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"We use most of our available water to produce what we eat, as well as some exports. Despite significant salinity problems, irrigation agriculture continues to expand and use more water ..."

In fact, in most of Australia's farmlands the rainfall is sufficient to raise crops to maturity in only a fraction of all years: not more than half of all years at most locations, and in some agricultural areas only in two out of 10 years.

Jarred Diamond, *Collapse*, Viking Press, p. 384, 2006

The arrival of aboriginal people in the continent, possibly as long ago as 140 000 years, and the impact of their 'fire stick farming' on an ice-age affected land was profound, altering the nature of vegetation over much of the continent. The impact of European settlement on this unique land in the past 200 years has been devastating.

Mary White, *After the greening – the browning of Australia*, Kangaroo Press, Australia,1994

Agriculture produces food for the nation as well as a diverse range of export products. It contributes $17.6 billion to export earnings annually and provides employment for nearly 400 000 people.[1] Overall, agriculture contributes about 2.7% to Australia's GDP.

Agricultural production is Australia's biggest water user, requiring around 19 000 GL annually. This is approximately 70% of available fresh water.[2] The Australian dilemma is that while our agricultural sector can be justifiably proud of its contribution to domestic and export food production, this has come at great environmental cost. Australian farming and land-management practices have brought about major changes in catchment hydrology[3] with many negative impacts upon the natural environment.

IMPACTS OF IRRIGATION

These impacts are represented in the steadily declining health of many rivers and streams, the absence and decline of natural riparian vegetation, extensive loss of wetlands, loss of tree cover, elevated water tables, substantial reductions in biodiversity, invasion by weeds and exotic plants, lowered water quality, high turbidity, bank erosion and siltation of river beds, elevated heavy-metal and nutrient levels in soils, toxic chemicals, pesticides and herbicides in soils and water, acid soils and the salinisation of extensive areas of land.[4, 5]

AREA IRRIGATED

There are two major types of farming in Australia: dryland farming and irrigation agriculture. Dryland farming takes up most agricultural land, producing sheep/wool, beef cattle, grains and legumes. Such farming relies mainly on seasonal rain, as well as some additional water from bores, rivers and streams.

In contrast, irrigation agriculture uses little land (about 1%, or 2 million ha of available agricultural land) but most of the available fresh water (mainly surface water and some groundwater). In total, this amounts to approximately 18 000 GL in an average year.[6] Furthermore, irrigation agriculture is highly concentrated with 1 472 241 ha in the Murray-Darling Basin (total area: 1 058 800 km^2) being used for irrigation.[7]

RELIANCE ON IRRIGATION AGRICULTURE

The history of this irrigation dependency is instructive. Soon after European settlement, it became evident that the farm practices of the home countries were not suitable in this 'new' land, with its dramatically different physical features and highly variable rainfall. Securing food production for a growing Australian population, as well as developing export products, would mean developing new farming practices using different types of grains and, ultimately, the application of extensive irrigation.

Water for irrigation goes to three main forms of agricultural output: pastures and fodder crops; broad-acre crops such as cotton, rice and soy beans; and intensive horticulture including vegetables, nuts and tree fruits.

The most intensive part of the irrigation industry in Australia is set up within designated areas, e.g. the Murrumbidgee Irrigation Area. Within this area, surface water is pumped from the major rivers and delivered to hundreds of farming units, usually of about 1000–1500 ha each. After passing through these properties, the residual water drains back into the system. Each farm unit contributes to the maintenance and running of the irrigation system and each holds an entitlement to a certain volume of water.

About two-thirds of Australia's production from irrigation takes place within the Murray-Darling Basin, which is known as Australia's 'food bowl', and produces rice, cotton, cereals, soy beans and fruit and vegetable crops.[8] This productivity is linked directly to the fact that the basin contains Australia's three longest rivers: the Darling, the Murray and the Murrumbidgee. Outside the basin, irrigation is used mainly for dairy pastures, seed crops, fodder, horticultural crops and sugar cane.[9]

There are striking differences in the volumes of water used and the dollar value of agricultural commodities produced from irrigation. Rice is the most water-costly crop, using 7458 L per dollar of output, compared with vegetables and fruit which are least water costly, using 379 L per dollar of output.[10]

The big increase in the use of irrigated land has occurred only in the last 40 years,[11] with major growth in irrigated horticulture, and the irrigation of sugar cane, rice and especially cotton. Within the last 20 years alone, land dedicated to irrigated cotton increased from 50 000 ha in 1980 to 375 000 ha in 1999. This expansion has contributed to the present problem of over-allocated water licences. Australia is now the third-largest exporter of raw cotton.[12]

