Sustainability Issues for Agriculture in Western Australia

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Anne Bennett, Ross Kingwell & Ross George
Department of Agriculture
South Perth, Western Australia

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EXECUTIVE SUMMARY

Agriculture has been and will continue to be a major component of economic activity in several regions of Western Australia, and agricultural communities will remain an important part of the social fabric and landscape of the State. Promoting the sustainability of agriculture is likely to produce three main outcomes: vibrant rural communities; profitable agricultural systems; and conservation of the natural environment.

In regions dominated by agriculture, structural change in agriculture is fuelling depopulation and unemployment pressures that in turn are leading to smaller, often less vibrant rural communities. Generating change that maintains the profitability of farming while ensuring rural communities remain attractive and vibrant is a serious challenge.

Another key challenge for sustainability in agriculture is how to ensure greater stewardship of land, water and remnant vegetation resources by farm and non-farm communities, including agribusiness and government. These communities and groups need to rely on, utilise and protect those resources without degrading their value. To achieve greater stewardship, that delivers desired sustainability outcomes, cost-effectively and fairly is a major challenge. The challenge is made more difficult because some of the threats to the productive capacity of the land are long in the making, such as climate change and salinisation. They have pervasive impacts on farms, and beyond farms, threatening native species, water catchments and urban infrastructure. Addressing these issues is likely to require co-ordinated local, regional, national and international innovation and collaboration.

Accepting all these challenges may lead agriculture to:

- better protect or even enhance the quality of its resource base;
- ensure its net impact on the environment is positive;
- meet community and political expectations with regard to environmental quality, animal welfare, and food safety; and yet
- maintain or enhance its local and international competitiveness; and
- bolster rural communities.

This paper describes briefly the main challenges to the sustainability of agriculture and outlines some means of responding to the challenges: market-based approaches; agricultural and environmental research and development; accelerated adjustment; and global and national policy initiatives.
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INTRODUCTION

To meet emerging community values related to sustainability, agriculture faces significant challenges to its traditional land and enterprise practices. Broad acre farming, pastoralism, horticulture and intensive industries have all contributed to a number of environmental problems such as salinity, greenhouse gas emissions, reduction in natural habitats and nutrient pollution.

These industries continually improve their efficiency in order to remain competitive on international and local markets. Striving for profit and efficiency has led to adoption of labour-saving technologies, with greater mechanisation, greater dependence on chemicals and larger production units that offer economies of size. As a result direct employment in agriculture has declined. Many inland areas strongly dependent on broadacre farming have experienced depopulation and a decline in their social services; all amidst an often deteriorating natural environment.

The challenge for many farm businesses, rural communities and governments is to balance a portfolio of needs and aspirations including:

- financial viability of rural businesses
- growth in export receipts
- low food prices
- visual amenity of rural landscapes
- a more “environmentally-friendly” agriculture
- a maintenance of rural lifestyles
- less erosion of community services (e.g. health, education).

To ensure that agricultural industries are underpinned by more sustainable practices, there is a need to:

- minimise negative impacts of agriculture on surrounding environments;
- boost or reward agriculture's positive impacts on the environment;
- employ least-cost, effective and socially accepted methods of ensuring that community and political expectations with regard to biodiversity, animal welfare, land and water stewardship, and food safety are satisfied; and
- ensure farm profitability and the international competitiveness of the rural sector are not eroded inappropriately, and rural communities are not unduly disadvantaged.

The purpose of this paper is to outline some key challenges to the sustainability of agriculture in Western Australia and a range of means for bolstering sustainability. The paper is intended to fuel discussion and promote informed policy formulation.

DEFINING SUSTAINABILITY

Although there is no consensus in the definition of sustainability, and there are a few ambiguities, most definitions encompass economic, social and environmental considerations. For example, the Government of Western Australia, in its Focus on the Future consultation paper, defines sustainability as “the simultaneous achievement of environmental, economic and social goals.” The three-fold goal is reflected formally in triple bottom line accounting.

A speech by the Premier of Western Australia’s in February 2002 included a statement that:
“...our long term well-being depends as much on the promotion of a strong vibrant society and the conservation of our environment as it does on economic development”.

and that:

“Social and environmental considerations should be integrated into all decisions at the beginning of the process, not bolted on afterwards.”

The Standing Committee on Agricultural Resource Management (now replaced by the Natural Resource Management Standing Committee) considers the essential elements of sustainable agriculture to include:

“... the use of farming practices and systems which maintain or enhance:
  • the economic viability of agricultural production
  • the natural resource base
  • other ecosystems which are influenced by agricultural activities.”

Interestingly, the social impact of agriculture on rural communities is not included in their list. However, more often definitions of agricultural sustainability do include rural communities. For example, the United Kingdom’s Round Table on Sustainable Development (1998) characterises sustainable agriculture as:

“Farming policies and practices which ensure an adequate supply of safe, nourishing and affordable food; and whose direct, indirect, upstream, downstream and future impacts sustain and nurture the soil, air and water and their productive capacity; provide jobs; protect and enhance wildlife, landscape, historic and cultural features; and minimise the use of non-renewable resources.”

Further, the Sustainable Development Commission (2001) declares that sustainable agriculture must:

- produce safe, healthy food and non-food products in response to market demands;
- enable viable livelihoods to be made from sustainable land management;
- operate within biophysical constraints and conform to other environmental imperatives;
- provide environmental improvements and other public benefits;
- achieve the highest standards of animal health and welfare, compatible with society's right of access to food at a fair price;
- support the vitality of rural economies and the diversity of rural culture; and
- sustain the resource available for growing food and supplying other public benefits over time, except where alternative land uses are essential in order to meet other needs of society.

In this paper sustainability of agriculture is defined as the development and use of farming practices and systems that generate vibrant agricultural communities, profitable agricultural systems and which conserve the natural environment.

To satisfy fully and consistently all these desired outcomes is, in most practical settings, a near impossible task. Even measuring how well agriculture performs in meeting these requirements is itself a time-consuming and potentially costly task. Often partial measures such as sustainability indicators are reported. Less frequently, multi-criteria sustainability indices are formulated which
require attaching relative weights to the various ingredients of the indices. Whoever ultimately
determines the relative weights implicitly unveils a relative importance of economic, environmental
and social issues for agriculture.

