

**Future Woolsapes
Land and Animal Management
2029**

**A report for Land and Water Australia and
Australian Wool Innovation Ltd**

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Table of Contents

1. A POSSIBLE SCENARIO FOR WOOL PRODUCTION IN THE YEAR 2029	3
1.1. All Zones in 2029	3
1.2. High rainfall zone in 2029	3
1.3. Wheat/sheep zone in 2029	3
1.4. Pastoral zone in 2029	4
2. RESEARCH IMPERATIVES FOR THE WOOL INDUSTRY	4
2.1. Short term (by 2010)	4
2.2. Medium term (outcomes by 2015)	5
3. CURRENT WOOL PRODUCTION DEMOGRAPHICS	6
4. COMPETITION FOR LAND WILL COME FROM MANY DIRECTIONS	6
4.1. Competing land use in agriculture	6
4.2. The urbanisation of Australia will continue	6
4.3. Water	8
4.4. Technology improvements in other industries	8
4.5. Expanding international demand for other agricultural products	9
4.6. Increasing national demand for land preservation	10
5. RURAL LAND OWNERSHIP AND MANAGEMENT	10
6. TECHNOLOGY IMPROVEMENTS IN THE WOOL INDUSTRY	11
6.1. The Genomics revolution	12
6.2. Information technology, electronics and communications	13
7. ANIMAL WELFARE AND THE WOOL INDUSTRY	14
8. ENVIRONMENTAL ISSUES IN WOOL PRODUCTION	15
8.1. Current causes of land degradation	16
8.1.1. Salinity	16
8.1.2. Soil Acidity	17
8.1.3. Weed management	17
8.2. Conclusion – Animal welfare and sustainability issues	18
9. PEOPLE ISSUES	18
9.1. Occupational health and safety	18
10. ANIMAL HEALTH	19
11. OTHER	19
11.1. Societal belief systems	19
11.2. Climate change	20
11.3. The great unknown	20
12. CONCLUSION	20

1. A Possible scenario for wool production in the year 2029

1.1. All Zones in 2029

- Fewer specialist sheep farmers.
- Larger farms or farm management units.
- Much higher levels of monitoring and auditing of the environment and resources than currently seen. Threshold indicators of site degradation will be required for various ecosystems so that managers can monitor and respond appropriately. This will occur as a result of expectations of both overseas consumers and the Australian Community.
- Much higher level of monitoring and auditing of animal welfare issues than currently exists.
- Added governmental powers relating to the environment, the resources and animal welfare.
- Increased costs associated with Occupational Health and Safety, environment and resource monitoring will need to be made up by larger increases in efficiencies elsewhere.
- Cost-effective control of disease, effective genetic improvement programs, efficient reproductive performance, and efficient flock and herd structure will be increasingly required to secure the financial stability of grazing systems into the future.
- A need for new technology to reduce the cost of production throughout the wool production pipeline.
- The development of supply chain management systems, to ensure product quality standards are met by raw wool producers.

1.2. High rainfall zone in 2029

- An increase in the number of mixed farming enterprises, with better soil types and topography tending towards horticulture, cropping, and other high value end usages rather than grazing management.
- Fewer specialist 'sheep-only' farms and those tending to occur on difficult topography or soil types
- Routine applications of lime, careful monitoring of salinity in much of the region.
- Substantially smaller area allocated to sheep.
- On land occupied by sheep, higher average stocking rates than those currently seen in this region
- A large proportion of properties owned by urban investors with little knowledge or background in farming.
- More leasing with competition from other industries.
- High value areas of farms leased for higher value pursuits.

1.3. Wheat/sheep zone in 2029

- This will remain as the predominant sheep grazing area in Australia and could increase its sheep population. There will be improved land use assessment, which will lead to some areas moving away from cropping and into perennial pasture production. Also, depending on demand for grains, it is possible the current grain

crop can be produced on less land. The future wool production from this region will largely be determined by changes in the grain industry.

- There will be a smaller number of larger farms within the region. Grains Research and Development Corporation (GRDC) predicts that by 2025 the number of grain farmers will reduce from the current 40,000 to below 30,000¹.
- There will be high volatility in sheep numbers depending upon relative commodity prices between grains and sheep.
- Wool quality issues associated with mixed farming will need to be addressed.

1.4. Pastoral zone in 2029

- The marginal sheep growing regions of the pastoral zone will be under considerable pressure to survive. Water use may be a limiting factor, with some areas prohibited from using Great Artesian Basin water. Landholders will be under pressure to install equipment to improve water efficiency, which will come at a high capital cost.
- Some of the arid regions of Australia will be running at stocking rates 30% less than those seen now. Consolidation of farms in these regions is inevitable. Some of this will come as a result of community pressure to maintain and preserve natural vegetation.
- Scale of production will be important, with an amalgamation of properties, as the required technological advances will need economy of scale to be profitable.
- Grazing strategies and flexibility in grazing management will be a key to long-term sustainable use of the pastoral zone by the wool industry
- Because of the low potential to intensify production in much of arid and semi-arid regions, technologies that increase productivity per head will be particularly appropriate. Each animal in the herd or flock must contribute to the total.

2. Research imperatives for the wool industry

With our review of the factors that we believe will affect land and animal management for wool production in 2029, we believe that the following developments should be considered as outcomes for research and development within the wool industry.

2.1. Short term (by 2010)

- **Mulesing to go:** The development of alternatives to mulesing or methods to minimise breech (and all blowfly) strike in sheep.
- **Reduce sheep mortality:** Easy, cost-effective systems to reduce sheep mortality rates, especially in young sheep. This could include detailing current knowledge of the causes and production of extension material to alert producers to the risks causing high mortality rates.
- **Training** high-performance farm managers, who have the skills listed on page 18 that will be required to manage the farm of 2029.
- **Wool harvesting:** Investigate alternatives with better OH&S outcomes than the current methods of wool harvesting.
- **Biosecurity:** Encourage systems to maintain and enhance Biosecurity at a farm, regional, and national level.

