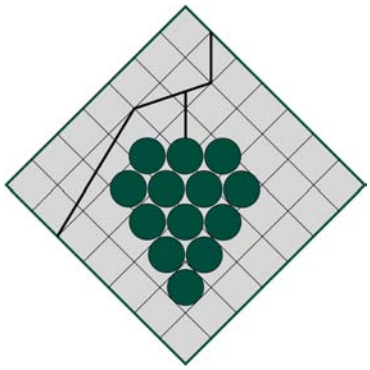




Water Policy Reforms and the Future of Australia's Wine Industry

FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

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Preface

Research projects of this nature rely on many people and considerable goodwill. The project involved a variety of workshops, focus groups and presentations. Important among these various events include a presentation at the First National Wine Industry and Environment Conference 31 October–1 November 2000; testimony to House of Assembly Select Committee on the River Murray on December 15, 2000; involvement in the South East Catchment Water Management Board's assessment to improve water trading; participation in the evaluation of the MDBC two-year review in October and November 2000, and participation in the workshop on Impediments to, and Options for, Expansion of Permanent Interstate Water Trading in the Murray-Darling Basin in Albury, 15 December 2000.

A workshop to discuss preliminary findings was held on Friday, 22 June, 2001. Participants included: Peter Hackworth (Executive Officer Phylloxera and Grape Industry Board); Kym Good (Chief Executive, Northern Adelaide and Barossa Water Catchment Board); Steven Smith (Acting General Manger Onkaparinga Catchment Water Management Board); Peter Hayes (Southcorp/Rosemont); Rob Thomas (Director Department of Water Resources); Keith Jones (SA Wine and Brandy's Environmental Officer); (Winemakers Federation); Mark Skewes (PIRSA vine irrigation specialist); and Kym Anderson (Director, Centre for International Economic Studies Adelaide University and GWRDC Board Director); Anita Poddar (GWRDC); Colin Roger (Dean, School of Economics, University of Adelaide) and Richard Thomas (water broker, banker, and rural financial advisor). I thank all of these people for their time, effort and many contributions.

In addition to these people, I am also grateful to Hugh Armstrong, Katherine Billette, Henning Bjornlund, Anthony Couroupis, Richard Damania Tim Elstone, Hugo Hopton, David Kernybone, Philip Killicoat, Lindsay Leake, Dan Luscombe, Darla Hatton MacDonald, Ian Murcoch, John Marsden, Jodie Smith,, Steve Srachan, Martin Stokes, Tony Thompson, Mike Young, Peter Winton. Last but not least is of course the GWRDC for the opportunity to contribute to the wine industry's efforts to improve water resource use in Australia. The responsibility for statements, judgements and errors are mine alone.

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Executive Summary

The policies, incentives and management practices shaping the future availability, access, use and quality of water have enormous implications for Australia's wine industry. Water plays a crucial role in a wide range of wine-related activities. Rainfall and irrigation influence grape quality, vine health, vintage variation, grape flavour, and wine complexity. Water prices affect cost competitiveness, risk management, and enterprise returns. Water use is an important marketing trait, with implications for geographical attributes and trade relations. Water management practices and winery waste water control impact on the industry's overall environmental reputation at home and abroad.

While grapes are a relatively high value, low volume irrigation activity, growers do depend on reliable supplies of good quality water at specific times throughout the year. Timely access to high quality water supplies is crucial to grape production and wine quality. Australia is undertaking major policy reforms to address a variety of water-related issues, including scarcity, environmental and quality concerns. To help cope with the implications of the rapidly evolving water reforms, it is essential that the industry remains involved in the ongoing water reform debates.

A number of international, national, and local forces are driving fundamental changes to Australia's water institutions. These rapidly changing water laws, water policies, water markets, licensing regimes, water administrations, and environmental regulations alter the incentives and opportunities facing grape growers and the wine industry. Wine grapes are one of the fastest expanding irrigated crops in Australia.

The wine industry has an important stake in how water institutions evolve, how they are influenced and how they are monitored, evaluated and adapted. This paper attempts to contribute to this process by reviewing the key factors motivating change in national, regional and local water institutions and how the resulting policy reforms effect irrigation performance, water markets, water use, and the profitability of grape growers.

What are the key factors motivating change in Australia's water institutions?

Irrigation trends in Australia are diverging from almost all of its OECD counterparts, including many of its major wine export competitors. The proportion of Australia's water used for agricultural purposes is increasing both in absolute and relative terms. The experience in the European Union, Japan and North America is the opposite -- less water for agriculture and more for cities and industries. Several reasons help explain these trends.

First, Australia is the driest inhabited continent and with less than 5 per cent of the areas cropped. Second, agriculture is more important to the economic prosperity of Australia than to most other advanced industrial countries. Third, 80 per cent of Australia's agricultural production is exported, the value of which accounts for one-fifth of all goods and services exports. Fourth, Australia has relatively abundant per

capita water supplies compared with its major agricultural export competitors. Fifth, Australia's geographical location, relative isolation, lower population pressure, and a rural sector generally free of polluting industrial activities provide it irrigation-related advantages. Sixth, the depreciating Australian dollar and increased product prices from export demand over the past few years helps explain why producers have been able to expand irrigation while facing increasing expenses imposed by water reforms. Seventh, international organisations seek lessons from Australia's experience to guide policies in dozens of other countries throughout the world. Finally, environmental pressures are forcing major changes to Australia's water institutions.

Irrigation and agricultural production in Australia

Agriculture is Australia's largest water user, accounting for some 70 per cent of the country's water consumption.The 2.1 to 2.4 million ha of irrigated crops and pastures represent less than 0.5 per cent of the total agricultural land and about 12 per cent of the total area of crops and pastures. The value of irrigated production fluctuates between 25 per cent and 30 per cent of Australia's gross value of agricultural output. Despite more than a decade of water reforms, deregulation and related structural changes, pasture irrigation dominates all crops for water with 40 per cent of the irrigated area. Historically the price of water has been set so low as to not be a critical factor in the choice of crop under irrigation.

In addition to rice, cotton and grapes are the crops with the highest proportion of growing area irrigated: 96 per cent for cotton and 81 per cent for grapes. During the past decade, cotton and grapes have been two of the fastest growing irrigated crops. The irrigated cotton area expanded from 252 thousand ha in 1993 to 382 thousand in 2000. Irrigated grape production has expanded from around 43 thousand ha to an estimated 125 thousand during the same period. The total area planted to grapes in 2000 is 146.2 thousand ha and an estimated 85 per cent are irrigated.

The ABS's *Water Accounts for Australia* suggests that average quantity of water used per ha on grapes in 1996-97 are: 15.9 ML/Ha in NSW; 10.5 ML/Ha in Victoria; 5.1 ML/Ha in South Australia; and 4.2 ML/Ha in Western Australia. The national average is around 9.3 ML/Ha. Even with the high proportion of furrow irrigation in NSW, water use data in that state appears too high and out of line with most reports on irrigation practices. Table 6 presents the differences in irrigation methods used in each of these three states.

This lack of reliable information on how much water is actually used by grape irrigators is an important concern for the wine industry. Published reports and irrigation specialists suggest that water use ranges from more than 15 ML/Ha in the MDB to less than 0.5 ML/Ha in the groundwater dependent regions of South Australia and Western Australia. Approximately 15 per cent of Australia's vine area receives no irrigation. An additional 3 to 5 per cent receive 'supplementary watering', to control water stress levels, to maintain vine health or to manage the risk of an extended drought.

The MDB is the high-water use, high-yield grape production zone in Australia. The MDB contains more than 80 thousand ha of Australia's grape area. The vast majority is irrigated, representing some 55 to 60 per cent of the total area planted to grapes and

more than two thirds of the irrigated grape area. The average grape yield (including table grapes) in the MDB is 18.2 t/ha. Average yields in the groundwater-dependent regions of South Australia and Western Australia is 9.5 t/ha, nearly 50 percent less.

About 90 percent of Victoria's grape area is in the MDB (34.5 thousand ha); 70 per cent of the area in NSW (24.4 thousand ha); and 40 per cent of South Australia's grape area (24.5 thousand ha). The Barossa and Clare districts in South Australia also have access to Murray River water (Langhorne Creek is included in the 24.5 thousand ha estimate).

The majority of South Australia's grape growers and the majority of the state's vine area are located in groundwater dependent zones, including the Adelaide Hills, Barossa, Coonawarra, Fleurieu, Limestone Coast, McLaren Vale, and Padthaway. Water use in these areas is relatively low, averaging from no irrigation to around 4 ML/Ha. These groundwater areas also produce the majority of the country's highest value premium grapes. Table 7 presents estimates for water use for 10 regions in South Australia. The data is based on area, production and yield information from ABS, PGIBSA and individuals with knowledge of local irrigation practices. The high water use area is South Australia's Murray region, accounting for 31 per cent of the area and averaging 7.5 ML/Ha or 68 per cent of the state's water used on vines.

How are environmental pressures impacting on water resource management?

During the past decade, increasing international economic integration and heightened environmental concerns abroad, as well as changing attitudes at home, have forced Australian farmers and policymakers to rethink the role agriculture can play in the economy and society and environment. The current trend at both local and national levels is to aim for more emphasis on sustainable agricultural development, recognizing its dual goals of economic efficiency and environmental protection. Agriculture is broadening its role beyond increasing productivity, expanding export earnings and enhancing rural incomes to include also evolving concepts of managing ecological processes and protecting environmental resources. In this, it is being accompanied by similar trends in other OECD countries and, increasingly, in middle-income countries as well.

Water-related environmental issues have become a key factor motivating change in Australia's water institutions. Water has moved to the forefront of national policy debates aimed at meeting expanding social, economic and environmental objectives. The primary agricultural activities causing water-related environmental problems in Australia are: (a) allowing runoff from fields to carry sediments, nutrients, organic matter and agricultural chemicals; (b) extracting too much water for irrigation, resulting in severe impacts on aquatic ecosystems, water quality and groundwater supplies; (c) inverting the natural pattern of river flows in southern Australia (high demands for irrigation during summer when river flows are low and low demand for irrigation during winter when river flows are high); and (d) clearing and using land and water in ways that result in rising water tables and salinity (Cullen and Bowmer, 1995). Table 8 presents an overview of how water use systems are linked to environmental problems in Australia.

What are the mechanisms for changing water policies?

One major program drives water policies: the 1994 COAG water reform agreement. Since the states and territories have prime constitutional responsibility for natural resource management, COAG represents the nation's attempt to integrate and coordinate water policies and avoid further fragmented efforts, policies and activities. The Commonwealth, New South Wales, Victoria, South Australia and Queensland governments established an inter-governmental agreement to provide for a special ministerial council to organise the Murray Darling Basin.

Environmental management in Australia involves a mix of market incentives, government regulations and voluntary approaches. Voluntary measures and agreements between governments, industry and community groups play a key role, with an increasing emphasis on economic instruments. Environmental issues are not the province of any one sphere of government. Although the Commonwealth Government has powers to enact laws affecting the environment and sustainable development, the Australian Constitution does not specifically deal with environmental powers. Most environmental legislative responsibilities rest with state/territory governments and most decisions that affect the environment occur at the local level. When international treaty obligations are at stake, however, the Commonwealth takes precedence over state/territory and local powers.

What is the emerging role of markets in resource management?

While research and extension on sustainable practices dominate Australia's policy response, full cost resource pricing and overcoming market failure through the creation of property rights are also being encouraged. Tradeable water entitlements delink water rights from land rights so they may be traded as a separate commodity. Transfers may be restricted to a single year, allowed for several years or be made permanent. A major policy trend during the 1990s has been the move away from an almost total reliance on the use of regulations to manage food safety and agriculture-related environmental objectives.

Over the past several years, the regulatory approach has been complemented by or, in some cases even replaced with, economic incentives, market instruments and property rights systems. Market mechanisms introduced to meet strategic objectives, include implementing the polluter pays, beneficiary pays and user pays principles. This more market-oriented approach also involves assessing total economic values for the costs and benefits attributed to environmental policies and government regulations, as well as the positive and negative externalities generated by agricultural production activities.

How do water policy reforms affect grape and wine competitiveness?

Australia's water policy reforms are leading to higher water costs per unit of water used as the country moves to adopt the COAG water reforms. Much higher unit costs are expected in the future as further reforms are enacted and as market forces influence the price for water. The Cap on water diversions together with tradeable water entitlements means that new enterprises would have to purchase an ever-scarcer water resource and face higher investment costs.

