

Water values

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Key messages

- * As a society, Australians value water highly for a range of economic, environmental, social, and cultural benefits, which at times are in conflict with each other.
- * Water resources are an input into the production of most goods, and water environments support economic uses such as fisheries, tourism, and recreation.
- * Healthy water environments provide valuable ecosystem services such as maintenance of water quality and habitat, and many people intrinsically value and feel highly attached to water-related environments.
- * For Indigenous Australians, water is central to culture and identity, as well as livelihood, but these values are poorly understood.
- * Increasingly market mechanisms, such as water trading, are used to resolve competing uses, but regulation, community aspirations, and valuation of ecosystem services are also important future drivers.

People value water and water environments for a diverse range of reasons. Water is essential for human life and wellbeing, is critical to food production, and is a part of many manufacturing and industrial processes. Australians have a deep connection with the water environments of rivers, lakes, estuaries, and coasts, which are central to much recreation and tourism, and for Indigenous Australians water environments have a deep spiritual meaning. Perceptions of dryness of the continent have also shaped the Australian 'psyche'.¹

Many of the values for water are shared, but it is the contested values that are at the heart of conflicts over water, such as determining sustainable levels of use. Large-scale water use inevitably has some impact on water ecosystems, so setting sustainable levels of use inevitably involves weighing up competing values. This chapter outlines the many benefits obtained from water and how they shape the way water is managed in Australia. Although it is convenient to describe separate social, cultural, environmental, and economic values for water, they are in fact closely intertwined.



Mandurah estuary, Western Australia. Photo: Bill van Aken, CSIRO.

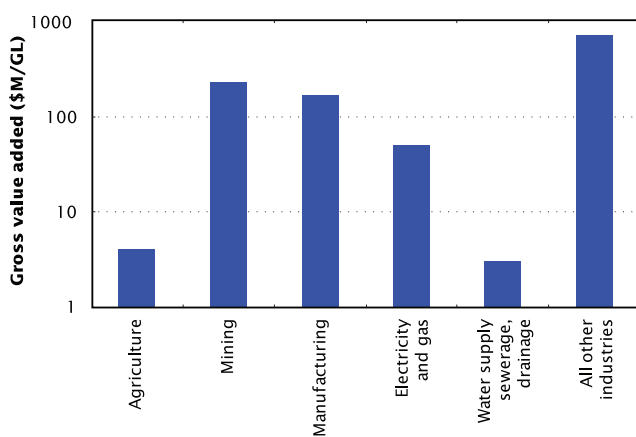
Water has been critical in Australia's history, both in shaping and responding to broader values that have changed over time. Some refer to the period from early European settlement through the first half of the 20th century as the expansionary phase of Australian water resources and the time since then as the maturing phase.² In the expansionary phase, the focus was on nation building, and populating rural areas, supported through irrigation. An icon of this phase was the Snowy Mountains Hydroelectric Scheme, the development of which reflected an emphasis at the time on the economic values associated with water.

The maturing phase has been marked by a shift to encompass a broader set of values, which at times compete with each other. These include increasing concerns over the condition of water ecosystems because water use led to degradation of natural environments, sometimes to the detriment of ongoing water use, such as high salinity levels having an impact on irrigated agriculture and town water supplies. At the same time, the economy has grown and become more diverse and settlement has concentrated in the large coastal cities. Decisions like the one to not proceed with dams on the Franklin River in Tasmania and the more recent moves to restore environmental flows in the Murray–Darling Basin reflect this shift in values.

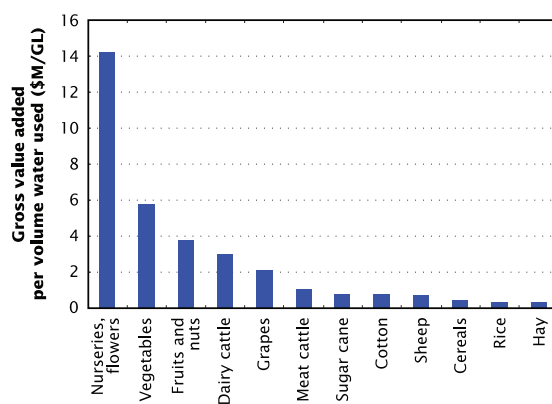
Economic values

Water is used in the production of almost all goods. Water resources are critical for irrigated agriculture, mining, households, and many industries, all of which are substantial users. The largest amount of water use is for irrigated agriculture, producing food and fibres (such as cotton).