Rather than determine the mix and weights of elements in an index, another approach for signalling
the need to improve sustainability is to identify the key challenges to generating desired economic,
environmental and social outcomes and then ascertain appropriate means for responding to those
challenges or issues. By developing discrete or co-ordinated responses to these challenges the
sustainability of agriculture can be improved. In other words, by taking sustainable agriculture and
breaking it into key issues with various means of response; desirable outcomes can be generated.

This concept is demonstrated in Figure 1. Components of sustainable agriculture are placed above
the line as outcomes (eg vibrant communities), and various means are shown below the line. Figure
1 is illustrative and is not inclusive of all possible means for developing sustainable agriculture.

The means for achieving sustainability address a range of challenges and deliver across various
scales; state, regional and local. In the next section the key challenges to the sustainability of
agriculture are outlined.
SUSTAINABILITY CHALLENGES FOR WESTERN AUSTRALIAN AGRICULTURE

There are many challenges to the sustainability of agriculture in Western Australia which are discussed briefly in the following sub-sections. Not all are equally pressing, tractable, or widespread. They are discussed in relation to the three main sustainability outcomes: vibrant agricultural communities, profitable agricultural systems; and conservation of the natural environment.

Challenges to vibrant rural communities

Industry structural adjustment

Most farm businesses are owned and operated by families. However, farming is a business so market and technical change and the vicissitudes of climate affect their operations. Farm families make decisions from which they intend to benefit financially. Since the 1950s many of these decisions have involved adoption of labour-saving technologies, increases in farm size, greater use of chemicals and machinery in farming, more crop species and animal breeds, and more intensive cropping. These changes, combined with the cessation of release of new land for farming since the late 1960s, have caused widespread structural changes in agriculture. Farms are now larger, more complex to manage and more dependent on purchased technologies. The search for profit, in the face of subsidised competition on international markets, has caused some farmers to make decisions that have deleteriously affected rural communities and the natural environment. Natural vegetation has been cleared to provide economies of size, eventually exacerbating salinity problems. Labour-saving machinery has been purchased at cost to some farm labourers, their families and other rural businesses in turn dependent on those families. It is difficult to build vibrant rural communities when the aggregate demand for rural labour declines and there are few off-setting local employment opportunities. However, it is equally difficult to ensure farm businesses remain profitable if they do not have access to new technologies.

Rural depopulation

In regions dominated by farming, fewer farm families and reduced employment in agriculture necessarily cause an exodus of other families directly or indirectly reliant on population such as service industries. Remaining farmers live in districts comprising fewer and larger farms with fewer local employment opportunities outside of agriculture. A sense of social alienation, particularly among under-employed youth, can develop.

In spite of continued cross subsidisation to rural areas, as a result of government policy to provide rural services and infrastructure, many inland rural regions continue to face a lack of employment opportunities and further depopulation. The decline in agricultural employment has added to depopulation pressures. In inland regions where the local towns each had a population less than 2000 and where agriculture, forestry and fishing accounted for more than 30 per cent of employment then total employment declined by 7 per cent between 1986 and 1996. Further encouragement to the exodus of labour is that male full time weekly earnings in agriculture are often less than in other industries and average earnings in inland regions are often less than in metropolitan regions. An

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* However, government policy, for example National Competition Policy, has also contributed to rationalisation.
additional disincentive is that many inland agricultural regions have much less industrial diversity compared with metropolitan regions⁷ so there are limited opportunities for employment in other sectors and fewer career pathways.

Higher rates of employment and pay in other sectors (e.g. housing, retail trade) that typically are located in metropolitan areas attract some families away from rural regions. Other factors contributing to reduced employment and population are the trend toward providing children with more years of education away from the farm and the decline in family size. All these influences result in the depopulation of many rural regions. For example, in 1991 the population of the central wheatbelt of Western Australia was 9585, which was 34 per cent less than in 1966. During this same period the number of people engaged directly in agriculture in this region fell by 43 per cent from 3593 to 2057.

From 1976 to 1995 the population of Western Australia grew by 47 per cent. However almost all inland rural shires experienced population declines over the period. Many of these shires experienced population losses of over 20 per cent.

Depopulation in inland rural regions will cause urban voters to grow in political importance. Hence, urban voters’ views on land and water management, sustainable farm production methods, biotechnologies and animal welfare will be accommodated increasingly in emerging government policies and actions. Also, as the age structure of Australia’s population alters in coming decades and the political power of the elderly increases, then governments will shift their funding and policy focus more towards that group. Social services such as rural health, community, tourism and information services may receive increased funding, perhaps at the expense of public funds for agricultural industry support and development.

The reality for many farming communities is that countering the social, economic and government policy pressures that encourage depopulation in inland rural regions is extremely difficult. Attempts to reverse the decline can be at the expense of some other adjacent region and can strain existing resources. Tonts and Jones⁸ report that "any services which were previously provided by state and federal government are now the responsibility of extremely small, and usually declining, country shires."

To sustain or energise agricultural communities requires addressing the following challenges:

- depopulation pressures
- decreased rural employment opportunities due to increased scale of mechanisation, comparatively low wages for the rural work and little diversity of job opportunities
- reduced services in some rural towns
- increased isolation for those remaining in rural communities
- rationalisation pressures on country towns and on services to these towns
- an ageing rural population and, in inland rural regions, a decline in political power.

**Challenges to profitable agricultural systems**

Agriculture and fisheries is the second largest export sector in Western Australia. In 2000, Agriculture and fisheries exports totalled $4.5 billion or 18 per cent of the State’s exports and is an
important economic industry for Western Australia. Food and beverage processing now represent the largest sector of the manufacturing industry, recording a turnover of $3.2 billion.

The economic performance of agriculture in Western Australia over the last 20 years has been remarkable in some ways, particularly given the underlying economic and policy environment in which Western Australian farms operate. The challenges to their financial prosperity include:

**Competitor protection**

The Common Agricultural Policy in Europe and various Farm Bills in the United States have channelled billions of dollars of direct and indirect support to the farm sectors in those regions. For example, crop and dairy subsidies in the United States are estimated to range from $US38 billion to $US57 billion over the next six years, up around 70 percent from current levels. In total around $US180 billion over the next 10 years will be available to support the US farm sector. By contrast Western Australian farmers receive a low rate of government or taxpayer assistance so their profitability largely depends on their access to superior technologies and their own managerial skills.

