Drivers of Structural Change in Australian Agriculture

Rural People and Learning Systems R&D Program
Foreword

This report provides an overview of current and future drivers of structural adjustment for Australia’s agricultural industries. It was commissioned by RIRDC with the aim of improving understanding of the drivers of structural adjustment among policy makers and industry stakeholders, so that they can design policies and programs to prepare farm owners, managers and regional communities for dealing with the pressures of change.

The report highlights three further research and development priorities for Australia’s rural industries:
- the need for ongoing improvements in competitiveness
- the pursuit of technical innovations throughout the supply chain
- enhanced flexibility so that farm areas will enable the agricultural sector to maintain profitability and continue making a significant contribution to the Australian economy.

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This report, an addition to RIRDC’s diverse range of over 1600 research publications, forms part of our Human Capital, Communications and Information Systems R&D program, which aims to enhance human capital and facilitate innovation in rural industries and communities.

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Executive Summary

What the report is about
This report provides an overview of current and future drivers of structural adjustment for Australia’s agricultural industries. It describes the ways these adjustment pressures impact on the rural and regional sectors, and options for farmers to manage these changes. The report also provides some preliminary analysis, by way of selected case studies, of the nature of specific instances of structural adjustment and possible government responses to facilitate change.

Who the report is aimed at
This report is aimed at researchers in Australia’s rural industry as it highlights priority areas of research in structural adjustment. It will also be useful to policy and decision makers for determining how to better prepare farm owners, managers and regional communities to deal with the pressures of change.

Background
Structural adjustment describes the larger and longer lasting changes in resource allocation that occur in response to changing economic conditions and is recognised as an essential part of economic growth and rising living standards. As economic circumstances and available technology are constantly changing, structural change is also a dynamic process. Ongoing structural adjustment in Australian agriculture is inevitable, and highly desirable, even though it imposes costs on some farm households and rural and regional communities. Industries and governments have an interest in minimising these costs so that the net benefits from industry change are higher.

Objectives
The primary objective of this paper is to foster an improved understanding of the drivers of structural adjustment among policy makers and industry stakeholders. The secondary objective of this paper is to present a framework that can be used to measure the vulnerability of different groups and regions to structural adjustment pressures in order to further assist with the development of effective policies and programs.

Methods
The rural livelihoods framework (Ellis 2000) identifies five types of capital – human, social, natural, physical and financial – on which rural livelihoods depend. They are affected by influences outside the individuals control and include the external drivers of structural adjustment. Using Australian Bureau of Agricultural and Resource Economics (ABARE) farm survey data, key indicators of the five types of capital were used to construct an index of the vulnerability of households in the Australian broadacre sector to adapt structural change.

Results
Structural change can occur as a result of one or a combination of factors. The factors driving structural change include:
• physical factors, for example, those relating to the supply and quality of natural resources and other factors of production
• policy induced factors, such as those emanating from government intervention to fulfill a wide range of policy objectives
• technological factors, such as innovations to raise productivity and increase competitiveness
• social factors, such as changes in people’s preferences which in turn alter consumption patterns.

These factors are mostly closely interrelated and their effects inevitably distil down to the market forces that allocate resources to their highest returning use. Some specific cases discussed in this

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report illustrate the way contemporary drivers of structural change can affect industry production, inputs and farm viability.

Regions of Australia that appear to be the most vulnerable to structural change include the western margin of the cropping areas in the wheat–sheep zone of the eastern states, as well as the more extensive grazing areas to the west of this margin. A similar but less widespread trend of high vulnerability can be seen in areas beyond the northern and eastern limits of cropping in the wheat belt of Western Australia.

Implications
The ABARE survey and analysis highlight how the notion of vulnerability can be measured using indicators of the different types of capital. Use of these can increase the capacity of farm households to cope with ongoing structural adjustment pressures. Many Australian farm households dependent on broadacre agriculture were found to lack an element or a combination of elements of the social, natural, physical and financial capital necessary for them to readily adapt to structural adjustment pressures. Defining these elements, weighted in accordance with their likely importance in determining the overall vulnerability, would represent vital information in identifying regions likely to be most affected by adjustment pressures.

This paper will assist in the development of policies and programs to better prepare farm owners, managers and regional communities for dealing with the pressures of change. This may be through investments in capacity building, research and development into new management practices or enterprise activities, information provision and extension, or programs to assist marginal producers to exit the industry.

Recommendations
It is recommended that research and development priorities for Australia’s rural industries include ongoing improvements in competitiveness, the pursuit of technical innovations throughout the supply chain, and enhanced flexibility so that farm areas will enable the agricultural sector to maintain profitability and continue making a significant contribution to the Australian economy.
1. Introduction

The forces of structural adjustment have contributed to significant change in the composition of the Australian economy. Agriculture has not been spared from these adjustment pressures which have reshaped farming as well as farming regions. The steady reduction in farm numbers through time and major changes in rural town populations, for example, are both outcomes from agricultural adjustment.

It is widely recognised that ongoing structural adjustment in Australian agriculture is inevitable, and highly desirable, even though it carries with it a range of implications for farm households and rural and regional communities. Industries and governments are interested in minimising the costs of adjustment for both individual firms and regional communities so as to achieve higher net benefits from structural adjustment.

The primary objective of this paper is to foster an improved understanding of the drivers of structural adjustment among policy makers and industry stakeholders. This will assist in the development of policies and programs to better prepare farm owners, managers and regional communities for dealing with the pressures of change. This may be through investments in capacity building, research and development into new management practices or enterprise activities, information provision and extension, or programs to assist marginal producers to exit the industry.

To further assist with the development of effective policies and programs, the secondary objective of this paper is to present a framework that can be used to measure the vulnerability of different groups and regions to structural adjustment pressures. This could be important in the identification of investment priorities and the development and delivery of targeted programs to assist in the adjustment process.

Chapter 2 of this report provides a general overview of structural change, including a discussion of the factors that can influence the pace of this change. Major trends in the Australian agricultural sector over recent years relating to farmers’ terms of trade and rates of productivity growth are also presented.

Major factors that are most likely to underpin structural change are discussed in chapter 3. These include changes in technology, changes in preferences that influence international and domestic consumer demand for agricultural products, policy induced reforms and changes in the supply of natural resources and other factors of production.

Methods for estimating potential economic impacts resulting from structural change are explored in chapter 4. Several examples are used to illustrate the potential impacts of the drivers of change identified in the previous chapter. They highlight the substantial difference in economic impacts between exporting and import competing industries.

A framework that can be used to measure the capacity of farms within regions to deal with adjustment pressures is presented in chapter 5. The results of recent empirical research to determine regions most likely to be vulnerable to structural change in Australian agriculture are also summarised.

Chapter 6 presents selected examples from the agricultural sector of different drivers of structural change. The impact of water trade reforms, land clearing regulations, the easing of restrictions on imports and changes in the wool industry on agricultural production and farm viability are explored. These case studies highlight the importance of prioritising research and development to achieve ongoing improvements in industry competitiveness, the pursuit of technological innovations throughout the supply chain and enhanced flexibility so that farm businesses and regional communities continue to adapt to change.
2. What is structural adjustment?

Economies are comprised of many individual economic agents, each aiming to maximise their welfare through the allocation of land, labor and capital across all feasible opportunities. Structural adjustment is the response of these economic agents to a shift in comparative advantage. It is the larger and longer lasting changes in resource allocation made in response to changing economic conditions and is recognised as an essential concomitant of economic growth and rising living standards (Argy 2004). As economic circumstances and available technology are constantly changing, structural change is also a dynamic process.

Structural adjustment in the various sectors of the economy mostly takes place gradually over extended periods of time, hence the bulk of the structural changes occur smoothly without causing major disruptions in terms of adjustment costs. Changes can nevertheless sometimes be abrupt and severe, resulting in significant costs for disadvantaged industries and for farm households in these industries.

Finally, structural adjustment can have implications for rural economies and regional communities because the agricultural sector’s demand for labor, goods and services, including downstream processing, changes. While these implications are noted throughout the paper, they are rarely, if ever, sufficiently important to resist the economic pressures for change. To do so would deny farm businesses and other businesses the opportunity to improve their long term profitability, with detrimental consequences for the Australian economy as a whole.

Pace of structural change

There are circumstances in which non-financial motives can serve to mitigate the economic forces in a competitive market. Some of the non-financial motives that slow the decline in numbers of small farms include a preference for a certain lifestyle and the relative immobility of skills and resources specific to agriculture. Some farm managers, for example, may supplement farm income with off-farm income so that they can continue to enjoy the farming lifestyle. For others, labor may not be perfectly mobile because of the costs associated with a change in occupation such as retraining and search costs.

Another factor that can slow structural adjustment is imperfect capital mobility. As in many other industries, investments in agriculture are sometimes irreversible in that the capital invested has a salvage value that is close to zero. Consequently, some farm businesses may continue involvement in an industry or activity even where new investments are no longer profitable. These farms may not change until the end of the economic life of the capital they’ve already invested.

In summary, quasi-fixity is a characteristic of many forms of agricultural production, resulting in slow rates of adjustment toward the long term optimal level of labor, capital and land use. Dealing with the process of structural adjustment can be difficult for some farm businesses and households because it often requires a movement away from familiar production activities or practices, or a new set of management practices and skills.

