing farms'.
- Interested in doing some fencing or shifting watering points to improve riparian condition? Talk to the local NRM body to see if they have grants or other assistance available.

What can be done by NRM managers

- Provide LWW booklets and guidelines to landholders receiving grants for riparian works to help them get the most out of their efforts. The booklets can be tailored to local needs and local contact details inserted via a sticker.
- Use the relevant 'Rapid Appraisal of Riparian Condition' to help determine regional priorities for riparian programs and to monitor progress over time. Three versions are available, one for each of the LWW Rivers sites, but they are easily modified to suit other regions. Training in their use can also be arranged through Land & Water Australia.

"Each individual's 'place', and their sense of place is different. If we are going to be successful in our co-operative efforts to repair and enhance Australia's natural environment, it is imperative that we recognise the importance and the meaning of each person's place to them, and understand and respect differences."

– Cynthia Dunbabin,
'Bangor'
Tasmania

More information

- Are my waterways in good condition: A checklist for assessing river, stream and creek health

- Managing rivers, streams and creeks: A woolgrower's guide

- Managing gullies on wool-producing farms and Managing in-stream wetlands on wool-producing farms

- Rapid Appraisal of Riparian Conditions: a Technical guide

- Wool Industry River Management Guide: High rainfall and wheat/sheep zones

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Rivers and Water Quality section of the website

"Timely decisions that adjust stock numbers to available feed are most important in demonstrating environmental viability in the Pastoral Zone."

– Alec Holm
Land, Water & Wool
Researcher

Managing Pastoral Country

Setting the scene

To those living outside Australia's rangelands, they may seem harsh and unforgiving country. To those who live and work there – many for generations – it is treasured land that rewards wise and careful management with valuable production and the maintenance of communities and culture.

The Pastoral Zone produces just over 12% of Australia's wool from 40% of the area grazed by sheep. Its 1,700 woolgrowers make up around 6% of the producer population.

In this country, managers have to be expert in assessing the condition of native pastures and how any season is unfolding, so timely decisions can be made about stocking levels.

The issues

One of the biggest challenges to the sustainable management of pastoral country is the variability of seasons. Managing dry spells is crucial to maintaining a profitable business and sustainable landscape as the foundation for future production.

Even though the region is typically dry, 'dry' doesn't equate with 'drought'. A real drought sometimes finds pastoralists as unprepared as producers in higher rainfall country. It can be a time of great stress. Finances may be grim, stock in poor condition and the well-loved landscape parched and thin.

Conversely, when seasons are good and pasture abundant, it is important to achieve high production from the property to offset the lean years – taking care to not overtax the vegetation and to leave it in a resilient condition for future dry times. It is equally important to maintain the ecosystems that it supports.

Today's pastoralist has a range of tools that help deal with these pressures in an informed manner with good data. Apart from investments in infrastructure such as fencing and water, decisions about stocking rates are the ones most likely to

affect production and the sustainable condition of the land. Land, Water & Wool concluded:

- Poor management of drought can ruin a business and result in virtually irreparable damage to the land, its productive capacity and its ability to maintain ecosystems.
- Drought, and the lead-up to it, is highly stressful and can be charged with inconclusive information, uncertainty and competing objectives.
- Good management needs good data – and good tools to help analyse it for informed decisions.

What LWW found

LWW has helped finetune some existing decision support tools used by pastoralists. It has developed some new ones to a stage of a 'working prototype' and has helped provide a much better understanding of how to maintain an important pasture species, Mitchell grass.

The collective experience has provided new insight into the types of tools that will be most useful to the pastoral industry.

Many pastoralists are finding that the first step in good management is to assess the capacity of the enterprise to withstand drought. This includes factors that are relatively stable (such as the amount and type of perennial feed on hand and the reliability of water) and more variable ones, (such as the age and distribution of stock and the numbers of grazing competitors such as rabbits, goats or kangaroos).

Good decision support systems include:

- Current and historic vegetation condition: This will often come from on-ground monitoring and past records and may be supplemented with satellite (remotely sensed) data.
- Seasonal weather information, especially cumulative rainfall: Historical records are very valuable and there may be forecasts (or seasonal risk assessments) available for the coming season. Using new software to convert this information into estimates of feed availability adds greatly to its value.
- Stock records: The number and distribution of stock (and, if possible, other herbivores) – especially in comparison with any 'average' rates – and their feed requirements.
- The ability to cross-reference all this information: For example, comparing past stock and rabbit numbers, vegetation cover and seasonal rainfall with that of the current (and forecast) season.

Monitoring feed availability (or the condition of the land) – including the stage of growth of key species –provides fundamental hard data for decision making. It reduces subjectivity and emotional inputs. Once feed reserves and condition have been assessed, the seasonal outlook can be factored in and major stocking (or trigger point) decisions made.

Mitchell grass is an example of a species where growth stage is important to stocking decisions. Allowing desirable grasses to seed has clear advantages but it is equally important to not overgraze the first flush of growth ('green-pick'). This early leaf growth provides the energy to build the plants' root system – and it is the roots that enable it to survive future dry spells.

Having historical records of feed availability helps managers compare the current season with past ones, especially when coupled with climate data and stocking information. Satellite imagery can be useful to show changes in vegetation over time; but it is not easy to convert into information useful to farm management. This usually requires a specialist, and the pastoral industry may not be of sufficient size to warrant a commercial service.

A rangeland monitoring site, Western Australia.

What can be done by woolgrowers

Pastoralists can find out more about monitoring and decision support tools that are available in different States.

- Pastoral Zone, Western Australia: Find out about 'Critical Decisions on Stocking Rates', assess the vulnerability of your property to drought and consider how to use seasonal and stocking rate information at critical times of the year (e.g. the date after which there is little chance of getting sufficient additional rain to produce green feed).
- Pastoral Zone, South Australia: Get in touch with the people at CSIRO who tested the use of satellite imagery and see if it's worth trying to make it more readily available.
- Pastoral Zone, NSW: Learn new ways to estimate a 'proper stocking rate' for comparison with current rates, and to do forward, seasonal projections by attending a grazing management update or Tactical Grazing short course. Tools that may be considered include the 'Glove Box Guide', 'Forage Square' and the DDH/100 mm index.
- Pastoral Zone, Queensland: Get involved with the Grazing Land Management program to learn new ways of conducting and applying the ABCD pasture condition guide for Mulga and Mitchell grass, and check out the new Mitchell grass management guidelines.