**Weakening relationship between farm and food prices**

The farm-gate share of each dollar spent by consumers on food is continuing to decline in many developed countries. For example in the US the farm-gate share of each dollar spent on food has declined from 32 per cent in 1970 to 23 per cent in 1996. An important growth area in retailing is not the provision of fresh produce, but rather the sale of prepared and partly prepared food lines. Time-pressed consumers in many markets are paying for food convenience. This trend is giving greater commercial power to food processing and retail chains rather than to commodity marketers. In turn, the bargaining position of farmers is lessened.

**Decreasing terms of trade**

Real prices for agricultural products display a declining trend greater than real prices of agricultural inputs. This is known as the cost price squeeze or the declining terms of trade. The Australian Bureau of Agricultural and Resource Economics (2002) predicted the downward trend in the terms of trade for primary producers to continue, falling a further 20 per cent over the next five years.

**Deregulation of markets**

As part of their quest for cost-savings and commitment to ‘free market’ solutions various Australian governments have moved away from market interventions by removing subsidies, reducing tariffs and removing price guarantees. Direct government involvement in commodity marketing has lessened. The guaranteed minimum price scheme for wheat, the reserve price scheme for wool and market milk pricing arrangements no longer apply, exposing primary producers to more direct market signals and price risk. Fuelling the withdrawal of direct government involvement in agricultural marketing was the Council of Australian Governments (COAG) endorsement in 1995 of the Competition Principles Agreement drawing on Hilmer et al. (1993). All Australian governments were committed to review, by the year 2002, all legislation that restricts competition. This places additional pressures on some agricultural industries to improve their productivity, efficiency and marketing ability. It encourages the exodus of some farm families and a shift toward larger production units employing greater mechanisation.

**Decline in the relative importance of agriculture in the nation’s economy**

As an economy develops, technological change and increased productivity contribute to rising income levels. Through time, there is typically a decline in the relative importance of agriculture and an increase, first in the relative importance of manufacturing industries, and, later in service industries. This does not necessarily mean that the actual agricultural output declines, rather that agriculture grows less rapidly than other sectors of the economy. This is a phenomenon occurring in
all developed countries that usually leads to a diminished relative importance of rural production and often a decline in the political power of the farm vote.

Queensland and Western Australia are forecast to have the highest economic growth rates of all Australian States over the next 15 years or so\textsuperscript{12}. In Western Australia energy and mineral production, urban housing and infrastructure and growth in the services sector are predicted to be the main sources of growth. As a result the economic role of the agricultural sector will diminish in relative economic importance.

Farmers have responded to these economic challenges by adjusting their input and enterprise mix, adjusting household expenditures, investing off-farm, maintaining high equity and increasing their production efficiency and scale of operations. Many farmers, particularly those managing large operations, increasingly rely on professional consultants to assist with enterprise, financial and marketing management. Most farm businesses employ new technology and research and development findings and innovation to increase productivity and profit. In coming years, profitable agricultural businesses are likely to be characterised by:

- either maintained diversification of enterprises (cereals, pulses, oilseeds, pastures, livestock, fodder shrubs and off-farm investments) or specialist, capital-intensive ventures (poultry, dairying, viticulture);

- production growth from yield improvement with a restricted increase in the proportion of the landscape sown to crops (grain and fodder). Biotechnology, not just transgenic technology, particularly in the plant sciences, will underpin productivity improvement and new product development. Market acceptance of some biotechnologies, once increasingly negative\textsuperscript{13,14} will improve with emergence of crops offering health and environmental benefits;

- revenue growth based not only on productivity improvement but also on production of commodities that attract price premia. Most large agricultural businesses will maintain their emphasis on exports, productivity improvement, product and market development. Farmers will continue to invest in improvements in technical and scale efficiency, and pursue input and product innovation. Increasingly farmers will share as equity partners in the development and application of new technologies. Farmers will also participate contractually in supply chains, and at times be an equity partner in those chains;

- greater commitment to sustainable farm practices due to regulatory and market pressures. The commercial world of agriculture will increasingly involve quality assurance, identity preservation, environmental and supply chain management and food safety;

- an ability to accommodate business risks. An increasing source of price and production risk will be risks surrounding contract and marketer relationships and sudden changes in consumers' perceptions of food health, safety and environmental impacts;

- greater use of contract services (eg machinery management, plant and animal health services, information management services, labour training and management);

- greater dependence on electronic technology\textsuperscript{15} and electronic management;
• greater dependence on strategic, co-ordination and business skills of agricultural managers as businesses become larger and more complex.

To ensure that agricultural businesses remain profitable will require the following issues to be addressed:

• Making the social and personal life on the farm attractive to the next generation of farmers. There is currently a cocktail of influences that militate against a welcomed familial succession in farming. Many rural towns cannot offer the social vibrancy of larger centres and urban areas. As family size decreases and children spend more years off-farm in formal education, the probability of children wanting to return to farming may be diminishing. Further, as farm size increases and farming systems and farm businesses become more complex, more sophisticated management will be required. More production and marketing alternatives, more input options, more combinations of production systems, an increasing array of opportunities for new technologies and more off-farm investment opportunities all increase the demands and stress on management. Children in farm families may see this stress first-hand and choose other career options.

Historically, most farm families were willing to sacrifice their standard of living and some personal enjoyment for the good of the business. In the future, this may be less common. The combination of high equity of many farm businesses, smaller family size, family break-up pressures and more investment choices outside the business, may mean a finer balance will have to be maintained regarding the financial and social viability of the farm business. If the farm business does not provide a standard of living within desired family obligations and aspirations then the long-term legacy of the family business may be in doubt.

• maintaining the flow of innovation that ensures farm products (and transformed agricultural products) remain competitive on local and international markets. A main influence on broadacre farming in the next two decades is likely to be biotechnology that will provide plants with new traits such as herbicide or pest resistance or quality enhancements. Much of the technology that underpins the development of these plants is, or is likely to be, subject to intellectual property right protection. For example, Figure 2 shows the escalation in plant patent applications to the US Patent and Trademark Office since 1963.
Ensuring WA farmers and local and interstate researchers have access to new technologies at reasonable prices and that they can be applied to WA crops and local farming systems may become an important issue. Often new technologies are expensive to develop and require significant investments in human capital and R&D infrastructure. Whether governments and farmers are able to afford these necessary investments in biotechnology development and application in future years is also an important issue that will effect the commercial sustainability of agriculture. An example of this biotechnology is the development of BarleyPlus™ by CSIRO. This is barley with high betaglucan, a low glycaemic index and high resistant starch. These characteristics mean the barley delivers health benefits to protect against cardiovascular disease, diabetes and colon-rectal cancer.