Productivity growth in agriculture

One of the most pervasive features of the agricultural sector is that it has faced steadily declining terms of trade over many decades; that is, the ratio of output prices to input prices (or what is conventionally known as farmers’ terms of trade) has decreased over time. Despite the declining trend in the terms of trade for farmers, agricultural output has been increasing (see figure A). This increase has been made possible by significant increases in productivity that have enabled producers (in aggregate) to remain profitable by lowering per unit costs of production.
Increases in agricultural productivity have enabled production, at given input prices, to expand at a faster rate than demand which is principally driven by population growth and rising incomes. As a consequence, prices for agricultural commodities relative to prices for all manufactured goods have declined significantly. Declines in input use per unit of output in agriculture (releasing more resources for use in other sectors) and relatively higher prices for other sectors’ products are largely responsible for the decline over time in the relative contribution of agriculture to the Australian economy.

In response to declining terms of trade, different agricultural industries have exhibited differential rates of growth in productivity. Building on earlier work by Knopke, O’Donnell and Shepherd (2000), ABARE has estimated farm level productivity trends in Australia’s broadacre agricultural and dairying industries in recent years. As shown in figure B, there has been a clear disparity in the rates of productivity growth between the different industries. While productivity in the cropping industries is estimated to have increased by an average of 3.6 per cent a year from 1977-78 to 2003-04, beef and dairy productivity increased by only 0.5 and 0.8 per cent respectively over the same period. Average productivity growth in the sheep industry was under 0.2 per cent a year.
Alexander and Kokic (2005) found that the significant differences in productivity growth that have occurred within each industry have mainly been a result of different structures of production among farms, and are often associated with farm size. Total factor productivity growth has been much higher on larger farms compared with that on smaller farms. Poorer productivity growth on smaller farms is largely a consequence of limited resource endowment. The most important means of generating productivity increases is the adoption of different technologies to enable feasible implementation of more efficient methods of production. To capture the full advantage of these technologies, often a minimum size of operations would be required. This has probably been the primary reason behind the observed increase in the average size of holdings in the farm sector over many years (see figure C).
3. Drivers of structural change in Australian agriculture

Structural change can occur as a result of one or a combination of many factors. The factors driving structural change include:

- social factors, such as changes in people’s preferences
- policy induced factors, such as those emanating from government intervention to fulfil a wide range of policy objectives
- technological factors, such as innovations to raise productivity and increase competitiveness
- physical factors, such as those relating to the supply and quality of natural resources and other factors of production.

These factors are mostly closely interrelated, and their effects inevitably distil down to the market forces that allocate resources to their highest returning use (Noble 1984). In this section of the paper, some of the main factors that are central to bringing about structural adjustment in Australian agriculture are discussed.

Change in technology

To remain viable in the face of steadily declining terms of trade, Australian farmers in all industries must strive for steady improvements in productivity growth. In particular, Australian productivity growth rates must match or exceed those of overseas competitors if agricultural industries are to maintain or increase international competitiveness. Larkin (2005) also pointed out that for Australia to be highly competitive in a global market, it will need to innovate throughout the supply chain.

Biotechnology is currently one of the most prospective fields of agriculture research and development. Methods such as genetic engineering have made it possible to improve plant varieties over short time periods. The extent to which biotechnology is adopted in Australian agriculture will have important effects on the future productivity and competitiveness of Australian agriculture.

Apted et al. (2005) and Abdalla et al. (2003) estimated that Australia’s agricultural industries, and the economy as a whole, could incur substantial costs if the introduction of cost reducing biotechnology is delayed or prevented while its competitors in the world market are progressively adopting such technology. Larkin (2005) also argued that, by 2006, the Australian cotton industry’s ability to compete would have severely eroded if it had rejected transgenic crops when all its overseas competitors were planting them. Instead, by opting for an early adoption of the technology, the cotton industry has positioned itself to be a world leader.

The availability of new technologies that increase enterprise productivity, or provide the avenue to alter enterprise mix or change land use, is a major driver of structural adjustment in agriculture. These technologies can take many forms, such as innovations in machinery, improved pest and nutrient management, leading edge information technology, and varietal improvements emerging from plant breeding programs and biotechnology applications.

As a new farm technology is sometimes more efficient when used on a larger scale; small farmers that are unable to employ the new technology cost effectively may lose their ability to compete. In this case, the introduction of a new technology may put greater pressure on small farms to amalgamate into — or be taken over by — larger production units. Reductions over time in the number of farms in most agricultural industries in Australia have most likely been the result of different cost structures and differential rates of growth in productivity between large and small enterprises.
Disease control at the farm–firm level

In contrast to a cost saving technology, a disease that becomes endemic raises the cost of production in the affected industry, which necessitates some degree of adjustment in resource use. The primary impact of disease on producers is the loss of commercial agricultural production. A production loss might be reflected by the reduction in output for a given level of inputs, or increased use of inputs, for the same level of output after a disease has become established.

In valuing disease costs, an affected industry would be primarily concerned with financial losses. Observed private losses could differ from economic losses (MacDonald and Crutchfield 1997). From an economic perspective, disease costs are measured in terms of the opportunity cost of inputs used in the production. Although it would be to the benefit of affected industries if governments eradicated diseases regardless of the cost, in the case of many diseases it would most likely be economically inefficient to do so.

There are two components of the total cost of disease for farmers: losses in revenue due to disease and the expenditure required to eradicate or control the disease. The higher the expenditure on measures of disease control, the lower the loss in revenue, and vice versa. In essence, there is a trade off between losses from disease and the expenditure on measures to reduce them. The economic approach in choosing disease control or eradication measures is to select the strategy that minimises income losses attributable to disease.

Many high cost producers could find their operations no longer viable when additional costs are incurred in disease management. These producers would be faced with having to either increase their efforts to reduce production costs or adjust out of the industry.

Consumer demand for agricultural products

Income growth, relative price changes, urbanisation and shifts in consumer preferences have altered consumption patterns globally in both developed and developing countries. These changing trends in consumption and expenditure have differed between developing and developed countries (FAO, 2004).

In developed countries, at current income levels, changes in diet and food purchases as a result of changes to household income are relatively small. More obvious is a greater emphasis on increasing sales of products that meet consumer demands for variety, food safety and quality as well as environmental and animal welfare attributes of production. In responding to changes in consumer preferences and their willingness to pay for varied product attributes, value adding processes to differentiate products in a way that meets the desired attributes have become increasingly important.

To meet these changing tastes and preferences, all agents in the processing and marketing chain must align their activities with consumer demand which, in turn, translates to a change in derived demand for primary commodity inputs. With respect to supply response, farmers can be expected to adjust their use of inputs to increase commodity production, most likely to meet emerging consumer demands. As a consequence, different agricultural commodities may face quite different medium to long term price outlooks, thus leading to differential rates and direction of structural change and input use within and between different agricultural industries.

In addition to changes in demand for traditional commodities, the growth in demand for products catering to tastes and preferences for products and production processes that are expected to satisfy some minimum standards can be expected to grow. An example of this can be seen in the expanding markets for organically certified food and for products that are produced at a minimal cost in terms of environmental impact and the impact on animal welfare.
In contrast to trends in developed countries, rising incomes in developing countries have a dominant and notable effect on diet composition (with relative increases in consumption of high value products) and on the overall demand for agricultural products. It is expected that developing countries will largely account for future increases in food demand through considerable growth in both population and per person food consumption (Regmi and Gehlhar 2005). In turn, this can be expected to result in higher import demand from these countries, which is likely to lead to commensurate changes in the structure of production of exporting countries, such as Australia, to meet increased global demand for food.

**Policy induced reforms**

Agricultural industries over the past few decades have undergone substantial restructuring as a consequence of the phasing out of government regulation and support. Since the mid-1980s, the government has introduced a wide program of microeconomic reform through which statutory marketing arrangements and price support schemes have been gradually dismantled. Affected industries include the wool, dairy, sugar, egg and horticultural industries. As a result of these reforms, Australian agriculture has undergone considerable rationalisation and can now be described as being significantly deregulated compared with competing industries in most developed economies other than New Zealand (with its largely unassisted agriculture).

Nevertheless, some industries remain partially or substantially protected from international competition because of Australia’s conservative approach to quarantine policy which is designed to reduce the risks of introduced diseases. Although the maintenance of a disease- and pest-free status is a priority for the Australian Government and private sector stakeholders, members of the World Trade Organisation (WTO) are likely to increasingly reduce trade restrictions in accordance with the provisions of the WTO sanitary and phyto-sanitary (SPS) agreement. Accordingly, the Australian Government is attempting to align its market access policy more closely with its WTO commitments.

Under the current Import Risk Analysis (IRA) framework, imports of a range of agricultural commodities may be permitted if issues related to the possible introduction of pests and diseases are successfully addressed. This could generate significant adjustment pressures, particularly in previously sheltered import competing industries. Consideration of the economic impact of increased import competition on local industries or regions is not a criterion used in the IRA process.

More recently, heightened awareness and a better understanding of the microeconomic reform process has been the impetus for policy change. Edwards (2003) asserted that such awareness has weakened, if not eliminated, most arguments for assisting particular industries at the expense of others. The shift in policy direction has been toward creating an economic environment that is conducive to increased market competition in the Australian economy, culminating in the introduction of the National Competition Policy (NCP).