The market value of water use can be described using marketplace concepts, such as the gross value added per gigalitre (\$/GL) of water used in production (Figure 2.1). The gross value added is the wholesale value of the goods produced minus the operating costs of production (input goods and labour). By this measure, water used in mining and manufacturing produces much higher economic values than water for irrigated agriculture.³ Within irrigated agriculture, nurseries, vegetables, and fruit have much higher gross value added than dairy and grapes, which in turn are higher than rice and cereals (Figure 2.2). The value added for each agricultural product can vary substantially from year to year as a result of changes in global commodity prices: for instance, the data shown in Figure 2.2 reflect the high price for dairy products in 2008–09.



▲ **Figure 2.1:** Gross value added per GL of water used by various industries, 2008–2009.³ Mining, manufacturing, and other industries are high-value economic users of water while irrigated agriculture produces less value per GL of water used.



▲ **Figure 2.2:** Gross value added of irrigated agricultural production across Australia for 2008–09. Nurseries, vegetables, fruits, and nuts produce the highest added value from irrigation.³

While the \$/GL metric is straightforward, it is not a reliable measure of the true value of water, because water is often a relatively small input cost and it is often not the input that limits production. The metric does not account for capital costs or any change in price that would come from changed production volume. Thus doubling the amount of water made available for manufacturing, for instance, would not produce double the value. Similarly, farm productivity, farm profits and, regional economies would not necessarily benefit from having all irrigation water go to the highest gross value crops. The costs of access to processing plants and the markets for those products needs to be considered, together with the impact on prices of increased production, and the suitability of the land and climate for the crop.

A better indicator of the economic value of a change in water use is the marginal profit added by an additional unit of water used. Those users who can generate the most value from using more water will be the ones that will purchase additional water. Alternatively, they would be the users who would benefit most from future development to make more water available for use.



Running tap, Perth. Photo: Bill van Aken, CSIRO.

Water ecosystems (rivers, lakes, estuaries, and wetlands) support a range of economic activities without water being consumed, including commercial fishing, tourism, and recreation. The economic value of freshwater extends to the coast and inshore marine environment. Some commercial species, such as prawns, rely on freshwater discharges from rivers, and the nutrients they bring, to sustain viable populations. The direct economic value of water environments can be estimated from the commercial value of the markets for tourism and other recreational activities. For example, Moreton Bay in south east Queensland is an estuary and marine area dependent on clean freshwater inflows from the adjacent rivers. Use of Moreton Bay earns \$10.5 million per year for the South East Queensland tourism industry, \$260 million for the recreational industry and \$60.1 million for the commercial fishing industry.⁴

Values of household water use

Good quality water for drinking, washing, and cooking is essential to sustain human life. The values embedded in domestic water go well beyond its cost and quality, as revealed by community reactions to the option of using recycled water for human consumption. Recycling wastewater or storm water is a technically viable and cost-effective solution for urban water supply (see Chapters 6 and 7), but there is significant community resistance to some uses. The closer the use gets to direct human contact, the less acceptable recycled water becomes. It is more acceptable for uses such as toilet flushing and open space irrigation, less acceptable for growing fruit and vegetables, which get eaten directly, and least socially acceptable as water for drinking and personal hygiene.⁵ At the heart of the concerns are emotions and perceptions of risk, and the perceived lack of trust in public institutions to be able to provide the highest level of drinking water service all day, everyday, for decades to come, especially in the face of emerging pollutants (see Chapter 5).