¹ GRDC, 2003, Towards a single vision for the Australian Grains Industry, 2005-2025

- **Increased communication** with future decision makers, through education in schools about the positive aspects of farming on the environment, and the role farmer's play in providing food and fibre.
- **Positive stories** about farm profitability are advertised to urban investors, along with methods to achieve this.
- **Prepare extension material** for land owners that do not expect to operate sheep farms and for 'mixed' farms running sheep.
- **Develop standard formats for leasing land**
- **Investigate and develop threshold indicators of site degradation** for various ecosystems.
- **Investigate, in conjunction with the GRDC,** sustainable grazing and cropping systems.

2.2. *Medium term (outcomes by 2015)*

- **Reduce the effects of "European-style" agriculture:** Engage in research to minimise the effects of dryland salinity, soil acidity, soil erosion and weeds on the agricultural land.
- **Wool as a by-product of a diversified farm:** Consider systems to integrate wool production more effectively into the wheat-sheep cropping areas.
- **Genomics** – encourage collaboration between practical scientists, farmers and molecular geneticists to achieve practical outcomes for the industry.
- **Water in pastoral areas** – develop low-cost systems for efficient water use in the pastoral zone.
- **Auditing systems** for environmental and animal welfare.
- Development of effective **supply-chain management** strategies for wool production.
- **Effective grazing management strategies** particularly for the pastoral zone that meet society's environmental concerns.
- **Sheep handling systems** –that are safe for the operator and sheep and can handle large numbers of animals quickly.
- **Development of decision support tools** – to allow farm managers to integrate all the monitoring and auditing information they will be required to collect.

2.3. *Long term (outcomes by 2029)*

- **Genomics** has identified and is producing products that enhance farm profitability and have widespread public acceptance.

3. Current wool production demographics

In 2001/02, there were estimated to be 39,000 wool producers, grazing nearly 80m Ha and producing 525m kg wool. The average specialist wool producer (40% all wool producers) produced 16.7T wool on 3200Ha. Mixed enterprise producers (60% all wool producers) produced 12T wool on 1470Ha². Around 33% of the sheep flock is managed in the high rainfall zone, 55% in the wheat-sheep zone and only 12% is managed in the pastoral zone³.

4. Competition for land will come from many directions

4.1. Competing land use in agriculture

Currently, sheep production is a dominant industry, by land area, in Australia. It is inevitable that in the 25 years to 2029 there will be increasing pressure for alternate use of the land currently used to graze sheep. It is likely that in the intervening period, in some regions wool production will be considered a relatively low value use of land, both socially and economically, when compared with the competing alternatives. Consequently, we expect that the area devoted to wool production, and particularly specialist wool production, is likely to significantly decline by the year 2029. This decline will not be uniform. We expect it will be most profound in the high rainfall zone and least profound in the wheat/sheep zone of Australia.

The drivers of this change will include:

- a) Increasing population and urbanisation within Australia;
- b) Competition for water use within Australia;
- c) Technology improvement in other industries;
- d) Expanding international demand for other agricultural products such as meat, milk, vegetables and timber; and
- e) Increasing national demand for preservation of areas of land with natural, aesthetic cultural, and heritage value.

4.2. The urbanisation of Australia will continue

It is possible that Australia's population will increase to 24m by 2029⁴. This is equivalent to creating one extra city the size of Sydney with its concomitant demands on resources, infrastructure & services. Although increased density of Australia's major cities will absorb some of this increase, urbanisation of existing rural landscape will continue to occur. On existing trends, Australian cities and large regional centres will continue to grow at more than twice the rate of small centres and rural towns.

The continued population growth and urbanisation of Australia will impact on wool production in a number of ways:

² Barrett, D. (2003) Australian wool industry. ABARE Research Report 03.5

³ *ibid*

⁴ Newton, PW, (2001) Australia State of the Environment Report 2001: Human Settlements Theme <http://www.deh.gov.au/soe/2001/settlements/summary.html#futurepopulation>

1. Domestic consumption of food will increase, as will the area of land dedicated to produce it. Some of this land is currently used for wool production.
2. Some of the rural regions around major towns will be urbanised by the year 2029. Urbanisation of rural landscapes is essentially an irreversible process. Although the proportion of land that will be urbanised will be small compared to the size of the continent, it causes a cascade effect that ripples through the entire rural landscape. Horticulture and other high value agricultural pursuits that typically surround large regional centres are displaced and then subsequently displace existing lower value agricultural enterprises, such as grazing enterprises (eg dairy) when they shift to new locations.
3. This inexorable urbanisation will reduce agriculture's contribution to GDP. Environmental issues associated with land used by agriculture will become the main social issue rather than economic arguments about land use. Since a large proportion of Australia's land area will still be used for grazing sheep, this will present an enormous challenge to sheep managers to ensure that the resource base is preserved for future generations.
4. The majority of decision-makers in the year 2029 are currently attending urban Australian primary and secondary schools and have little contact with agriculture. According to a 2001 National survey, conducted by the Kondinin Group in Western Australia, only 12% of year 5 students indicated that they had ever visited a farm⁵. Only 46% of children consider farmers as very important to their daily lives, just over half the children believed the food they ate came from a farm, and most tellingly, almost 1 in 3 of urban children surveyed were completely unsure about why pesticides were used in farming. At the same time, Australian school curricula includes education about the environment and the effects of farming and agriculture on environmental damage.
5. Increased urbanisation of Australia will have, and is already having, another possibly more profound effect on Australian agriculture. About 1/3 of all rural properties that have been sold during the last three years in south-east Australia have been purchased by people living in cities who have little or no expertise in the management of agricultural enterprises. Rural properties are purchased by city interests for a variety of reasons. Lifestyle and holiday expectations may influence property use as much as expectations of financial gain – either immediate or in the future.