A number of reasons help explain why higher unit water costs and increasing water delivery costs are not imposing problems for non-pasture irrigators. These include:

- water costs are only a small proportion of total costs. For those cases where input costs are small yet critical, producers have flexibility to reduce costs in other areas (taxation options, corporate structure);
- alternatives are available to offset higher unit water costs and provide opportunities for cost-saving improvements (as the cost of leasing water rights is tax deductible);
- much more water is used in production processes than necessary, so many irrigators are able to make management changes to greatly reduce their water consumption;
- all current on-farm irrigation investments are much more efficient in water saving technologies than previous investments, and they utilise management systems such as under-canopy sprinklers, mini-sprinklers, drip systems, centre-pivot systems that produce 'soft rain', laser land forming, soil moisture measuring equipment, and efficient drainage;
- in South Australia, the use of furrow irrigation declined from 50 per cent of the total area in 1976 to 20 per cent by the mid 1990s (while in Victoria's Sunraysia district 70 per cent is irrigated by furrow and flood methods and in New South Wales it is 84 per cent);
- changes to improve water use efficiency are also taking place in the livestock sectors (such as replacing dams with piped reticulation systems for stock watering);
- over the past decade, higher water charges have encouraged water transfers out of low-value uses and locations (as with water entitlements used on pasture in South Australia's Lower Murray being transferred to vegetable production in the Riverland; and
- higher water prices have allowed irrigators to sell off part of their entitlement, invest the money in new water-saving technologies and then sell more of their entitlement.
-

What lessons can be drawn from the pilot interstate trade project?

Among the key features of the two year pilot evaluation include:

- In the two year period ending in September 2000, the pilot project allowed 51 trades involving 9. 8 GL of water worth more than $9.9 million.

- Interviews with water brokers and Commission records indicates that there has been a net trade of water into the trial area of approximately 30 GL form Victoria.

- Significant amounts of NSW water is trading from the Murrumbidgee Irrigation Area into the trial area;

- Less than 1 per cent of the water traded across State boundaries was being used at its origin (i.e. virtually all the water being traded permanently was sleeper water);

- In virtually all (99 per cent) of cases, the water traded was not being used at its origin and in virtually all cases it has moved to a very profitable use.

- Three trades were worth more than $1 million. In net volume terms, more than 90 per cent of the water moved to South Australia. The total volume of water traded involved less than 1/100th of the total water applied in the area –from Nyah to Murray Mouth,

- During the first two years, virtually all water has gone to high value uses. Around three-quarters into new irrigation development using state-of-the-art technology. The value of some of the transactions involved exceeds $0.5 million and in some cases over $1 million.

- The bundle of rights associated with a one ML entitlement in each State is not identical. In addition each State has different environmental management and planning requirements, different fee and charge structures and different penalty schedules.

- The use of temporary water markets varies from State to State due to differences in policies and major water uses. Victoria and NSW have a tradition of fluctuating annual supplies, adopting land and water uses to accommodate those fluctuations. In contrast, the financial penalties for exceeding the licensed water allocation in South Australia are often less than the price of temporary water. Less incentive exists to rent water in these circumstances. The incentive is to exceed allocation rather than trade water.

- Irrigators in trial areas of NSW and Victoria have access to more upstream water than irrigators in South Australia. Across the border in NSW, high security water is trading for around $1,000/ML and in Victoria's Sunraysia district, water trades for around $730 for low salinity impact and $1,000/ML in high salinity impact areas. Further upstream, in the Goulburn-Murray Irrigation District, water trades at around $750/ML. Data from NSW indicates that similar trading patterns are occurring in this State.

- With the value of water used on properties far exceeding the value of land, banks are insisting that investments and developments be underpinned by secure water rights. Banks are also requesting water as security for their loans.

The report's conclusions and recommendations that are important for the grape and wine industry include:

- the most pressing issue is establishing a simpler, quicker more transparent water registration system for water rights;
- inconsistencies among State procedures, processes, water rights, information requirements, penalties, data collection and recording methods within the existing pilot trading area;
- expanding the project area upstream introduces more complications further delaying trades, placing ever greater work loads on already over-stretched State departments, increasing transactions costs and lengthening time delays.

How would more interstate water impact on Australia's economy?

In the water pricing reform scenario, there is a redistribution of irrigation activity from upstream to South Australia with pricing reforms. There is an overall decline in agricultural output but this is outweighed by the benefit in terms of reduced salinity damage. Similarly, in the case of taxing producers for the full cost of salinity damage, the benefit of reduced salinity outweighs the reduction in national income.

What issues and regions should the grape and wine industry focus on?
An important task for the grape and wine industry is to determine which water related issues are priorities in a local, state and national context; in a short and long run context; and in an area context. The overall water policy advocacy strategy involves: assigning priority to those areas where problems of water allocation, water scarcity and environmental degradation are greatest; understanding the technical, environmental and economic issues necessary to manage the physical aspects of the aquifers and the Murray Basin; and providing education, incentives and information to manage the irrigators.

One way to characterize the grape and wine industry's overall response to irrigation and water related issues is presented in Figure 6 which divides the country's grape producing areas into a 2 x 2 matrix with high and low productivity and value areas and high and low vulnerability areas.

Figure 6: Grape Production, Water Use, Environmental Vulnerability and Policy Responses

Productivity and Grape Value Potential	**Vulnerability to Water-related Environmental Damages or to Water Scarcity**	
	Low	**High**
Low	Low policy intervention ---------- Low research priority	Large penalties for damages ---------- Environmental research
High	Yield-promoting policies ---------- Yield and quality promoting grape research	Policy promoting precision water use production ---------- Sustainability research

The Murray River Basin would have areas that fit into any of the four cells. Most of the high value, groundwater dependent grape producing areas would fit into either of

the two lower cells. The higher rainfall areas of NSW and Victoria would fit into the two left hand cells.

The key recommendations from this research are:

a) promote rules to reduce uncertainty and help coordinate expectations;

b) involvement in decision making to influence all policy bodies including local water catchment boards, water authorities, state and regional agencies, and national level bodies;

c) push harmonization of water rights definitions, licensing procedures, and state registration systems for Murray River water rights;

d) lobby for higher penalties for misuse and over use of water;

e) seek quicker, simpler water license transfers (similar to land transfers) to lower transactions costs (especially time) for water transfers;

f) establish a Murray River Basin wide registration system based on the Torrens Title system;

g) move from a fixed allocation water license to a proportional allocation water license to accommodate unforeseen climatic on environmental events. For example, each license would specify a share (say .003 per cent) of a five year allocation (4GL) for an entire basin or aquifer. The next five year allocation would be announced two years before it begins or three years into the current period to provide planning information for investors and irrigators;

h) promote metered pumps and credible verification system;

i) encourage more technical and hydrological analysis to feed into farm dam policy reforms;

j) encourage long term water leases and temporary water trades to provide growers financial savings (via tax incentives) and security of supplies;

k) form alliances with horticulture, rural communities, environmental groups to influence institutional and regulatory systems;

l) promote education, extension and information dissemination to take advantage of the 6 per cent of growers who account for 50 per cent of irrigated properties.

Water Policy Reforms and the Future of Australia's Wine Industry

Randy Stringer

Introduction and overview

The policies, incentives and management practices shaping the future availability, access, use and quality of water have enormous implications for Australia's wine industry. Water plays a crucial role in a wide range of wine-related activities. Rainfall and irrigation influence grape quality, vine health, vintage variation, grape flavour, and wine complexity. Water prices affect cost competitiveness, risk management, and enterprise returns. Water use is an important marketing trait, with implications for geographical attributes and trade relations. Water management practices and winery waste water control impact on the industry's overall environmental reputation at home and abroad.

While grapes are a relatively high value, low volume irrigation activity, growers do depend on reliable supplies of good quality water at specific times throughout the year. Timely access to high quality water supplies is crucial to grape production and wine quality. Australia is undertaking major policy reforms to address a variety of water-related issues, including scarcity, environmental and quality concerns. To help cope with the implications of the rapidly evolving water reforms, it is essential that the industry remains involved in the ongoing water reform debates.

A number of international, national, and local forces are driving fundamental changes to Australia's water institutions. These rapidly changing water laws, water policies, water markets, licensing regimes, water administrations, and environmental regulations alter the incentives and opportunities facing grape growers and the wine industry. Wine grapes are one of the fastest expanding irrigated crops in Australia. In South Australia alone, irrigated grape production has increased by more than 100 per

cent in the past 8 years. Wine grape production now accounts for some 33 per cent of the state's irrigated area, up from less than 15 per cent just a decade ago (ABS; 2001).

The wine industry has an important stake in how water institutions evolve, how they are influenced and how they are monitored, evaluated and adapted. This paper attempts to contribute to this process by reviewing the key factors motivating change in national, regional and local water institutions and how the resulting policy reforms effect irrigation performance, water markets, water use, and the profitability of grape growers.

What are the key factors motivating change in Australia's water institutions?

Irrigation trends in Australia are diverging from almost all of its OECD counterparts, including many of its major wine export competitors. The proportion of Australia's water used for agricultural purposes is increasing both in absolute and relative terms. The experience in the European Union, Japan and North America is the opposite -- less water for agriculture and more for cities and industries. In fact, during the past four decades, the area under irrigation in Australia has expanded sixfold, while agricultural area increased by more than one-third, the average farm size doubled in area; and the volume of farm chemicals used per year trebled (ABARE, 1997a, 1997b, 1998, 2000; Chisholm, 1997; Stringer and Anderson, 2001). Several reasons help explain these trends.

First, Australia is the driest inhabited continent. Most of its soils are shallow and infertile. While 60 per cent of the country's land area is used for agriculture, only 5 per cent of that agricultural land has sown pasture grasses and less than 5 per cent is cropped. The rest is arid leased land used for grazing cattle and sheep on native grasses for meat and wool production. Even so, most sheep and cattle are grazed in the higher-rainfall, mixed-farming zones, with only a small proportion in the arid and semi-arid range lands that cover the majority of the continent.

Second, agriculture is more important to the economic prosperity of Australia than to most other advanced industrial countries. While primary agriculture's contribution to national production is not large, at around 3 per cent of Gross Domestic Product (GDP), the entire agricultural and food processing industry contributes 12 per cent of

GDP and 7 per cent of employment (DFAT, 1999; ABS, 2000a). it is expected to continue playing a significant role in regional economic development and as a foreign exchange earner.

Third, 80 per cent of Australia's agricultural production is exported, the value of which accounts for one-fifth of all goods and services exports. While that one-fifth share is much smaller than it was in earlier decades, any downturn in agricultural exports still has important macroeconomic implications for Australia. That plus the high dependence of farmers on exports means Australia is unusually sensitive to policies and practices at home and abroad that affect its agricultural competitiveness.

Fourth, Australia has relatively abundant water supplies compared with its major agricultural export competitors (Table 1 and Figure 1). In per capita availability terms, Australia has 16 times more water than South Africa, 9 times more than Italy, 6 times more than France and Spain, and 2 times more than Argentina and the US. Among the major wine producers, only Chile has more water per capita with 3 times as much as Australia. In addition, 70 percent of water use in Australia is for agricultural purposes compared with 12 per cent in France, 40 per cent in the US and 53 per cent in Italy.

Fifth, Australia's geographical location, relative isolation, lower population pressure, and a rural sector generally free of polluting industrial activities provide it irrigation-related advantages. The country's 19 million inhabitants are heavily concentrated in urban centres along the south-eastern and south-western coastlines, with most people living and working in cities. More than 80 per cent of the entire population occupy just 1 per cent of Australia's land surface. The country's eight state and territory capital cities account for two-thirds of the population and more than two-thirds of employment (SEAC, 1996). Water use in many Australian cities declined and operational efficiency increased during the 1990s due to water reforms that led to higher prices and reduced subsidies (AATSE, 1999).

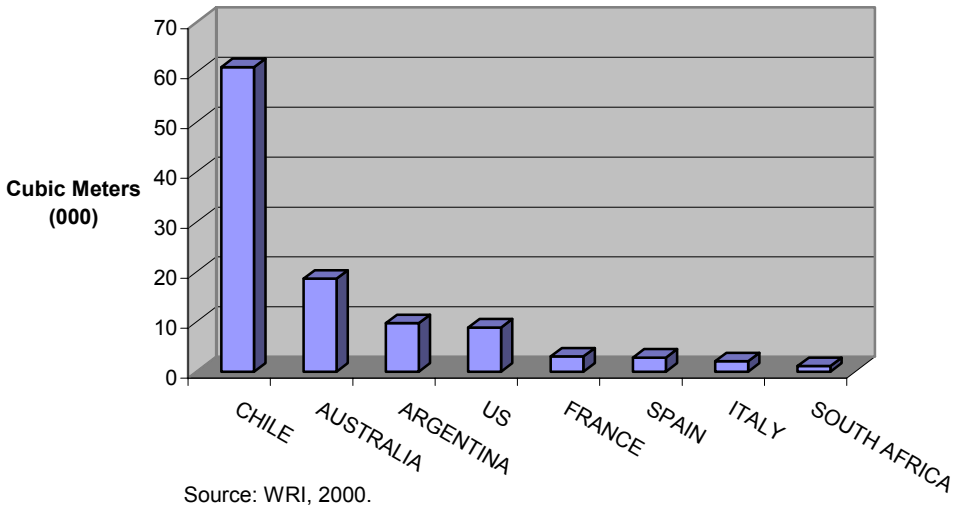
In contrast, the population of California, the major grape producing state in the US, is expected to increase from 34 million in 2001 to 47.5 million in 2020. Over this time

Table 1: Water use in Australia and its wine export competitors

	Per Capita Availability	Per Capita Use	Agriculture's Share	Irrigated Area
	m^3	m^3	%	(000) Ha
Chile	61,007	1629	84%	1,800
Australia	18,638	839	70%	2,057
Argentina	9,721	822	75%	1,561
US	8,838	1844	40%	21,400
France	3,047	704	12%	2,000
Spain	2,821	897	68%	3,640
Italy	2,080	840	53%	2,698
South Africa	1,110	391	72%	1,350

Source: World Resources Institute 2000 and FAOSTAT, 2001.