In Australia, up to half of domestic water use is for garden watering, providing the aesthetic and other values of a verdant garden. In recent years, under household water restrictions, surveys showed that people were willing to pay up to twice the price of water at the time to secure reliable supplies of water for their gardens.^{6,7} Of course, garden watering does not require potable standards of water quality and alternative sources can be found for the price people are willing to pay.

Environmental water values

As well as the direct economic uses, water-dependent ecosystems provide a myriad of ecosystem services of indirect economic value and they have intrinsic value beyond any economic consideration. Water ecosystems provide services such as processing waste and keeping water clean, or providing biodiversity as genetic capital for future applications (Figure 2.3). Costs for human provision of the services (such as for treatment of water quality) might be much higher if the ecosystem services were not maintained. In this way, a monetary value to people can be placed on the ecosystem services provided. A highly influential analysis of global ecosystem services showed that ecosystems provided at least as much value to the economy as the human production of goods and services,⁸ but ecosystems also have benefits beyond their human utility.

Ecosystems can be valued purely for their own sake, or merely from the knowledge of their existence. Individuals express bequest values for ecosystems, wanting to preserve them not just for their own benefit but for the equal benefit of generations to come: a core concept of environmentally sustainable development as first defined.⁹ Others have deeply held sense of place and belonging towards water environments such as the Murray River, which has an emotional significance for people throughout Australia. Residents of Perth have developed a sense of attachment towards the many groundwater-fed lakes and wetlands of the city and support the use of water to sustain the wetlands.¹⁰ Further, there is a strong sense of responsibility for the environment and a sense of entitlement to fair and equitable access to the continuing benefits deriving from these environments that extends beyond mere economic value.

Ecosystems may be appreciated purely for the diversity of organisms that they support, placing intrinsic worth on all organisms, including, but not limited to, humans. From this perspective, all ecosystems and species are of value whether they contribute to human wellbeing or not.



Paddle-steamer 'Emmylou' at Echuca, Victoria. Photo: Bill van Aken, CSIRO.

Provisioning Services	
	Food: Ecosystems provide the conditions for growing food such as fish in wild habitats.
	Raw materials: Ecosystems provide materials for construction such as fine timbers.
	Fresh water: Ecosystems provide surface and groundwater.
	Medicinal resources: Many plants are used as traditional medicines and as input for the pharmaceutical industry.
Regulating Services	
	Local climate and air quality regulation: Water and vegetation reduce temperature extremes.
	Carbon sequestration and storage: As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues.
	Moderation of extreme events: Ecosystems can create buffers against natural hazards such as floods.
	Waste-water treatment: Micro-organisms in soil and in wetlands decompose human and animal waste, as well as pollutants.
	Erosion prevention: Vegetation prevents river and foreshore erosion.
	Pollination: Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee.
	Biological control: Ecosystems are important for regulating pests and vector borne diseases.
Habitat or Supporting Services	
	Habitats for species: Habitats provide everything that an individual plant or animal needs to survive. Migratory species need habitats along their migration routes.
	Maintenance of genetic diversity: Genetic diversity distinguishes different breeds or races, providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial species.
Cultural Services	
	Recreation and mental and physical health: The roles of natural landscapes and green space for maintaining mental and physical health is increasingly being recognised.
	Tourism: Nature tourism provides considerable economic benefits and is a vital source of income for some regions.
	Aesthetic appreciation and inspiration for culture, art and design: Language, knowledge and appreciation of the natural environment have been intimately related throughout human history.
	Spiritual experience and sense of place: Nature is a common element of all major religions; natural landscapes also form local identity and sense of belonging.

▲ **Figure 2.3:** The range of services that water ecosystems may provide for people.¹¹

Legislation that protects species and ecosystems such as the *Australian Environment Protection and Biodiversity Conservation Act 1999*¹² protects species and habitat for their own sake, not because they have economic value per se. The Ramsar Convention is a similar international agreement to protect migratory birds and internationally significant wetlands.¹³ Metrics used to value biological diversity in a marine or freshwater aquatic habitat include the number of endangered species, species richness and diversity, and the presence of indicator species.