The NCP has put significant emphasis on microeconomic reform over the past decade, with government enterprises at both Commonwealth and state levels undergoing significant change with a view to improving performance, cost effectiveness and service delivery. Financial sector deregulation and competition policy reforms in several key infrastructure sectors and other previously protected areas of the economy, such as utilities and transport, have also changed the business environment for Australian farms.

**International trade**

The provision of various types of support (including export subsidies, quotas and tariffs) has sustained internal prices that are higher than the world price in countries such as the United States and members of the European Union. The maintenance of higher internal prices in these regions has served to shield their farmers from many of the adjustment pressures confronting Australian farmers — but at a high cost in terms of resource misallocation and economic growth. The provision of farm income support
has often sent incorrect market signals to all stakeholders resulting in the over-commitment of resources to agriculture and the creation of large surpluses of farm outputs, thus suppressing prices received for agricultural products in the world market.

International trade distortions have maintained downward pressure on world prices for many key agricultural products, such as dairy, grains and beef. Trade reform and the removal of agricultural support policies in major producing and consuming countries would raise world prices for some products and, because Australia is a small economy with relatively low protection, benefit its exporting industries.

Trade liberalisation would provide greater market opportunities for Australian farmers and encourage the allocation of resources to their most efficient use (Roberts et al., 1999). With potential declines in producer supports and advances in reducing agricultural trade protection over the coming years, it is expected that the terms of trade for the Australian agriculture sector will improve, relative to other sectors in the economy. As a result, additional land, labor and capital will be drawn to agriculture. Shifts in resource use as a result of reductions in restrictions on trade could be expected to herald a period of increased structural adjustment as Australian farmers move to take advantage of the new market opportunities that would be most likely to emerge following trade liberalisation.

Although the agricultural sector as a whole could be a net gainer from this process, some industries within the sector — for example, industries for which international trade is already largely liberalised — could face increased costs as a result of adjustment. Adjustment pressures on such industries would stem mainly from increased competition in input markets, resulting in higher costs of production but without the benefits of significant increases in product prices. Understanding the nature and magnitude of potential changes, and which industries and regions could be most vulnerable to these changes, would assist in developing policies to aid adjustment in the affected industries and regions in a more effective and timely manner.

**Natural resources and the environment**

Changes in the natural resource base of a country, or regions within the country — either through depletion of existing resources or discovery of new ones — could engender significant structural change in the national, regional or sector economies. The change in resource endowment could be rapid, such as that brought about by the discovery of a new and valuable resource, or it could be gradual, with its effects accumulating over lengthy time periods.

*Resource degradation*

There are varying degrees of land and water resource degradation in parts of Australia. In 2001-02, more than half of all broadacre and dairy farmers reported signs of degradation on their properties, while 23 per cent reported a significant degradation problem (ABARE 2003). The link between land management and degradation is complex because of time lags and the effects of technological changes and climate variability on productivity.

The dynamic nature of farm productivity itself would make it difficult to observe and measure deterioration or depletion of natural resources. Typically long time lags between cause and discernable effect in degradation processes and the impacts of degradation beyond farm boundaries would mean that individual farmers might not have an incentive to invest in managing degradation to an extent that coincides with that desired by the community. In such a case, there could be a role for government in developing policies that encourage a more efficient use of resources to meet society’s expectations.

The complex and difficult to measure links between land management and changes in productivity could make the long term future benefits of investing in sustainable farming difficult to weigh against the immediate costs. Current uncertainties should not, however, deter ongoing scientific and economic efforts to minimise, halt or reverse declines in the natural resource base.
Water resource degradation in Australia has been the impetus to a policy environment that aims to improve the long term sustainability of the riverine environment and river salinity through increases in environmental flows. But an increase in environmental flows will largely have to be sourced from existing consumptive uses such as irrigation, thus imposing costs on groups or regions from where the environmental flows are sourced.

Beare and Heaney (2002) argued that developing a scheme for trade in water rights has the potential to reduce the opportunity costs of increasing environmental flows. Not only will water trading foster the gradual movement of water to higher value uses such as viticulture and horticulture, it can also provide a mechanism for managers to source environmental flows from the lowest returning irrigated activity. To realise these potential gains, impediments and restrictions to trade will need to be removed. A key objective of the National Water Initiative is the establishment of institutional arrangements for water trading that will broaden the scope of the water market in Australia (COAG 2004).

Areas where there is a significant reduction in irrigated activity would be expected to face intense adjustment pressure, which would extend to local towns and the regional economy.

**Biodiversity and vegetation conservation**

The management of Australia’s land and vegetation resources is increasingly subject to regulatory control, reflecting increasing community demands for environmental services. The Productivity Commission (2004) found that these regulations have adversely affected the returns of many landholders by imposing a range of restrictions on farm practices.

The broader benefits that the conservation of native vegetation can generate — such as biodiversity, wildlife habitat, improved water quality and carbon sequestration — are public goods that may be underprovided by private landholders facing limited market based incentives. Under such circumstances, government involvement in native vegetation management is justified if the benefits of such intervention outweigh the costs involved.

Davidson and Elliston (2005) demonstrated a clear link between the vulnerability of farm households and the increased regulation of farm inputs and practices. The survey results suggested that growing regulatory control of agricultural inputs is likely to have a negative impact on farm viability through increased farm costs and restricted choice of management practices in the future.

Ensuring that native vegetation management policies are economically efficient and deliver environmental outcomes at the lowest possible cost to the community requires an understanding of the cost that these policies are imposing on agricultural landholders. Native vegetation regulations can impose opportunity costs on the farm sector that take the form of lost income, which has consequential effects on land values because farmers are unable to clear and crop as they wish.

In a recent ABARE survey, around 20 per cent of New South Wales’ farmers reported that they would like to clear rangelands for crop development (Davidson et al. 2006). This demand for additional cleared land reflects the ongoing pressure to move investment out of wool production, as well as the availability of new crop varieties and cropping practices. The opportunity cost of preventing this development to conserve native vegetation for environmental services was estimated to be as much as $1.1 billion (in net present value terms) across the study region.

When reported on a per hectare basis, the estimates reveal that the potential opportunity cost of conserving native vegetation varies widely across the region. In some regions — predominantly in the Central Division — the opportunity costs of conserving native vegetation were as high as $1445 per hectare. In other regions — particularly in the Western Division — the costs were as low as $129 per hectare.
The considerable variation in the cost of conserving native vegetation across the study region suggests that increasing regulation of agricultural input markets, without paying due attention to potential costs, is affecting farmers’ viability in some regions more than in others. This would be likely to magnify structural adjustment pressures affecting these regions, making it more difficult to deal with the coincidence of multiple adjustment pressures.

There may be scope to achieve the desired level of environmental outcomes at lower cost to the farm sector, however, if more flexible policy instruments are adopted. To the extent that equivalent environmental outcomes can be achieved, it appears that conserving native vegetation on land with lower agricultural productivity could reduce the total economic cost of achieving the desired environmental benefits and alleviate some of the considerable adjustment pressures that would otherwise be put on farms and regions.

**Developments in climate**

*Drought*

Australian agriculture has developed in a way that includes managing businesses to cope with climate variability. Droughts are inevitable and the extended period of dry conditions in the early part of this decade has been a timely reminder. As such, issues such as the impact of drought on production and incomes, the effect of drought relief policies, and the ways in which drought adjustment measures could be designed and delivered in a manner that maximises the effectiveness and efficiency of rural adjustment have generated considerable debate on both social and economic grounds.

Droughts generally have significant impacts on crop yields and livestock numbers and, consequently, on farming communities’ household incomes. This engenders significant financial impacts by eroding farm equity and increasing debt servicing loads and social impacts that can be manifested in the possible loss of property ownership and, with it, a preferred lifestyle. In severe cases, droughts entail substantial transfers of resources from the community to agriculture. Historically, drought in Australia has been treated as a disaster. Such treatment has been criticised at various times for discouraging farmers from restructuring their production processes to suit drier conditions. Some elements of drought policy may have reduced the incentive for farmers to adopt better management practices and develop strategies that better prepare them for times of drought. The idea that drought should be treated as a manageable risk element that can be incorporated in farmers’ decision making processes was discussed in great detail in the report of the Drought Policy Review Task Force (DPRTF 1990). The risk management concept was central to the task force’s recommendations. These recommendations form the foundation on which recent drought policies have been based.

Apart from its direct impact on the rural sector through substantial losses in rural income, drought has a secondary or flow-on effect on regional and national economies. This effect is transmitted through links between rural and other industries via the supply of, and demand for, farm inputs and other products. The major links through which changes in the rural sector can affect the rest of the economy are discussed in detail in Bradley, Harris and O’Mara (1988). They include links through consumption of farm outputs, investment, farm input demand (which is mostly met by the non-farm sector) and the effects of changes in farm commodity prices on consumption of non-farm products which, in turn, affect output and employment in non-farm industries. With regional industries dependent on agricultural production, the flow-on effects of drought are generally most profound in regional economies.