Figure 1: Per Capita Water Availability: Australia's Main Competitors



Source: WRI, 2000.

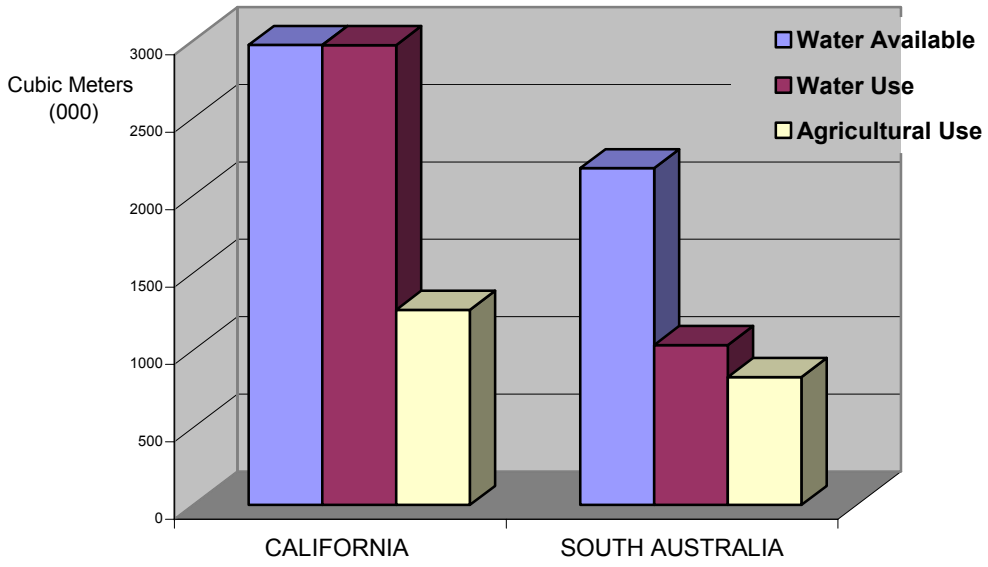
period, the share of water going to urban users is expected to increase by 4 per cent while agriculture's share declines by 4 per cent (DWR, 1998). At present, agriculture accounts for 43 per cent of total water use in California. Irrigation in South Australia accounts for 80 per cent of total water use and the state faces no foreseeable population pressure (Figure 2). The total area of irrigated vines in California is 218,000 ha compared to 125,000 in Australia and 50,000 in South Australia.

Sixth, the depreciating Australian dollar and increased product prices from export demand over the past few years helps explain why producers have been able to expand irrigation while facing increasing expenses imposed by water reforms. For example, the real value of both wine-grape production and wine production has grown at more than 10 per cent per annum over the past 12 years (Anderson, 2000). Over the last 9 vintages, grape prices have increased 90 per cent (ABS, 1997; 1998; 1999; 2000b). The volume of wine exports has risen from less than 5 per cent to more than 30 per cent of production, and will soon exceed 50 per cent of sales. Australia is now the world's largest wine exporter after the European Union bloc, having been a net importer of wine as recently as the early 1980s.

Seventh, international organisations seek lessons from Australia's experience to guide policies in dozens of other countries throughout the world. Many developing countries face water scarcity issues so severe that health, life and food security are threatened. With some of the highest income and best educated irrigators any where in the world, the OECD, the World Bank, and the United Nations recognise Australia's experience as key to solving water scarcity and water related environmental problems.

Other international pressures are commercially motivated, as wine export competitors keen to identify subsidies to grape growers through water pricing policies, for example. This information can be used in trade negotiations in an attempt to slow Australia's progress into their traditional markets. Additional international obligations influencing water policies include UNCED follow-up requirements, post-Uruguay Round and WTO obligations, environmental treaties on climate change, biodiversity and desertification and adoption of internationally-accepted codes and practices such as CODEX, HACCP and ISO.

Figure 2: Water use in California and South Australia



Source: DWR 1998; ABS 2001

Finally, environmental pressures are forcing major changes to Australia's water institutions. Over time, the long-term trends in water use, land clearing, intensification and specialisation have brought about extensive changes to the country's natural resources. While crop productivity growth has been sustained by more intensive water use practices, by-products have included soil structure decline, soil and water erosion, and increased levels of salinity and acidity. The increased demand for water, changing agricultural technologies and management systems are altering soil, landscape, vegetation and water resources in ways that can result in pollution, contamination, resource degradation and habitat loss.

To address problems associated with nutrient loads and eutrophication, increasing water salinity, declining wetlands and declining river health, the Murray Darling Basin Ministerial Council imposed a permanent Cap on water diversions in 1997. Establishing a Cap involves the complex task of allocating water for environmental needs as well as for agricultural producers and other users. The Cap on water

diversions represents the most significant water resources initiative since the establishment of the MDB Ministerial Council in 1985, and is widely recognised as a landmark decision in Australia's natural resource management (MDBC, 1998). The Council aims to balance economic and social benefits and the environmental uses of water in the rivers. The cap is defined as 'The volume of water that would have been diverted under 1993/94 levels of development. In unregulated rivers, this is expressed as an end-of-valley flow regime.

Irrigation and agricultural production in Australia

Agriculture is Australia's largest water user, accounting for some 70 per cent of the country's water consumption (Table 2). The 2.1 to 2.4 million ha of irrigated crops and pastures represent less than 0.5 per cent of the total agricultural land and about 12 per cent of the total area of crops and pastures. The value of irrigated production fluctuates between 25 per cent and 30 per cent of Australia's gross value of agricultural output (Cape, 1997; ABS, 2000b).

Irrigation supports the production of all rice, most vegetables, milk, fruit, grapes, cotton and significant amounts of soybeans and sugar, while its contribution to meat, cereal, pulse and oilseed production is relatively minor (DPIE, 1998). Table 3 presents the 1997 data from the ABS report, *Water Account for Australia* showing GVP returns per ML of water use for specific crops. Vegetables, fruit and grapes are the high value water users; pasture, rice, sugar and cotton are the low value users.

NSW, Queensland and Victoria account for some 88 per cent of the water consumed in irrigation and 90 per cent of the irrigated area (Table 4). NSW dominates, consuming 46 per cent of the water on 44 per cent of the irrigated land. The average water use per ha varies from more than 20 ML/Ha in Western Australia to 2.2 ML/Ha in Tasmania. At the national level, pasture accounts for more than 44 per cent of irrigated area; cereals accounts for 23 per cent, and cotton for 17 per cent.

Despite more than a decade of water reforms, deregulation and related structural changes, pasture irrigation dominates all crops for water with 40 per cent of the irrigated area (Table 5). Historically the price of water has been set so low as to not be a critical factor in the choice of crop under irrigation (Smith, 1998). Much of this

Table 2: Australia Net Water Use by Sector 1997

	ML	Share
Agriculture	15,502,973	69.9%
Services To Agriculture	18,815	0.1%
Mining	570,217	2.6%
Manufacturing	727,737	3.3%
Electricity/Gas	1,307,834	5.9%
Sewerage/Drainiage Services	1,706,645	7.7%
Other	522,513	2.4%
Household	1,828,999	8.2%
Total	22,185,733	100.0%

Source: ABS: Water Account for Australia 4610.0.

Table 3 Australia Irrigated Water Use 1997

	Gross Value	Net Water Use	Return per ML	Share of Water Use	Area	Share of Area	Water Applied
	$M	ML			Ha		ML/Ha
Livestock, Pasture, Other	2540	8,795,428	0.29	56.7%	1174687	57.1%	7.49
Pasture					934000	45.4%	
Cereals					184000	8.9%	
Others					56687	2.8%	
Vegetables	1119	634,913	1.76	4.1%	88782	4.3%	7.15
Sugar	517	1,236,250	0.42	8.0%	173224	8.4%	7.14
Fruit	1027	703,878	1.46	4.5%	82316	4.0%	8.55
Grapes	613	648,574	0.95	4.2%	70248	3.4%	9.23
Cotton	1128	1,840,624	0.61	11.9%	314957	15.3%	5.84
Rice	310	1,643,306	0.19	10.6%	152367	7.4%	10.79
Total	7254	15,502,973	0.47	100.0%	2056581	100.0%	7.54

Source: ABS, 2000b

Table 4: Irrigation Use in Australia by State 1997

STATE	Water use	Proportion of total water use	Area	Proportion of area	Average water use
	ML	%	Ha	%	ML/Ha
NSW	242,288	37.4%	15,194	22%	15.95
VIC	217,888	33.6%	20,800	30%	10.48
QLD	4,062	0.6%	800	1%	5.08
SA	171,836	26.5%	30,432	44%	5.65
WA	11,113	1.7%	2,654	4%	4.19
TOTAL	647,187	100%	70,364	100%	9.19

Source: Water Account for Australia 4610.0 and ABS 7113.

Table 5: Area of crops and pastures irrigated in Australia, 2000

	1992	1993	1994	1995	1996	1997	1998	1999	2000
					Ha (000)				
Pasture	1081	1184	1362			934	1048	986	925
Rice	114	106	125	119	137	152	147	148	131
Other cereals	161					184	231	219	253
Cotton	274	252	257	216	277	332	381	375	382
Sugar cane	146	154	168			173	201	156	202
Vegetables	96	89	96			89	103	97	99
Fruit (incl. nuts)	99	125	144			82	86	94	97
Grapevines		43				70	88	108	120
All other crops	15							77	84
Total	1986					2057	2365	2,251	2,384

Source: ABS Agriculture, Australia, 1999-2000 (Cat. 7113.0).

irrigated water still goes to low value uses. Figure 3 presents data from a 1997 benchmarking study of irrigation performance in NSW. Irrigated grape production out performs cotton, lucerne and rice. Grapes averaged 3.4 ML/Ha and returned $6.45 per ML compared with cotton which averaged 7.5 ML/Ha and returned $0.58 per ML; lucerne which used 9.4 ML/Ha and returned $.048 per ML; and rice averaging 12.8 ML/Ha and retuning $0.27 per ML. These numbers suggest a large potential for high value irrigation activities to draw water away from pasture, rice and sugar.

In addition to rice, cotton and grapes are the crops with the highest proportion of growing area irrigated: 96 per cent for cotton and 81 per cent for grapes (ABS, 2001). During the past decade, cotton and grapes have been two of the fastest growing irrigated crops (Figure 4). The irrigated cotton area expanded from 252 thousand ha in 1993 to 382 thousand in 2000. Irrigated grape production has expanded from around 43 thousand ha to an estimated 125 thousand during the same period. The total area planted to grapes in 2000 is 146.2 thousand ha and an estimated 85 per cent are irrigated.

The ABS's *Water Accounts for Australia* (2000) suggests that average quantity of water used per ha on grapes in 1996-97 are: 15.9 ML/Ha in NSW; 10.5 ML/Ha in Victoria; 5.1 ML/Ha in South Australia; and 4.2 ML/Ha in Western Australia (Figure 5). The national average is around 9.3 ML/Ha. Even with the high proportion of furrow irrigation in NSW, water use data in that state appears too high and out of line with most reports on irrigation practices. Table 6 presents the differences in irrigation methods used in each of these three states.

This lack of reliable information on how much water is actually used by grape irrigators is an important concern for the wine industry. Published reports and irrigation specialists suggest that water use ranges from more than 15 ML/Ha in the MDB to less than 0.5 ML/Ha in the groundwater dependent regions of South Australia and Western Australia. Approximately 15 per cent of Australia's vine area receives no irrigation. An additional 3 to 5 per cent receive 'supplementary watering', to control water stress levels, to maintain vine health or to manage the risk of an extended drought.