What can be done by NRM managers

State and regional natural resource management agencies may consider how to work with industry to help develop and promote decision-support tools for pastoralists, e.g. through training or education programs.

They could also consider supporting the manipulation and provision of information such as satellite imagery and climate data – and the options for cross-State collaboration to make service delivery more efficient.

CASE STUDY: Warwick family, SA

Getting a handle on just what feed resources are available is a challenge for any grazier, but particularly so for those in the vast spreads of the rangelands. That was the point of the Land, Water & Wool Managing Pastoral Country project, Wool Producers with Remote Control, which looked at how satellite imagery might aid grazing management.

David Warwick, a pastoralist from South Australia's Flinders Ranges, owns one of four properties in the region chosen for a trial of the technology. At first, David was unimpressed. "The imagery showed bare areas as grassed and grassed areas as scrub," he said.

However, with some 'ground-truthing' and tweaking, a truer picture began to emerge. And so did the tool's potential.

"It's got promise as a way to monitor land condition in the longer term," David said. "Conservation groups want to turn all this country into a national park. Pastoralists need to demonstrate that we're looking after the environment, and this might be one tool that we can use to do it."

He can also see imagery's potential as a drought management tool that would allow an accurate whole-of-property assessment of feed reserves on which to base decisions. For it to be useful in this situation, David believes it needs to be allied to good rainfall probability information. But, more work needs to be done before he can see a place for it in his day-to-day management.

"It has to be more cost-effective and more easily accessed by computer. If that was the case, I could see it as a great tool for triggering decisions."

Leader of the remote sensing project, Dr Gary Bastin, at CSIRO Sustainable Ecosystems in Alice Springs, agrees.

"What's now required is for us to put the technology in the hands of grazing families, and help them to develop it in a way that is most useful to them," Gary said. "They need to be comfortable that the imagery is telling them what we think it is telling them."

The next phase is to develop ways of delivering satellite imagery to pastoralists in a form they want to work with.

CASE STUDY: Alan and Krystyna Dick, Qld

Alan and Krystyna Dick bought 'Heywood', east of Cunnamulla in Queensland, a few years ago and have been in drought conditions almost ever since.

Eager to learn more about how to improve the property's grazing value, they attended an EdgeNetwork Grazing Land Management (GLM) course.

The course includes a focus on assessing pasture condition and classing it according to its stock carrying capacity. Depending on condition, land is classed as A, B, C or D – and Land, Water & Wool has helped refine that process.

"Attending the GLM workshop gave us a much better understanding of the soil and vegetation on our country," Alan said. "The mulga country is a good source of high protein feed for stock in times of drought and using it properly for fodder can be the difference between completely de-stocking or just decreasing numbers.

"By learning how to accurately monitor pasture growth, or the lack of it, we can adjust our stocking rates to prevent over-grazing and to enable pasture to re-seed. The ABCD method will be a good tool for setting stocking rates and monitoring pasture and soil condition in the future."

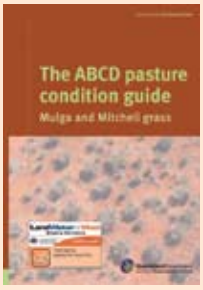
Alan and Krystyna have established monitoring sites on their property, where they regularly take photos and assess progress "to make sure our classing is on track". They keep in touch with others involved in the GLM course and are keen to hear how others get on with their new skills.

More information

- Insights – Case studies on how woolgrowers are successfully managing pastoral country for profit and sustainability

- Critical decisions on Stocking Rate – instruction and decision support manual

- ABCD Pasture Condition Guide for Mulga and Mitchell grass regions



- Mitchell Grass Recovery – Drought Information Kit

- Mulga as a feed source fact sheet

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Managing Pastoral Country section of the website

"A better understanding of our own rainfall history has caused us to modify our management system."

– Pastoral woolgrower

Managing Climate Variability

SOI (Southern Oscillation Index):

The SOI records fluctuations in the air pressure difference between Tahiti and Darwin, which is coupled with variations in ocean surface water temperature. It can be an indicator of El Nino weather conditions that bring drought to much of Australia.

Setting the scene

Climate variability has a big impact on both the returns and the environmental sustainability of grazing enterprises, no matter where they are in Australia. Having a feel for the season ahead can reduce that impact.

Land, Water & Wool research has found that improved climate predictions ('seasonal risk assessments' or SRAs) can help woolgrowers match livestock numbers to probable feed availability with greater confidence, especially in certain regions and at particular times of the year.

More woolgrowers are using climate information as part of normal enterprise management and planning. Some are using the information to develop 'trigger points' for important stocking decisions. Understanding the probability of various seasonal outcomes leads to better decisions and better returns – as well as helping maintain the condition of the country.

The LWW Climate Program set out to tackle these uncertainties and make seasonal risk assessment more reliable and useful for grazing enterprise management.

The issues

Climate risk is a major factor in a profitable and sustainable grazing enterprise, affecting pasture condition and decisions about stocking rates.

LWW has concentrated on the particular times of the year when SRAs can make a difference to management. For most sheep producers, that is winter-spring when, for example, an El Nino event (as shown by a low Southern Oscillation Index [SOI]) can seriously reduce the odds of getting useful rainfall and adequate pasture growth.

Until recently, woolgrowers in most parts of Australia made limited use of SRAs in their management decisions because of:

- lack of familiarity with using locally interpreted seasonal risk assessments;
- confusion between weather forecasts and seasonal risk assessments
- varying confidence in seasonal forecasts applying in different areas at different times of the year;
- the difficulty of converting SRAs into local information that can be used in decision making or farm management such as pasture growth estimates; and
- a limited capacity to forecast climate conditions beyond the current season.