Ensuring that farmers participate in product transformation rather than simple, low-cost commodity production is an innovation challenge. Developing niche products or differentiated products, regional brands and eco-labelling are all examples of innovation that assist agriculture to be more sustainable.

- **Traceability.** The ability to manage and trace inputs and outputs of the farm business is likely to become an increasingly important feature of farm management. Food safety, identity preservation and environmental concerns will dictate the need for this form of management.

- **Effective networks.** Farmers will need to be networked with neighbours, agri-business and industry in order to capitalise on market opportunities and ensure their views are represented in policy-making.

- **Farmer training and education.** The portfolio of enterprises in many agricultural businesses in the future will, in many cases, be greater. The switch in relative emphasis between various enterprises may be more rapid and the demands on management, knowledge and skill will be greater. Accordingly, 'whole-of-life' learning will be needed if farmers are to capitalise on opportunities or protect the profitability of their businesses.

### Challenges to the conservation of the environment

Historically, agricultural development in Western Australia was underpinned by the release and clearing of land for agriculture, with agricultural technology and innovation further boosting production and farm profit. However, land release ceased following the severe drought of 1969 and questions were raised about the suitability of farming in marginal lands. Gradually, concerns began to be raised about other impacts of traditional farm practices on farmland.

Such is now the awareness of environmental issues that farm practices will increasingly be influenced by environmental quality and landscape amenity concerns. In some international markets, mainly Europe, environmental concerns are increasingly likely to be used as a trade barrier, requiring incoming agricultural goods to be produced in ways that verifiably do not harm their environment.

#### Land resource quality

Salinity and soil acidity are topical issues in Western Australia. The first national State of the Environment report identified extensive deterioration of natural resources through dryland salinisation, particularly in Western Australia. Nulsen and Evans estimated the agricultural area
affected by salinity in Western Australia in 1996 was 1.8 million hectares. A significant further proportion of the rural landscape is at risk from rising saline water-tables (see Figure 3).

Besides farm land, rural infrastructure, waterways and bushland were also recognised to be affected by salt. Other land quality issues were raised such as loss of soil structure, water-repellence of some soils, waterlogging, wind erosion, traffic hard-pans, deterioration in remnant vegetation and nutrient run-off causing pollution problems.

The use of land for growing traditional annual pastures for sheep production came under criticism. McFarlane and George, for example, considered that grazing sheep on annual pastures in the woolbelt was not ecologically sustainable. They said:

“...shallow-rooted annual pastures contribute to widespread salinity in the area, annual legumes are acidifying the soils and making them water repellent, and bare, detached soils from heavy grazing cause sheet and rill erosion during autumn storms. To counteract this degradation, the woolbelt needs more perennial pastures and deep rooting crops, fodder shrubs and trees. Only then can it become sustainable in both economic and conservation terms.”

Figure 3: Predictions of salinity risks to WA agricultural areas in 2020
**Biodiversity**

Already it is known that among OECD countries, Australia has a higher percentage of threatened mammals than USA, Japan, Finland, Ireland and Norway and a high number of extinct and threatened plants.† Land use, mainly for agriculture, has caused nearly 90 per cent of temperate woodlands and mallee to be cleared and replaced mainly with annual crops and pastures.

Currently 60 per cent of birds and 80 per cent of mammals, listed as threatened, have suffered habitat loss. Also introduced pests and weeds are affecting not only agricultural production but also bushland, reducing its native flora and fauna. Yet over 70 per cent of international visitors to Australia identify the main reasons for their visit as the unique flora and fauna and the open landscape.37

**Greenhouse gas emissions**

Agriculture is the second biggest contributor to greenhouse gas emissions through its emissions of methane and nitrous oxide‡. The National Greenhouse Gas Inventory estimates that agriculture contributes approximately 27 per cent of total national greenhouse emissions, although in Western Australia agriculture is estimated to contribute approximately 32 per cent of State emissions.

Savanna and temperate grassland burning emissions, as estimated for WA, largely account for both the relatively high contribution by agriculture to the State’s emissions profile and to agriculture sector emissions growth. In 1999 savanna burning emissions accounted for 40 per cent of WA agriculture sector emissions. Nationally, savanna burning represented only 14 per cent of agriculture’s emissions. Livestock contribute approximately 60 per cent of emissions from agriculture.

Concentrations of methane and CO₂ have increased rapidly in the last 150 years (see Figure 4). Much of this increase is attributed to human activity, particularly the clearing and burning of vegetation and the use of fossil fuels.

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† see the IUCN red list of threatened species at http://www.wcmc.org.uk

‡ carbon dioxide emissions are not accounted for as international inventory methodology assumes there is balance between uptake and emissions in agriculture crops and pastures, and for livestock.
Figure 4: Changes in the concentrations of methane and CO₂ over the last 1000 years

**Climate change**
Climate change, arguably due to greenhouse gas emissions, is forecast to greatly affect agriculture by causing:

- Decrease in autumn rainfall, implying a later start to growing seasons, while the forecast decrease in spring rainfall will curtail growing seasons. Combining these rainfall changes with expectations of increased evaporation suggests growing seasons will be shorter.
- Warmer winters and springs, combined with higher CO₂ concentrations, may increase crop yield, even under declining rainfall. However, grain protein may decrease under higher CO₂ levels.
- Rising temperatures (see Figure 5) have implications for all agricultural crops via potentially large changes in heat or chill accumulation and the frequency of temperature extremes. A potential benefit for grain and horticulture crops would be the reduced risk of frost. However, conversely more hot days during grain or fruit filling could reduce yields. Tree crops are particularly sensitive to temperature trends because of the longer lead times associated with their establishment and development compared with annual crops. Those currently growing at the warm margin of their climatic range will likely face reduced cold accumulation and increased heat stress. Adaptation will require a wider range of available varieties.

