1. Introduction (Geography and Climate)

The population of Australia is about 25 million people with 85% of these living within 50 km of the coasts. Population density ranges from above 10,000 people per square km to less than 0.2 persons per square km in the arid centre.

Human habitation of the Australian continent is estimated to have begun around 65,000 to 70,000 years ago, with the migration of people by land bridges and short sea-crossings from what is now Southeast Asia. These first inhabitants were the ancestors of modern Indigenous Australians. Aboriginal Australian culture is one of the oldest continual civilizations on earth. Subsequent to European settlement (which commenced in the late 18th century) and immigration from many diverse regions the population has steadily increased, particularly over the last 60 years.

1.1 Land and Climate

Australia comprises a land area of about 7.7 million square kilometres. Although this is just five per cent of the world’s land mass, Australia is the planet’s sixth largest country after Russia, Canada, China, the United States of America and Brazil. It is also the only one of the largest six nations that is completely surrounded by water.

Australia's land mass is:

- almost as great as that of the United States of America
about 50 per cent greater than Europe, and
32 times greater than the United Kingdom

Australia is the smallest of the world’s continents. It is also the lowest, the flattest and (apart from Antarctica) the driest. The highest point on the Australian mainland is Mount Kosciuszko, at 2228 metres above sea level. The lowest point is the dry bed of Lake Eyre, South Australia, which is 15 metres below sea level.

Australia is surrounded by many thousands of islands. Nearly 40 per cent of the total coastline length comprises island coastlines.

Nearly 20 per cent of Australia’s land mass is classified as desert. As well as having a low average annual rainfall, rainfall across Australia is also variable. The rainfall pattern is concentric around the extensive arid core of the continent, with rainfall intensity high in the tropics and some coastal areas.

1.2 Climate

Climatic zones range from tropical rainforests, deserts and cool temperature forests to snow covered mountains. Within this climate, our plants and animals have evolved on a geographically isolated continent, through a time of a slowly drying climate, combined with continuing high variability.

Australia is the driest inhabited continent in the world; rainfall is extremely variable, and droughts are common. The community has become more aware of this because of the extended dry conditions experienced across much of the country during the millennium drought. With these pressures on the environment and economy, the Intergovernmental Agreement for a National Water Initiative (NWI) was signed by the Australian Government and all state and territory governments to better manage Australia’s scarce and valuable water resources.

Australia is a relatively arid continent, with 80 per cent of the land receiving less than 600 millimetres of rainfall per year, and half receiving less than 300 millimetres of rainfall per year. Development across Australia has been heavily dependent on access to water resources that are far more variable in volume and quality than in other parts of the world.

On average, only 12% (less than 3% in the drier areas and up to 24% in the wetter areas) of rainfall enters the rivers; the remaining rainfall is accounted for by evaporation, used by vegetation or stored in lakes, wetlands and groundwater aquifers. Almost 50% of Australia’s average annual run-off enters the Gulf of Carpentaria, a region of relatively limited water resource development, and the Timor Sea.

2. Rivers and Agriculture

2.1 Rivers

Rivers are one of the most important natural features of the Australian environment. There are many different types of rivers in Australia, their character, dependent ecosystems, and unique flora and fauna determined by climate and geomorphology. Rivers in northern Australia are influenced by monsoonal rains; the arid interior receives sporadic, heavy rainfall from tropical cyclones, resulting in spectacular flooding, while the southern parts of Australia receive more uniform rainfall in a temperate climate.

Rivers sustain billabongs, large floodplains, and lakes and estuaries, the nurseries of bountiful fisheries. Rivers are the home of red gum and coolabah trees. The spiritual role of rivers in Dreamtime stories of Aboriginal peoples is also very important. Rivers were the pathways for European explorers
and subsequent colonists, and our largest rivers became important corridors of trade. Few Australian
towns are far from a river, with many of them on a floodplain.

Many of Australia’s distinctive and important rivers are severely degraded. Australian rivers are under
increasing pressure from over-extraction, pollution, catchment modification and river regulation. All
rivers within regions with intensive agriculture are degraded to some degree by human activity.