What LWW found

- The SOI system provides the most easily interpreted and useful seasonal climate and pasture growth forecasts for most regions of Australia, except Western Australia.
- For many regions, seasonal risk assessments (SRAs) can be made with confidence, at certain times of the year, if the SOI is behaving in certain ways. These relationships vary in different regions but woolgrowers can now know when – and when not – to look to SRAs for their region.
- As well as using historical rainfall and pasture data, SRAs can be used to predict pasture growth in many regions at particular times of the year. This is more useful to farm planning than merely predicting rainfall, as it can be factored into decisions about stocking rates.
- This information enables woolgrowers to develop 'trigger points' for making key decisions about stocking.
- Using SRAs can add value to enterprise management decisions about feed availability and stock numbers.
- Many woolgrowers say using SRAs is giving them new insights into the variability of their local climate that rainfall records and human memory alone could not provide.
- Australia is now a world leader in applying SRAs to grazing.

At those times when seasonal climate outlooks are reliable, woolgrowers can combine this information with an understanding of the climatology and climate variability in their own region, and current pasture conditions, to assess climate risk for management decisions affected by climate, such as stocking rates.

The operational SOI phase system has a zero lead time, i.e. it provides an outlook at the end of each month for the coming three months. These forecasts are not sufficient to support some decisions that require an assessment of climate risk with greater lead time or for more than three months ahead.

Specific Climate program findings for major woolgrowing regions of Australia included:

NSW Pastoral Zone: The SOI phase system, with assessments based on the probability of exceeding normal pasture growth, is the best currently operational SRA system for western NSW. It is most effective for three-month outlook periods starting between June and September. At other times, trigger points for stocking decisions can be determined using historical pasture growth patterns in the WinGRASP model.

Tools for managing seasonal risk, based on climatological data and the findings from LWW, have been published in the booklet 'Betting on Rain: Managing seasonal risk in western NSW', available at: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/69614/betting-on-rain.pdf.

"I'm a slight pessimist. If a Seasonal Climate Forecast is talking a 50% chance of it being dry that would have much more effect on me than a 70-80% chance of being wet."

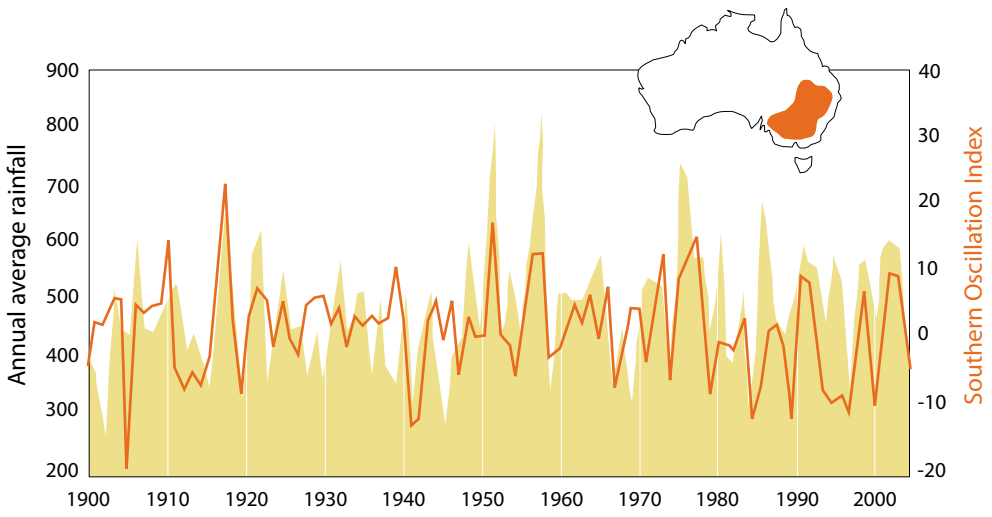
– Longreach grazier

"Using CRA (Climate Risk Assessment) makes you the bookie rather than the punter."

– Climate forecaster

"The climate website is a unique product and is just what I'm looking for."

– Queensland woolgrower



The El Nino Southern Oscillation phenomenon: rainfall in the Murray-Darling Basin over the past century correlates closely with changes in the SOI.

Managing Climate Variability continued

"Better managers don't over-stock to start with. They stay out of the drought for longer, which gives them a longer time to think about selling. We have noticed that if you have any grass on the ground at the end of the drought, the country recovers a lot faster – the response is a lot quicker to rainfall than coming from seed."

– Warrego grazier NSW

South Australian Pastoral Zone: The three-month SOI risk assessments for rainfall and pasture growth have considerable reliability between June and November in significant parts of the South Australian rangelands. This is explained in 'Climate Risk Seasonal Outlook, a pocket guide'.

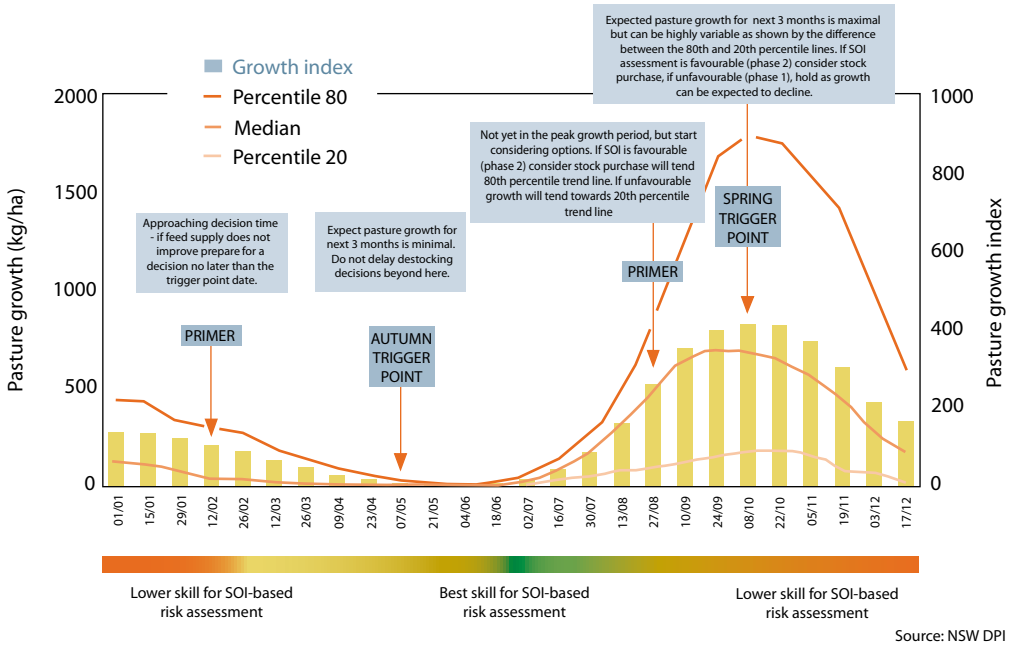
The guide shows graziers the times of the year that climate indicators can lead to a 70% or higher probability of increased or decreased rainfall or pasture growth, and the trigger points for property management decisions. At other times of the year they should use long-term climate records.