Table 6: Irrigation Methods Used in NSW, South Australia and Victoria

	NSW	Vic	SA	Australia
Irrigation Method	Percent of Area			
	%	%	%	%
Spray method (excl. microspray)	11	12	44	22
Drip or Microspray	3	5	33	8
Furrow or flood	85	82	21	70
Other	1	1	1	1
Irrigation methods reported	100	100	100	100

Source: ABS Agriculture, Australia, 1999-2000 (Cat. 7113.0)

Figure 3:
Water Performance: NSW Benchmarking Study
1997

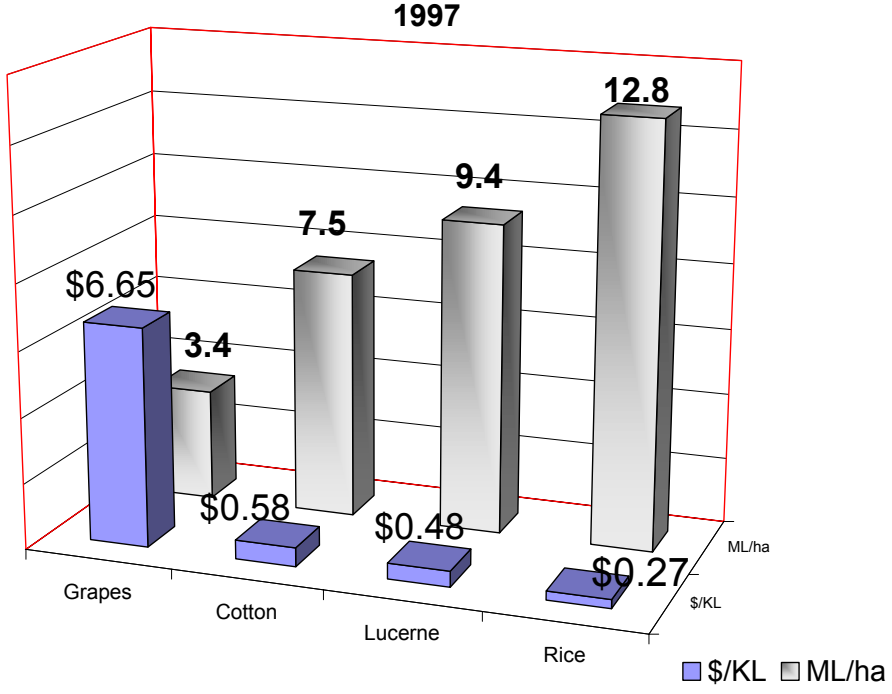


Figure 4: Growth in Irrigated Area for Grapes, Cotton and Rice

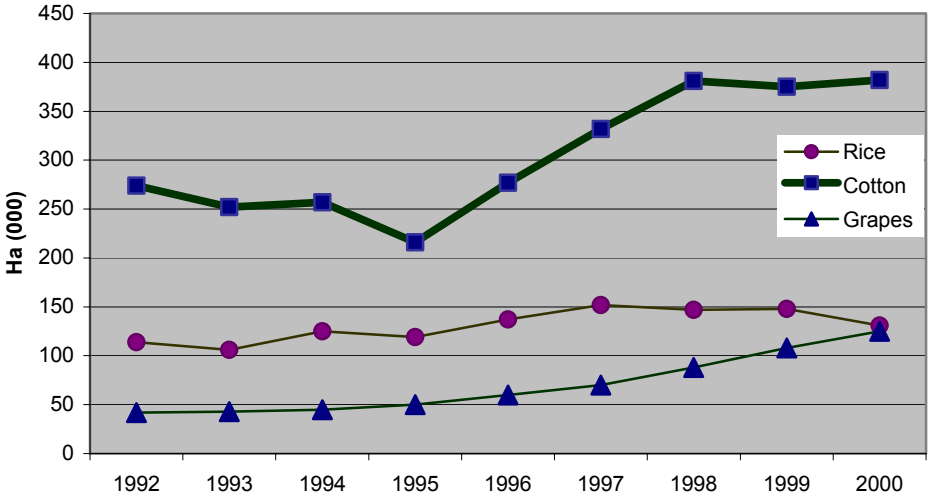
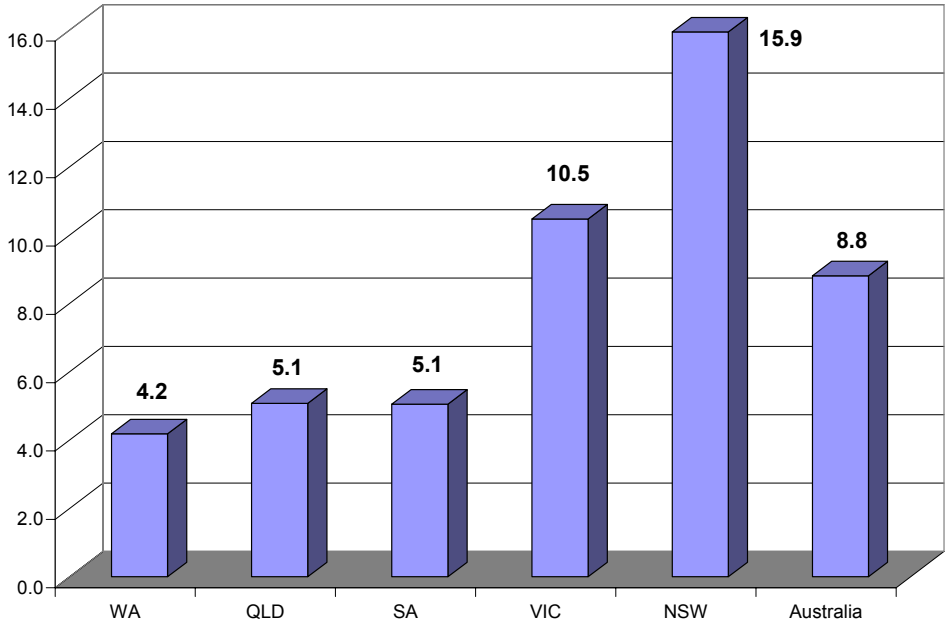


Figure 5: Average water use on vines by state (ML/Ha)



The MDB is the high-water use, high-yield grape production zone in Australia. The MDB contains more than 80 thousand ha of Australia's grape area. The vast majority is irrigated, representing some 55 to 60 per cent of the total area planted to grapes and more than two thirds of the irrigated grape area. The average grape yield (including table grapes) in the MDB is 18.2 t/ha. Average yields in the groundwater-dependent regions of South Australia and Western Australia is 9.5 t/ha, nearly 50 percent less.

About 90 percent of Victoria's grape area is in the MDB (34.5 thousand ha); 70 per cent of the area in NSW (24.4 thousand ha); and 40 per cent of South Australia's grape area (24.5 thousand ha). The Barossa and Clare districts in South Australia also have access to Murray River water (Langhorne Creek is included in the 24.5 thousand ha estimate).

The majority of South Australia's grape growers and the majority of the state's vine area are located in groundwater dependent zones, including the Adelaide Hills, Barossa, Coonawarra, Fleurieu, Limestone Coast, McLaren Vale, and Padthaway. Water use in these areas is relatively low, averaging from no irrigation to around 4 ML/Ha. These groundwater areas also produce the majority of the country's highest value premium grapes. Table 7 presents estimates for water use for 10 regions in South Australia. The data is based on area, production and yield information from ABS, PGIBSA and individuals with knowledge of local irrigation practices. The high water use area is South Australia's Murray region, accounting for 31 per cent of the area and averaging 7.5 ML/Ha or 68 per cent of the state's water used on vines.

How are environmental pressures impacting on water resource management?

For years, policies inducing Australia's agricultural transformation were guided by socioeconomic objectives that seldom included explicit valuation of the environment, much less the concept of ecologically sustainable agriculture. Growth in production, enhanced producer income, stable prices for producers and consumers, and increased net exports of agricultural products tended to be the dominant objectives of farm policy in Australia. Policy instruments used to achieve these objectives included generous tax concessions for land clearing, publicly-funded capital works to expand irrigation, and large fertilizer price subsidies.

During the past decade, increasing international economic integration and heightened environmental concerns abroad, as well as changing attitudes at home, have forced Australian farmers and policymakers to rethink the role agriculture can play in the economy and society and environment. The current trend at both local and national levels is to aim for more emphasis on sustainable agricultural development, recognizing its dual goals of economic efficiency and environmental protection. Agriculture is broadening its role beyond increasing productivity, expanding export earnings and enhancing rural incomes to include also evolving concepts of managing ecological processes and protecting environmental resources. In this, it is being accompanied by similar trends in other OECD countries and, increasingly, in middle-income countries as well.

Table 7: Estimated Water use on Vines in South Australia's Grape Regions

	Growers - Irrigators	Bearing in 1999	Total Area 1999	ML/Ha	Estimated ML	Tonnes 1999	T/ML	Yields
McLaren Vale	328	3509	4688	1.2	4688	49797	44.92	14.19
Adelaide Hills	183	1019	2217	1.5	3326	7810	7.05	7.66
Clare	202	2476	4224	3	12672	19694	2.33	7.95
Murray	1251	12474	17874	7.5	134055	258987	1.93	20.76
Limestone Coast	87	1873	3722	4	14888	39409	5.29	21.04
Padthaway	21	2694	3133	4	12532			
Coonawarra	83	3430	4536	4	18144	24369	2.69	7.10
Langhorne Creek	88	2266	4367	4	17468	25495	2.92	11.25
Barossa	564	6860	8944	4	35776	63647	4.74	9.28
Mount Lofty	43	384	539	4	2156	5000	2.32	13.02
Other	62	236	818	0.5	409			
Sub-total			55062					
Total	2912	37221	55062	4.4	256114	494208	2.57	13.28

Source: PGIBSA for areas and author's estimates for water use.

Until recently, Australia's agricultural producers have been largely insulated from the demands of environmental groups and from government restrictions on their activities. Now, however, the various local, national and international pressures described above are forcing policymakers to address agricultural environmental and health-related issues and to examine ways to promote more sustainable farming practices. Australian policy recognises that environmental and ecologically sustainable development issues

must be dealt with at all levels of government if the resource base is to be used optimally.

Water-related environmental issues have become a key factor motivating change in Australia's water institutions. Water has moved to the forefront of national policy debates aimed at meeting expanding social, economic and environmental objectives. The primary agricultural activities causing water-related environmental problems in Australia are: (a) allowing runoff from fields to carry sediments, nutrients, organic matter and agricultural chemicals; (b) extracting too much water for irrigation, resulting in severe impacts on aquatic ecosystems, water quality and groundwater supplies; (c) inverting the natural pattern of river flows in southern Australia (high demands for irrigation during summer when river flows are low and low demand for irrigation during winter when river flows are high); and (d) clearing and using land and water in ways that result in rising water tables and salinity (Cullen and Bowmer, 1995). Table 8 presents an overview of how water use systems are linked to environmental problems in Australia.

Water and irrigation-related environmental pressures are greatest in the river system contained in the Murray Darling Basin (MDB). The MDB covers one-seventh of Australia's landmass, and crosses four states (New South Wales, Queensland, South Australia and Victoria). The MDB contains more than 70 per cent of the country's irrigated area and produces 90 per cent of the value of irrigated food crops. In addition, it supports more than 50 per cent of the country's crop land and produces more than 40 per cent of the country's total agricultural output value (ABS, 1996). Some 95 per cent of MDB water diverted for human use goes to agriculture and the flows of all but one of the rivers within the system have been modified to support the growth of agricultural industries. Additional pressures are stemming from the fact that the MDB is rich in Aboriginal cultural heritage sites and includes some 140 conservation areas and numerous internationally-recognised wetlands.

Extensive use of superphosphate fertilizer in the MDB has been singled out as the primary source of phosphorous, which led to the world's largest toxic blue-green algal bloom in the summer of 1991-92. The algae expanded over a 1000-km stretch of the Darling River, resulting in the closure of water supplies and major disruptions to local

communities. Local, state and national governments responded by establishing the Murray Darling Initiative. This environmental crisis is credited as the single most important impetus in generating cooperative action and the development of best-practice management activities to address water issues in Australia (ABS, 1996).

Table 8: Water Use and Environmental Concerns

Water System	Issue	Policy Intervention	Results
Groundwater	Overuse of water and contamination	Bore metering and licensing; regulations and tradeable water rights.	Limited effect
Farm dams	Proliferation reduces streamflow particularly during dry conditions.	Local restrictions and moratoriums	Farm dams only recently considered in water resources planning.
Irrigation systems	Major user of stored water with salinization, waterlogging, nutrients, pesticides.	Water pricing, reform and restructuring of industry, demand management; improved technology.	Still minimal application.
Catchment pollution	Most water bodies in areas of agriculture affected by fine and coarse sediment, elevated nutrients loads, and increased volume and rate of run off in some areas.	Strategic revegetation and farm forestry; clearing bans; drainage; soil conservation and fertilizer management; tree planting to reduce salinity; stream bank stabilisation, catchment management and Landcare.	Landcare working in some areas, Stream bank stabilisation is costly and partially successful.

What are the mechanisms for changing water policies?

One major program drives water policies: the 1994 COAG water reform agreement. Since the states and territories have prime constitutional responsibility for natural resource management, COAG represents the nation's attempt to integrate and coordinate water policies and avoid further fragmented efforts, policies and activities. The Commonwealth, New South Wales, Victoria, South Australia and Queensland governments established an inter-governmental agreement to provide for a special ministerial council to organise the Murray Darling Basin.