Australia is fortunate in having many water ecosystems of high intrinsic worth or that are treasured by society, as evidenced by the results of surveys of their use for recreation and tourism, and the increased property values observed in the vicinity of water ecosystems. These include the Kakadu wetlands, Lake Eyre, the Murray and Darling Rivers, Moreton Bay, Port Phillip Bay, and the Swan River; and coastal rivers such as the Daly River, Clarence River, and Thompson River, to name a few. The degradation of rivers and estuaries in recent decades has led to public awareness of the importance of sustaining these environments (see Chapter 9).

There are over 1000 estuaries in Australia, of which 50% are in near pristine condition¹⁴ and there are over 900 wetlands listed as being of national importance, of which 64 are also of international significance.¹⁵ There are 346 species of native fish in Australia, and before their decline, wetlands supported over one million water birds, including plovers, sandpipers, and stints, which migrate seasonally from the Arctic Circle to Asia and then on to Australia and New Zealand.

It is often convenient to express environmental values of water in monetary terms so that their value can be compared directly with economic uses of water. The three main ways to monetise ecosystem values are: through conventional markets, such as the value the water would have if put to economic use; implicit markets, such as the value of an estuary estimated from the increase in nearby residential housing prices; and constructed markets, by eliciting the willingness to pay for improvements to an ecosystem.

More than 60 studies have estimated use and non-use values of the natural capital assets and the ecosystem services these assets supply across the Murray–Darling Basin.¹⁶ For example, the willingness to pay to restore the Coorong and Lower Lakes of the Murray River, is estimated to be \$5.8 billion.¹⁷ Interestingly, while such attempts to put an economic price on the intrinsic values of water ecosystems are fraught with uncertainty, the revealed values for the Murray–Darling Basin are of the same magnitude as the \$10 billion that is being spent by the Australian Government, with community support, to restore environmental health of the Basin. Support for such levels of government expenditure is another indicator of the importance society places on these ecosystems. Whether that ecological restoration should come at significant cost to irrigation water use, however, is being contested through reactions to the Murray–Darling Basin Plan at the time of writing.



Collecting bush tucker, Kakadu wetlands Northern Territory. © Skyscans.

Indigenous values

Indigenous Australians attach deep spiritual significance to water ecosystems. They believe water to be a sacred and elemental source and symbol of life, which has sustained watershed communities for thousands of years, and governed Indigenous peoples' relationships to each other and country.^{18,19}

Indigenous perspectives and values relating to water are not widely understood and have been neglected in water use decisions and water management. There is now more attention being given to Indigenous beliefs, interests, and common-law rights under Native Title. National water policy now recognises the need to include Indigenous people in all activities relating to water planning and management.²⁰ Indigenous groups have identified water management as one of the most pressing environmental problems they face, alongside climate change. The diversity across Indigenous communities throughout Australia is likely reflected in a diversity of views and opinions about water use and management. Indigenous people express a strong desire to be involved in land and water management in order to fulfil customary obligations to care for their country.

Water is also of value to contemporary Indigenous livelihoods. Indigenous people have rights under the common law to access cultural water sites and to maintain customary use and access of places and the plants and animals that depend on water. Many Indigenous people and communities rely heavily on aquatic resources to supplement their household incomes. Some Indigenous landowners and corporate organisations also have water entitlements and wish to develop water-based enterprises. Indigenous organisations have argued that their people have a

right to benefit from the economic use of water and the development of water resources. Greater access to economic opportunities from water could improve the socio-economic position of Indigenous people.

Water policy reform, ratified by the Commonwealth, states and territories in the National Water Initiative, has started to enable some dimensions of Indigenous water values to be recognised,²¹ but progress towards including Indigenous values in water planning remains slow.²²

Resolving conflicts in values

Competing values for water and increasing demands on a fixed resource often result in conflicts over access to water, and trade-offs or compromises between different groups are inevitable. The over-arching challenge of sustainable water use, for example, is to balance the consumption of water with the intrinsic and economic values of maintaining water environments in good condition. The resolution of conflicting values for water in Australia is being achieved through a combination of regulation, planning, and markets.