Queensland Pastoral Zone: In some parts of Queensland, SOI forecasts for the warm season (Nov-Mar) can be produced in September, giving Queensland graziers more time to make key management decisions. Tools to help woolgrowers make good decisions are increasingly reliable and available on the web and as a newsletter. A comparison of various seasonal forecasts in different grazing systems indicated that the use of seasonal forecasting could be worth 60 cents/ha – or $17,000 to a typical 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.

Western Australian Pastoral Zone: The SOI has limited application in Western Australia, but climate risk information is part of the box of decision tools that can be used by station managers to set appropriate stocking rates, adjust sheep numbers as seasonal conditions unfold and minimise drought losses, based on their own judgement and historical climate information.

Wheat-Sheep and High Rainfall Zones: Seasonal climate forecasting now works fairly well for most of Australia's High Rainfall and Wheat-Sheep Zones at certain times of the year. Woolgrowers can use LWW's Climate Drafting Gate to see how this applies to their own area and other tools are also being developed based on the success of those for the rangelands.

In South Australia, a 'Climate Risk Seasonal Outlook' guide has been produced for primary producers in the cropping regions and workshops are available to show how to interpret and apply its information.



Source: NSW DPI

Example of the use of seasonal risk assessment to develop trigger points for important stocking decisions.

What can be done by woolgrowers

- Find out how seasonal risk assessment (SRA) works and how it differs from weather forecasts.
- Explore the reliability of seasonal forecasts and pasture growth predictions in your area.
- Use SRA or historical records of climate, pasture growth and rainfall to develop trigger points for enterprise decisions, such as when to sell stock.
- Explore the use of seasonal climate forecasting for planning stocking rates, pasture and fodder conservation and reducing enterprise risk.

What can be done by NRM managers

The increasing reliability and usefulness of seasonal risk assessments is also helpful to natural resource managers for planning longer-term catchment management strategies. They create an opportunity for landholders and natural resource managers to work more closely together and jointly develop the tools needed for sustainable and profitable use of landscapes under an increasingly variable climate.

Training may be needed for woolgrowers before they are confident in using the tools developed through Land, Water & Wool. Resource management agencies may want to support programs that promote and deliver these education services.

"Some people think that to be financial you have to run thousands and thousands (of sheep), but we have made more money from running less stock, and we are sort of the last ones to get into a drought."

– Warrego grazier, NSW

CASE STUDY: Robert & Kathryn Mitchell, WA

Robert and Kathryn Mitchell run a 139,100 ha, Merino-based enterprise on Barnong Station, in the lower region of the Gascoyne Murchison, Western Australia.

The station's carrying capacity is 9,814 DSE. However, over the past 10 years they have averaged 5,000 DSE. The station is made up of granitic hills, mulga washplains and, in the lower areas, saltbush pastures. The Mitchells are active members of the Yalgoo Climate Bestprac group.

"One thing that we learnt was that there was very little forecasting skill for our region and hence we recognised and accepted that we should not hold too much faith in anything that is forecasted, whether it is positive or negative," Kathryn said.

"We did learn how to set our key and critical dates, and they have been useful in our feed budgeting. The idea of key and critical dates was not brand new for us, as we did sort of know when we should be looking to make a decision about what we should be doing with our stock.

"However, defining the two specific dates has clarified our thinking and given us a point to work towards. It 'forces' us to make a decision and not procrastinate hoping for additional falls in the next week or the week after.

"So, in many ways, knowing our key and critical dates has given some additional structure to our planning and decisions. We also learnt that the chance of getting anything substantial during the summer was fairly small and highly variable, and hence it should rarely be included in long-term planning."

Robert says the region is very 'hit and miss'.

"I learnt that because there were no good predictors of future seasonal conditions, we have to fall back on historical records and averages," he said.

"I learnt that if you have not got the rain then you cannot afford to sit around and wait. You have to make decisions based on the feed you have now and how long that is going to have to last you until the chance of getting good rain is more than 80% again. The overall lesson I picked up was that you have to be diligent in what you do and be decisive."

Key date:

Date from which there is more than 80% chance of getting the amount of rainfall required for a season break.

Critical date:

The end of the growing season.

CASE STUDY: James Milson, Western Queensland

Longreach sheep and cattle producer James Milson, 'Somerset', says relevant, timely and accurate forecasting for rainfall and pasture growth is an invaluable tool in planning stock management strategies and sales.

James monitors seasonal risk assessment systems such as the SOI index and 40-day wave to help predict seasonal outcomes and believes that medium-term, region-specific rainfall forecasts which factor in the effect on pastures will be a major step forward for industry.

"If we are told in May or June that it's probable the summer will be dry, we can make management decisions in areas like weaning, stocking rate and stock sales accordingly," he said. "If we can get our predictions right 70% of the time, it will make a big difference to profitability.

"More often than not, woolgrowers make most of their money in two or three years out of 10. If we can capitalise on those years and minimise losses in the intervening years, long-term profitability will jump."

CASE STUDY: Tony Thompson, Brewarrina, NSW

It is the power of the new seasonal risk assessments to predict pasture growth some months ahead that interests woolgrowers like Tony Thompson, who has 14,100 ha at Bourke and Brewarrina, NSW.

Drought reduced his flock to a few hundred head.