*Long term climate change*

Climate changes would have potential to alter the production risks associated with farm management decisions. Therefore, longer term shifts in climate may put adjustment and adaptation pressure on Australian broadacre industries. The development of a capacity that explores the nature and extent of longer term climate change and the consequent impacts on agriculture could provide an insight into potential adjustment in the agricultural sector and its constituent industries. This information could be crucial in aiding investment decisions to adapt to these changes.
An analysis presented by Kokic et al. (2005) used two climate change scenarios to simulate a range of potential environments to which agricultural producers might, in time, need to adapt. In the study, changes in pasture growth provided a basis for estimating the potential impacts on the broadacre agricultural industry (wheat yields and land values). In the reference case (see map 1), a relationship was established between pasture growth, land values and wheat yields over a 10 year period (1991-92 to 2001-02). These relationships, together with the predicted change in pasture growth (based on a combination of an increase in temperature and different levels of rainfall), were used to predict the change in land values and wheat yields to 2030. In the analysis, scenario 1 represents the lowest range of projected temperature increase combined with the lowest range of rainfall change. For all cases, the lowest rainfall change range reflects a reduction in rainfall. Scenario 2 represents the lowest range of projected temperature increase combined with the highest range of rainfall change. For all cases, the highest rainfall change range reflects an increase in rainfall. The implementation of this climate change scenario produced favourable simulated pasture production over most of the continent.

The results of these scenarios on land values and average wheat yields are also shown in map 1. As expected, marginal cropping and grazing areas, with few alternate production opportunities, may experience the largest land value changes. In many of these regions, the decline in wheat yields under scenario 1 is expected to be greater than any likely increase in economic productivity from the adoption of new techniques and technology.

From this analysis, it is apparent that a range of adaptation strategies both on and off farm, and at the policy level, would be necessary to reduce vulnerability over the long term. These strategies can be classified into two categories: those that occur in the short term, such as crop and livestock diversification, and those that occur over the longer term, such as infrastructure and development of new technologies and/or new varieties tolerant to climatic stress.

To enhance farmers’ ability to manage for short term (drought) and long term climate variability, further climate and economic research on the nature and magnitude of risks associated with climate change may be needed. The climate research could provide more information about causes and patterns of occurrence of drought and long term shifts in climate and make it possible to evaluate the feasibility of various strategies to counter the effects of climate change. The economic research could provide information that would promote the development of more cost-effective policies to deal with short and long term climate change.
Map 1: Land values and farm survey wheat yields
4. Quantifying the pressures from structural change

The aim in this chapter is to illustrate quantitative approaches for estimating the potential impacts of some of the main drivers discussed in chapter 3. First, an illustrative example of potential impacts on different regions and producer groups from the introduction of an input augmenting technical change is presented. The analysis draws some implications for government and industries’ roles in investing in productivity enhancing research and development. Second, a hypothetical example quantifying the economic impacts of opening the domestic market for a commodity - with and without incident of disease incursion - is given. The example clearly highlights the substantial difference in economic impacts between exporting (internationally competitive) and import competing industries.

To estimate potential economic consequences of technical or regulatory actions for a domestic agricultural industry, it is necessary to first determine plausible demand and supply parameters for the Australian market. In addition, a number of market variables would be needed. These include current prices and quantities in the domestic market and potential post-change prices. The situation against which the impacts were measured is represented by the current market equilibrium; that is, the prevailing situation in the domestic market in the absence of policies and technologies represents the base against which changes resulting from a possible structural change can be assessed.

Estimates of supply and demand parameters, together with market variables for the affected industry, can then be used in a partial or general equilibrium model to estimate the potential economic impacts of a change in production structure (quantities, prices and impacts on welfare, as deviations from the reference no change situation).

Effects of a technical change

Once the above parameters are made available, a scenario could be constructed to illustrate the potential effects of a hypothetical change in production costs. The scenario would simulate the effect of a shift in supply from a change in production structure; for example, a change emanating from the introduction of a cost saving technology. With this information, the new equilibrium prices, and thereby quantities, following a technical change could be easily determined. These variables could then be used to estimate the potential impact of the technology on producers and consumers. If the primary production comes from different regions, the responses of each region’s producers to changes in either prices received or costs of production would probably differ, reflecting different production structures among regions. This means that potential impacts of similar policy actions or technological changes would also be different in different regions.

To gauge differential regional impacts, production response parameters (supply elasticities) in all regions would need to be estimated or derived. These supply elasticities, together with the likely consumer response to a change in prices, form the basis of estimating welfare impacts of a structural change on producers in different regions, and on consumers.

Distribution of benefits from technology induced supply shifts

In general, producers supply more of a commodity at higher prices and/or if improvements in production technology result in lower costs of production. For ease of presentation, supply and demand schedules in figure D are taken to be linear.

Initially, farmers produce along the supply curve $S^0$ in figure D. $Dd$ represents the domestic demand curve for the product. The intersection of the two curves, $S^0$ and $Dd$, determines equilibrium market quantity and price before adoption of the cost saving technology, at $Q_0$ and $P_0$ respectively.
Technology adoption causes a shift in the supply curve from $S^0$ to $S'$, but the demand curve remains at $Dd$; that is, for the case represented in figure D, the innovation generates cost reductions but has no impact on product quality or other demand shifting factors.

Falls in prices, caused by increased supply, would result in more of the product being demanded - along the downward sloping demand curve. The new market price is determined, at $P_1$, by the intersection of demand curve $Dd$ and the new supply curve $S'$. Cost savings per unit of production from adopting the technology are represented by $ab$, the vertical distance between the two supply curves, or by $P_0c$ on the price axis. In comparison, the market price has fallen by $P_0P_1$. For producers, the fall in prices as a result of increased supply is more than compensated for by the decline in unit cost of production, indicating that not all cost savings are passed on to consumers.

In figure D, producer surplus\(^1\) before and after the supply shift is represented by the area of triangles - $P_0an$ and $P_1eo$ respectively. The change in producer surplus following the technological change is the difference between the areas of the two triangles ($P_1eo - P_0an$). With $P_0c = ab = on$, it follows that $P_0an$ and $cbo$ are equal; therefore, the change in producer surplus is equal to $P_1eo$ less $cbo$, or the area bounded by $P_1bce$ in the diagram; that is, producers receive a net gain of $P_1c$ per unit of production up to $Q_0$, and half that amount per unit for additional supply ($Q_1 - Q_0$). The change in producer surplus in each time period is calculated as:

$$\Delta PS = (K + P_1 - P)[Q_0 + 0.5(Q_1 - Q_0)],$$ or

$$\Delta PS = 0.5(K + P_1 - P)(Q_1 + Q_0)$$

\(^1\) Producer surplus is defined the difference between minimum prices at which producers are willing and able to supply a good (indicated by the position of the supply curve) and the market price they actually receive. 

$$\frac{(Q_0 - Q_1)}{Q_0} = (P_0 - c)/P_0 \times \varepsilon$$

but $(Q_1 - Q_0)/Q_0$ equals the shift in supply, $k$, and $P_0 - c$ equals the reduction in unit cost, $K$. Substituting in the above equation gives:

$$K = (k \times P_0)/ \varepsilon.$$
where $P_1$ is the equilibrium price with the technology, $0$ is the equilibrium price without the technology, $Q_1$ is the equilibrium quantity with the technology and $Q_0$ is the equilibrium quantity prior to the technical change.

$K$ translates the quantity shift into a per unit cost reduction along the price axis (Hafi, Reynolds and Rose 1995); that is, the vertical shift in supply ($= ab = P_1c$), and can be approximated by:

$$K = \frac{k \times P_0}{\varepsilon}$$

where $k$ is the percentage shift in supply quantity and $\varepsilon$ is the elasticity of supply.

Consumer gains are mainly driven by the fall in prices and higher consumption, with total gains represented by the area $P_0aeP_1$.

$$\Delta CS = (P_0 - P_1)\left[ Q_0 + 0.5(Q_1 - Q_0) \right], \text{ or } \Delta CS = 0.5(P_0 - P_1)(Q_1 + Q_0)$$

The welfare impacts of equivalent rightward and leftward shifts in the supply curve would be similar in absolute magnitude (but of opposite signs), given the symmetry of response to movements in prices. This means that the above analysis is equally applicable to an upward shift in supply as it is to a result of higher costs of production (for example, due to pest or disease establishment), but with consumers (in the absence of imports) and producers experiencing welfare losses.

**Some empirical results**

In a policy formulation context, prior knowledge of growers’ supply response behaviour is most relevant as it directly relates to the potential impacts of policies and actions that affect producer costs and prices. It is evident from empirical studies (Abdalla and Sheales 2005) that, with a given shift in supply, the lower the producer response, the higher the economic gains will be, and vice versa.

Under a given elasticity of demand, consumer surplus is also estimated to be lower, the higher the supply elasticity, owing to the latter’s influence on the equilibrium price. Moreover, a lower price elasticity of demand would result in lower producer gains and higher consumer benefits compared with those realised under a more elastic demand.

In general, the uptake of technological innovations in production systems is not costless and, accordingly, the rates of adoption differ among producers depending on their ability and preparedness to adopt the new technology. Although the production sector would, in aggregate, benefit from a cost reducing technical change, there are likely to be losers and winners among individual producers or producer groups. The losers could include two main groups:

1. Those who, because of the nature of their production structure or for some other reason, are unable to adopt the cost reducing new technology. While now facing lower product prices following technology adoption elsewhere, this group would still incur the pre-technology cost of production.
2. Those with low adoption rates compared with the industry average. Producers in this category would be likely to experience a loss if their adoption rates of the technology (and, consequently, declines in unit costs) were too low to offset the general declines in market prices as a result of higher supply. The cost of adjustment for producers in these two groups would largely be determined by the rates of technology uptake by other producers and the extent of per unit cost savings from the technology. The higher the uptake and/or cost reductions, the greater the adjustment pressures, and vice versa. To identify regions and producer groups that would be most likely to bear the cost of adjustment would require more
detailed data, however, to enable the analysis to be undertaken at a much lower level of aggregation.