By the year 2029, it is probable that there will be a substantial dislocation between land ownership and management expertise in sheep enterprises, particularly within the high rainfall zones of Australia. This creates both a series of opportunities for the wool industry and a series of potential problems. Farm owners will not have the skill base to make decisions about the factors influencing profit on a farm. This requires a group of trained farm managers, who are not farm owners, to manage these farms. Profitability on these farms must be higher, in order to pay the costs of well-educated farm managers. New entrants to the industry provide the opportunity for new ideas and ways of "doing business". That farming can be profitable must be advertised to these people.

⁵ <http://www.kondinin.com.au/WorkbootSeries/ag2classroom.asp>

4.3. Water

Of the more than 23,000 gigalitres of water currently used in Australia every year, 70% is used for irrigation⁶. Irrigated agriculture is highly valuable to Australia in both economic and social terms. While it currently occupies only 4% of agricultural land in Australia, irrigated land accounts for 25% of the gross value of agricultural production. Many of Australia's water resources are now under significant pressure. Urban and industrial sectors are continuing to grow and overall water use has increased by 65% since 1985. At the same time, the agricultural sector is under pressures to reduce levels of water extraction in areas of over allocation and allocate more water to the environment.

It is likely that by the year 2029, new institutional arrangements, including water trading, will shift water use in agriculture in Australia. Although only a small proportion of sheep are currently grazed on irrigated land, changes in irrigation land will have a "domino effect" that will impact on land use well outside irrigated areas.

The most efficient and profitable use of water is in horticulture. By 2029, a greater proportion of the water that is available for agricultural use will be used for horticulture. Although part of this may be taken up by reductions in rice and cotton production, dairy and other grazing industries that currently enjoy irrigation will be impacted. Consequently, the displaced industry will shift to alternate regions, particularly the high rainfall areas that are currently occupied by sheep farmers.

Water use will also be a major consideration for sheep properties in the pastoral zone. Currently, there are about 14000 bores tapping into the Great Artesian Basin. Of the total estimated annual extraction of 570 Gigalitres from this basin, about 500 gigalitres are used by the pastoral industries. Rehabilitation of artesian bores will be expected during the next twenty years and water savings will need to be achieved. It is certainly possible that some areas will be stopped from tapping into artesian bores, removing agricultural production from these regions. Pipe reticulation systems, replacing bore drains and other infrastructure investments may be needed in this region. In some cases the cost of this infrastructure may be commercially prohibitive.

More broadly, harvesting of water on farms in all areas, but with particular impacts on water catchments areas, is likely to become more regulated and monitored by Government agencies. Farmers may not own "their (excess) rainfall".

4.4. Technology improvements in other industries

Technology improvements in other industries will shift land use in Australia. Technology improvements in cropping will be particularly influential.

Improvements in crop genetics and management will mean that by the year 2029, more grain will be produced from less land. This will have important implications for the wool industry, particularly in the wheat/sheep zone of Australia.

Technologies such as raised bed cropping, combined with new varieties of crops suitable for high rainfall areas will probably lead to large regions of the high rainfall zones of southern Australia being converted across to crop production and away from permanent pasture.

⁶ Jonas Ball, Sinclair Knight Merz Pty Limited, State of the Environment Australia Report 2001, Inland Waters Theme Report, <http://www.deh.gov.au/soe/2001/inland/summary.html#waterresources>

4.5. Expanding international demand for other agricultural products

All agricultural products and services are now part of a competitive market place; they need to preferentially attract potential customers in order to maintain market share. The ability of the various agricultural industries to respond to the requirements of the consumer will largely determine their future.

By the year 2029, quality of product, from the consumer's perspective, will be a fundamental issue. Quality of product is now being described, objectively measured and improved. Research has shown that many important quality attributes, such as the flavour of a steak or the comfort factor of a suit, are strongly influenced by farm management practices, especially animal breeding programs. This suggests that entire agricultural supply chains will need to have a unified and coordinated approach in order to deliver products that are consistently fit for purpose. In some supply chains, such as wool, this is currently lacking. Creation of supply chains requires commitment of all parties to trade with each other. High level supply chain management will require:

- An understanding of production processes of all parties;
- An understanding and knowledge of the requirements of all parties, and agreement to produce product to meet these requirements;
- A competitive advantage for both parties as a result of entering into collaborative trading agreements.

It is likely that by the year 2029 Asia will be the dominant customer for agricultural products from Australia. Red meat and milk are the Australian products with the greatest growth potential. Wool is also a potential beneficiary.

Since the 1980's, meat consumption in South-East Asia has been growing at about 5% per year whilst milk consumption has been growing at about 3% per year. In some countries, such as China, the growth has been dramatic, where meat and milk consumption has almost doubled during the last ten years. This rapid growth is likely to continue into the future.

Two factors will drive the growth in demand for animal-derived food consumption in South-East Asia. The first is increased disposable income. Worldwide, there is a strong positive relationship between per capita income and per capita meat consumption, until a 'saturation' point is reached. Per capita consumption of meat has grown most rapidly in those regions where incomes have grown most rapidly. Real income of consumers in developing countries doubled since the early 1960's and is continuing at this rate.

The second driving force towards greater animal intake is urbanisation. About 45% of the world's population now live in cities and 80% of the world's population growth is occurring in the cities of developing countries. As affluence increases, urban-based consumers are more likely to diversify their diets into meat and milk. Urban food consumers have greater food choices and more diverse dietary and cultural influences than those typically found in rural areas.

Consequently, dairy and, to a lesser extent beef, are likely to be major competitors for land during the next twenty-five years. Further encroachment of dairy into the 'wool' regions of the high rainfall zone is a very high probability. This could take several forms, including more agistment of non-lactating dairy cattle.

Feed-lotting beef cattle and dairy cattle could also become more prevalent in the future. Such industries would require grain, possibly produced on land that is currently grazing sheep.

Other agricultural industries, some predictable, some unpredictable, will take land out of grazing production. One of the major changes in south-eastern and south-west Australia has been the planting of large areas of land for blue-gum production. The prices paid by timber companies for land has encouraged many producers to leave their “traditional” farming lands and move to lower rainfall and lower valued properties. These forces will accelerate during the next 25 years.