![Figure 5: Global temperature trends, 1860 to 1999.](image)

- Decreased pasture production and lower milk yield for the dairy industry at higher temperatures. Other animal husbandry issues will also change under a warmer climate.
- Decreased rate of spread of salinity under a drier, more evaporative climate. However, daily rainfall events over summer are projected to become more intense, and this might lead to increased episodic recharge.
• Changes in the daily rainfall distribution affecting on-farm water storage. Although the intensity of events might increase, so will the period between rain events. Combined with higher evaporation rates, it is likely that storage capacity would need to be increased.

• More frequent extreme weather events (e.g. consecutive days of extreme heat, severe thunderstorms) that will affect rural and urban communities and cause crop and stock losses.

• Increased risk from insect pest and weed competition. Higher temperatures are favourable to many insects, though their ultimate activity will be dependent on any changes to summer rainfall. A warmer climate might also favour many plant diseases.

• Possible extinction of native species with restricted climatic ranges.

However, as many of the effects of global warming on agriculture are gradual, it is expected that incremental technological improvement and plant breeding improvements will lessen the severity of many of the main impacts for agriculture.

**Water availability**

Future development of agriculture and thus regional economic growth will be dependent on continued access to water resources. Yet already climate change is thought to be a main cause of the observed 50 per cent reduction in run-off into public reservoirs in the South West. Recharge to groundwater supplies has also reduced. Since the mid-1970s streamflow into Perth dams has fallen (see Figure 6).

![Figure 6: Annual streamflow into Perth’s water supply dams](image)

*Source: Water Corporation*
About 45 per cent of WA’s water use is for agriculture compared with around 30 per cent for mining and industry. Irrigation use of groundwater is about 300 giga-litres per year with over 90 per cent of this occurring in the Perth groundwater division\textsuperscript{9}.

Irrigation water use will come under increasing pressure from competing uses such as public water supply and industrial use. Agriculture will also be under scrutiny in regard to its efficiency of use of water, its water allocations, its receipt of cross subsidised water supplies (e.g. Comprehensive Water Scheme) and its impacts on water quality through salinisation and nutrient export.

**Food safety**

Highly publicised food safety breakdowns and the emergence of genetically modified (GM) food ingredients have fuelled consumer concerns over food health in recent years. Governments have responded to these consumer concerns by increasing the regulation of the production, processing and importation of food\textsuperscript{38,39}. Retailers also have responded, particularly in Europe and North America, by implementing production contracts, identity preservation systems and quality assurance systems that effectively guarantee food quality across the food supply chain\textsuperscript{40,41}.

In Europe a standard known as EUREP-GAP\textsuperscript{42} has been developed by a working group of retailers, suppliers, growers, importers and food service personnel. It is a HACCP-based system to accredit good agricultural practice. Although first applied to the fresh produce sector it is to be extended to other crops, livestock, floriculture and feed production. Some retailers have announced that all suppliers will need to be EUREP-GAP accredited by 2004.

Increasingly, individual farmers and whole agricultural industries are introducing quality assurance systems so that the quality and safety of their product more closely matches consumer requirements\textsuperscript{43,44}. In Western Australia, farmers, marketers and government agencies are collaborating to establish quality assurance systems for a range of agricultural products\textsuperscript{45}. These systems will enhance food safety and minimise environmental costs by ensuring ‘best practice’ production systems are implemented. Risks of chemical contamination will be lessened, food spoilage reduced and food chain problems will be more readily identified. As consumers become more interested in food quality and safety, increasingly quality assurance and supply chain management systems will be employed to guarantee the nutritional integrity of food products.

**Pest and diseases**

As a biological process, food production is always exposed to pest and disease threats. Current agricultural systems use a variety of management approaches in lessening the impact of diseases and pests. Many approaches rely, to varying degrees, on the use of chemicals. However, a number of plant and animal pests and diseases are expressing increased tolerance to chemical control methods, threatening the productivity of agricultural systems. Even GM plants that offer disease or herbicide resistance will have a limited life due to the likely emergence of weeds resistant to herbicides and pests resistant to pesticides.

There is also the likelihood that exotic weeds, pests and diseases could establish themselves in Western Australia, threatening many existing agricultural systems. The ease of overseas and interstate travel and the volume of goods transported around the world mean the risk of disease and pest incursions is likely to increase. Already some agricultural industries have been exposed to

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\textsuperscript{9} The Perth groundwater division is one of the most stressed in terms of percentage of available water allocated
significant disease and pest threats (e.g. anthracnose in lupins, apple scab, Queensland fruit fly, skeleton weed in broadacre crops).

Exotic vermin (e.g. foxes, rabbits and wild cats) and weeds (e.g. bridal creeper) once established are known to greatly threaten native wildlife and natural habitats, so surveillance and control of pests and diseases will have ramifications not only for farm businesses but probably also for natural environments.

In Western Australia the central issue is how to ensure greater stewardship of land, water and remnant vegetation resources by farm and non-farm communities. These communities need to rely on, utilise and protect those resources without degrading their value. To achieve that outcome cost-effectively and fairly is a major challenge.

In summary, the greatest impacts on Western Australia's natural environment in coming years are likely to come from causes mostly outside local immediate control (e.g. climate change) and from past patterns of land management (clearing of land for agriculture based on annual species) that will generate a range of negative impacts. Species depletion, habitat loss, salinisation and threats to water catchments and infrastructure are all examples of challenges to sustainable agriculture and the natural environment. Rising to these challenges will require a variety of responses that draw on local, national and international initiatives.

RESPONDING TO CHALLENGES FOR SUSTAINABLE AGRICULTURE

Maintaining and building market share and international competitiveness, increasingly will require agricultural industries to demonstrate that community and political expectations are met with regard to sustainability issues, particularly those regarding environmental impacts, animal welfare and food safety. The sustainability of agriculture in the medium term will depend on its management of farm resources and the better integration in farm decision-making of the beneficial and adverse off-site impacts of agricultural activity. The sustainability of agriculture will also depend on how issues beyond the farm gate, such as urban greenhouse gas emissions or subsidisation of agriculture in major economies, are addressed.

The following sub-sections discuss some means of responding to those issues. The list of desirable responses is not exhaustive but indicates part of the way forward in developing sustainable farming. market-based approaches; agricultural and environmental research and development; accelerated adjustment; and global and national initiatives.