Abdalla and Sheales (2005) showed that, following input augmenting technical change in production of agricultural commodities, aggregate gains to producers and consumers depend on the magnitude of the price elasticities of supply and demand. The relationship is such that the lower the supply elasticity and the higher the elasticity of demand, the greater the producer gains and the lower the gains to consumers.

The main conclusion that can be drawn from this information is that prior knowledge of supply and demand parameters could be a crucial element in allocating funds for research and development. It would be more feasible for industries’ and growers’ representative groups to direct a major part of their productivity enhancing research toward products with inelastic supply and more elastic demand. In contrast, there seems to be a strong case for government contributions to research and development for commodities with relatively higher supply elasticities and/or lower elasticities of demand, reflecting larger consumer gains that could be obtained from improvements in the productivity for these goods.

**Impacts of potential competition from imports**

Allowing imports of previously banned commodities would have different impacts on different groups within the community. Industries still protected from imports under these technical barriers may face increased import competition if market access were granted as a consequence of an import risk analysis. The main group that is likely to be adversely affected by lifting import bans on commodities is the domestic producers of a commodity that is currently being produced at a higher cost relative to its cost of production in potential exporting countries. Increased import competition could hence have a significant impact on market prices and, thus, would represent the potential for significant production restructuring in some industries.

Australia has a favourable animal and plant health status compared with many of its trading partners. The country’s geographic isolation, together with strict quarantine protocols and contingent rapid response disease eradication programs, means that Australia is at a relatively low risk from outbreaks of animal diseases. The emphasis of the WTO on freer trade in agricultural products as well as other non-commercial pathways such as human dispersal through increased passenger traffic, however, could increase the risk of disease outbreaks. Coupled with the expansion in both extensive and intensive commercial animal production, the potential losses from disease outbreak for the Australian economy could be substantial — exacerbating adjustment pressures within agricultural industries.

*Effects of market access with and without disease incursions*

The economic impacts of opening up the Australian market to imports can differ widely between *import competing* and *exported* goods. Figure Ea illustrates the economic effects of allowing imports on the export industry of a small economy.

The supply curve without trade is $S_0$. With trade allowed, some producers might gain; for example, with the relaxation of the quarantine controls on the imports of cheaper intermediate inputs, such as improved genetic materials, importing producers might be able to obtain advantages in export markets for their finished products.

If this is the case, the supply curve will shift out to $S_1$. Based on these supply relationships and a world price of $P_w$, domestic production would be at $Q_0$ in the absence of trade. With trade, production would shift to $Q_1$ resulting in a net gain in producer surplus equal to the area $BCD$.

If there is a disease incursion (or risk of incursion), however, the supply curve will shift back to $S_2$. Production would fall to $Q_2$ with a net loss in producer surplus equal to the area $ABC$. Overall, there
would be a trade off between the production gains $BCD$ and the probability of loss ($ABC$) if there was a pest incursion.

For an import competing industry in a small economy, domestic production would be at quantity $QD_1$ and price $Pd$ in the absence of imports (see figure Eb). With the advent of imports, domestic prices would fall to the landed import price $Pm$, causing domestic production to contract to $QD_2$. However, total supply, consisting of domestic production and imports, would expand to $QT_1$. As a result, consumer benefits would increase by the amount represented by $PdEFPm$ because of lower prices and increased consumption. Domestic producers would forgo income due to the decrease in prices received. $PdEHpm$ gives the producer losses. The net gain from free trade is $EFH$.

In the event of disease outbreak, cost of the disease is represented by a shift in the domestic supply curve to $S$. Disease costs to the domestic industry are associated with declines in production (the difference between $QD_2$ and $QD_3$) and the cost of disease control and eradication. The loss to the domestic producers due to disease outbreak is the area $OIH$ and the net gain from trade is $EFH$.

The net gain from trade ($EFH$) will be more likely to exceed the disease cost ($OIH$), the higher the domestic price relative to the world price, the higher the price response of producers and consumers below point $E$, the lower the likelihood of disease incursion, and the smaller the losses from the disease. The above analysis is based on the assumption that each good is either an export good or an import competing good. For most goods, there is the potential for both imports and exports to occur at the same time, therefore, a combination of the above analyses is usually applicable. It is also assumed that a pest (and/or the import controls) only affects the good being imported. This is frequently not the case and there may be additional costs from other sources.

In summary, Australia has managed to stay relatively free from diseases through effective disease protocol implementation. Consequently, it has been able to bolster productivity and trade competitiveness of its agricultural products. Nevertheless, expansions in commercial agricultural production, coupled with global moves to freer world trade have increased the risk of disease incursions and spread. This is likely to put heavier demands on national resources for disease control and for assisting adjustment processes in high cost domestic industries resulting from alleviating trade restrictions on imports.
impacts of imports on a small company with and without disease

impacts on an exporting industry

impacts on an import competing industry
5. Capacity for change

There are ongoing pressures for structural change in regional and rural Australia as a result of the various factors outlined in chapter 3. Assessing the capacity of farm households and regional communities to adapt to this changing environment is important for the development of research priorities and more efficient and effective policies to assist the adjustment process.

To anticipate more accurately where detrimental impacts of structural adjustment could be greatest, two aspects of the problem must be considered. First, knowing the likely impacts of different drivers of structural adjustment and determining which regions would most likely be exposed to them could considerably assist in understanding which regions or industries are likely to come under the greatest pressures for adjustment. Second, this would need to be combined with a measure of the ability of farm households in these regions to handle the expected pressures for adjustment.

Nelson et al. (2005) developed an index of the vulnerability to external pressures of farm households in the Australian broadacre agricultural sector. The rural livelihoods framework of Ellis (2000) was used to select key indicators of the five types of capital — human, social, natural, physical and financial — on which rural livelihoods depend. ABARE farm survey data collected from the broadacre grazing and cereal cropping industries between 1992-93 and 2001-02 were used to construct each indicator.

The framework recognises that access to these five types of capital is affected by a range of processes that are outside the individual’s control (see figure F). The latter influences include the external drivers of structural adjustment, such as policy implementation and change, market trends and shocks as well as climate variability and climate change. These are often unpredictable, but can have a profound effect on the use of assets to generate livelihoods.

Other influences on the ability of a farm household to access resources include social relationships, institutions and organisations. Social relationships refer to the position of individuals within society, which is influenced by factors such as gender, ethnicity, age and religion. Institutions such as laws and less formal rules that help to make human interaction more predictable can also modify access to assets such as natural resources. Government agencies are one of many types of organisations that can influence access to resources, along with non-government organisations and industry associations.

Source: Ellis (2000)
Constructing a vulnerability index

To construct a robust measure of vulnerability, a number of different dimensions must be taken into consideration. Each of the five dimensions - human, social, natural, physical and financial capital - can be individually ranked before being aggregated to an overall measure of vulnerability. One advantage of this approach is that it transparently presents the individual dimensions of vulnerability so that those interpreting the information can apply their own weighting to each component. Carney (1998) developed a cobweb framework that can be used to capture the multiple dimensions of the livelihood asset base that determine vulnerability (see figure G).

Source: Carney cited in Ellis (2000)

In Nelson et al. (2005), the key indicators - based on an ABARE survey - of the level of the five types of capital on which rural livelihoods depend are shown in table 1.

These variables were selected following tests to ensure that no one indicator was highly correlated with any other indicator, and that each of the 12 indicators represented a different aspect of overall vulnerability. Using the geographic location of each survey farm, each of the variables contributing to the measure of vulnerability was mapped to a surface of grid points across Australia using the kernel smoothing technique (Cowling et al. 1993). The main purpose of the ranking procedure was to derive a robust overall index in which extreme values of any one of the input variables did not overly influence the index in any region to such an extent that its contribution greatly exceeded that of any other. The rank values were then standardised to values between zero and one to account for the fact that the datasets had a variable number of grid points of equal rank.

To construct one single measure of vulnerability, each of the 12 component indicators needed to be assigned a weight. In the absence of information on the relative importance of any one component over any other, each type of capital was given an equal weight in the final vulnerability index to account for the different number of indicators used to represent each type of capital. Consequently, the index derived from this work should be regarded as just one of a possible range of indexes. With the availability of more information on the importance of each type of capital in different regions, different weights could be assigned to each type of capital and the implications for the results of placing different weights could be tested.