Through COAG the state/territory governments agreed that: water should be priced to reflect social cost and benefits; subsides and cross subsidies should be removed; tradeable property rights would be established; and market mechanisms would be used to encourage more efficient management and use. COAG aims to sustain and restore ecological processes and biodiversity of water-dependent ecosystems.

COAG is illustrative of how Australia has begun responding to environmental pressures by committing to a process of adapting sustainable development concepts, programs, and policies to suit domestic socioeconomic conditions, including prevailing agricultural production, consumption and trade patterns.

During the 1990s, the environment became a mainstream political concern in Australia and community participation is recognised formally in agricultural programs, initiatives and legislation (Campbell, 1994; 1996; Alexandra *et al*, 1996; Thomas, 1996; EDO, 1996; Sarkissian *et al*, 1997; Archer *et al*, 1998;). Government agencies and large and small businesses incorporate environmental concerns into their overall management plans. Firms, local communities and environmental organisations are increasingly cooperating in environmental management initiatives (Cato, 1995). For example, the Australian Conservation Foundation and the National Farmers' Federation jointly address land degradation issues. Many environmentally relevant decisions are made by industry, special-interest groups and individuals, either acting alone or collectively (SEAC, 1996).

Environmental management in Australia involves a mix of market incentives, government regulations and voluntary approaches. Voluntary measures and agreements between governments, industry and community groups play a key role, with an increasing emphasis on economic instruments. Environmental issues are not the province of any one sphere of government. Although the Commonwealth Government has powers to enact laws affecting the environment and sustainable development, the Australian Constitution does not specifically deal with environmental powers. Most environmental legislative responsibilities rest with state/territory governments and most decisions that affect the environment occur at the local level. When international treaty obligations are at stake, however, the Commonwealth takes precedence over state/territory and local powers.

The Commonwealth Government guides, manages and coordinates state/territory and local governments through councils, programs, inquiries, access (or denial) of federal funds and mutually-developed policy strategies. Several of these national processes have significant influences on water resource management.

The Council of Australian Governments (COAG), which includes the Prime Minister and the leaders of the state, territory and local governments, is the peak body overseeing closer cooperation on issues concerning clarification of roles and responsibilities in environmental regulations. Among other tasks, COAG has been responsible for overseeing the finalisation of the InterGovernmental Agreement on the Environment (IGAE) and the National Strategy for Ecologically Sustainable Development (NSESD).

The IGAE was established in 1992 to avoid damaging disputes about environmental matters between the different levels of government and to establish conditions under which the various governments will interact. The Agreement provides a mechanism to: define the roles of each level of government; reduce intergovernmental environmental disputes; provide greater certainty in government and business decision making; and provide better environmental protection.

The IGAE sets out four main principles to inform government policy making and program implementation:

1. the precautionary principle, which stipulates that where the threat of environmental damage is serious or irreversible, lack of scientific proof of damage is not a defence against action to prevent the degradation;
2. inter-generational equity, which stipulates that the health of the environment should not be eroded for the benefit of the present generation at the expense of the future generations;
3. conservation of biological diversity and ecological integrity; and
4. improved valuation, pricing and incentive mechanisms such as including environmental factors in valuation of assets and services, introducing polluter-pays principles, and introducing market mechanisms to maximise benefits.

The Agreement also outlines three ways in which governments should incorporate environmental issues into their decision making processes: first, ensure that

environmental issues are considered when formulating policies; second, ensure that the identified environmental issues are properly examined; and third, ensure that measures adopted are cost effective and not disproportionate to the significance of the environmental problem.

The National Strategy for Ecologically Sustainable Development (NSESD) provides the guiding framework for most environmental and natural resource management efforts. The Strategy aims to enhance individual and community well-being and welfare by following a path of economic development that: safeguards the welfare of future generations; provides for equity within and between generations; protects biodiversity; maintains essential ecological processes and life support systems.

The NSESD calls for pricing and economic instruments as means for achieving better management of Australia's natural resources and to ensure that adequate attention is given to social and environmental costs when assessing the use of pricing, taxation and other economic instruments (NSESD, 1992). The overall policy approach is to promote research and adoption of sustainable development and best practice techniques. Local and state/territory governments are, however, increasingly experimenting with economic policies such as property rights (establishing tradeable water entitlements and tradeable salt discharge rights), as well as imposing full cost resource use pricing to cover environmental damage.

Four national level programs assist COAG's water agenda and influence how agricultural activities use water resources: (1) the Wetlands Policy; (2) the National Land and Water Resources Audit; (3) the Australian National Water Quality Management Strategy; and (4) the Murray Darling Basin Ministerial Council. The Wetlands Policy focuses on wetlands protection and management to meet Australia's obligations under the Ramsar Convention on Wetlands. It thus has direct implications for agricultural water users close to identified sites and indirect implications for upstream and up-catchment water users. The purpose of the National Land and Water Resources Audit is to undertake an economic evaluation of environmental degradation. The information is then used to adapt water policies and programs to changing ecological and environmental circumstances.

The Commonwealth and all state/territory governments participate in the National Water Quality Management Strategy (NWQMS). This Strategy aims to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development. It applies five environmental values to fresh, marine and estuarine waters: ecosystem protection; recreation and aesthetics; raw water for drinking water supply; agricultural water; and industrial water.

To achieve the NWQMS objectives, local and state/territory governments focus attention on diffuse sources of pollution in the rural environment. This includes improving the quality of run-off of agricultural land through improved natural resource management, best management practices and codes of conduct. Attention is given to point sources of pollution in the rural sector, such as dairy shed effluent, dairy processing waste, winery waste and other water-intensive industries. The NWQMS envisages that regulatory, market-based and education approaches should be used in developing water quality management plans (ANZECC, 1998).

In the recent past, ecologically sustainable development has been promoted by the Commonwealth via the Natural Heritage Trust (NHT), which funds programs important to agricultural producers. NHT represents a practical example of how resource management in Australia has moved away from technical forms of centralised government planning to a more community-based, participatory resource management regime that recognises the plurality of stakeholder interests (Crean *et al*, 1999).

NHT-funded programs relevant to grape irrigators include the following.

The National Landcare Program involves farmers working together with the community and governments to address environmental problems too large for individuals to handle. More than one-third of Australia's farm population are members of Landcare groups. Recent assessments conclude that the Program has been successful in using an integrated approach to natural resource management problems and in achieving genuine public ownership (Cullen, 1997).

The National Rivercare Program is a major investment in activities to improve the health of Australia's river systems outside the Murray Darling Basin. It targets on-ground works, research and development with practical application and community awareness. Some activities already funded include action by community groups to improve water quality in local rivers, stormwater management, water quality and nutrient management and activities focusing on environmental flows.

The Murray Darling 2001 Initiative provides funding to improve water quality, restore riparian land systems, wetlands and floodplains, integrate catchment management and flow management strategies, and encourage economically and environmentally sustainable development. It is rehabilitating the Basin's natural systems while protecting its productive assets.

The National Land and Water Resources Audit aims to identify the true extent of rising salinity, erosion and other degradation of land and water that threatens national prosperity. The audit provides an independent, objective assessment of the degradation arising from approximately 20 key types of land and water problems and includes an economic analysis of each problem. It is the most comprehensive audit of its kind ever undertaken in Australia.

What is the emerging role of markets in resource management?

While research and extension on sustainable practices dominate Australia's policy response, full cost resource pricing and overcoming market failure through the creation of property rights are also being encouraged. Tradeable water entitlements delink water rights from land rights so they may be traded as a separate commodity. Transfers may be restricted to a single year, allowed for several years or be made permanent. A major policy trend during the 1990s has been the move away from an almost total reliance on the use of regulations to manage food safety and agriculture-related environmental objectives.

Over the past several years, the regulatory approach has been complemented by or, in some cases even replaced with, economic incentives, market instruments and property rights systems (Corbyn, 1996; Jones, 1997; Gunasekera, 1997). Market mechanisms

introduced to meet strategic objectives, include implementing the polluter pays, beneficiary pays and user pays principles. This more market-oriented approach also involves assessing total economic values for the costs and benefits attributed to environmental policies and government regulations, as well as the positive and negative externalities generated by agricultural production activities.

In April 1995, COAG laid the foundation for more emphasis on market mechanisms by establishing principles and guidelines for national standard setting and regulatory reforms. These principles and guidelines, which were amended in November 1997, require a review of existing regulations to determine whether effective alternatives to explicit government regulation exist.

In addition to water pricing, entitlements and trading arrangements, COAG set out recommendations covering institutional reforms, environmental considerations, water-related research, taxation issues and consultation and public education. Community participation in the development and implementation of COAG objectives is encouraged either indirectly through Integrated Catchment Management (ICM), which is partially funded by the Commonwealth, or directly through state/territory legislation requiring community consultation before catchment plans are approved. The main principles include the following.

The COAG water principles have spawned new water legislation in most states and territories. For example, South Australia's Water Resources Act 1997 provides a comprehensive system of transferable water property rights, incorporates principles of ecologically sustainable development, provides holistic water resources management within the context of integrated catchment management, establishes water for the environment, and devolves greater responsibility for water resources to local communities through the establishment of catchment management boards.

The New South Wales government established a framework of water reforms aimed at achieving a better balance in the sharing of water between the environment and water users to ensure long-term sustainability consistent with the COAG requirements. The NSW legislation allows key aspects of the COAG reforms to be implemented, including: ecologically sustainable development principles applied to all decisions

made under water legislation; new opportunities for temporary trading on regulated streams; and new powers for managing groundwater. Likewise, Victoria passed the Water Resources Act 1997 to amend the Water Act 1989 and to provide for similar COAG-induced reforms.

How do water policy reforms affect grape and wine competitiveness?

Australia's water policy reforms are leading to higher water costs per unit of water used as the country moves to adopt the COAG water reforms. Much higher unit costs are expected in the future as further reforms are enacted and as market forces influence the price for water. The Cap on water diversions together with tradeable water entitlements means that new enterprises would have to purchase an ever-scarcer water resource and face higher investment costs.

Moreover, irrigation system fees are increasing not only to cover operating expenses and capital costs of storage and supply structures, but also to cover refurbishment and replacement of depreciating infrastructure. Many irrigation structures are now at or near the end of their useful lives (Crabb, 1997). In addition, irrigators are forced to present farm management plans, pay environmental levies on water use, establish salinity prevention plans and to pay salinity fees when purchasing water.

The increased production costs associated with water policy reforms tend to be only a small proportion of investment costs and operating expenses for grape producers. For those cases where input costs are small yet this input is essential, producers find new ways to offset increases (such as taxation options, corporate restructuring, or leasing water rights instead of purchasing water (since payments to lease water are fully tax deductible).

At the same time, the volume of water used per irrigated crop is likely to decline and, in many cases, so too will the total expenditure on water-related expenses. This is because producers conserve water by using less as its price rises, including through investing in new water-saving technologies. Other market incentives are also influencing water use. For instance, the trend among grape growers is to produce high-value grapes with concentrated juice through lowering yields. Keeping grape

yields down means using less water. This trend implies even lower water requirements and higher returns per unit of water used. High-quality grape production is encouraged by wineries through appropriate incentives in their contracts with growers.

Indeed, there is little evidence in Australia that these higher per unit water costs are imposing an enterprise-threatening situation for any irrigated crop, except for pasture. Even there, pasture producers are taking advantage of the higher water prices and selling some of their unused allocation, or selling their properties which are then put to higher value uses.

The evidence suggests that water entitlement transfers between irrigators have been from lower- to higher-valued commodities (Crabb, 1997; Marsden-Jacob 2000; Young et. al 2000). Investments in the wine industry, horticulture and the dairy industry in the state of South Australia, for example, are sending strong price signals and banks are insisting that these developments be underpinned by secure water rights.

From 1995 to 2000, water prices in South Australia's horticultural areas with access to Murray River water have increased from $500 to $1200 per ML, before falling back to around $1000ML/Ha in 2001. In those areas dependent on groundwater, water trading is thin and prices can reach to more than $30,000 per ML. Dairy, rice and cotton producers are facing a greater cost-price squeeze than horticultural producers as overall subsidies to their industries are reduced.

Increased product prices from export demand are the main reason why these increasing expenses imposed by water reforms and cost-increasing environmental policies have not reduced horticultural production in Australia. The real value of both wine-grape production and wine production has grown at more than 10 per cent per annum over the past 12 years (Anderson 2000). Over the last 9 vintages, grape prices have increased 90 per cent (ABS 1997, 1998, 1999, 2000b).

Since 1995, grape growers in South Australia with access to River Murray water expanded their vine area by 67 per cent. Grapes, especially premium grapes, are a

relatively high value, low volume water user compared with other irrigation activities. Irrigation costs (including fuel for pumping costs and all related fees and levies) can range from 5 per cent to 15 per cent for grape growers. Grape growers can out-bid most other irrigation activities due to higher profit margins compared with other competing agricultural water uses.