4.6. *Increasing national demand for land preservation*

The community is placing high value on undeveloped land in Australia. Through conservation organizations such as the Wilderness Society, widespread public campaigns are underway to encourage public support for the cessation of land clearing. Clearing of land will reduce throughout Australia. Already, most Australian states have implemented legislation prohibiting the clearing of private land of native vegetation.

Pressures are already in place to increase the area and scope of National Parks and biodiversity. This pressure is likely to be highest in more remote areas or areas of high aesthetic or biological value. In response to both Government and market forces, there has been an increase of about 60,000 Ha per year in new tree plantations.

By 2029, farmers may be obliged to conserve native grasses or other native flora and fauna. This is likely to lead to a net loss in land available and in an increase in costs for farmers who have these obligations, as they will be unable to maximise the productive capacity of that land. For example, stocking rates on native pastures are lower than those of improved pastures with fertiliser applications.

Interestingly, land preservation also offers a significant opportunity for wool production. Properly managed sheep livestock systems are almost certainly one of our best methods to preserve the massive pastoral zone region, and large parts of the temperate zone grasslands, whilst utilising their resources for humans. Almost any other alternative use of these regions would cause more damage. A positive attitude to conserving grassland regions of Australia may therefore be the wool industry’s best defence.

5. Rural Land Ownership and Management

Rural land ownership is likely to change. As explained previously, we expect a higher proportion of farms to be owned by city interests that have no expertise or experience in managing sheep farms. Management of these farms will be handed to professional managers, who may be running more than one property. Separation of land management and land ownership offers interesting opportunities for the wool industry. For example, skilled managers could run appropriately large numbers of sheep; it allows for a clear entry point into the industry for young skilled people without capital. However, potential efficiencies from separation of land ownership and land management are not guaranteed outcomes.

Many Australian sheep farms currently have tired and sub-standard infrastructure, such as shearing sheds. Changes to occupational work and safety practices during the next 25 years may mean some of these facilities will require significant capital expenditure to meet expected standards. This may be the trigger point for some farmers to sell, or exit the wool industry, or lease.

The capital required to enter farming, or wool production acts as a disincentive for new entrants, leading to a “tired and old” workforce. As the current generation of wool producers retire, leasing of farms will become more frequent, especially farms that are too small to

comfortably maintain a family unit. Once again, this could potentially expand the usefulness of skilled managers within the industry.

6. Technology improvements in the wool industry

There is low adoption of some existing technologies within the wool industry that are known to be highly cost-effective. There is a high probability that most of those technologies will become more widely adopted during the next 25 years. These include monitoring and proper best practice nutritional strategies for sheep, monitoring and the control and treatment of internal parasites, grazing management strategies, genetic improvement strategies and monitoring and improvement of pastures. Some of the potential effects of this will include:

- Higher stocking rates in the high rainfall zone;
- Fewer mortalities of sheep in all zones;
- Lower cost of production in all zones;
- Improved product quality from all zones;
- Reduced requirement for labour.

During the next 25 years new technologies will become available to the wool and other industries. Our knowledge and understanding of our world is increasing rapidly. Currently, we are in midst of the “genomics / proteomics” revolution, and the “information technology age” to name just two. Some of the claims made by experts in this field lead us to only imagine what the world will be like in 25 years time.

Some of the new technologies that are on the horizon may not have a direct economic benefit to the farmer. However, demands for product quality, particularly with reference to animal welfare may require their use. For example, individual records of particular sheep may be required to comply with animal welfare quality standards imposed by some of our future markets and customers.

We expect that it is moderately probable that the following will be commercially available within 25 years:

- **Remote monitoring of sheep** – this will allow producers to examine and document the welfare, disease status and possibly keep other records of their sheep flock. Remote monitoring of sheep negates the necessity for handling animals in order to manage their welfare. Also it allows for the use of strategic nutritional practices to increase survival, particularly of weaner sheep, currently the most at risk.
- **Efficient sampling and record keeping of individual sheep** – while maintaining records on thousands of sheep flocks may provide no economic advantage to the producer, and will increase labour costs, it is possible that this may be a requirement imposed by the community, as per the requirement of “managing sheep individually”.
- **Satellite imagery to assist with pasture monitoring and grazing decisions** – using satellite imagery removes the need for producers to manually monitor feed availability and the condition of individual paddocks on a regular basis. Often while this technology may not in itself provide a benefit (methods to assess feed availability and pasture composition currently exist), it is possible that the automation of this type of information will lead to its increased use.

- **Numerous labour saving automated or semi-automated devices** – tedious, simple tasks such as drenching, crutching, other tasks needed for disease control urgently require new and innovative systems to allow the animals to be treated quickly and humanely. This may include portable animal handling and management systems, or fixed systems that can be cheaply purchased and used on farms.
- **Virtual fencing** – this is likely to be of most benefit to the wheat-sheep and pastoral zones. Currently, many fences have been removed from cropping properties and virtual fencing could lead to a low cost method for producers in the wheat-sheep zone to re-enter the sheep industries. Animal welfare considerations are important in the design of remote fencing (ie the use of electric shocks, must be minimised).

It is probable that most of these items will come, at least initially, at a cost that has an attractive marginal rate of return only for the larger sheep farmer, who can take advantage of scale. Consequently, such technologies will tend continue the drive towards bigger management units.

6.1. ***The Genomics revolution***

Productivity improvements and changes in product produced in the livestock industries is limited by the natural ability and time it takes for animals to reproduce. For example, to change a genotype of sheep through natural reproduction methods takes many years. Five years after the introduction of a new ram source, the oldest ewe age group on the property will still only contain ½ of the genes from the new ram source. This affects the elasticity of supply of sheep products and the responsiveness of wool producers to change their product in relation to market changes.