2.2 The Murray Darling Basin

The Murray-Darling Basin (MDB) is well known as Australia’s “foodbowl” but it is much more than
that, as its agricultural output makes a major contribution to the national economy. Agriculture is
the dominant economic activity in the MDB accounting for about 39% of the nation’s gross value of
agricultural production in 2005-2006 (Australian Bureau of Statistics [ABS], 2008). On an area basis,
in 2005–06, the MDB contained 65% of Australia’s total area of irrigated crops and pastures.
Important irrigation industries are dairy, cotton, rice and horticulture (in particular viticulture). The
MDB has been the initiator of many experiments in irrigation reforms capping water extractions and
water trading entitlements.

2.3 Agriculture (areas sown, types of crops etc.)

Agricultural businesses operate across about half of Australia’s total land area. 87% of the land
farmed is used for grazing and 31 million hectares are cropped.

The gross value of Australian agriculture was $60.8 billion in 2016-17 with crops accounting for $32
billion. The dominant crops, by weight, were sugarcane, wheat, barley, oats and canola.

Australia irrigates 2 million hectares of land for cotton, rice, fruit crops, grapevines, pastures and
vegetables. The annual farm gate value of produce from irrigation farms is about $12.0 billion
Australian, or more than 25% of the total agricultural production of the nation.

The main irrigation area is the Murray-Darling Basin (covering parts of South Australia, New South
Wales, Queensland and Victoria). Water required for irrigation is stored in reservoirs in the upper
reaches of the main streams and rivers and is released to downstream irrigators and environmental
purposes.

3. Water Management in Australia

3.1 Water resources (Availability – surface water & ground water, Present use)

Total consumptive use of water in 2016-17 was 16,287 gigalitres. Of this amount, 10,233 gigalitres
was consumed by the agriculture; 1,483 gigalitres was consumed by the water supply services
industry; a further 2,662 gigalitres by all other industries; and 1,909 gigalitres by households.
Australia’s average water consumption is 432 litres per capita per day.
3.2 Development of Storages (Multi-purpose, Single purpose for irrigation)


Australia has over 500 large dams providing water for domestic, irrigation and industrial use. Many of these dams have a multiple supply function with larger catchments with irrigation use often having multiple dams in the upper catchments. Many of the irrigation farms of the central and northern Murray Darling basin have on-farm storages which capacity greater than 1 gigalitre.

As with other industries, the 1980s saw a change in focus for water management. No longer was the focus on bigger dams to solve water issues, but rather, consistent with other microeconomic reforms of the time, options were being examined to improve the allocation of existing entitlements. The objective behind this was to promote efficiency and equity in water allocation while protecting the environment.

4. Irrigation

4.1 Development of irrigation (Irrigation development overview, Ultimate irrigation potential, Flow irrigation, Types of irrigation systems, Drainage of irrigation schemes, Pressurized irrigation/micro irrigation (Sprinkler irrigation, Drip irrigation), Ground water irrigation including conjunctive use of ground & surface water for irrigation, Lift irrigation from rivers, lakes etc., statistics on these.

The formative years of irrigation in Australia were in the 19th Century and the major irrigation developments occurred initially in the Murray-Darling Basin, where the conditions were the most conducive to such development. The late 19th and early 20th centuries saw a dramatic increase in irrigation development both in the Murray Darling Basin and elsewhere, as predominantly state governments attempted to overcome a natural water scarcity.

In New South Wales, 500,000 ha of pastures, and 200,000 ha of rice and cotton are flood irrigated. Extensive earth and concrete lined channel supply systems divert waters from storages and waterways to irrigation districts. Many of these systems have been in use for 50-80 years.

In Victoria, 500,000 ha of pastures are flood irrigated. Major channel systems divert water from the river systems to the irrigation districts.

In South Australia, Victoria and New South Wales, over 100,000 ha of high value horticultural crops (citrus, grapes, stonefruit, almonds, vegetables) are sprinkler or drip irrigated. In horticultural irrigation districts water is often distributed in low pressure pipelines, which have often replaced the older channel systems. South Australia also irrigated 60,000 ha of pastures.