A recent study of how irrigation reforms are impacting horticulture farms in the Murray Darling basin concludes that the rate of expansion is likely to slow but production is unlikely to fall as water becomes scarcer (ABARE, 1999). The study suggests that producers will purchase more water, invest in improved irrigation equipment, adopt new irrigation management practices, and change their enterprise mix.

The ABARE study also concludes that increases in water charges are unlikely to lead to a fall in water use by horticulture in the Murray Darling Basin since water charges are only a small proportion of total costs, while the returns to water in horticulture are high. Water expenses ranged from 2 to 7 per cent of total cash costs. As water expenses increased from $40 to $100 per Ml (with other prices held constant), gross margins fell from around $6500 per ha to $5900 per ha for grapes and from $3500 per ha to $2800 per ha for citrus.

A review of the social and economic impacts of the Cap on diversions from the Murray Darling came to similar conclusions (Marsden Jacob, 2000). The fundamental aim of the CAP is to guarantee water security on a valley-by-valley basis. The Cap provides the basis for a workable water market by establishing a fixed water supply that reflects the scarcity value of water and a much less risky long-term investment climate for high value agriculture and value-adding processing dependent on a secure resource base. With a Cap on water diversions in place, high-value developments can take place at the expense of existing lower value activities.

The review concluded that the Cap-initiated reforms to water trading will enhance the economic benefit of water trade in NSW, estimated to exceed $65 million annually with benefits across the Basin estimated to exceed $100 million annually (Marsden Jacob, 2000). In addition, the study found the Cap had produced major immediate

benefits with little commensurate cost. The improved investment climate brought about by certainty over water security, improved property rights and improved trading arrangements are attributable to the Cap.

A number of reasons help explain why higher unit water costs and increasing water delivery costs are not imposing problems for non-pasture irrigators. These include:

- water costs are only a small proportion of total costs. For those cases where input costs are small yet critical, producers have flexibility to reduce costs in other areas (taxation options, corporate structure);
- alternatives are available to offset higher unit water costs and provide opportunities for cost-saving improvements (as the cost of leasing water rights is tax deductible);
- much more water is used in production processes than necessary, so many irrigators are able to make management changes to greatly reduce their water consumption;
- all current on-farm irrigation investments are much more efficient in water saving technologies than previous investments, and they utilise management systems such as under-canopy sprinklers, mini-sprinklers, drip systems, centre-pivot systems that produce 'soft rain', laser land forming, soil moisture measuring equipment, and efficient drainage;
- in South Australia, the use of furrow irrigation declined from 50 per cent of the total area in 1976 to 20 per cent by the mid 1990s (while in Victoria's Sunraysia district 70 per cent is irrigated by furrow and flood methods and in New South Wales it is 84 per cent -- Crabb, 1997);
- changes to improve water use efficiency are also taking place in the livestock sectors (such as replacing dams with piped reticulation systems for stock watering);
- over the past decade, higher water charges have encouraged water transfers out of low-value uses and locations (as with water entitlements used on pasture in South Australia's Lower Murray being transferred to vegetable production in the Riverland (WRMS, 1994; Crabb, 1997); and
- higher water prices have allowed irrigators to sell off part of their entitlement, invest the money in new water-saving technologies and then sell more of their entitlement (Young et al., 2000).

What lessons can be drawn from the pilot interstate trade project?

The Murray-Darling Basin Ministerial Council approved a pilot interstate trading program in November 1997. The project allows for permanent water trades between irrigators in the pilot area incorporating New South Wales, Victoria and South Australia (from Nyah to the Murray Mouth). The project aims to improve the efficiency and effectiveness of consumptive water use, by encouraging the movement of water from current irrigation activities to higher value irrigation developments. The

evaluation of the pilot (conducted in October and November 2000) provides valuable lessons and insights into the institutional and regulatory reforms necessary to improve efficiency in water use.

Among the key features of the two year pilot evaluation include (Young and Stringer, 2000):

- In the two year period ending in September 2000, the pilot project allowed 51 trades involving 9. 8 GL of water worth more than $9.9 million.

- Interviews with water brokers and Commission records indicates that there has been a net trade of water into the trial area of approximately 30 GL form Victoria.

- Significant amounts of NSW water is trading from the Murrumbidgee Irrigation Area into the trial area;

- Less than 1 per cent of the water traded across State boundaries was being used at its origin (i.e. virtually all the water being traded permanently was sleeper water);

- In virtually all (99 per cent) of cases, the water traded was not being used at its origin and in virtually all cases it has moved to a very profitable use. The buyer survey indicated that three quarters of all purchases caused an expansion of irrigation with 59 per cent going into viticulture and 18 per cent into horticulture. This is perhaps best illustrated by data on trades into South Australia where virtually all the water has gone into very high value uses. The bulk of the water (64 per cent) has moved into the Riverland to water new vineyards, new horticulture, a recreation area and some olives. The water moving to the Lakes District at the very bottom of the Murray System is to facilitate the development of new state-of-the-art Greenfields Dairies.

- At least six trades involved inter-dependent entities (effectively the one inter-dependent parties moving water from one location to another); Brokers were involved in 100 per cent of trades involving people at arms length from one another; Most trades involved a broker acting for the seller and a separate broker acting for the buyer;

- Three trades were worth more than $1 million. In net volume terms, more than 90 per cent of the water moved to South Australia. The total volume of water traded involved less than 1/100th of the total water applied in the area –from Nyah to Murray Mouth,

- During the first two years, virtually all water has gone to high value uses. Around three-quarters into new irrigation development using state-of-the-art technology. The value of some of the transactions involved exceeds $0.5 million and in some cases over $1 million.

- The bundle of rights associated with a one ML entitlement in each State is not identical. In addition each State has different environmental management and planning requirements, different fee and charge structures and different penalty schedules.

- Examples of property rights differences within the pilot zone include:

  a) Victoria issues High Security licences and, once all High Security Entitlement demands have been satisfied, makes additional "sales" water available in some areas. It is not possible to carry forward unused water from one year to another but a well developed temporary market for water exists.
  b) New South Wales has a system of High and General Security licences, has a well developed temporary market and allows some licence holders to carry unused water forward from one year to the next under a continuous accounting system.
  c) South Australia only issues the equivalent of a High Security Licence, commonly known as a "water-taking" licence but also issues "water-holding" licences that allow people to "hold" water but not use it without first transferring it to a water-taking licence.

- Permanent and temporary water markets are linked directly and indirectly by their price differential, variations in that price differential, resource constraints, State and Commonwealth tax laws, the price of permanent water, the financial penalties for exceeding allocations, transactions costs, output prices, and water and land management practices, to name a few.

- These linkages influence the demand and supply of water for sale and for lease. For example, in much of the pilot region, producers of crops such as grapes and citrus require long-term secure access to water supplies. Vegetable, potato, rice and other annual crop producers are more comfortable sourcing water from the temporary market.

- The use of temporary water markets varies from State to State due to differences in policies and major water uses. Victoria and NSW have a tradition of fluctuating annual supplies, adopting land and water uses to accommodate those fluctuations. In contrast, the financial penalties for exceeding the licensed water allocation in South Australia are often less than the price of temporary water. Less incentive exists to rent water in these circumstances. The incentive is to exceed allocation rather than trade water.

- The major factor explaining why all the water is moving into South Australia is the state's fixed supply relative to shifting demand. In particular, investment in the wine and horticultural industries. From 1995 to 2000, water prices in South Australia have ranged from around $500/ML in the Riverland to more than $25,000/ML in McLaren Vale. Water prices in South Australia's Riverland have more than doubled since the mid-1990s. River Murray water licenses in South Australia are trading currently in the $1,000 to $1,150/ML range.

- Irrigators in trial areas of NSW and Victoria have access to more upstream water than irrigators in South Australia. Across the border in NSW, high security water is

trading for around $1,000/ML and in Victoria's Sunraysia district, water trades for around $730 for low salinity impact and $1,000/ML in high salinity impact areas. Further upstream, in the Goulburn-Murray Irrigation District, water trades at around $750/ML. Data from NSW indicates that similar trading patterns are occurring in this State.

- With the value of water used on properties far exceeding the value of land, banks are insisting that investments and developments be underpinned by secure water rights. Banks are also requesting water as security for their loans.

The report's conclusions and recommendations that are important for the grape and wine industry include:

- the most pressing issue is establishing a simpler, quicker more transparent water registration system for water rights;
- inconsistencies among State procedures, processes, water rights, information requirements, penalties, data collection and recording methods within the existing pilot trading area;
- expanding the project area upstream introduces more complications further delaying trades, placing ever greater work loads on already over-stretched State departments, increasing transactions costs and lengthening time delays;

The pilot project two-year evaluation was reviewed by at a two day workshop in Albury, December 14 and 15, 2001. This workshop examined and analysed the evaluation and made several recommendations regarding the future of interstate trade. The Executive summary is provided in Appendix A. A few of the important recommendations are

- The irrigation industry uses many different terms to describe the same things. More confusing still, one term can have several different meanings. This becomes especially important when comparing situations in different states. General agreement on a specific set of terms and a clear common understanding of those terms would help make it clear what rights are being traded in any given transaction.

- The main obstacle to expanding interstate trade lies in the different States approaches to sharing delivery infrastructure costs. This results in restrictions on trade out of certain districts which is a major impediment to trade.

- In effect, NSW and SA assume that there are individual rights, and responsibilities, attached to communal water delivery infrastructure, and that these are bound together with water entitlements. By contrast, Victoria assumes that individuals have sole rights to their water entitlements, and that contemporary water authorities exist only in contemplation of the services they can provide to individuals wanting to make use of their own rights to water.

- Relative to other issues considered by the workshop, there was not a clear common understanding of the need for exchange rates. But the mood of the discussion was constructive. There was general recognition of the need to establish a stronger foundation for community consultation and debate.

- Similarly, the workshop consensus was that where there was a need to build environmental protection into trading rules, then this should be done as simply and as transparently as possible. It was no good simply hoping that trading rules designed to enhance economic efficiency, would have positive environmental side effects.

How would more interstate water impact on Australia's economy?

To explore how more interstate water impact on Australia's economy, Stringer and Wittwer (2001) examined the impact of greater water trade reforms using. FEDSA-WATER, a national level CGE model of Australian. The model allows for the removal of implicit subsidies on water usage in irrigation industries in New South Wales and Victoria, and the removal of small implicit taxes on usage in South Australia, for the various irrigation industries. A second scenario taxes producers for salinity. In the water pricing reform scenario, there is a redistribution of irrigation activity to South Australia with pricing reforms. The overall decline in agricultural output is outweighed by the benefit in terms of reduced salinity damage. Similarly, in the case of taxing producers for the full cost of salinity damage, the benefit of reduced salinity outweighs the reduction in national income

The divergence in state approaches to water management has greatly complicated water management in the MDB. The basin's hydrological, ecological, economic and social systems do not stop at state borders. The rules, institutions and incentive structures governing the use of water do differ in each state. For example, until 1998, when a pilot interstate water trade project was trailed, permanent trades in water entitlements were not allowed between irrigators in the different states. The Murray Darling Basin Ministerial Council agreed to the pilot permanent interstate water trade in the Mallee regions of New South Wales, South Australia and Victoria for a two-year period.

Introducing market pricing of water to irrigation industries is one possible application of FEDSA-WATER. This CGE model can explore the economic implications of a

MDB wide market on four of the major irrigated crops -- pasture, cotton, rice and grapes. Prices for permanent water entitlements vary from around $400/ML in the pasture, cotton and rice producing zones of NSW, to $700/ML in the pasture and grape zones of Victoria, to more than $1000/ML in South Australia. Allowing trades across all state would reduce prices paid by South Australian irrigators and increase NSW prices. In the following scenarios, a price of $700 across the basin is used.

In the FEDSA-WATER model, agents respond to the changes in relative prices of inputs. In practice, there may be, at least in the short- to medium-term, a degree of inertia at least in some regions. Rice growers, for example, may perceive that their crop-specific capital, infrastructure and managerial expertise prevents them from cultivating other crops. To the extent that such inertia exists, particular regions may lose considerably from pricing reforms, and to a greater extent than we model on the assumption of full adjustment.

Our scenario depicts the removal of implicit subsidies on water usage in irrigation industries in New South Wales and Victoria, and the removal of small implicit taxes on usage in South Australia, for the various irrigation industries. These subsidies are measured in terms of relative prices to irrigation users, rather than as social subsidies or taxes. We include the latter (in the form of salinity damage) in the transformation function of each agricultural industry in the model (see appendix A.3).[1]

The major focus is on the redistribution of activity between industries and regions with the pricing reforms, and with the impact of the pricing reforms on salinity damage. As we would expect, the irrigation industries in NSW (cotton, rice and irrigation pasture NSW) lose from the reforms. The costs of production for cotton rise by 2 per cent, for rice by 7 per cent and for irrigation pasture NSW by almost 13 per cent. Outputs in these sectors decline by 0.4 per cent, 1.1 per cent and 1.0 per cent respectively.