While the DNA structure of humans has been mapped, scientists are currently in the process of understanding that map and applying this knowledge to the animal kingdom. As knowledge of DNA and the proteins it encodes increases, so does our potential understanding the biological basis for factors affecting sheep and wool and meat production, by individual sheep.

The greatest potential for technological improvements comes not necessarily from genetic manipulation of animals, but rather the development of novel compounds that improve or manipulate production quickly. These may allow us to manipulate animals quickly (without reliance on the breeding cycle) according to consumer trends, disease outbreaks or current wool markets.

Genomics has the potential to provide us with an understanding of the genetic mechanisms affecting the biological outputs and survival of animals. Given that areas of DNA code for the production of proteins, it is possible we may be able to manufacture these compounds at low cost, allowing us to manipulate animal production, in a similar manner to that which exists in the plant industry.

Proteomics⁷ is the understanding of the proteins an animal produces and their interactions with each other and the environment. Improved understanding of these proteins may

⁷ The complete sequence of several genomes including the human one is known. However, the understanding of probably half a million human proteins encoded by some 30,000 genes is still a long way away and the hard work to unravel the complexity of biological systems is yet to come. A new fundamental concept called proteome (PROTEin complement to a genOME) has recently emerged that should drastically help phenomics to unravel biochemical and physiological mechanisms of complex multivariate diseases at the functional molecular level. A new discipline, *proteomics*, has been initiated that complements physical genomic research. Proteomics can be defined as *the*

elucidate potential compounds that have the effect of dramatically altering a sheep's production, resistance to disease, and overall "fitness".

It is possible that tools from the genomics and proteomics areas may enable producers to rapidly change the outputs from animals depending upon market conditions.

For example, let us assume that genomics has identified that sheep with consistently low fibre diameter and high fleece weight have a particular allele in their DNA structure. Given that DNA provides codes for the construction of proteins within the cell, we can then examine that piece of DNA, and identify the protein for which it codes. By finding a method to clone that piece of DNA (possibly using bacteria), we can mass produce that protein, and potentially administer this to the animals, and improve their production. In the same way, if we identify and understand the difference in muscle structure and formation in meat sheep animals, compared with Merinos, we may be in a position to manipulate the animal, depending upon market situations.

In a similar process, understanding the genetic mechanisms that confer resistance to individual diseases offers the potential to develop new methods of disease prevention and control, for most sheep diseases. In all cases, a clear method of describing the phenotype of "resistance" is required.

Given the history of practical achievements in this area, the possibility of achieving outcomes of this magnitude within 25 years is quite low. It is imperative that teams of molecular geneticists work in collaboration with practical production scientists and producers so that practical outcomes for this technology are identified and researched.

Consumer acceptance of products of such technologies will be an essential part of this change. This will require longitudinal studies of the effects of such technologies on the animals, consumers, and the environment but the current negative consumer sentiment to genetically modified crops provides a salient warning.

6.2. Information technology, electronics and communications

Electronics and communication technologies are likely to provide significant advantages to farm managers, who will be required to maintain, manage and make decisions on the plethora of information that will be available to them.

Wool price risk management has been greatly assisted by widespread adoption of the fax and the Internet. Wool price information, weather alerts and production information can be readily and immediately accessible by most people in rural and regional Australia, through established communications infrastructure. Decision support tools to enable producers to collate, interpret and manage this information will be essential to achieve optimum outcomes.

Monitoring pasture biomass through satellites in space, fencing without fencing, and individual sheep identification are all examples of the potential use of electronics for wool production.

The use and implementation of these technologies will require high capital outlays and will need to demonstrate an economic return to the producer, through improvement management decisions, reduced labour costs or improved market access and price received. The high capital outlay will place these technologies in the domain of larger, more profitable

qualitative and quantitative comparison of proteomes under different conditions to further unravel biological processes. Ref: http://au.expasy.org/proteomics_def.html

producers. For smaller, less profitable producers these technologies may prove to be unviable for their enterprise because they will be too expensive for their operation.

7. Animal welfare and the wool industry

In the year 2029, consumers, particularly in the western world, will make purchasing decisions not just on the nature of the product itself but also on an ethical judgement of the nature of the production system. Animal welfare and ecological sustainability issues will be particularly important. Was this product made in an environmentally friendly way? Were the animals treated properly? These factors may not be as important for products exported to Asian markets.

Pressure to change practices that appear to interfere with the welfare of sheep will be driven by consumers in the western world and by Australian laws. Already, the EU recognises that “animals are sentient beings”. Their animal welfare policy states the need to “ensure that animals need not endure avoidable pain and suffering and obliges the owner / keeper of animals to respect minimum welfare requirements”. Activities such as horn debudding, mulesing and teeth grinding are banned in Europe, unless performed under anaesthesia by a trained veterinary surgeon. By the year 2029, we expect that the EU and other markets will have developed labelling regimes that promote animal welfare standards for animal based products.

It is highly likely that a number of practices and outcomes that are currently the norm within the wool industry will be banned or considered unacceptable by the year 2029.

These include (adapted from Cronin et al, 2002⁸):

1. **Land transport of sheep** – high probability that it will be closely regulated and monitored by 2029;
2. **Mass export of sheep for slaughter overseas** – high probability that this will have ceased by the year 2029;
3. **Sheep mortality** – high probability that mortality rates currently accepted by the industry will be considered unacceptable. Intense scrutiny of peri-natal lamb mortality, weaner mortality and deaths due to exposure likely. With larger property size and more extreme weather events, reduced labour units per sheep, sheep mortality rates could increase and create larger problems for the industry;
4. **Mulesing** – high probability that this will have been banned and replaced by a more expensive alternative by the year 2029, or at least regulated so that only licensed operators can mules sheep;
5. **Disease control programs** – will be monitored and failure to adhere to industry understanding of best practice may be considered unacceptable. Monitoring is likely to be mandatory to establish compliance with minimum standards;
6. **Intensive management welfare** concerns, such as feedlots and specialised fine wool shedded sheep production, will come under close scrutiny.