In regard to irrigated horticulture, there has been a significant recent shift into 'high-value' products. For example, the value of the almond crop in Australia rose from $7 million to $29 million between 2000–01 and 2004–05, a four-fold increase. By comparison, the value of the relatively low-value orange crop fell by 20% in the same period.[13] High-value crops, such as almonds, tend to be water hungry and productivity can be significantly increased if more water is used strategically within a growing cycle. In overall terms, between 1983–84 and 1996–97, water used in irrigated agriculture increased by around 76%.[14]

THE SCOPE FOR WATER EFFICIENCY

We enjoy plentiful, high-quality yet low-cost food in Australia. Our strong dependence on irrigated agriculture to produce the food we eat, as well as our export produce, is likely to continue.

At present, there are 73 irrigation systems throughout the country which are operated by 38 businesses. Irrigation employs 370 000 people and has a gross value of $39 billion.[15]

Much of the infrastructure associated with this intensive irrigation is now quite old, with approximately 31 000 km of channels, pipes and waterways.[16] Losses of water from evaporation and leakage can be as high as 30%. At the same time, climate change, lower volumes of available surface water and overuse of groundwater mean that our irrigation industries will need to embrace substantial water-efficiency measures – and as soon as possible.

ACHIEVING BEST PRACTICE

While there are legitimate claims that parts of irrigated agriculture are already water efficient, there is still enormous scope for further substantial savings. Calculations for the Murray-Darling Basin alone, show that if half of the existing enterprises adopted best practice, the water savings would be in the order of 900 GL per year. Significant savings can also be achieved by improving delivery systems. In an average year some 6800 GL of water travels through irrigation delivery systems. About 23% of this is lost through leakage and evaporation. Reducing this loss to 20% would save 300 GL. Reducing this loss to 15% would save almost 600 GL annually.[17]

The move from current levels of efficiency to super efficiency on a national scale will require irrigation farming improvements in four key areas:

- major improvements in farm management with widespread adoption of best-practice measures that require low on-farm investment
- high on-farm investment coupled with this best practice, including the installation of modern water-measuring technology, adoption of new plant types and different water and fertiliser regimes
- major off-farm, water-use efficiency gains, including refurbishing and lining of channels to reduce leakage, covering channels to reduce evaporation and installing modern metering/monitoring systems
- major structural changes in both policies and practices for irrigated agriculture, including water pricing, access to rural finance, support of environmentally appropriate rural enterprise and regulation of inappropriate forms of farming.

It is estimated that adoption of best practice, the refurbishing of irrigation systems and getting the right policy framework in place could result in water savings of at least 3000 GL per year over 10 years.[18]

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NEW FORMS OF LAND USE

In addition to irrigated agriculture expanding, there are also new forms of agricultural land use that impact on rates of water consumption in local situations (newer forms of land use, such as eucalypt plantations, are outlined in the 'Forests & Fires' section).

One of these is almond farming. The almond tree originated in central Asia and was cultivated as a source of food in ancient Greece. In Australia, almonds have been cultivated north of Adelaide for some time because this region has a climate ideally suited to the requirements of almond production. To obtain good yields, almond trees need water throughout the summer, and the water requirement is about 6–10 ML per hectare per year. Trees can produce for up to 20 years, and in Australia the industry has two sectors: farms with old trees; and those with trees that are 6 to 7 years old.

Corporate investment in new areas of horticulture during the past decade has targeted almonds, olives and grapes. Almond production is an example of a sector where scale of operation and a high level of water application are key ingredients. This new type of farm enterprise is likely to be owned by a publicly listed company operated through a managed investment scheme (MIS). One such enterprise at Robinvale in Victoria already has almost 2400 ha of almond trees planted.[19] Production is maximised by applying large amounts of water – about 15–17 ML per hectare per year.
To deliver this, water has to be traded into the area through either temporary or permanent trades. The production figures available indicate that it takes about 6 L of water to produce a single almond.

SALINITY: A CONTINUING PROBLEM

Agricultural production for both dryland farming and irrigation agriculture is linked to the major problems we now face with salinity.

The dryland salinity problem has come about as a result of excessive tree clearing for the introduction of shallow-rooted crops, such as wheat and pasture for livestock, causing water tables to rise. At the same time, large quantities of salt are mobilised in the rising groundwater and some of this salt is deposited on the soil surface. In some situations salt lying on the soil surface will be dissolved by rain and then find its way into streams and, eventually, rivers.