The draft report on a sustainability strategy for Western Australia⁴⁶, released in September 2002, commented on agriculture that:

“... there are very real and significant challenges to achieving sustainable agriculture in Western Australia, as there are in many parts of the world. Shifting agriculture to a more sustainable basis will require continued innovation to develop new industries which do not impact the environment and new policy settings that recognise and reward sustainable agricultural production (p.11).”
Market-based approaches

As a provider of environmental services, agriculture could benefit from policy changes that facilitate the establishment of markets for environmental services. For example, establishing a market of carbon credits, underpinned by a carbon accounting system, will assist agriculture to adopt enterprise mixes that either store more carbon or which reduce farm greenhouse gas emissions. The draft report on a sustainability strategy for Western Australia also recommends further investigation of other market-based approaches such as biodiversity offsets, integrated ecosystem services trading, tax incentives and environmental stewardship rebates.

Various State and Federal government departments are involved in a range of pilot studies of environmental service markets. Eventually it is likely that some markets in some settings will become established to improve the sustainability of agriculture. These markets will ensure that environmental consequences, positive and negative, are more strongly factored in to farm management and marketing decisions.

With future markets expected to place greater emphasis on quality assurance, production certification, identity preservation, environmental amenity, supply chain management and food safety, the opportunity exists to develop audited best management practices to position agricultural firms for future commercial realities.

The Department of Agriculture and agribusiness firms have provided significant technical support to farmers over a number of years and these same groups, in consultation with farmer groups and marketers, are able to develop best management practices (BMPs) for farmer groups and individuals. BMPs often assist farmers to be more commercially and environmentally sustainable. To be effective, BMPs need to be robust, consistent and meet standards that transparently demonstrate the pursuit of sustainable agriculture.

The following are some current examples of developments in WA agriculture that are based on BMPs or which include BMPs:

(i) The Department of Agriculture is currently developing BMPs for irrigators in the South West Irrigation Area. The approach compares an environmental situation analysis with an audit of industry practices so that practices that pose the greatest environmental threat can be identified and corrected. The essential or priority features of farm or enterprise management are then incorporated in the set of BMP.

(ii) For the past 20 months the Mingenew-Irwin Group has been working on an environmental equivalent to Quality Assurance (QA) through testing the application of an Environmental Management System (EMS). Like QA, an EMS is an auditable system which is used to prove to a third party a particular level/ type of management. But where QA focuses on food safety and quality an EMS focuses on a business’s environmental impacts.

** The Mingenew-Irwin Group (MIG) is a farmer driven organisation formed in 1997. The Group has a strong environmental focus but also farming system development and the education/up-skilling of its membership. Numerous agricultural companies support the Mingenew-Irwin Group, with sponsors including Elders, Nufarm, Aventis, AWB Ltd and the WA Department of Agriculture.
At this stage the Mingenew-Irwin Group members will be able to undergo EMS training from early 2003, so that the environmental module can be added to their QA program. Once a number of growers have been trained the next step will be identifying market niches which may see premiums paid for QA and EMS. Already several marketing organisations have indicated their support.

The significant outcome of this process is that the Mingenew-Irwin Group members will remain at the cutting edge of the industry. Adoption of QA and EMS will place growers in a position whereby they are ready to respond to market signals, changes and requirements.

(iii) For the past two years the Grain Pool, which mainly markets lupins, barley and canola, has encouraged grain growers to undertake QA certification. Some of the markets they service require or will require QA certification. The QA accreditation process involving farmers receiving joint training in Great Grain and SQF 1000CM certification. Around 245 grain growers in Western Australia completed their QA certification in 2001.

(iv) Pastoralists in the Gascoyne-Murchison region are formulating and coordinating a number of sustainability initiatives as part of the Gascoyne-Murchison Strategy (GMS). The GMS comprises four core programs, one of which is a regional environmental management program. The aim of this program is to improve natural resource management at the paddock scale through to a regional scale. Initiatives under this program are helping the pastoral industry prepare for future change and ensure the industry is accountable for its use of public resources. The pastoral industry is in the process of constructing a management framework that demonstrates responsible production to industry stakeholders and consumers.

The framework will provide a QA approach to enterprise management that clearly defines management objectives across a range of themes including financial, social, environmental and legislation. By June 2002, each of the participating pastoral stations was to have had their management system independently audited, after which they will have a foundation for launching a credible ‘clean, green’ marketing program. Environmental mapping has helped the managers to work towards ecological sustainability and ensures they are producing ‘green’ products. QA certification ensures they are controlling critical product safety and quality hazards and producing ‘clean’ products. It also enables their ‘clean, green’ claims to be independently verified.

(v) The Fitzgerald Biosphere project is a set of collaborative activities that aims to protect a unique natural environment and improve the sustainability of a region that includes agriculture. The project is in its infancy but is a demonstration as to how community, conservation groups, government and business can work together in the pursuit for sustainability. These groups have come together to develop the idea of the biosphere.

The Fitzgerald Biosphere reserve is one of 12 areas in Australia identified as an area of significant biological diversity closely linked with economic activity. The Fitzgerald and Bookmark Biospheres are the only two that recognise and attempt to exploit the potential of such a partnership. The Fitzgerald region has traditionally relied on agricultural industry for its community and economy, yet the region includes a natural environment of marked diversity. The Fitzgerald Biosphere project seeks to promote the significant value of the biosphere reserve, particularly its terrestrial and marine diversity, and its role as a place for recreation and as a source of future livelihoods.
Primary production will remain as part of the biosphere community but emphasis will be placed on undertaking primary production that is sensitive to the needs of the natural environment. Primary producers in the area recognise the marketing niche this may create and are currently investigating the idea of branding. A Biosphere Reserve label has the potential to attract investment into the community, provided investors can see integrity in the operations undertaken in the biosphere. The community is interested in shifting away from its reliance on primary industry by developing tourism, eco-tourism and other industries to diversify and expand the local economy.

**Research and Development**

Historically, research and development (R&D) has generated new products and innovations either to solve a range of problems or to provide new opportunities. R&D will be a main means for developing new industries and innovations that are both profitable and less damaging to the environment and thereby will promote the sustainability of agriculture. Traditionally agricultural R&D mostly has sought to boost production. However, if agriculture is to become more sustainable then environmental and social considerations increasingly will need to be imbedded in the earliest stages of R&D training, prioritisation and funding. In short, rather that attach a sustainability spin or angle to existing R&D findings, the R&D efforts need to be co-ordinated and informed by social and environmental considerations at the outset. Examples of research areas and innovations that will bolster the sustainability of agriculture are:

- **Tree crops** (e.g. tagasaste, blue gums, oil mallees, maritime pines). Tree crops compete against annual crops and pastures for land use in agricultural areas. The sustainability advantages of tree crops are that being deep-rooted they lessen recharge and thereby combat salinisation. They act as carbon sinks and help reduce concentrations of greenhouse gases. They add to enterprise diversity in rural regions and, in some cases, may provide additional employment opportunities. Improving the relative profitability of tree crops to the point where they become a dominant part of the agricultural landscape will add to the sustainability of agriculture.