The increased recognition of the economic importance of water has led to a recent trend towards using market mechanisms to resolve competing uses, particularly in rural areas. Entitlements to access water have been formalised and separated from land titles and can now be bought and sold, as can the annual allocations of water for those entitlements (see Chapter 8). In 2007–08, over 1500 GL of water was traded in the Murray–Darling Basin, mitigating the economic losses as a result of low allocations in that drought year.²³ Water markets are imperfect, because regulations exclude some users (such as the limits on trade from some irrigation districts discussed in Chapter 8), but there are opportunities for further innovations. One example might be to enable irrigators to manage their own reliability of supply by purchasing ongoing storage in a reservoir rather than being given an annual allocation of water. Carry-over rights are a form of this access to storage and are implemented in some systems.

For markets to work well, the price of water should include all costs. Although the price of water has increased to reflect true costs, capital costs are sometimes subsidised by governments and costs to the environment are not always included. In some areas, the price of water has been disaggregated to reflect different aspects of cost, including storage in reservoirs, costs of supply infrastructure, and costs of managing the provision of water. Treating water as an economic commodity is not acceptable in many societies, because it is not always considered ethical to charge people the full cost for an essential and natural resource such as water. The price of water, though, is typically for the provision of services such as safe, reliable, piped water. Bottled water, which is of high quality, refrigerated, and is widely available in a convenient container is priced at a few dollars per litre. Potable and reliably supplied domestic water, piped to your home, is

priced at a few dollars per thousand litres, whereas irrigation water, provided in larger quantities and of variable quality and reliability, costs much less than a dollar per thousand litres. In an open market, therefore, the price of water reflects the balance of supply and demand for the service, and its perceived value, not just its cost.

Water plans and regulations are used to ensure that licensed users have equitable and reliable access to water and to ensure protection of water environments. For example, an interim cap on diversions in the Murray–Darling Basin was introduced in 1995 to ensure the reliability of existing entitlements and to halt further ecological degradation of river, wetlands, and floodplains. The limits on use of water in the Murray–Darling Basin are being revised now, through the Murray–Darling Basin Plan, to restore and protect ecosystems.

There is now much more knowledge being generated to better inform water plans. The water requirements of ecosystems are increasingly well understood and can be applied to set limits to use that protect ecosystem values (see Chapter 9). There are also several techniques to include non-market values of water and users of water who do not have entitlements, such as cultural uses of water by Indigenous communities and others. An important first step is to catalogue these broader sets of values, such as poorly appreciated Indigenous water uses, and incorporate them into decision making, and this is a current area of research.

The trade-offs between different levels of water use can be shown in a cost–benefit analysis, where all costs and benefits can be expressed in monetary terms. This can reveal whether a community's overall welfare will be improved as a result of a particular water project or policy decision. Ecosystem services can be included in a cost–benefit analysis to broaden its scope, which is another active area of international research. Where there are non-monetary values, multi-criteria analysis can be used to include different social, cultural, and environmental aspirations. Each aspiration is weighted in importance and prospective water plans are scored as to how well they meet these aspirations.

Despite the rapidly improving knowledge and techniques used to value water, they are yet to be fully incorporated in water plans. The National Water Commission observes that many plans still lack any transparent consideration of community values or the needs of the environment and trade-offs between values are rarely shown or used in community consultation.²¹ Recent public criticism of the lack of transparency and consultation in the proposed Murray–Darling Basin Plan is a stark example.

A benefit of showing trade-offs between competing values is that it can drive innovation towards finding solutions where both human and environmental benefits are increased. This might be achieved by changing the timing of water use or the way water is supplied down a river. This raises the prospect of optimising the planning and operation of water resources to meet multiple values: an area of research that is growing as the potential cost of conflicts over water use increases. As demand for water grows, the best solution for communities might be to look for more efficient and equitable ways of meeting their needs.

Further reading

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