Table 1: Farm survey variables used to construct vulnerability index
<table>
<thead>
<tr>
<th>Capital</th>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Operator education (↓)</td>
<td>Level of education, ranked from one (no schooling) to six (completed a university or other tertiary qualification)</td>
</tr>
<tr>
<td></td>
<td>Spouse education (↓)</td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>Partnerships (↓)</td>
<td>Number of partners running the business including the operator</td>
</tr>
<tr>
<td></td>
<td>Internet use (↓)</td>
<td>Used the internet (yes/no)</td>
</tr>
<tr>
<td></td>
<td>Land care membership (↓)</td>
<td>Member of a land care or similar group (yes/no)</td>
</tr>
<tr>
<td>Natural</td>
<td>Degradation (↑)</td>
<td>Proportion of farm area significantly degraded (per cent)</td>
</tr>
<tr>
<td></td>
<td>Pasture Growth Index extreme (↑)</td>
<td>Average proportion of days that the pasture growth index is less than 0.05 over a 10 year period</td>
</tr>
<tr>
<td>Physical</td>
<td>Diversity of income sources (↓)</td>
<td>Diversity measure of on-farm receipts from wool, beef, wheat, other winter crops and summer crops</td>
</tr>
<tr>
<td></td>
<td>Area operated (↓)</td>
<td>Area of farm operated (hectares)</td>
</tr>
<tr>
<td>Financial</td>
<td>Average income (↓)</td>
<td>Mean farm cash income ($)</td>
</tr>
<tr>
<td></td>
<td>Income risk (↑)</td>
<td>Inter-quartile range of farm cash income divided by mean farm cash income over a 10 year period</td>
</tr>
<tr>
<td></td>
<td>Off-farm income (↓)</td>
<td>Average ratio of off-farm income to total on and off-farm income</td>
</tr>
</tbody>
</table>

Arrows show the relationship between each variable and vulnerability.

**Vulnerable regions**

Mapping the final vulnerability index highlights the regions of Australia where broadacre farm households are likely to be most vulnerable to external influences such as structural adjustment (see map 2). The red shaded areas show broadacre farming communities with a vulnerability index in the highest 10 per cent overall. The orange shaded areas identify regions with the next highest 10-25 per cent vulnerability index.

Regions of Australia that appear to be the most vulnerable according to this index include the western margin of cropping areas in the wheat–sheep zone of the eastern states, as well as the more extensive grazing areas to the west of this margin. A similar but less widespread trend of high vulnerability can be seen in areas beyond the northern and eastern limits of cropping in the wheat belt of Western Australia.

The presence of significant on-farm degradation problems and fewer business partners contributes to the high degree of vulnerability of farming communities across parts of the eastern states. While farmers in isolated regions reported problems with erosion, water and soil quality, and salinity, the form of degradation common to the largest proportion of farms across the eastern states of Australia relates to weeds, including woody weed encroachment.

Low levels of spouse education also contributed to the relatively high vulnerability score in north western New South Wales and in parts of central Queensland. A number of factors contributed to the high vulnerability of farms in areas along eastern New South Wales and into south east Queensland. These included lower than average on-farm incomes and a number of land degradation problems.

The regions around Rockhampton and Cairns in Queensland recorded high vulnerability because of a lack of diverse sources of farm income, which, in turn, contributed to higher variability in income over time. Farms in these regions also faced problems with land degradation and relatively low levels of education.
Map 2: Vulnerability across agricultural regions

The ABARE survey and analysis highlight how the notion of vulnerability can be measured using indicators of the different types of capital that can increase the capacity of farm households to cope with ongoing structural adjustment pressures. The results illustrate that many Australian farm households dependent on broadacre agriculture lack an element, or a combination of elements, of the social, natural, physical and financial capital necessary for them to readily adapt to structural adjustment pressures. Defining these elements, weighted in accordance with their likely importance in determining overall vulnerability, would provide vital information in identifying regions likely to be most affected by adjustment pressures.
6. Structural change — selected examples

In the previous sections, the drivers of structural change have been defined and a framework for quantifying the effects of adjustment pressures on both rural households and regional communities provided. Using specific cases, illustrations are now provided of the way some of the contemporary drivers of structural change could affect industry production, inputs and farm viability.

The National Water Initiative — water trade reforms

The role of government policies as a factor behind structural change is exemplified in the National Water Initiative to reform water trading in Australia. A major objective of the 2004 National Water Initiative was to establish institutional arrangements for water trading that will broaden the scope and depth of the water market in Australia (COAG 2004). Another aim of the initiative was to increase the productivity and efficiency of Australia’s water use through market pricing mechanisms that channel water use into the highest returning activities. For systems in which there is an overuse of water, actions are to be taken to restore these systems to environmentally favourable levels of extraction.

One of the more important reforms contained in the National Water Initiative is the progressive removal of barriers to interregional trade in water. Removing these barriers across a system such as the southern Murray Darling Basin will allow water to be traded into regions where it can be used in higher returning activities. It will also provide greater flexibility to manage competing consumptive and environmental demands.

The likely pace of change when interregional water trade is opened up is unclear. Many irrigation assets are non-salvageable and can be regarded as a ‘sunk’ cost. Irrigators may therefore defer their decisions to sell their water until these assets reach the end of their economic life. Consequently, potential adjustment pressures in irrigation districts that are likely to stem from water trade reforms may be less than some stakeholders fear.

Freer interregional trade paves the way for water resources to be reallocated between irrigators. Some regions will be net sellers and others net purchasers. The net outcome will be an increase in the economic returns to water, but the impacts on economic activity in the buying and selling regions are less clear.

It is clear, however, that the negative consequences for structural adjustment beyond the farm gate are likely to be most keenly felt in the selling region. When the level of irrigated activity in the selling region declines, the demand for goods and services from agriculture are likely to be negatively affected. For example, demand for farm inputs other than water and the supply of agricultural produce used in local processing are both likely to contract. But the negative effects in the selling region are likely to be offset by the positive effects in the expanding region.

Understanding the nature of these negative impacts requires a sound understanding of the activities withdrawn from irrigation, the time frame over which this is likely to occur, and the importance of these activities in the regional economy. The data and models needed to investigate this in detail are becoming increasingly available and, therefore, are an area for further research.

Land clearing regulation

Actions that could drive structural change and result in adjustment pressures on rural communities may be manifested in regulations aimed at protecting natural resources, such as conservation of biodiversity in ecosystems. An example of this is the regulatory control over broad scale clearing of native vegetation by states and territories in Australia, which has been increasing since the mid-1980s. This regulatory approach has intensified in most jurisdictions since the mid-1990s, with more stringent controls introduced to effectively halt broad scale clearing (Productivity Commission 2004).
For states such as South Australia, Victoria and Western Australia, the increased regulatory control affects a relatively small proportion of agricultural land because of previously high levels of clearing. In New South Wales and Queensland, however, there is a much higher proportion of agricultural land suitable for development or redevelopment. The increased regulatory control of vegetation management is likely to have a much larger impact in these states.

Land clearing and woody weed management represents a development opportunity for many rural landholders. However, the benefits of increased agricultural productivity must be weighed against the costs of clearing and the ongoing costs of managing regrowth (ABARE and BRS 2003). At a higher level, the economic returns from land clearing must also be weighed against the marginal value to regional ecosystems of the land to be cleared.

Where vegetation regulations prevent farmers clearing and developing their land as they see best, farmers bear the costs as forgone opportunities for development. Even when some land clearing is allowed, private landholders may still be burdened with excessive costs, such as the transaction costs of dealing with regulators and delays in the approval process (Productivity Commission 2004).

In the face of rapidly changing technology and fluctuating commodity markets, inflexible regulatory control over vegetation management practices will have a potentially significant negative impact on future farm profitability. This effect is likely to be felt most strongly in those regions of Australia where the expanding cropping margin comes into conflict with inflexible vegetation management regulations.

Following the Australian Government’s response to recommendations in the Productivity Commission Inquiry into the impacts of native vegetation and biodiversity regulations, Davidson et al. (2006) have assessed the economic impact that native vegetation management is having on the broadacre agriculture sector.

Based on face-to-face surveys ABARE has conducted with 386 broadacre farmers across a 400 000 square kilometre region of central and western New South Wales in 2005, Davidson et al. (2006) quantified the extent to which native vegetation is having an impact on farm productivity and returns.

Analysis of data collected as part of the survey found that farms with lower vegetation density generally have higher total factor productivity. From this, it can be concluded that restrictions on vegetation management of invasive scrub on agricultural land is likely to have a negative impact on the productivity growth of some farms. However, this is not to say that continual removal of vegetation will necessarily lead to higher productivity. At low vegetation densities, there is evidence that increasing vegetation levels are - to a point - consistent with increased productivity on some farms, particularly grazing properties. Vegetation removal to a level below that which generates private benefits to farmers is likely to have a negative impact on productivity.

The way in which vegetation was having an adverse impact on farm productivity varied across the study region and between farm enterprise types. In the rangelands, increased levels of woody vegetation were found to lower carrying capacity. On mixed livestock and cropping properties, regulations preventing the further development of land for either more intensive grazing or for cropping were also imposing costs in the form of forgone development opportunities.

On the farms with some cropping activities, isolated paddock trees were found to limit the efficiency of crop management. The presence of isolated trees is preventing the efficient use of cost saving GPS (global positioning system) technologies in many instances. The impact of this is likely to increase over time as the trend toward larger farms continues. It has been emphasised that, while the survey was conducted in New South Wales, the general findings are relevant to other jurisdictions.
Ensuring that native vegetation management policies are economically efficient and deliver environmental outcomes at the lowest possible cost to the community requires an understanding of the cost that these policies are imposing on agricultural landholders. Native vegetation regulations can impose opportunity costs on the farm sector that take the form of lost income, which has consequential effects on land values because farmers are unable to clear and crop as they wish.