In other states, a similar range of crops are produced. Queensland also irrigates 140,000 ha of sugarcane. Many inland areas of Australia have been developed only through the irrigation industry.

4.2 Irrigation Management

Access to irrigation water is controlled by the government with the amount available to any irrigator, or the area that may be irrigated, regulated. Significant private irrigators do exist, but most regional water supply infrastructure is owned, constructed, maintained and operated by government agencies.

Before the 1970s, property rights to irrigation water resided largely with state governments. Since the 1970s, there has been a transfer of property rights from state governments to either individual irrigators or to collectives of irrigators that have taken over ownership and management of the distribution infrastructure. In the MDB, the Murray-Darling Basin Authority (formerly the Murray-Darling Basin Commission restructured in 2008) is the supreme body to address land, water and
environmental management issues across the basin. Currently, various legal and corporate forms of irrigation management entities are operating in the MDB.

Water governance in Australia is now operating under the COAG water reform framework, it requires the development of a comprehensive system of water allocations (including water sharing plans) and entitlements. These reforms were commenced in 1994 and enhanced in 1995 when NSW, Victoria, South Australia and Queensland agreed to implement a cap on diversions as part of the Murray-Darling Basin Agreement, based on 1993-94 levels of utilisation.

In 2003, COAG agreed to refresh its 1994 water reform agenda by developing a new National Water Initiative. Among other things, the Initiative set out reforms for best practice pricing and institutional arrangements. This included:

- promoting the economically efficient and sustainable use of water;
- giving effect to the principles of user-pays;
- achieving pricing transparency; and
- facilitating the efficient functioning of water markets.

Box 1  
Overview of Australia’s national water reform and key events

1863: Inter-colonial conference discusses management of the River Murray
1887: South Australian Royal Commission examines the effects of irrigation on river navigation in the River Murray
1914–1917: New South Wales, Victoria and South Australia sign the River Murray Waters Agreement and establish the River Murray Commission
1970: River Murray Commission publishes detailed study of irrigation and salinity
1981: River Murray mouth closes temporarily
1987: Murray–Darling Basin Agreement signed
1989: River Murray Salinity and Drainage Strategy agreed
1992–1996: Commencement of corporatisation and price regulation in urban water
1994: COAG agrees to Water Reform Framework and National Competition Policy
1995: Initial cap on water diversion from the River Murray
1997: Millennium Drought commences (persists until 2009)
2004: National Water Initiative
2007–2008: Water Act 2007 (Cwlth) passed and Murray–Darling Basin Authority created as a result of the National Plan for Water Security
2012: Murray–Darling Basin Plan takes effect
2013: COAG agrees next steps in water reform.
2017: Review of the Murray Darling Basin Plan commences
2017: Productivity Commission Review into National Water Reform progress


The Australian Government recognised the returning of irrigation diversions to sustainable levels would be facilitated by a funding stream that would also minimise impacts on regional and rural communities. The Sustainable Rural Water Use and Infrastructure Program (SRWUIP) was established as a national program which invests in rural water use, management and efficiency, including improved knowledge and market reform. Water savings arising from SRWUIP investment
in infrastructure efficiencies are shared between the irrigators/irrigation water providers and the Commonwealth (for environmental use).

4.3 Modernisation of irrigation systems

Irrigation technology continues to evolve both at the system and farm level and to keep up to date significant investment by governments (principally via Sustainable Rural Water Use and Infrastructure Program - SRWUIP) has seen dramatic improvements in water use efficiency in systems by reducing conveyance losses (operational, seepage and evaporation) and on-farm by adoption of ‘state of the art’ micro, spray and surface irrigation systems.

Irrigation infrastructure operators have often seen system efficiencies improve by more than 15% with some realising much higher efficiency gains (more than 30%). While many lower cost system efficiency options have been implemented by system operators, it is the cooperative approach between governments and system operators, involving millions of dollars, which has reaped the benefits to operators, farmers and the environment.