"But, I believe that if I am able to maximise use of the pasture growth flushes that periodically occur in the region, my target stocking rate of 7,000 DSE is well within reach," Tony said.

Tony helped LWW scientists refine the AussieGRASS model for the landscapes of north-western NSW by providing calibrated maps of different land types, monitoring weather stations and soil moisture probes on his property.

At the same time, he learned more about the Southern Oscillation Index (SOI), which climatologists say from June through to August provides a strong indication of the coming season in western NSW.

"If it gets to the time of the year when the SOI is able to give a good pointer to the coming season, and the grass model is predicting good growth, we'd be encouraged to stock more aggressively," Tony said.

"But if all the indications were negative, we might be persuaded to de-stock more aggressively."

More information

- Betting on Rain –Managing seasonal risk in Western NSW

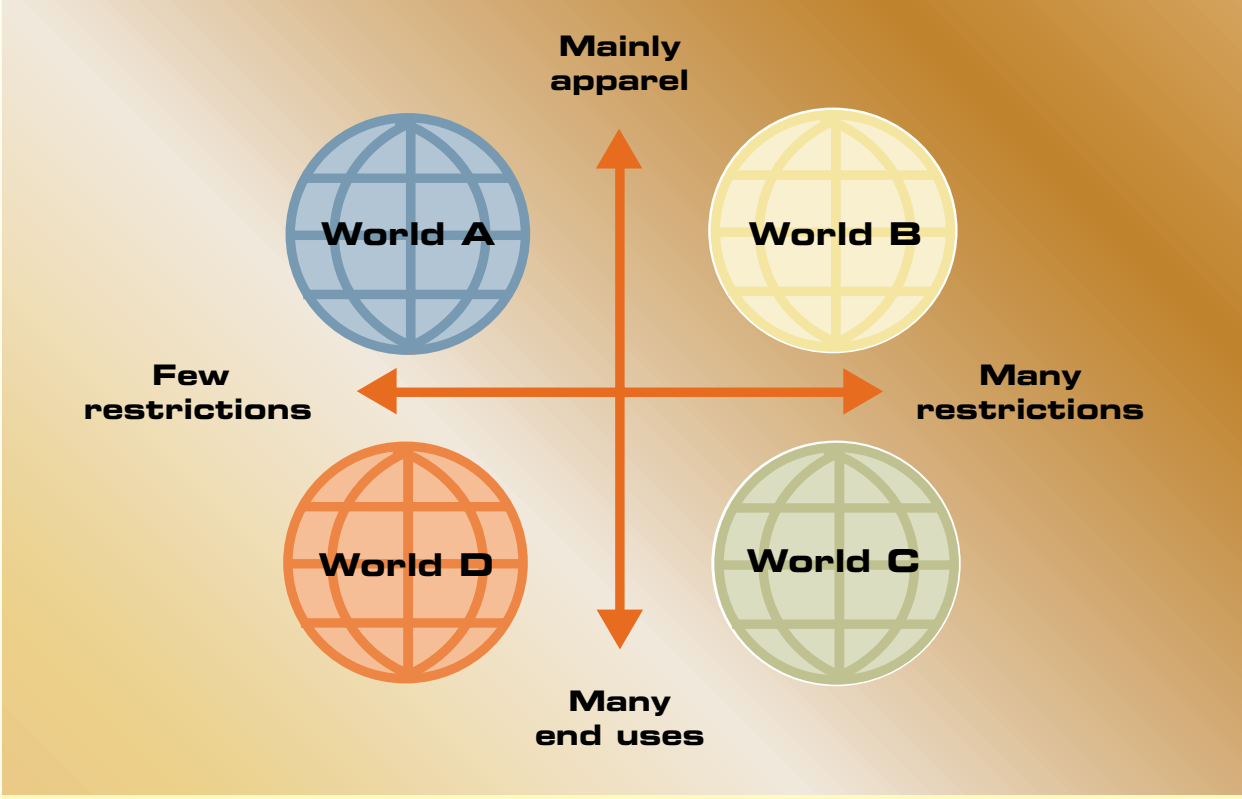
- Climate Risk Seasonal Outlook Pocket Guide for wool producers in the Pastoral Rangelands of SA

- Conversations about Climate: seasonal variability and graziers' decisions in the eastern rangelands

- QLD LWW Climate Website: http://www2.dpi.qld.gov.au/climate/14793.html

- 'Drafting Gate' – on-line information and decision-support tool

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Managing Climate Variability section of the website



Future Woolscapes developed four future scenarios based on different end uses for wool and different levels of regulation.

Future Woolscapes

"Where observation is concerned, chance favours only the prepared mind."

– Louis Pasteur

Setting the scene

The wool industry needs to think hard about its future. Through Future Woolscapes, Land, Water & Wool asked leading growers and technical experts to explore how the world and the wool industry might evolve in the coming 25 years and the main factors that will influence it.

Technical papers were commissioned in areas such as technology trends, fibre markets, consumer demand, climate change and on-farm management. Links to these reports can be found in the Future Woolscapes section of www.landwaterwool.gov.au. Panels then created four future scenarios for the industry, based on varying end uses for wool and differing levels of freedom in society and markets – on whether regulation in society (and wool production) increases or decreases, and whether wool has one main end use (apparel) or develops new ones.

These four scenarios are not predictions of what *will* happen. They are scenarios for what *might* happen – or what *could* happen if we wished it to. They are designed to inform our thinking, stimulate ideas and help the industry and individual woolgrowers prepare for what the future may hold, in wool production and in the marketing and social context in which it operates.

The issues

- What might the world look like in 20 or 30 years ?
- How will technology, social change, environmental policy and global politics affect the way we live and work?
- What effect will these possible changes have on rural Australia and, specifically, on the wool industry?
- What should the wool industry be thinking about, or doing, today to prepare for these possible situations?

What LWW found

The most important conclusions were:

- Over the coming 25 years the wool industry can expect rising cost pressures and far greater competition from other fibres.
- Specialist woolgrowers will need to do better than the average 2% productivity gain/year of recent decades.
- Producers face the likelihood of increasing scrutiny from governments, consumers and society on how they operate their enterprise.
- Harnessing new and existing technologies to create new production systems and new products will be paramount.
- Some relocation of wool production is likely due to climate change, economic pressures and competition for reliable rainfall country from cropping.