In the ABARE study region, around 20 per cent of farmers reported that they would like to clear rangelands for crop development. This demand for additional cleared land reflects the ongoing pressure to shift enterprise mix out of wool production as well as the availability of new crop varieties and cropping practices. The opportunity cost of preventing this development in order to conserve native vegetation for environmental services was estimated to be as much as $1.1 billion across the study region in net present value terms.

When reported on a per hectare basis, the estimates reveal that the potential opportunity cost of conserving native vegetation varies widely across the region. In some regions — predominantly in the Central Division — the opportunity costs of conserving native vegetation were as high as $1445 per hectare. In other regions — particularly in the Western Division — the costs were as low as $129 per hectare (Davidson et al. 2006).

The considerable variation in the cost of conserving native vegetation across the study region suggests that there may be scope to achieve the desired level of environmental outcomes at a lower cost to the farm sector if more flexible policy instruments are adopted. To the extent that equivalent environmental outcomes can be achieved, it appears that conserving native vegetation on land with lower agricultural productivity could reduce the total economic cost of achieving the desired environmental benefits.

Relying only on a regulatory regime to manage native vegetation is likely, therefore, to lead to an outcome that fails to deliver environmental services at the lowest possible cost. Determining the balance of land allocated between agricultural production and environmental services using a regulatory approach based on substantially incomplete information is likely to be costly to society, particularly across areas where the opportunity cost of native vegetation conservation is relatively high. Furthermore, the use of regulatory settings that determine how much, what types and where native vegetation is mandated to be conserved is unlikely to deliver the outcomes that the community desires, given continual changes in ecological, market and social environments.

In contrast, an economically efficient native vegetation management policy is one that is flexible enough to respond to these changes in ecological, market and social environments. An efficient policy regime is likely to make use of a broader suite of tools - including market based instruments, such as auctions and tenders - that can take advantage of the broad variation in the private costs of conserving native vegetation that the ABARE survey has identified. Specifically, the cost to society of achieving its desired environmental outcomes is likely to fall significantly below the above estimation if landholders are able to alter the location, density and mix of native vegetation on their properties where it is possible to do so without jeopardising the environmental services such vegetation provides in aggregate.

Bans on broad scale land clearing may heighten adjustment pressures, therefore, by constraining the adoption of new technologies which, in turn, limits future productivity growth. Paralleling the farm level impact, there are also wider consequences for rural communities. By denying farms the opportunity to diversify, small rural communities on the edge of the expanding cropping margin are also likely to suffer. This may affect the rural communities and economies that are least able to cope.
Easing of restrictions on imports

Opening the Australian market to new imports — in order to comply with Australia’s commitments under the WTO Sanitary and Phytosanitary (SPS) agreement, for example — could be a significant driver of structural change in some domestic agricultural industries.

Australia adopts a conservative approach to pest and disease risk, reflecting the importance of agricultural production to the nation and a favourable animal and plant health status. Under existing quarantine regulations, imports of a range of agricultural commodities are not permitted because of the possible introduction of pests and disease.

Quarantine protocols aimed at curbing the entry of pests and diseases through international trade are guided by the SPS agreement. Australia is a member of the WTO, and a signatory to numerous agreements, including the SPS agreement. The aim of the SPS agreement is to obligate members to observe common rules when establishing their acceptable level of protection on quarantine. These rules have been designed to establish legitimate quarantine protocols for the purpose of safeguarding against potential pest and disease incursions, but should not restrict trade beyond that purpose. It would contravene the provisions of the SPS agreement if a member instituted measures that are more trade restrictive than necessary to prevent the entry of a disease.

Biosecurity Australia initiates an Import Risk Analysis (IRA) when an application is received from another country seeking to export a nominated agricultural product to Australia. An IRA involves two main components. First, there is an assessment of the scientific evidence about the pest and disease risks associated with importation of the nominated product. Second, where necessary, quarantine, monitoring and surveillance protocols are established that will allow imports to proceed without breeching Australia’s acceptable level of protection against agricultural pests and diseases.

If the decision flowing from an IRA is to allow imports of a certain product, the domestic producers of that product could face substantially increased import competition. In recognition of this possibility, the Australian Government may commission a separate economic assessment to gauge the anticipated economic impact on an industry of a change in quarantine policy following an IRA. It is important to note, however, that assessments of the economic impact of allowing imports are carried out independently of the relevant IRA and have no bearing on the quarantine decision making process.

The issues that are addressed in an economic assessment of an IRA decision are mostly those that would have a bearing on whether there are likely to be any structural adjustment implications from the decision. They include whether imported products would compete directly with Australian products sold on the domestic market, what market share might be captured by imports and the effect on Australian prices, investment, incomes and profits, the sensitivity of the results to changes in import prices and transport costs, the Australian and region specific economic consequences of imports, and the capacity of the local industry to adjust — including to diversify and seek additional export markets. In essence, the focus is on determining the Australian industry’s likely relative competitiveness in international markets.

Broadly, domestic industries can be classified into two main groups in terms of international competitiveness: exporting and import competing. Prior to the advent of imports, each industry group would have been the sole supplier of its product in the domestic market. The extent of adjustment needed following import entry could differ markedly between the two industry groups.

Export industries

Within this group, production is already internationally competitive because commercial proportions of production are being traded in the international market at prevailing world prices. In other words, domestic industries within this group are likely to be producing at costs of production that are comparable to those of producers elsewhere. When domestic prices are already at parity with world
prices, allowing imports of products with similar quality attributes would not be expected to have a
discernible impact on domestic prices.

Where domestic prices remain unaffected by the advent of imports, the impact on domestic producers
of allowing imports are likely to be minimal. With imports arriving at prevailing world prices,
however, Australian producers may need to export more in order to maintain returns. In this case,
Australian exporters may incur adjustment costs in devising new marketing strategies to deal with
greater volumes of production destined for the export market.

Another possibility is that a potential supplier introduces a mix of products that are highly
differentiated on the basis of variety and quality. Assuming that imports of highly differentiated
products will be traded in a new and largely independent segment of the market, they may have only a
minimal effect on the existing market (ABARE 1997).

Examples of exporting industries are the Australian pig meat, apple and table grape industries. These
industries have demonstrated their ability to compete with international producers on export markets.
All major varieties of apples and table grapes produced in Australia are exported, with table grape
exports accounting for about a half of total production. On this basis, the Australian market is
effectively open to world market competition.

Import competing industries
Industries that sell all of their production on the domestic market and are not subject to competition
from imports may not be internationally competitive. Lack of competition from imports can mean
these industries are higher cost producers than similar industries located in overseas’ countries. Being
insulated from import competition, producers in these industries typically receive prices higher than
those prevailing in world markets.

Opening up the domestic market to imports under these conditions would cause domestic prices to fall
toward world prices, resulting in significant adjustment pressures for the domestic industry. The extent
of adjustment would depend on the magnitude of the cost differentials between Australian producers
and their counterparts in potential exporting countries — the larger the cost differences, the greater
would be the expected burden of adjustment for domestic producers.

An example of such an industry would be the Australian banana industry. As presented in figure H,
the large differences in producer prices between Australia and prospective major suppliers indicate a
need for significant structural adjustment if banana imports are allowed. The case of bananas
illustrates how a sudden change in import competition as a result of an IRA decision could be a strong
driver of structural adjustment.
Adjustment in the wool industry

Australia is the world’s dominant producer and exporter of wool, accounting for around 25 per cent of global output of greasy wool. Despite its global importance, the Australian wool industry provides an example of how an erosion of competitiveness as a result of slow progress in developing cost saving practices, coupled with declines in world demand for the product being produced, can drive structural adjustment. (This section draws heavily on information and analysis presented in ABARE (2006).)

In the early 1990s, wool made up around 90 per cent of the combined gross value of production for the sheep and wool sectors; but by 2004-05, this had fallen to around 60 per cent. Dickson et al. (2006) observed that the decline in wool production and returns mainly reflect changes in consumer tastes and preferences that have been — and continue to be — the main drivers behind the significant contraction in the global demand for wool. The international textiles and clothing industry is fiercely competitive and there is a high degree of substitutability between the various fibres — particularly wool, polyester and cotton.

Shrinking wool production and falling prices point to a sustained contraction in demand for wool rather than simply fibre substitution by processors. In established markets, wool is losing ground to new fabrics, such as synthetics, that have been developed to achieve the same functionality as wool but also include other characteristics, such as being light weight and smooth on the skin.

Australia’s changing wool industry

In the Australian sheep industry, a weakening in demand for wool and declining prices has triggered a shift in focus away from wool production to lamb and sheep meat production. Between 1993-94 and 2003-04, the typical sheep and wool specialist and mixed enterprise wool farms changed dramatically.

For specialist sheep and wool producers, the focus on wool contracted markedly, while receipts from lambs and sheep for slaughter increased. The share of receipts generated by beef cattle and cropping activities remained largely unchanged. For mixed enterprise wool producers, cropping activities remained the largest enterprise, wool production contracted and production of lambs and sheep for slaughter increased.