- **Soil amelioration** (liming, controlled traffic, gypsum, contouring, claying). Improving or ameliorating the degraded soil resource by chemical or physical means will promote the sustainability of agricultural activity. Soil acidity can be managed through liming and species selection. Contouring can reduce soil erosion and improve water management across rural landscapes. Gypsum can improve soil structure in hard-setting clays and facilitate crop establishment. Claying can improve the water-holding capacity of soils.

- **Deep-rooted pastures** (e.g. balansa clover, lucerne). These species offer the potential to reduce recharge and lessen the rate of onset of salinisation. These pastures could form a useful complement to other feed sources. As the area of salt-affected land increases and saltland pasture species grow in importance then finding low-cost complementary feed sources, such as deep-rooted perennials, may also become important.
- Precision farming. This involves developing and applying technologies that recognise, interpret and inform the management of spatial variability. It offers the potential to reduce waste in applying inputs and to improve the timeliness and effectiveness of input use. Hence, problems such as chemical leaching, spray drift, feed losses and over-grazing can be reduced. Enterprises can be better matched and managed according to spatial characteristics such as soil characteristics, stored soil moisture levels and weed burdens.

- Raised bed practices and drainage. Improvements in these technologies will prolong or boost the profitability of agricultural activity. An issue for drainage, however, is ensuring that drainage discharge from farms does not harm downstream natural environments.

- Options for “living with salt”. Low cost de-salinisation technologies, saline aquaculture and more productive saltland pasture species are all examples of responses to saline environments that may deliver more profits to farm businesses.

- GM technology that delivers farming system, environment and consumer health benefits. Using this technology to reduce herbicide and pesticide use, to reduce applications of artificial fertilisers and to provide health benefits to consumers will provide benefits to rural communities and the natural environment. The technology also offers the opportunity to better service niche markets by increasing the opportunity to grow varieties with specific characteristics.

- Controlled traffic can restrict the development of soil hard pans, reduce fuel use and facilitate crop growth.

- Weather and climate forecasting. Increasing the accuracy of weather and climate forecasting facilitates risk management by farmers. It enables farmers to undertake farm operations with greater certainty of their outcomes and provides farmers with tactical and strategic opportunities to capitalise on weather events or climatic trends.

- Pest and disease control. Boosting the effectiveness of pest and disease control can generate benefits to farm businesses and/or bestow benefits to the natural environment. For example, better control of foxes and rabbits can benefit farmers and the natural environment. Improving disease and pest resistance in farm animals and plants can reduce production losses and increase farm profits. Increasing the effectiveness of quarantine barriers can also benefit farmers, rural communities and the natural environment. Disease outbreaks such as foot and mouth or BSE are known to have large adverse impacts on rural industries so minimising the risk of entry of such diseases is extremely important.

- Communication technology. As farm management increases in complexity and as the population density of some rural regions lessens then communication services will become increasingly valuable. Accordingly, fast, reliable and affordable information and communication services will become a pre-requisite for sustaining rural businesses and regional communities.

Who should fund this R&D and how it should be funded are important policy and practical issues. There is a large body of literature that outlines the principles of resolving these issues. To fully describe those principles and apply them to the R&D agenda listed above is beyond the scope of this discussion paper. Suffice to say, there is likely to be a role for farmers and governments, as
beneficiaries of the R&D, to contribute to its funding. There is also a need to assess R&D initiatives to ensure their technical feasibility and economic desirability.

**Accelerated adjustment**

In some situations the sustainability of natural environments, agricultural businesses and rural communities will only be achieved by accelerated adjustment with greater regulation and co-operation. Accelerated adjustment is usually in response to national, state, regional or local community pressures. One well-known example in WA is the cessation of logging old growth forests.

Community concerns about the natural environment are increasingly being reflected in government policy and regulation. For example, under the Environmental Protection (Amendment) Bill 2001, introduced to Parliament in 2002, it will be an offence to cause environmental harm. In defence, proof must be provided that approval was given to undertake the activity. Alternatively the defendant must prove they were operating under a code of practice endorsed by the Department of Environmental Protection or by the Agricultural Practices Board under the Agricultural Practices (Disputes) Act 1995.

Options to accelerate change in WA rural regions are:

(i) establishing enforceable sustainability targets for various agricultural and urban regions. Communities in each region would need to prioritise and co-ordinate their actions to ensure targets were met (this is now a national policy initiative under the National Action Plan for Salinity and Water Quality);

(ii) creation of wildlife corridors by imposition of land use planning regulations involving land purchase and/or compensation payments;

(iii) identifying high value natural environments and targeting public and private funds to protect these areas;

(iv) introducing environmental cross-compliance for government assistance to agricultural industries;

(v) providing payments for particular environmental outcomes;

(vi) fostering eco-labelling and “land welfare” accreditation of agricultural practices;

(vii) encouraging farm businesses to be equity investors in farm product value-adding activity; and

(viii) developing regional brands to advance the prosperity and industrial diversity of unique rural regions.

Accelerated adjustment requires a just process for achieving desired landscape scale changes. If, for example, farmers are required to reduce their greenhouse gas emissions, then the main initial focus would be on reducing burning in the rangelands, reducing emissions from livestock and reducing artificial nitrogen. Implementing the required changes would differentially affect rural businesses. Establishing transitional arrangements and reducing inequities, while generating the required adjustment would be a major policy challenge, yet may stimulate new opportunities such as carbon trading with commercial timber plantations, biomass production and alley farming.

Accelerated adjustment will be supported by developing regional targets for sustainable resource use and incorporating them into regional natural resource management plans. This will help inform the priorities for public expenditure on accelerated adjustment.
Planning regulations may need to be altered to promote more environmentally benign land management practices. Local governments, for example, could incorporate regional sustainability priorities into their town planning and land use schemes.