[1] The results at the macroeconomic level are of academic interest only. If we treat pre-reform water pricing as a combination of input taxes and subsidies on water usage in the specific industries we focus on, then removing these taxes and subsidies provides direct tax reductions to maintain revenue-neutrality. The result for real GDP is positive. But if we do not maintain budget neutrality, by excluding the value of the implied net subsidy to irrigators, without allowing for direct tax reductions, real GDP decreases slightly when we introduce pricing reforms.

The results are presented in Tables 9 and 10. A surprising result is that grapes in Victoria lose. The main reason for this appears to be intra-domestic substitution: although the costs of production change little with the slight change to the price of water used in Victorian grape production, the costs of production of irrigated grapes in South Australia drop by almost one per cent. We assume a high degree of interstate substitutability of grapes between South Australia and the rest of Australia as inputs into wine. Consequently, some of the output growth of 1.2 per cent in South Australian grapes is at the expense of Victorian grapes, through a change in relative regional prices.[2]

In addition to a redistribution of activity from the rest of Australia to South Australia, there is also a small reduction in the overall output of irrigated industries with the price reforms. As measured in national accounts terms, there is a small increase in national welfare arising from the pricing reforms of $29 million.[3] The social benefit arising through reduced salinity damage is $24 million. The latter figure is sensitive to two sets of assumptions. The first is the proportional value of salinity damage arising from each type of agricultural activity. The second is transformation parameter choice.

The proportional value of salinity damage requires a closer examination of available estimates than we have managed to this point. The choice of parameter choice has been dealt with to some extent, through the use of systematic sensitivity analysis (Arndt and Pearson 1996). In this analysis, we vary the transformation parameter from its base value of 2 by plus or minus 1.75 (with a uniform distribution) in order to obtain the estimated standard deviations shown in parentheses in Table 9. This scenario shows us that pricing reform has a positive effect on salinity externalities, mainly because we assume that the most environmentally damaging industries are those with the largest implicit subsidies for water usage.

Next, we go a step further and introduce taxes on each of the industries to reflect the environmental damage inflicted by them. In each case, the additional taxes equal approximately the value of salinity damage within the database. In each irrigated

[2] At present, the model does not include the same substitutability between NSW grapes and those from elsewhere. To do so would reinforce the substitution effect, with larger gains for South Australia.
[3] Aggregate real consumption is used as the measure of welfare, with aggregate real investment, real

sector, the price of water moves from its present price inclusive of an implicit tax or subsidy to a price determined purely by the salinity damage. In the model closure, we assume that the additional revenue raised is used specifically to repair salinity damage, so that there is no direct tax reduction to offset the revenue from taxing salinity damage.

In all irrigated industries, outputs decline as the costs of production rise. The magnitude of these declines is small, given the very large cost hikes particularly for cotton and rice. It is possible that the aggregation of downstream industries in the database masks the extent of possible declines: more aggregated downstream industries will suffer smaller cost hikes if a primary product rises than in the case of more disaggregated industries, such as ginned cotton. With the decline in agricultural output, aggregate consumption decreases by $95million, but the reduction in the salinity damage is $222 million, with a standard deviation of $72 million arising from varying the transformation parameters in agriculture by ±1.75.

Table 9: Water pricing reforms

Percentage change from base case unless indicated otherwise

	National	**SA**	**ROA**	
Aggregate consumption[a]	$29m	$39m	-$10m	
Salinity externality[b]	-$24m	$4m	-$28m	
		($3m)	($11m)	
Industry outcomes	**Output SA**	**Producer price SA**	**Output ROA**	**Producer price ROA**
Dryland	0.09	0.00	-0.16	-0.03
IrrigPasture	0.99	-0.52	-0.66	-0.14
IrrPastVIC	..	..	-0.65	-0.14
IrrPastNSW	..	..	-0.99	12.65
Cotton	..	..	-0.37	2.09
Rice	..	..	-1.13	7.08
Othagri	0.19	0.00	-0.03	-0.02
Grape	1.21	-0.67	-0.62	-0.12
GrapeNSW	..	..	-0.39	0.63

a The Commonwealth budget balance is exogenous.
b The standard deviation arising from varying the transformation parameter between outputs and salinity from 2.0±1.75 is in parentheses.

government expenditure and the trade balance all exogenous.

Table 10: Taxing the salinity damage of each irrigation activity

(Percentage change from base case unless indicated otherwise)

	National	SA	ROA	
Aggregate consumption[a]	-$95m	$30m	-$125m	
Salinity externality[b]	-$222m	$0m	-$222m	
		($10m)	($72m)	
Industry outcomes	**Output SA**	**Producer price SA**	**Output ROA**	**Producer price ROA**
Dryland	0.18	-0.04	-1.27	-0.14
IrrigPasture	-3.27	6.95	-4.43	6.55
IrrPastVIC	..	..	-5.07	12.05
IrrPastNSW	..	..	-5.57	34.91
Cotton	..	..	-5.68	39.91
Rice	..	..	-5.69	40.04
Othagri	-0.80	0.03	-0.25	-0.15
Grape	-3.04	7.53	-2.36	6.63
GrapeNSW	..	..	-3.27	6.95

a The Commonwealth budget surplus increases by $755m, with these funds used for salinity repair.
b The standard deviation arising from varying the transformation parameter between outputs and salinity from 2.0±1.75 is in parentheses.

Summary of modelling outcomes

In the water pricing reform scenario, there is a redistribution of irrigation activity from upstream to South Australia with pricing reforms. There is an overall decline in agricultural output but this is outweighed by the benefit in terms of reduced salinity damage. Similarly, in the case of taxing producers for the full cost of salinity damage, the benefit of reduced salinity outweighs the reduction in national income.

These are a preliminary set of results, which will change as better estimates of salinity damage become available. The direction of results did not change as the transformation parameter varied within the range discussed. Some of the most serious concerns with reforms to water pricing originate at a district level. The model is based on much larger regions so that potential losses in some regions could be understated. In addition, the aggregation of downstream processing industries in the model's database may also mask some of the potential losses to primary activities whose costs rising with pricing reforms or taxes on salinity. Both district and downstream industry disaggregation would help estimate the potential effects of pricing reforms and taxes in further modelling.

What issues and regions should the grape and wine industry focus on?

An important task for the grape and wine industry is to determine which water related issues are priorities in a local, state and national context; in a short and long run context; and in an area context. The overall water policy advocacy strategy involves: assigning priority to those areas where problems of water allocation, water scarcity and environmental degradation are greatest; understanding the technical, environmental and economic issues necessary to manage the physical aspects of the aquifers and the Murray Basin; and providing education, incentives and information to manage the irrigators.

One way to characterize the grape and wine industry's overall response to irrigation and water related issues is presented in Figure 6 which divides the country's grape producing areas into a 2 x 2 matrix with high and low productivity and value areas and high and low vulnerability areas.

Figure 6: Grape Production, Water Use, Environmental Vulnerability and Policy Responses

Productivity and Grape Value Potential	**Vulnerability to Water-related Environmental Damages or to Water Scarcity**	
	Low	**High**
Low	Low policy intervention ---------- Low research priority	Large penalties for damages ---------- Environmental research
High	Yield-promoting policies ---------- Yield and quality promoting grape research	Policy promoting precision water use production ---------- Sustainability research

The Murray River Basin would have areas that fit into any of the four cells. Most of the high value, groundwater dependent grape producing areas would fit into either of the two lower cells. The higher rainfall areas of NSW and Victoria would fit into the two left hand cells.

The key recommendations from this research are:

m) promote rules to reduce uncertainty and help coordinate expectations;

n) involvement in decision making to influence all policy bodies including local water catchment boards, water authorities, state and regional agencies, and national level bodies;

o) push harmonization of water rights definitions, licensing procedures, and state registration systems for Murray River water rights;

p) lobby for higher penalties for misuse and over use of water;

q) seek quicker, simpler water license transfers (similar to land transfers) to lower transactions costs (especially time) for water transfers;

r) establish a Murray River Basin wide registration system based on the Torrens Title system;

s) move from a fixed allocation water license to a proportional allocation water license to accommodate unforeseen climatic on environmental events. For example, each license would specify a share (say .003 per cent) of a five year allocation (4GL) for an entire basin or aquifer. The next five year allocation would be announced two years before it begins or three years into the current period to provide planning information for investors and irrigators;

t) promote metered pumps and credible verification system;

u) encourage more technical and hydrological analysis to feed into farm dam policy reforms;

v) encourage long term water leases and temporary water trades to provide growers financial savings (via tax incentives) and security of supplies;

w) form alliances with horticulture, rural communities, environmental groups to influence institutional and regulatory systems;

x) promote education, extension and information dissemination to take advantage of the 6 per cent of growers who account for 50 per cent of irrigated properties.

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Appendix A

Workshop Report

Impediments to, and Options for,
Expansion of Permanent Interstate Water Trading in the Murray-Darling Basin

Country Comfort Hotel, Albury
15 December 2000

Tim Cummins & Associates

Executive Summary
On 15 December 2000, a workshop considered a comprehensive Two Year Review of the Pilot Interstate Water Trading Project in some detail. While adding several constructive criticisms of the pilot project, the workshop participants agreed with the Review's finding: *"Provided that [the] spirit of adaptation and willingness to solve problems as they emerge continues, we see no reason to stop the trial."*

The workshop went beyond endorsing the continuation of the pilot project. The participants agreed that, notwithstanding several unresolved problems, permanent interstate water trade should ultimately be expanded beyond the Mallee region.

The workshop saw expansion upstream to the Barmah Choke as the logical first step. Beyond that, once NSW enabled intervalley trade between the Murrumbidgee and the Murray, then interstate trade could be expanded to include the Murrumbidgee, the Goulburn and the Lower Darling. Trade on the Border Rivers between NSW and Queensland would have to wait until Queensland established its cap on diversions.

The reality of long-term leasing provides an incentive to formalise permanent interstate trade. For many buyers, leasing provides greater financial management and taxation benefits than permanent trade. The existing regulatory systems do not distinguish between long-term leasing and temporary trade. Consequently, water retailers miss the asset management signals they would receive if information about long-term leases were publicly available.

Provided third party costs could be minimised or avoided, most workshop participants were keen ultimately to see interstate trade taking place wherever it was physically possible. Similarly, they were keen to enable full and free interstate trade in a way that delivered certainty to the market.

Balanced against this however are the political and institutional risks posed by placing more load, more quickly, on the frail administrative system that now underpins

interstate trade. Besides, there are still many barriers to full and fair intrastate trade. These will also act as quantum barriers to interstate trade.

The two year review highlighted each State's lack of a simple, quick, transparent water registration system. And it placed this in stark contrast with each State's existing land registration system. Even confined to intrastate trade, these administrative systems transmit significant political, institutional and financial risks. Interstate trade compounds these risks.

The workshop concluded that fixing the administrative system was the number one priority. However, it also concluded that there was no time to waste in breaking-down the other barriers to interstate trade.

Apart from fixing the administrative system, the workshop identified four other tasks requiring immediate attention. These were to:

1. Start speaking the same language;
2. Find ways to adjust infrastructure without distorting trade;
3. Protect the environment using clear-cut tools;
4. Sort-out the intrastate trading problems.

The irrigation industry uses many different terms to describe the same things. More confusing still, one term can have several different meanings. This becomes especially important when comparing situations in different states. General agreement on a specific set of terms and a clear common understanding of those terms would help make it clear what rights are being traded in any given transaction.

The main obstacle to expanding interstate trade lies in the different States approaches to sharing delivery infrastructure costs. This results in restrictions on trade out of certain districts which is a major impediment to trade.

In effect, NSW and SA assume that there are individual rights, and responsibilities, attached to communal water delivery infrastructure, and that these are bound together with water entitlements. By contrast, Victoria assumes that individuals have sole rights to their water entitlements, and that contemporary water authorities exist only in contemplation of the services they can provide to individuals wanting to make use of their own rights to water.

Relative to other issues considered by the workshop, there was not a clear common understanding of the need for exchange rates. But the mood of the discussion was constructive. There was general recognition of the need to establish a stronger foundation for community consultation and debate.

Similarly, the workshop consensus was that where there was a need to build environmental protection into trading rules, then this should be done as simply and as transparently as possible. It was no good simply hoping that trading rules designed to enhance economic efficiency, would have positive environmental side effects.

The workshop favoured the term "conversion factors" over "exchange rates." It was thought to carry less baggage and less potential for misunderstanding.

If conversion factors are needed, the participants thought that those people most familiar with the various computer models used to manage river flows, were best placed to determine the actual numbers proposed for use in conversion factors. Nonetheless, they did not think that these should be imposed without some sort of sanity testing. For example:

- whether a trading system could be designed without conversion factors.
- whether there was a consensus amongst the various modelling agencies.
- whether the rationale for chosen numbers could be explained clearly and simply.