Industry

- The wool industry would benefit from a clear vision for the future. It would help it overcome the challenges of politics and negative perceptions (internal and external).
- There is likely to be further agricultural specialisation as farmers seek to increase productivity and better match land capability to production. This may involve significant relocation of wool production into less arable areas.
- Wool and sheep meat production may diverge, as woolgrowers specialise.
- The scale of the enterprise and its ownership structure may alter significantly. Economies of scale and capital investment will need to increase.
- The 'new age farmer' will require a different set of skills from today's producer – more business-orientation and less farm labour.
- Due to ongoing pressure from competing fibres and other agricultural industries, incremental gain across the industry may not be sufficient to avoid significant restructuring.

Farm productivity

- Human labour will become scarce. The woolgrower population will continue to age (from an average of 55 to 60 years). There will be a continuing need for labour saving technology.
- The real price of wool could continue to fall by around 2% per year. Profitability must come from brainpower, not brawn. Productivity and quality improvements will become paramount.
- Harnessing new technologies will be vital to overcome current production and processing impediments (parasites, wool harvesting, sheep health and bio-security, genetic progress, cost and time of processing, etc).
- Emerging themes in sheep management include individual measurement and monitoring, aligning nutrition with production and remote management.

Managing natural resources

- Sustainable resource use is likely to be increasingly important – demonstrating 'zero impact' on the environment may be needed. This issue may be further affected by climate change.
- Sheep and wool become an important element in sustainable and profitable land use. This will need to be demonstrated to the market and to farmers.

"When thinking about the future, it is not about being right, but about being ready."

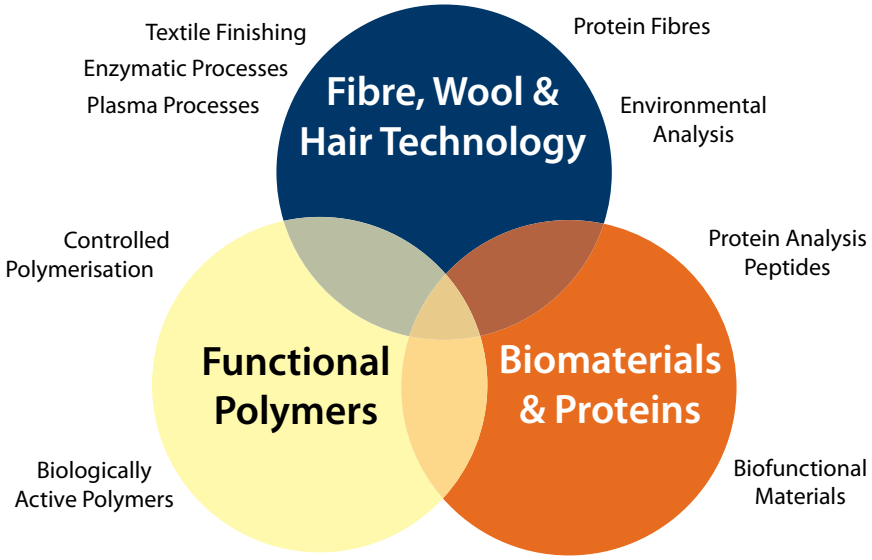
– Bronwynne Jones
LookOut Futuring Services

Fibre processing and markets

- Synthetic fibre production will grow unabated (from 57 to 107 million tonnes, mainly polyester). Price competition will be fierce and synthetic product development will continue to mimic the properties of natural fibres.
- In an environmentally conscious world, wool processing – especially scouring – will be closely scrutinised and may prove a limiting factor for the industry.
- The welfare of both animals and people is likely to be of future importance to wool's market image.
- The ability to track fibre and demonstrate the degree of sustainability and welfare in its production will probably be needed in the coming 25 years.
- Wool's lower productivity and higher cost of processing compared to other fibres may limit its ability to penetrate increasingly demanding markets. The location of processing centres may shift.
- China's market dominance and whether it will remain the wool processing centre of the world is a key issue.

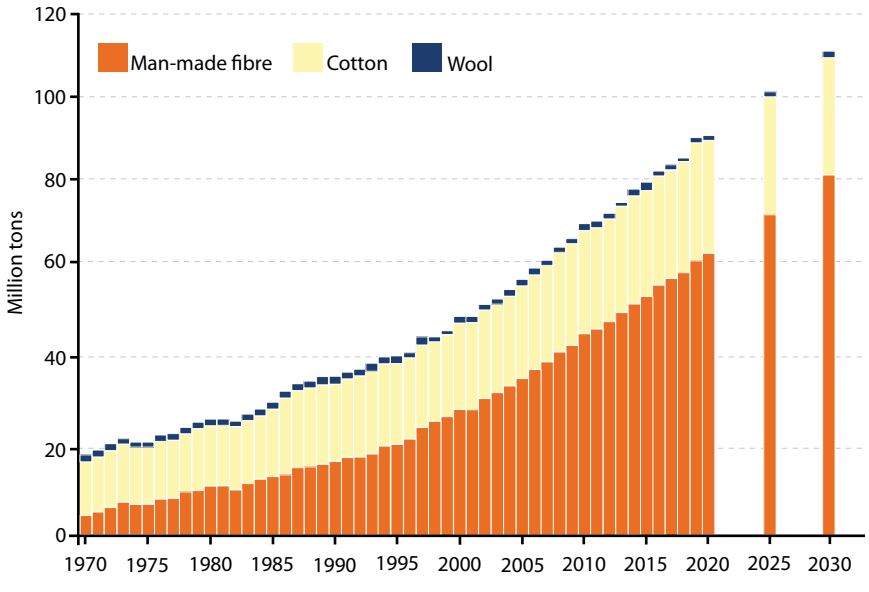
Consumers

- Consumer markets will change. There will be eight billion people in the world, most with instant access to information. Consumers may be far more 'environmentally aware' and scrutinise the 'footprint' of the entire pipeline of any product they look to purchase. They may be far more focused on value, more East-oriented than West, very health conscious, and the comfort and fit of apparel will be more important.
- To meet the needs of the future consumer, investment in new technologies, products and targeted marketing programs are important to provide value, individuality, immediacy, wellbeing and confidence, comfort, security and environmental assurance. Development and adoption of new technologies to meet these challenges will be vital.