In the case of irrigation, the effects of tree clearing are compounded by the application of large volumes of water (usually delivered as flood irrigation) onto poorly draining soils. The soils become waterlogged and the excess water seeps down to salty groundwater.[20] The water table consequently rises and salt is brought to the land surface.

In both cases, salinity has emerged as a major environmental problem, accounting for a major loss of agricultural productivity, a significant amount of infrastructure damage as well as shortening the lifespan of expensive plant and machinery.[21] The annual economic loss attributed to the salinity problem in Australia is estimated at about $1 million per 5000 ha of land affected.

By 2100 the area of saline-affected land may be as high as 5 million ha, representing an annual loss of about $1 billion.[22] National and state programs to combat the processes and effects of salinity are already underway and this will remain a major cost.

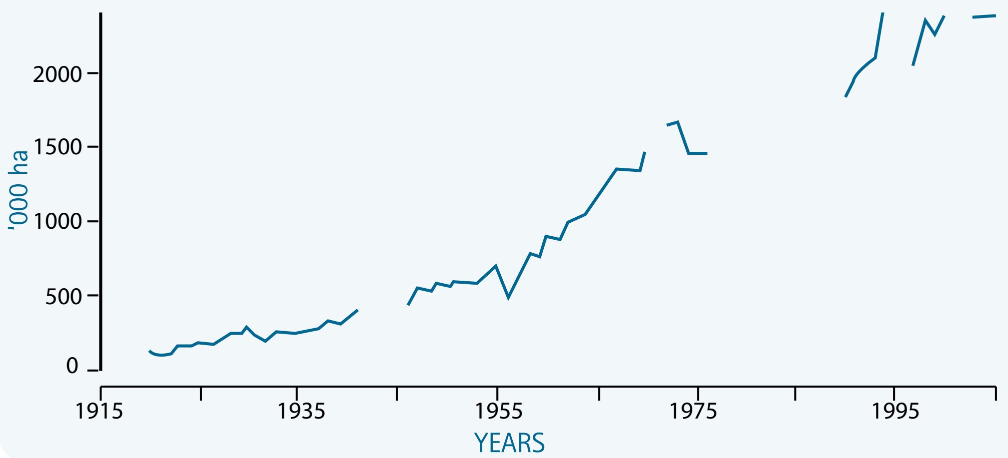

Figure 1. Growth in area of land irrigated in Australia from 1920 to 2005

Since 1915, there has been steady growth in the area of land irrigated. Breaks in the line represent when data were not collected. The big increase commences in the 1960s.

Source: Australian Bureau of Statistics, *Water account, Australia, 2004-2005*, cat. no. 4610.0, ABS, Canberra, 2006.

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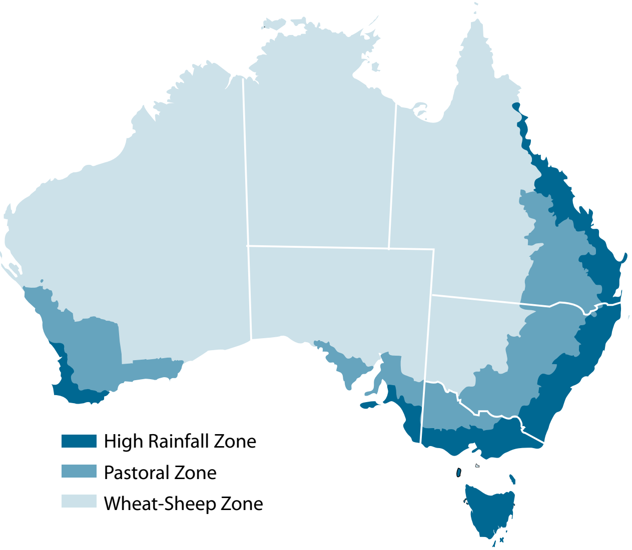

Figure 2. Main farming zones across Australia

The production of agricultural commodities takes place in different parts of Australia. Rainfall, rainfall variability and soil type are major determinants of the locations for various forms of farming. Broadly, the different forms of farming are carried out in three geographic zones across Australia: the pastoral zone, the wheat/sheep zone and the high rainfall zone.

Source: National Land and Water Resources Audit, *Australian agricultural assessment,* vol. 2, NLWRA, Canberra, 2001, p. 238.

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