The workshop participants found the detail of deliberations about conversion factors confusing. They want to be presented with a set of preferred numbers coupled with a simple, clear and concise justification of that preference.

Beyond arriving at a set of conversion factors, the workshop participants wanted to know how this could be built into the trading rules without distorting trade. They wanted to know what the numbers would mean in the workaday world, they also wanted to know how this would protect the environment. If this story was persuasive, they would find it easier to live with whatever set of conversion factors was ultimately put in place.

The workshop touched on a raft of problems with intrastate trading within each state. It concluded that temporary trade, permanent trade, intrastate trade and interstate trade are all linked. For water trading to move forward, all these parts must be treated as an integrated whole.

Since temporary intrastate trade accounts for the greatest volume of trade, intrastate trading problems must be resolved if interstate trade is to deliver its full potential. If they are not resolved, they will ultimately, pose the greatest barrier to the expansion of interstate trade. The MDBC has a role in facilitating discussion between the States and in encouraging compatible solutions to common problems.

Appendix B

The theoretical structure of FEDSA-WATER

B.1. Introduction

FEDSA-WATER, the CGE model used in this study, is in the ORANI family of general equilibrium models described in Dixon et al. (1982).

A.2. Configuration of FEDSA-WATER's database

Figure A.1 illustrates the absorption matrix or flows database of FEDSA-WATER. The column headings identify the agents who buy 'C' commodities. The source 'S' of these commodities may be either domestic industries, located in two regions, South Australia or the rest of Australia, or foreign suppliers. The agents for sales are producers, investors, households, overseas exports, Commonwealth and state governments and changes in inventories.

Examining the row headings, in addition to the basic sale flow, each transaction includes four different sorts of margins 'M'. These include wholesale and retail markups, restaurant and hotel markups imposed on on-premise sales of beverages, transport costs and insurance. An important part of margins usage in a CGE model is to distinguish between different prices by type of transaction. In addition, there are two types of commodity taxes: both the Commonwealth and state governments may impose a tax on each transaction. To complete the production column, there are primary inputs of labour, capital and agricultural land, and associated income taxes.

Figure B.1: The FEDSA-WATER database

		Absorption matrix					
		1	2	3	4	5	6
		Production	**Investment**	**Household**	**Export**	**C'wealth govt.**	**State govts.**
	Size	**← I →**	**← I →**	**← I →**	**← I →**	**← I →**	**← I →**
Basic flows	**↑ CxSxR ↓**	BAS1	BAS2	BAS3	BAS4	BAS5	BAS6
Margins	**↑ CxSxRxM ↓**	MAR1	MAR2	MAR3	MAR4	MAR5	MAR6
Taxes: CG	**↑ CxSxR ↓**	TAX1CG	TAX2CG	TAX3CG	TAX4CG	n.a.	n.a.
Taxes: St.	**↑ CxSxR ↓**	TAX1ST	TAX2ST	TAX3ST	TAX4ST	n.a.	n.a.
Labour	↑ OxR ↓	WAGE					
	↑ OxR ↓	INCTAX					
	↑ OxR ↓	PAYROLL					
Capital	↑ R ↓	KAPRENT					
	↑ R ↓	KAPTAX					
	↑ R ↓	LNDTAX					
Land	↑ R ↓	AGLND					
	↑ R ↓	AGRITAX					
Other	↑ R ↓	OTHCOST					
	↑ R ↓	CO1TAX					
	↑ R ↓	ST1TAX					

I = number of industries

C = number of commodities

S = number of sources

R= number of regional destinations

M = number of commodities used as margins

O = number of occupations

CG = Commonwealth government

ST = state governments

	Joint production matrix
Size	**← I →**
↑ CxR ↓	SHOIRJ

	Import duty
Size	**← 1 →**
↑ C ↓	VIMPORT

Each cell in figure A.1 contains the name of a data matrix. *MAR1* is a 5-dimensional matrix containing the costs of margin services 'M' on sales of commodities C from sources S to industries I for intermediate usage in region 'R'. Each industry within the structure of the model may produce any of 'C' commodities.

B.3. The transformation function of FEDSA-WATER

The MAKE matrix shows the value of output of each commodity by each industry. The database has been modified so that each agricultural output also entails salinity damage. For most agricultural industries, the initial value of salinity damage is set at 5 per cent of the total value of output. For rice, the damage is set equal to 20 per cent of the output value and for cotton, the corresponding figure is 30 per cent. The transformation parameter between agricultural outputs and salinity damage is set at 2.0 (since salinity is recorded as a negative value, outputs and salinity are complements in production).

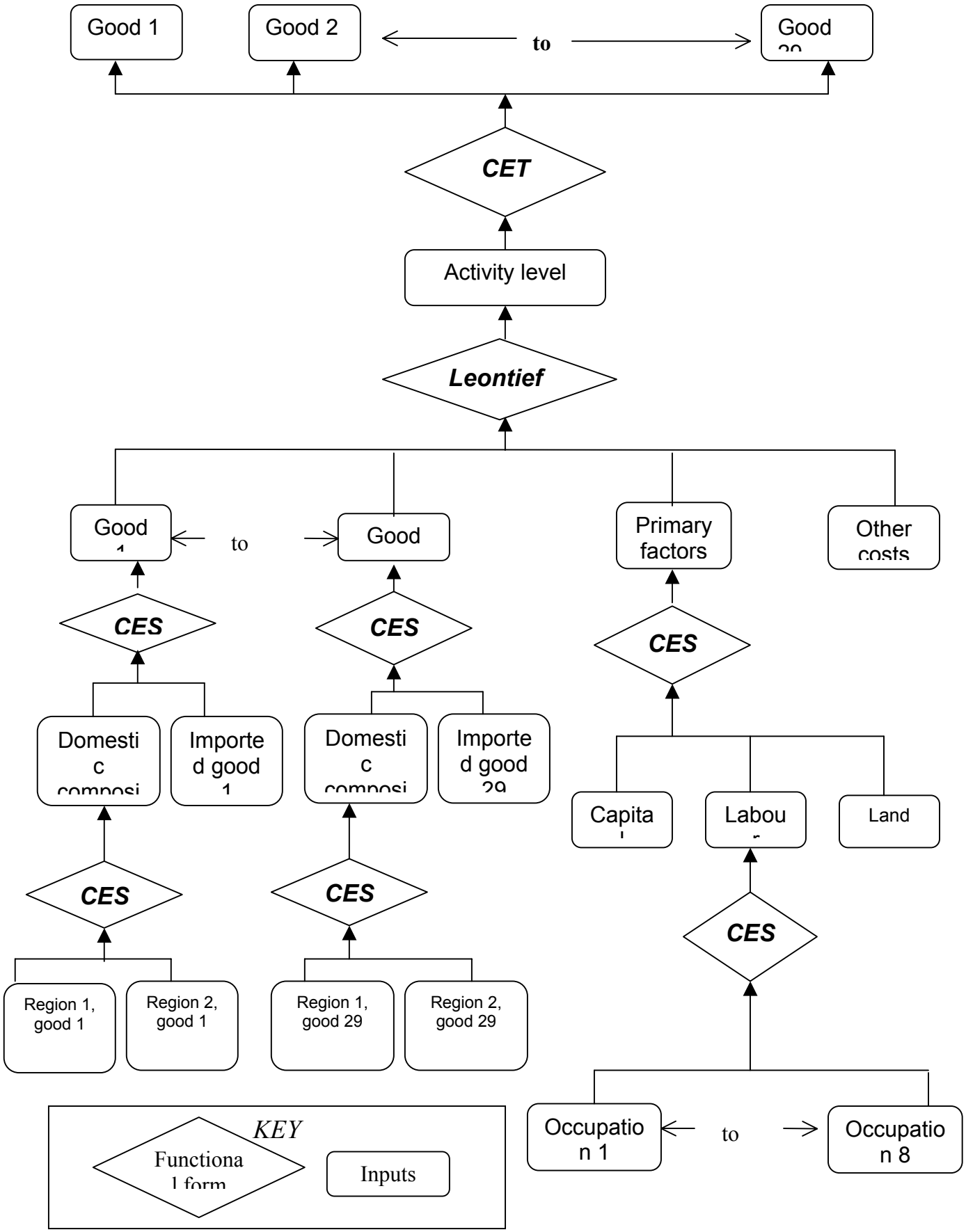
B.4. Overview of the model's equations

Blocks of equations deal with production, investment, household consumption, exports, Commonwealth expenditure and state government expenditure. Subsequent parts cover margins, prices, primary factor prices, market clearing equations and regional and national aggregates.

B.5. Structure of production

Figure A.2 summarises the structure of production within the model. Separability assumptions keep the production specification of the model manageable.

Figure B.2: Structure of production in FEDSA-WATER



At the top of figure A.2, we assume input-output separability. Consider the production function of an industry, given as:

$$F(\text{inputs}, \text{outputs}) = 0 \qquad \text{(A.1)}$$

We write this as:

$$G(\text{inputs}) = X_TOT = H(\text{outputs}) \qquad \text{(A.2)}$$

where X_TOT is an index of industry activity.

B.6. Demands for intermediate inputs

Further separability assumptions apply in a series of nests in the G function. Demands for intermediate inputs into production are based on the assumption that producers' purchases from each source are imperfectly substitutable. This occurs in two CES (constant elasticity of substitution) 'nests'. In the first, changes in the domestic nest occur through substitution as a result of differences between the regional and domestic nested prices (at the bottom of figure A.2). In the second, changes in the domestic-international nest result from Armington substitution (Armington 1969).

B.7. Demands for primary factors

The first problem is to choose a combination of labour types to minimise the total labour cost. Different types of labour are substitutable according to a CES function linking occupation-specific labour costs to the composite labour cost.

At the next level the primary factor costs are minimised for a given primary input requirement. Labour (a composite of occupations), capital and land have CES substitution possibilities. Agricultural land is usually fixed in supply in each industry. We could make the supply response of each agricultural industry larger by moving some of the production costs from land to capital, which is variable in the long run within the model.

The effective (i.e. nested) intermediate input and primary factor demands, plus other costs (including production taxes) are Leontief. This means that as the composite price of each input varies, the proportions of each composite input demanded remain unchanged, for a given technology.

B.8. Demands for investment inputs

Unlike production, there are no direct primary inputs into investment. Rather, primary inputs are indirectly involved in capital creation through the intermediate inputs. For example, one of the important inputs into investment, construction, is relatively intensive in its use of labour. In determining the mix of intermediate inputs by source, investment demands follow the two stage nesting process (domestic-domestic and domestic composite-import) with CES substitution, as applies to production.

B.9. Household demands

As is the case for demand for intermediate inputs into production and investment, the nested household commodities are determined by two CES functions. The allocation of household expenditure between commodity composites is derived from the Klein-Rubin utility function (Klein and Rubin 1948-49).

The expenditure on each composite commodity is a linear combination of prices and total nominal expenditure, hence the term 'linear expenditure system'. The form of the demand equations implies that household expenditure includes a 'subsistence' component, purchased independently of price. The remaining expenditure is the 'luxury' component.

B.10. Export demands

Separate export demands exist for traditional and non-traditional exports. 'Traditional' exports include primary products, some downstream manufactures from primary products, the three wine industries and, for GST simulations, tourism-related exports. Non-traditional exports generally only account for a small proportion of the output of the commodity so classified.

Traditional exports face downward sloping demand curves with a constant commodity-specific export demand elasticity. Non-traditional exports have an exogenous commodity composition due to a Leontief aggregation. The total quantity of non-traditional exports is related to the average non-traditional export price by a constant elasticity demand.

B.11. Demands for margins

The percentage change in margins associated with each transaction is set equal to the percentage change in the volume of each type of sale.

B.12. Prices for each type of purchase

The percentage change in output prices are equal to the cost-share weighted sum of percentage changes in the components of production. This imposes the zero pure profits condition on production. The same conditions applies to capital creators. The prices faced by importers depend on shifts in commodity import prices, tariff rates and the nominal exchange rate.

B.13. Primary factor prices

The price of labour is calculated as the value-weighted sum of the percentage changes in the unit value of take-home wages, the income tax rate on labour and payroll tax rates.

B.14. The model's database and parameters

The ABS 1996-97 input-output table was initially split into two regions, South Australia and the rest of Australia. A 75 sector version of this database was then projected to 1999-00, using FEDSA, the CGE model on which FEDSA-WATER is based, using available state accounts, production, trade and consumption data. FEDSA-WATER has been modified by disaggregating "other agriculture", as appears in the national input-output tables, into various irrigation industries. There are three irrigation pasture industries in the model, with region-specific entities for NSW and Victoria (to distinguish them from pasture elsewhere in Australia). Cotton and rice, grown entirely in NSW, appear as separate industries. There are grape industries in South Australia and the rest of Australia, with a separate NSW grape industry (to distinguish it from the Victorian industry in the rest of Australia region).

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