Source: Aachen University, Germany, 2004

A Meeting of Many Sciences: How will science create new fibre and product development opportunities?



Source: PCI Fibres

Fibre Production 2030: Synthetic fibre production is predicted to grow strongly.

"New technology is often seen as a threat rather than an opportunity."

– David Sackett
Holmes Sackett & Associates

"It appears to be essential to have a more open and well-informed dialogue between scientists, opinion leaders, educators and the public, to develop an educational program and to focus on genetically modified products that are commercially and socially beneficial."

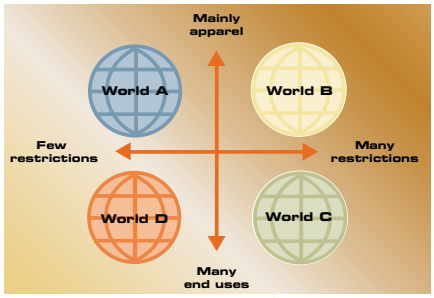
– Prof. Herman Raadsma, University of Sydney

"Consumer demand is for product and at most for fabric, rather than for fibre."

– PCI Fibres

"Consumers will focus their purchasing power on the effect of wool production on the environment, animal welfare, and the community. "

– MacKinnon report



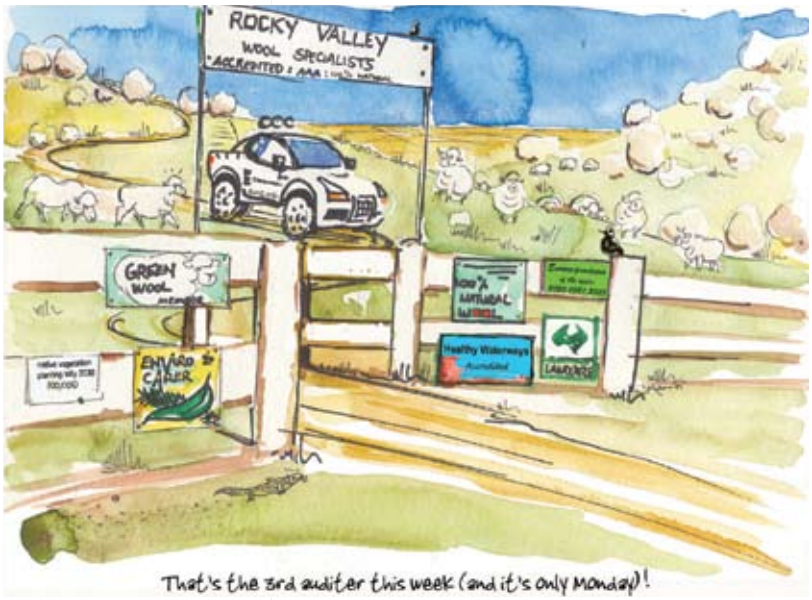
In the year 2030

I'll finish the virtual fencing after lunch Russell!

World A. The squeeze continues

In this scenario the consumer is king, health and environment are key issues and government intervention is low.

- Sheep are 'easy-care'.
- Like-minded woolgrowers exploit environmental accreditation and consumer health consciousness as part of an industry marketing strategy.
- Growers are quick to adopt advanced technologies such as virtual fencing and new reproductive techniques.
- Specialist woolgrowers are still profitable.
- Woolgrowing almost disappears from pastoral areas.



That's the 3rd auditer this week (and it's only Monday)!

World B. Fashion police rule

There are strict rules on the use of land, water and vegetation.

- Agriculture is compelled by consumer and public demand to operate under environmental accreditation.
- The sheep industry polarises into wool and lamb specialists, with the wool clip being far smaller than it is today.
- Fine wool is marketed as a specialist 'green' product aimed at wealthy consumers and operates mainly in non-arable country due to surging world demand for food.
- Pastoral industry specialises in lamb production.
- Wool industry avoids genetic modification (GM) technologies to maintain its 'green' credentials.

World C. Accredited crimp is king

In a hi-tech, high-regulation world, wool diversifies into many end products.

- Corporate farms replace family spreads.
- Growers need a licence to operate and face regular audits.
- Research is opening up large new markets, especially medical.
- All scouring now takes place on-farm.
- Elite woolgrowers use flock analysis and objective measurement to meet licence requirements.
- 20% of production is shedded.
- The word 'wool' can only be applied to fibre of 18 micron and finer and it is marketed as a new product called SuperExcel.
- The origin of wool is trackable and consumers can identify the property from the garment label.
- Wool byproducts are now used in cosmetics, sun creams and medications.

World D. Wool ain't wool

In this scenario, government intervention in industry is low and wool has developed many novel end uses.

- A united, aggressive industry develops a whole-of-value-chain approach and a global chain of ECO stores to market its certified products.
- Processing is done in eco-parks close to major markets.
- Grower focus is on easy-care sheep and strict specification to meet market demands.
- Sheep and wool products now include cosmetics, pharmaceuticals, apparel, industrial

Future Woolscapes continued

What can be done by woolgrowers

Consider each of the scenarios. Some predictions are common to all of them and appear likely to happen. Ask questions such as:

- Is my enterprise ready for increased scrutiny of its environmental and animal welfare management?
- Is my enterprise ready to take advantage of existing and new technologies in order to remain cost-competitive against rapid technological advances expected in synthetic fibres?
- Am I geared to adopt labour-saving technologies?
- What are the technologies that will most benefit my enterprise in terms of both economic return and sustainability?
- How am I going to adjust the enterprise to climate change?
- Am I going to be a wool specialist, producing an elite product in high demand, or a generalist producing wool as one of several agricultural products?
- Are new markets opening up for wool which I need to explore?
- Can the industry develop an international marketing approach tuned to 21st century consumer demand?
- How can I help my industry develop a clearer vision and plan for the future?