**State, national and global initiatives**

A number of conventions, declarations, agreements and programs have been endorsed by national and State governments. In combination these agreements and programs will influence or direct the sustainability of agriculture. Those that are applicable to agriculture are listed below.

**National Action Plan for Salinity and Water Quality, 2000.** Its goal is to motivate and enable regional communities to use coordinated and targeted action to:

- prevent, stabilise and start to reverse trends in dryland salinity affecting the sustainability of production, the conservation of biological diversity and the viability of our infrastructure; and

- improve water quality and secure reliable allocations for human uses, industry and the environment.

**Natural Heritage Trust.** The Commonwealth Government has committed $1 billion over five years to consolidate and continue the achievements of the first phase of the Trust, established with $1.5 billion from the partial sale of Telstra.

**Rio Declaration on Environment and Development, 1992.** It is a statement of higher order international principles in policy making. Includes recognition of sustainable development - not compromising the environment and resource base of future generations, recognising the interdependence of environment, development and security, actively integrating economic and social policies, preserving ecological integrity, and employing the precautionary approaches.

**Convention on Biodiversity, 1992.** Its overall objectives are the conservation of biological diversity, sustainable use of its components and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources. It provides a framework for global action to conserve and use biological diversity in a sustainable manner. It addresses the full range of biological diversity at genetic, species and ecosystem levels in all environments. It employs the precautionary principle as its guiding concept, with each country being responsible for the conservation and sustainable use of its biological resources.

**National Strategy for Ecologically Sustainable Development, 1992.** Its core objectives are to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations; provides equity within and between generations; protects biological diversity and maintains essential ecological processes and life support systems.

**Intergovernmental Agreement on the Environment, 1992.** This seeks to facilitate a coordinated approach by the three tiers of government and operates on four main principles: the precautionary principle, intergenerational equity, conservation of biological diversity and ecological integrity; and improved valuation, pricing and incentive mechanisms.
National Strategy for the Conservation of Australia's Biodiversity, 1996. Its goal is to protect biological diversity and maintain ecological processes and systems. It aims to bridge the gap between current activities and those measures necessary to ensure the effective identification, conservation and ecologically sustainable use of Australia's biodiversity.

National Water Quality Management Strategy, 1992. This provides a basis for improving the whole-of-government management of water resources. Its objective is to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development. This is now underpinned by a State strategy.

National Water Resource Policy, 1994. In 1994/1995 the Council of Australian Governments (COAG) agreed to reform water policy with the intent of separating water rights from land rights, increasing the reliance on market mechanisms for water allocation, ensuring that water is available for maintaining natural resources and the environment and ensuring the sustainable use of an increasingly scarce resource amongst uses and users. Currently Western Australia is completing its policy for water reform.

National Dryland Salinity Program, phase II, 1998. This focuses on researching, developing and extending practical approaches to manage dryland salinity effectively across Australia. It targets development of understanding and tools that will support on-ground works financed by other programs. It also targets development of best practices by land managers.

National Weeds Strategy, 1997. It takes a strategic approach to weed management problems of national significance, addressing environmental and agricultural weeds equally. The NWS describes the nature of the problem, discusses why existing weed management measures are not adequate and lists the roles and responsibilities of government, community, landowners and land users.

State Weed Plan, Western Australia, 2001. This plan is broad and over-arching, and seeks to raise the awareness of all Western Australians of weed problems. It provides opportunities for community involvement in weed management through integrated and prioritised programs. Support services for landholders and community actions are also included.

The Kyoto Protocol, 1997. This is an international treaty under which developed countries have agreed to limit net greenhouse gas emissions. Australia and the United States have decided not to be signatories to this treaty.

State Bioenergy Policy (Draft), 2002. The Cabinet Standing Committee on Environmental Policy is developing a State Bioenergy Policy.

All these agreements and programs will affect the sustainability of agriculture to various degrees. If global environmental issues become incorporated more frequently in national agendas then their influence will become more pervasive.

CONCLUSION

There are three main outcomes of sustainability for the rural sector: vibrant agricultural communities; profitable agricultural systems; and conservation of the natural environment. To consistently promote all three is a difficult task, for often they are not mutually inclusive. At times
there is a requirement to trade-off what may be a short-term business or community advantage, in return for longer-term environmental benefits for future generations.\textsuperscript{58}

The process of generating sustainability will involve governments, businesses and communities. Each has a role in promoting and influencing sustainability. Communities have a role in:

(i) helping define the criteria for sustainable agriculture,
(ii) defining areas of the public resource that need protecting;
(iii) providing local experience, practical knowledge and support for adoption of sustainable management;
(iv) being consumers who, by their purchases, provide feedback to producers and government about what products and production methods and accreditations, are valued by them;
(v) being citizens who, by their observation and experience, provide feedback to producers and government about the progress in improving the sustainability of agriculture.

Industry and agribusiness have a role in:

(i) raising awareness of the opportunities for and threats to sustainability;
(ii) promoting and improving sustainable management practices and land use systems;
(iii) supporting land managers with the skills, knowledge and values to adopt sustainable production systems; and
(iv) raising community and government understanding of the impacts on agricultural industries of policy and innovation for sustainable development.

Governments have a role in:

(i) identifying and protecting priority public assets, including natural environments;
(ii) research and development that ordinarily would not be funded by agricultural industries or agribusiness yet which represents high return to the community and which protects or improves natural environments or community assets;
(iii) resource assessment and monitoring that generates information for use by all tiers of government to assist in planning, reporting and policy formulation;
(iv) education and communication. Increasing the knowledge of all members of society helps ensure that decisions are based on sound knowledge and credible analyses. Communicating research findings, the outcomes of monitoring, and options for policy also helps properly informed decisions to be made;
(v) building and maintaining the institutional infrastructure (e.g. law-making, property right protection, regulation enforcement) upon which societal action depends;
(vi) policy formulation and implementation. Governments are appointed to satisfy political need: including the need for policy leadership. Governments are expected to generate policies that ensure economic well-being, that natural resources are used sustainably and that communities are supported.

This discussion paper has outlined a number of challenges to the sustainability of agriculture in Western Australia. It has discussed some main means to address these challenges. No single response is likely to be appropriate. Rather a portfolio of approaches and activities, on a range of scales, is likely to be necessary to ensure that the agricultural sector improves its sustainability. The outcomes of improvements in sustainability will benefit the farm and other sectors, rural and urban communities, and the natural environment.
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