⁸ Cronin, GL, Bartlett, JL, Edge, M.K., and Hemsworth, PH, (2002) Identifying animal welfare issues for sheep in Australia. Proceedings of the Wool Industry Science and Technology Conference, Hamilton, Vic

Already, one website developed by an animal liberation group portrays wool production as analogous to fur production in the early 1970's⁹. Their justification is the practices of mulesing and live sheep exports to the Middle East.

We note that belief systems perceived to be “extremist” in the 1970's are now becoming mainstream and are affecting the collective consciousness of the Western world. Similarly, some of the views considered ‘extremist’ now could be mainstream views by the year 2029.

8. Environmental issues in wool production

We are in no doubt that that issues to do with the environment and resource management will be key determinants of land use both in agriculture generally and within wool production specifically by the year 2029.

Already, for Europeans, the environment is seen to have the highest influence on quality of life in Europe, over and above social and economic aspects¹⁰.

As part of their plans to minimise adverse environmental effects, the EU has introduced an Integrated Product policy (IPP), which seeks to minimise the impact on the environment of products available for purchase in the EU. This includes examination of all the processes leading to production of products, and includes the impact a product's manufacture (from raw material to final end product) has had on the environment¹¹.

Increasingly, Governments are under pressure to implement environmental reforms and improvements by urban dwellers. Australian citizens are becoming more aware of the impact of the effects of farming practices on the Australian environment and, particularly the more affluent parts of our society are demanding and purchasing products that are perceived to have been produced with less impact on the environment.

By 2029, customers of Australian wool may demand details about production methods associated with damage to the environment. As a consequence, it is possible that detailed information about land management practices may be required for all produce entering this market, irrespective of the number of processes that the garment has been through prior to purchase by the consumer.

The Australian Federal Government is encouraging producers to develop and implement environmental management systems, as a means of demonstrating that environmental damage has not occurred as a consequence of the production system.

By the year 2029, detailed documentation of management practices affecting the land, and also the implementation of monitoring systems to alert producers to changes in the landscape that may require some form of mitigation will probably be required.

It is quite possible that markets in western communities will not purchase agricultural produce without such a system in place.

The industry will also be required to document its environmental footprint. For example, by 2029, the wool industry may need to demonstrate that it is not a net producer of greenhouse gases, or be prepared to pay a cost for the gases that it emits.

⁹ <http://www.woolisbaad.com>

¹⁰ Office of Official publications for European Communities, 2003 “The Environment – What Europeans Think”. http://europa.eu.int/comm/environment/pubs/brochure_en.pdf

¹¹ <http://europa.eu.int/comm/environment/ipp/integratedpp.htm>

8.1. Current causes of land degradation

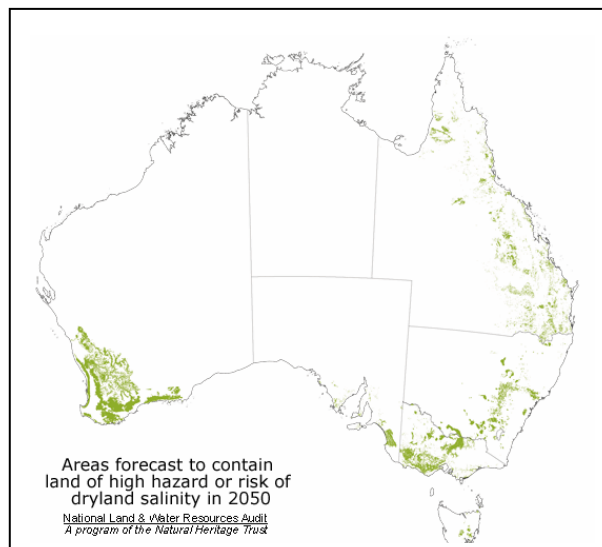
The major environmental issues confronting the wool industry include soil salinity and acidity, land degradation due to weed infestations, the protection of wildlife habitats and remnant vegetation, and soil loss from wind erosion and soil structure¹².

Many of these negative outcomes can currently be prevented through the adoption of grazing technologies. Ensuring that minimum requirements for ground cover are met can mitigate the effects of wind erosion. Soil acidification, a growing problem throughout the wheat-sheep areas can be mitigated through lime application. Weed invasions can be reduced through grazing management and maintenance of productive competing plants. Ensuring bare ground is kept to a minimum will also enhance weed control. Salinity is best managed through prevention.

8.1.1. Salinity

Approximately 5.7 million hectares of Australia's agricultural and pastoral zone have a high potential for developing dryland salinity through shallow watertables¹³. Predictions based on groundwater trends, field surveys and landscape characteristics indicate that unless effective solutions are implemented, the area could increase to 17 million hectares by 2050. Most is agricultural land (more than 11 million hectares). Although grazing management with deep rooted perennial plants can assist in alleviating rises in the water table, salinity is best managed by avoiding risky practices such as excessive land clearance. Re-vegetation of affected areas with native plants, in particular trees and native grasses provides the best methods of rehabilitating affected land.

For many areas, the processes that cause dryland salinity are already in place, and mitigation technologies are not available. It is likely that in 2029, the amount of agricultural land affected by salinity will increase. Systems to predict the early onset of dryland salinity



are required.

¹² Benchmarking Rural Industries' Practices and Productivity Performance and Review of Industries' Capacity to Change – Wool, <http://audit.ea.gov.au/anra/agriculture>

¹³ <http://audit.ea.gov.au/anra/land/>

Figure 1: Predicted areas forecast to contain land of high hazard or risk of dryland salinity in 2050¹⁴

8.1.2. Soil Acidity

Currently, the high rainfall areas are most at risk of developing soil acidity. In the long term, this issue is not confined to these areas. Modelling the pH levels of Australian soils 5 and 10 years into the future indicates large areas at risk of rising acidity (Figure 1). Most of these areas cover the current wheat-sheep zone. By the year 2029, land managers will be expected to reduce that risk. This will be achieved primarily through capital application of lime to pasture. However, capital application of lime is costly and requires a long-term perspective on industry profitability.