The two major factors behind the above developments have been changes in relative returns from wool and sheep meat, and differences in productivity growth between the agricultural industries - particularly those of cropping and livestock. Reflecting these trends, the bulk of investment in the sheep industry has occurred in the wheat–sheep and high rainfall zones, where producers have the greatest opportunity to diversify out of wool production.

Changing relative prices

Over the past decade, prices received by Australian farmers have changed radically in real terms. Strong international and domestic demand resulted in beef cattle, mutton and lamb prices increasing significantly between 1994-95 and 2004-05. During that period, grain and wool prices experienced year-on-year volatility, but declined overall in real terms.

A marked decline in the price of wool relative to other agricultural commodities led producers to change enterprise mixes on their farms. Producers with the opportunity to do so expanded their cropping and beef cattle activities and reduced sheep numbers. This resulted in the total number of farms with more than 200 sheep falling by 16 per cent between 1994-95 and 2004-05. In some locations, cropping was a viable alternative to wool production because strong productivity growth more than offset the effects of stagnant grain prices in real (net of inflation) terms. The attractiveness of beef cattle production was enhanced by a combination of higher prices and greater (albeit, still modest) productivity growth than for sheep.
Since 1994-95, sheep numbers have fallen by 15 per cent as producers reallocated resources away from wool production and into alternative enterprises. As sheep numbers fell, the supply of lamb and mutton also declined at the same time as demand for sheep meat was growing. The resultant increase in lamb and mutton prices relative to wool has led to a restructuring in the breed, age and sex composition of the sheep flock. The proportion of merino sheep in the Australian flock has declined over the past 10 years, and wool production has fallen more than sheep numbers, reflecting the development of a generally younger, more female dominated flock with increased orientation toward the production of lambs for slaughter.

**Changes in micron over time and by zone**

Over the past decade, the average diameter of merino wool produced in Australia (measured in microns) fell steadily as wool producers responded to relatively higher prices for finer wool. Figure I depicts the proportion of wool of different microns in different years. Despite a 41 per cent contraction in total wool production between 1994/95 and 2004-05, production of wool of 19 microns or less rose by 61 per cent. Moreover, the proportion of the clip that measured 19 microns or less increased from 13 per cent to 32 per cent.

![wool_production_graph](image)

According to ABARE survey data, the average diameter of the main merino fleece line produced on broadacre farms that are mainly dependent on wool (that is, where over 50 per cent of farm receipts come from wool sales) fell from 21.2 microns in 1992-93 to under 20.1 microns 2002-03. In comparison, on broadacre farms with a greater focus on sheep meat production, the average micron of the main merino fleece line has remained relatively unchanged.

The reduction in the average diameter of the main merino fleece line was greatest in the high rainfall regions of Australia. This reflects a gradual change in the flock structure as well as selection of finer wool producing sheep. As lamb and sheep slaughter prices rose, producers also increased their focus on sheep meat production, resulting in sheep flocks with a lower proportion of wethers and a high proportion of younger ewes and hoggets that produce finer and lighter fleeces.

Producers in the wheat–sheep zone have the greatest potential to diversify into a range of agricultural enterprises, including grains, beef cattle, wool, and lambs and sheep for slaughter. In this case, as wool prices fell, producers responded by reducing wool production and expanding more profitable enterprises rather than focusing heavily on improving wool quality. Conversely, in the pastoral zone, little change was observed in the average micron of the main fleece line until 2002, when de-stocking
in response to drought resulted in heavy culling and substantial change to the flock composition, and reduced feed availability resulted in a degree of hunger fineness in the clip.

**Productivity growth**

Producers facing declining real commodity prices can maintain the profitability of their farm by enhancing their productivity. Productivity growth is simply a measure of the efficiency with which inputs are used to produce outputs. The key measure of productivity improvement on wool producing farms is total factor productivity, which is calculated by dividing an index of the volume of total outputs by an index of total inputs.

Productivity growth results from technological change and the adoption of better farming methods to improve on-farm efficiency. Annual rates of productivity growth must exceed the rate of decline in terms of trade (the ratio of prices received for outputs to prices paid for inputs) for farm incomes to be maintained or improved.

As discussed earlier, grain and beef producers have realised higher rates of growth in productivity than in the sheep industry. The difference in the productivity growth of these sectors has provided an important incentive to alter the enterprise mix by reducing sheep numbers and, where possible, expanding cropping and beef cattle activities.

Not all sheep enterprises, however, have experienced poor productivity growth. Since the mid-1990s, the adoption of new technologies and farm management practices has led to appreciable gains in the quality and quantity of wool and sheep meats produced by specialist and mixed enterprise sheep farms. Productivity has been assisted by producers responding to higher lamb and sheep prices by increasing turnoff and dedicating a proportion of the sheep flock to crossbred sheep and greater numbers of specialist meat oriented breeds. Sheep industry productivity growth has also been driven by producers selectively breeding a merino sheep flock that produces finer wool, steadily falling sheep death rates and an increase in lambing rates.

**Wool production, by size of operations**

Wool production occurs on farms undertaking a diverse range of broadacre agricultural activities. One of the main factors influencing the financial performance of sheep and wool producers is the scale of the farm’s operations. To further investigate this, specialist and mixed enterprise sheep producing farms with more than 200 sheep were classified into four categories according to wool production in 2003-04:

1. less than 11 000 kilograms (63 bales, using an average bale weight of 176 kilograms)
2. 11 000–22 000 kilograms (63–125 bales)
3. 22 000–44 000 kilograms (125–250 bales)
4. more than 44 000 kilograms (250 bales).

The smallest farms in terms of flock size, that make up 65 per cent of wool industry farms (specialist and mixed enterprises), produced only 26 per cent of Australian wool clip in 2003-04. These farms were predominantly mixed enterprise wool farms (see table 2 and figure J). In contrast, farms producing more than 44 000 kilograms of wool accounted for only 4 per cent of wool producing farms, but accounted for 22 per cent of Australian wool production. This category had an equal distribution of specialist and mixed enterprise wool producers.

In terms of the physical characteristics defining the four size groups, the flocks of the larger farms had a higher proportion of merino sheep. Merino wool accounted for 60–68 per cent of production from the smallest flocks, but nearly all of production from the largest flocks.

Further, wool cut per sheep shorn for specialist sheep producers was 14 per cent higher for the largest size group than for producers in the smallest group, and 21 per cent higher for the largest size mixed enterprise producers than for the smallest group. Specialist wool producers in the smallest size group recorded negative rates of return on capital (excluding capital appreciation) averaging –3.4 per cent.
Rates of return for all other groups were positive, with mixed enterprise wool producers in the 22,000–44,000 kilograms group recording the highest return of 4.0 per cent. Mixed enterprise wool producers achieved higher rates of return than specialist producers within any size group. A similar pattern was observed when looking at the rate of return including capital appreciation.

Better performing farms
Many factors contribute to farms outperforming the industry average, including seasonal conditions. Farming practices and the willingness of the farm operator to innovate and adopt new practices are also likely to be significant.

Land management and marketing success can be strongly affected by a producer’s access to, and response to, information. As part of the daily management of the farm, the better performing farms were more likely to use the Internet to track market prices and meteorological information. By combining detailed regional meteorological information with input applications, producers can optimise the return on inputs, such as fertilisers and crop and pasture chemicals.

The better performing producers were also more likely to invest time in discovering new farming practices by participating in learning activities like conferences, workshops and demonstration and field days. They were also more likely to implement changes to farm management practices. In the three years to 2003-04, it appears that only a relatively small proportion of wool producing farms enjoyed high levels of profitability.

The top 25 per cent of better performing farms in each group made a healthy profit during this period. Rates of return, including capital appreciation for the better performing farms, averaged over 20 per cent. This is in strong contrast to the average financial performance of the remaining 75 per cent of farms in each group. These farms, on average, recorded modest or negative farm business profit.

Mixed enterprise wool producers have a range of diversification options. Over the past decade, these producers have responded to relative price movements and productivity gains by reducing their dependence on wool and expanding production of grain crops, prime lambs, sheep for slaughter and beef cattle. Consequently, between 2001-02 and 2003-04, wool receipts represented only around 15 per cent of total cash receipts for the average mixed enterprise wool producer.
Specialist wool and sheep producers, by contrast, have fewer viable production alternatives to wool and sheep. This is likely to be caused by a range of factors, including climate and the natural resource endowment of the land operated. Consequently, in the three years to 2003-04, on average, these producers relied heavily on receipts from wool, lambs and sheep for slaughter to the extent that they accounted for over 70 per cent of total farm cash receipts. With wool prices in real terms likely to continue to trend downward over the long term, the future viability of many specialist wool and sheep producers will depend on the adoption of farming practices that realise significant productivity gains.
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Drivers of Structural Change in Australian Agriculture

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This study is an overview of current and future drivers of structural adjustment for Australia’s agricultural industries. It describes the ways these adjustment pressures impact on the rural and regional sectors, and options for farmers to manage these changes. The report also provides some case studies of specific instances of structural adjustment and possible government responses to facilitate change.

It highlights priority areas of research in structural adjustment and will be useful to policy and decision makers to determine how to better prepare farm owners, managers and regional communities to deal with the pressures of change.

RIRDC’s R&D Program on rural people and learning systems aims to improve productivity, environmental sustainability and wellbeing in rural and regional Australia through R&D that contributes to building stronger and innovative institutions, communities, group activities and personal capacities.

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