What can be done by NRM managers

Future Woolscapes has generated four alternative scenarios of the future and a series of commissioned papers. These resources would be ideal for use with industry groups to explore their local implications.

The insights gained from Future Woolscapes are being applied by Australian Wool Innovation and other industry organisations in their forward planning and could similarly be used by regional and State resource management bodies.

CASE STUDY: James & Belinda Davis, WA

– Winners of the wool industry's McLachlan Medal for 2030

"There are three secrets to our success in winning this award.

- We have always taken the attitude that we want to adopt new technology as fast as it's available and commercially proven – and we've done that working with the industry's publicly listed R&D corporation.
- We have worked very hard at getting information about what is going on in the SuperExcel fibre market around the world and we are able to respond quickly to the requirements of those markets.
- We use human capital – the knowledge and experience of a lot of clever people. We employ a number of specialists, whose sole business is contracting to the SuperExcel industry, and we bring them in as needed.

"We're an individual family company and we're hands-on operators. Over the years we've obtained all the necessary qualifications and licences needed to run any primary production enterprise – animal welfare, sustainable environment, staff safety, etc. Management is highly regulated and we are audited once a year, but thankfully always get a big tick.

"We prefer to put our efforts into our stock, so our land is now on a 15-year lease from a large financial trust which specialises in the wool industry, using superannuation funds from city people.

"In the old days, the industry was down and few saw a future. But enough people were dedicated to wool fibre. A core group got together and redefined what was produced. Anything 18 micron and finer was designated as wool (called SuperExcel for marketing reasons) and the rest went into the multi-fibre commodity market to be blended with all kinds of fibre. Apparel is still the number one outlet but there are a whole lot of other uses – in medicine, in the environment, in air filters.

"Genetic engineering is now widely accepted and we use it extensively to help in our production. We also use an intelligent management device implanted in every lamb that gives us its genetic profile, its health status, how much SuperExcel it has produced that day, the micron, weight and so on. Our customers also get this information.

"We've been chemical-free in pasture and fodder production for years, but have been using microbiological stimulants to improve pasture growth.

"One of our exciting developments has been installing our own on-farm scour to ensure wool is totally free of all contaminants by the time it reaches the customer. It's completely environmentally friendly.

"Another is our transgenic lambs which can produce a SuperExcel product on demand in terms of micron and strength, by triggering with special feed supplements.

"Our cost of production is now down to $16 a kilogram and our free-range grazed sheep cut around 12 kg/head of SuperExcel for which we get about $20/kg on our long-term contract with Nanjing Wool. The margin is what's important.

"Travelling round the world, we get a real buzz seeing how designers from Asia and Africa are using SuperExcel, bringing out fantastic colours and new fashions."

More information

- What might the world and the wool industry look like in 2030?

- Future Woolscapes - Commissioned Research Papers

Four Futures Scenarios and Commissioned Research Papers are available at the Futures section of the Land, Water & Wool website at www.landwaterwool.gov.au/research.asp?section=16

For more products, search the on-line Product Directory at www.landwaterwool.gov.au or visit the Future Woolscapes section of the website

Appendix 1: About Land, Water & Wool

Land, Water & Wool has been a $19.89 million investment by Australian Wool Innovation, managed by Land & Water Australia.

The mission of Land, Water & Wool is to: "Provide the Australian wool industry with the knowledge, tools and enthusiasm to minimise its environmental impact while enhancing productivity, and to enable it to position itself as the world's most sustainable woolgrower of premium natural wool".

Its aims have been to:

- fully understand woolgrower's needs and aspirations in relation to the management of natural resources;
- provide the motivation, capability and commercially practical tools for woolgrowers to adopt innovations to improve both productivity and reduce the impact of wool production practices on key environmental issues;
- identify key gaps in our knowledge base and implement scientifically sound and commercially applicable research programs to address them; and
- establish long-lasting networks of like-minded woolgrowers and demonstrate outcomes in commercial environments by working directly with them.

Land and Water Australia have managed all administrative and operational aspects via:

- Program Manager (Anwen Lovett, then Mike Wagg);
- Project Officer (Catherine Viljoen, then Andrew Lawson); and
- Program Co-ordinator (Russell Pattinson, Miracle Dog Pty Ltd).

Land, Water & Wool has involved six main sub-programs and a suite of 'delivery' projects:

- Sustainable Grazing on Saline Lands – managed by Warren Mason (RPC Solutions);
- Native Vegetation & Biodiversity – managed by Jann Williams (NRM Insights);
- Rivers & Water Quality – managed by Siwan Lovett and Phil Price (Lovett-Clarke Consulting and Mackellar Consulting Group);
- Managing Pastoral Country – managed by Barry White, Rohan Nelson and Andrew Lawson (AGEC Consulting and Land & Water Australia);
- Managing Climate Variability – managed by Barry White and Mike Wagg (AGEC Consulting and Land & Water Australia);
- Future Woolscapes – managed by Russell Pattinson (Miracle Dog); and
- Delivery – managed by Peter Hanrahan (Peter Hanrahan Consulting).

Communication services have been overseen by Kim Mitchell and Jane Thomas (Currie Communications), Fleur Flannery and Sandy Brogan (Land & Water Australia).

The program has received considerable guidance from the Sustainable Wool Advisory Group and from AWI personnel Lu Hogan and Renelle Jeffrey.

SWAG Members	
Current	Former
Tom Dunbabin (Chair)	Will Crozier (Chair)
James Street	Peter Day
Michael Lloyd	Andrew Nicolson
Richard Weatherly	Wal Merriman
Mary Goodacre	Marcus Arthur
Andrew Southwell	

For information on the program and its operations, see 'Land, Water & Wool: program management report'.

Appendix 2: Photographers

The photographs in this report have been provided by a wide range of contributors. The project team is grateful for their assistance.

Pages 7-9	Kellie Penfold
Page 8	Currie Communications
Page 10	AWI
Page 11	AWI
Page 13	Matt Appleby
Page 13	Kim Mitchell/Currie Communications
Page 14	Krystyna Dick
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Page 19	Kylie Nicholls
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Page 22	Kerry Bridle
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Page 33	Biz & Lindsay Nicolson
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