Figure 4.11 Modelled estimated years for Australia's agricultural soils (pH >4.8) to reach pH_{ca} 4.8 at minimum (A) and maximum (B) rates of acid addition, and in the absence of lime applications.

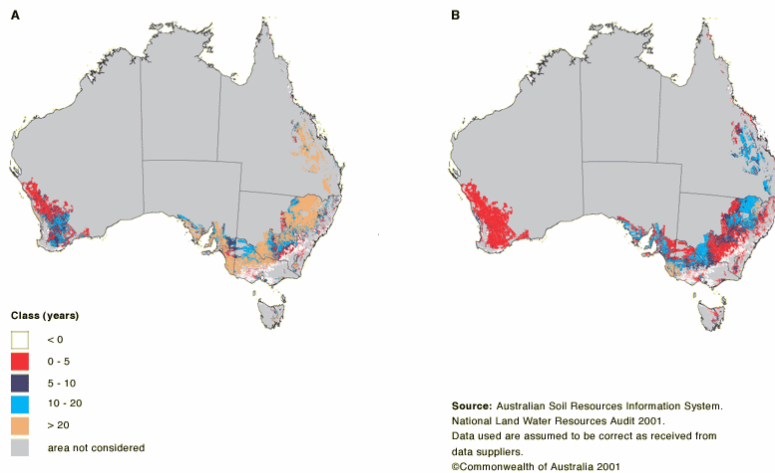


Figure 2: Estimated years for Australian Agricultural soils to reach a pH of 4.8¹⁵

8.1.3. Weed management

Weed infestation and mismanagement creates problems for adjoining properties. Introduced weeds, such as serrated tussock, are currently reducing the productive capacity of land in Australia and must be managed to ensure that the threat they impose for Australia's grasslands is removed. The strategies available to mitigate weed infestation depend on the nature of the weed.

Increased cropping, increased use of contractors and increased international travel all increase the risk of introduction of exotic weed species. Biosecurity is a big issue for weed management. Improved quarantine practices for regions and individual properties, and regional programs to eradicate major species are likely to be practices increasingly necessary in the future for land holders.

¹⁴ http://audit.ea.gov.au/anra/land/land_frame.cfm?region_type=AUS®ion_code=AUS&info=sal_context

¹⁵ From: http://audit.ea.gov.au/anra/land/land_frame.cfm?region_type=AUS®ion_code=AUS&info=soil_acid

8.2. Conclusion – Animal welfare and sustainability issues

The issues of increasing concern about animal welfare and the sustainability of land management challenge our traditional views and set new limits for their management. However, at the same time offer exciting new opportunities for sound progress in animal production. For example, reducing animal mortality and improving animal welfare lead to positive improvements in profit for the sheep industries. This is a “win-win” position. Similarly, reducing the impacts on the environment from poor farm management practices will lead to more productive land in the longer term.

A positive and creative attitude to animal welfare and sustainability issues, avoiding both unjustified fear and suspicions, will strengthen the ethical framework of societies, enhance professional esteem of producers and benefit marketability of products in the future.

9. People Issues

By the year 2029, the managers of wool enterprises will need high-level skills or access to high level skills in the following disciplines:

1. Production skills – requiring a fundamental knowledge of factors influencing cost of production and the ability to reduce this as much as possible;
2. Financial skills – including mechanisms for price risk management;
3. Marketing skills – the ability to sell livestock and wool for prices higher than that achieved by the “average” producer;
4. Self and staff management skills – will become more important as farms scale up;
5. Natural resource management skills- to meet with societal expectations.

In our opinion, of this list, production skills are currently the most developed and natural resource management the least developed within the industry. As to where will this level of expertise will derive, it is unclear to us.

Farmers in the future will need to be good managers and interpreters of data. Some of this data will be required to enable farmers to enter or maintain major markets. For example, vendor statements about residues or the welfare of animals used in the production of agricultural goods may be increasingly necessary to market goods. Other uses for this data will be required for wool sales.

Compliance with societal expectations for land management is likely to be an important component of farming practice. While Governments may not legislate to enforce producers to adhere to monitoring requirements, it is likely that without some environmental monitoring systems in place, producers may have no market for their produce.

Trained, informed and experienced advisers will be required to assist with data interpretation and decision making on farms. These advisers must have a knowledge of the whole farm system and the production pipeline, rather than just having specialist knowledge in one area.

9.1. Occupational health and safety

Occupational health and safety is an area of current attention that will only increase during the next 25 years. At the moment, most injuries occurring in the wool industry relate to shearing, which is a high risk activity, leading to many back strains and injuries. For the producer, this is causing high insurance premiums and increased civil action claims.

It is highly likely that by 2029, currently accepted shearing practices will be considered unacceptable. Thus, alternatives to the current system of wool harvesting (and crutching) are urgently required.

We expect that by 2029, shearing will be performed in a manner that places far less stress on the operator, particularly methods which do not exclusively rely on an operator to restrain the sheep. We expect novel methods of wool harvesting, through either mechanical or biological methods will have a greater role to play in the harvesting of Australia's wool clip.

With increases in labour efficiency required by land managers, we anticipate this will increase the need for contract labour, and more efficient means of undertaking routine tasks, such as drenching, dipping, jetting sheep etc. Sheep handling equipment, allowing operators to handle and manage large groups of sheep in a short space of time will also be in high demand. The establishment of portable systems to yard and administer treatments to sheep will be required. Such systems currently exist. Ten years ago, most footrot eradication programs were undertaken by the farm owner. Today, footrot eradication tends to be in the domain of experienced contractors with specialist equipment to facilitate the task required. We expect this to occur for most menial husbandry practices, with novel handling systems to be developed.

We also expect that chemical usage will be subject to more stringent OH&S control, once again favouring the use of registered contractors rather than unlicensed owner-operators.

10. Animal health

Currently, chemicals are the major weapon in managing disease on farms. For example, strategic drenching of sheep is used primarily to control internal parasites (worms), jetting is used to control and manage blowfly strike, and dipping is used for lice control. Prolonged and inadvertent use of these chemicals leads to the development of parasites resistant to their effects. There is an urgent need to implement programs allowing integrated management techniques so that chemical use can be minimised and the effectiveness of chemicals to be maximised over time.

It is possible that if programs were established now, that we could have sheep that are far more resistant to parasitic infection. Resistance of sheep to internal parasites and some external parasites has some genetic components. Further understanding of these components may provide additional "tools" for managing and controlling these diseases, particularly in combination with other management strategies.

Chemical application also carries risk to the operator. In the future, some chemicals currently in use may not be freely available for producers to use in their management of animal disease, in terms of both the operator and the environment.

There are ongoing threats of exotic disease with increased international travel. Reduction of trade barriers increases the likelihood of exotic disease outbreaks in Australia, with resultant implications for trade and Australia's livestock industries.

11. Other

11.1. Societal belief systems

Belief systems that were considered to be confined to the "extreme left" activists are now becoming mainstream. The public is educated, empowered and knowledgeable.

11.2. Climate change

In writing this report, we have not considered the impact of climate change on agricultural production. Predicted changes in climate may also influence our future definitions of what we know currently as the high rainfall, wheat-sheep and pastoral zones. The predictions we have made for these areas may also be exacerbated by climate change. Also, we have made assumptions that the total rainfall in Australia will remain the same. This may not be the case.

11.3. The great unknown

The wool industry has been adversely affected over the last 20 years, by unpredictable global events. These include events such as, the attacks on the World Trade Centre in September 2001, the fall of the eastern European communist economies, and the Tiananmen Square massacre in China. There is no doubt there will be other global events will occur over the next 25 years that are not predictable, but which will have a major effect on Australia's wool industry. These could be positive or negative. Whatever these events will be, the wool producers of 2029 must be in a position to manage their effects.

These events will be "left field" events, but could include:

- Failure of the Chinese economy;
- Reduction in oil supply due to unrest, terrorism, accidents or something else in the Middle East;
- An improvement in the economies of Eastern Europe;
- Bioterrorism in Australia would be devastating to Australia's livestock industries. Bioterrorism in competing countries is likely to increase demand for our "disease free" livestock;
- The discovery of new and important zoonotic diseases affecting both sheep and humans;
- Further terrorist attacks affecting major transportation routes through the developed world.
- Most likely, this will be something that is currently, not "on our radar".

12. Conclusion

Australian wool production in 2029 will be different to that which exists today.

The Australian wool producer will be expected by society and consumers to know and understand his / her land and animals, and also be able to detail all practices, affecting land, plants and animals on that property. Consumers will focus their purchasing power on the effect of wool production on the environment, animal welfare, and the community. The profitable Australian wool producer in 2029 will understand the climate, production and price risks associated with managing their business and will have effective strategies in place to mitigate these effects such as data management systems, which include decision support tools.

Competition for land that is currently used for sheep farming will continue into the foreseeable future. Urbanisation, efficient and sustainable water use, technology improvements for alternative agricultural enterprises and the likely growing demand for food products from South East Asia are key drivers of future land use in Australia. To compete, wool production must become an "attractive" use of that land and deliver economic benefits to the owner as well as social and environmental benefits to the country. The area

exclusively allocated to sheep farming is likely to diminish, especially in the high rainfall zone of Australia. Mixed farming is likely to increase, as will leasing of smaller farms to professional managers.

A substantial proportion of sheep enterprises in Australia will be owned by city interests who have little agricultural background or expertise. This separation of land ownership from land management will create a number of opportunities and problems for the wool industry for example, by providing opportunities for existing sheep owners to expand businesses without the need for capital to purchase land. There is an associated problem of finding the labour required to achieve the tasks of managing the farm.

The community and its perceptions will have an influence on land use, especially through animal welfare and environmental considerations. Increased urbanisation in Australia will lead to a disjunction between urban and rural dwellers, resulting in a reduced understanding of agricultural practices by the majority of Australians who have a large impact on political outcomes. The implications of this will include a requirement by wool producers to demonstrate their “stewardship” of the land, and management. Management practices impacting adversely on the environment will not be tolerated.

Emerging technologies such as improved understanding of the biological characteristics of sheep, through genomics and proteomics promises to provide improved mechanisms to select those animals best suited to Australian conditions, with potentially higher disease resistance and ability to withstand inclement weather conditions. Also, through an improved understanding of the physiology causing disease resistance and “fitness”, we may be in a position to develop (low cost) products, which improve a sheep’s tolerance and adaptation to the environment.

Electronics and communication are likely to provide opportunities for farmers to monitor and manage their farming system, in particular the risks associated with climate, production and price. However, these are likely to come at a high cost, requiring economy of scale and possibly reducing labour requirements for sheep production. Such technologies will tend to favour larger sheep enterprises, and will consequently hasten the increase in size of the average farm, especially in the pastoral zones of Australia. Labour-intensive practices will be expected to occur in a systematic, labour-efficient manner, which minimises injury risk to workers. It is possible, that some current practices, such as shearing will not be acceptable in 25 years time. Alternatives to current methods of wool harvesting are urgently required.

Product safety and integrity is currently an important theme in agricultural production throughout the developed world. Traceability of product from “paddock to plate”, “farm to fork”, or possibly, “shearing shed to fashion house” is currently perceived to be a panacea for improving consumer confidence in the western world. With mandatory animal identification, comes the ability to collect information on individual animals and potentially use this information to improve profits on the farm.

Belief systems perceived to be “extremist” in the 1970’s are becoming mainstream and are affecting the collective consciousness of the Western world. In addition, with an increasing proportion of people in western countries living in cities and having no direct contact with or understanding of agriculture, small but professional lobby groups will have the potential to exert an even greater effect on public opinion in 2029 that is currently or presently the case.