The more extensive irrigation infrastructure operators have made use of SRWUIP funding to modernise their irrigation infrastructure. Under this modernisation, old manually operated structures have been replaced with automated gates, leaky channels have been replaced by lined channels and pipelines and old-style Dethridge outlets have been replaced with modern accurate farm outlets. Many of these automated systems are so controlled that farmers are able to order water and see it being delivered to their farm offtake via computer.

Water savings from efficiency gains from these modernisations have been reallocated to the environment to reduce diversions to sustainable levels.

5. Irrigation Issues

5.1 Salinity & waterlogging in irrigation areas

The Basin Salinity Management Strategy (BSMS) is a response to the significant threat that salinity poses to the Murray-Darling Basin. The strategy’s objectives help communities and governments work together to control salinity and protect water quality, environmental values, regional infrastructure and productive agricultural land. In 2001, the Basin Salinity Management Strategy (2001–2015) replaced the Salinity and Drainage Strategy, the first coordinated salinity management initiative established in 1988. The BSMS reached the halfway point in 2007.

5.2 Farmer participation & irrigation management transfer (IMT)

Australia adopted IMT and have followed this approach in its economically important river basins including the Murray-Darling Basin (MDB). While some smaller government irrigation schemes were transferred to WUAs as early as the mid-1980s major schemes did not start this transfer to the early
In the Murray Darling Basin, major irrigation infrastructure is now operated/managed by WUAs through various types of ownership, these include private companies, cooperatives, trusts and state-owned corporations.

The transfer process was assisted/facilitated by the government, farmers, industry organizations and irrigation agencies. Momentum for further devolution of powers to water users was provided by the Water Reform Framework (1994) which required that constituents in the irrigation sector be given a greater degree of responsibility in irrigation management.

IMT has now successfully been implemented in Australia. In some instances, governments paid for or contributed to the upgrading of infrastructure (both on farm and off-farm) prior to transfer.

5.3 Water Quality Issues

The Australian Water Resources Assessment 2000 (NLWRA, 2001) identified major nutrient (mainly nitrogen and phosphorous) exceedances in nearly two-thirds of assessed basins.

Salinity, the saltiness of the water, was a major water quality issue for 32% assessed basins in the NLWRA 2001. High levels of salinity occur in catchments where a large proportion of land has been cleared. Increased salinity in ground and surface water will worsen the irrigation salinity problem that many farmers already face.

Turbidity was a major water quality issue in 61% of assessed basins.

Many issues affect the water resources and ecosystems of the MDB including salinity, erosion, blue-green algal blooms, water quality, and invasive species. Climate change and resultant possible increases in drought pose a significant risk to the availability of surface water in the MDB.

Over the years, the combination of natural droughts and increasing human use of the waterways for agriculture, manufacturing and communities has led to a decline in the health of the Basin.

5.4 Future Issues

As at June 2019 Australia was seven years into the 12-year Murray Darling Basin Plan. With more than 77,000km of rivers the environmental reform plan is perhaps the world’s most ambitious river reform agenda. With an average annual flow of around 33,000GL, the Plan aims to transfer up to 3,200 GL of previously commercially available water to the environment. Already around 20% of water previously available for irrigation has been returned to the environment. The reform covers the entire catchment and is designed to achieve healthy rivers, healthy communities and a continuing capacity to produce food and fibre.

Water recovery has been via direct purchase of water entitlements by Government, along with funding for on and off farm efficiency, where half the water saving is given back to the Government and half retained for maintaining or increasing production. The Commonwealth Environmental Water Holder now holds more than 2,800GL of water entitlements, which assessments show are already producing positive environmental outcomes.

Over the coming years the reform challenge includes putting in place ‘supply’ projects that will deliver water to environmental assets with reduced loss, thus allowing improved environmental outcomes without removing productive water. The plan also has $1.7 billion allocated to fund further projects which improve water use efficiency and return additional water to the environment.

Climate Change and ongoing drought pose real challenges with long term inflow scenarios changing as warming produces more frequent drought, lower overall rainfall but with more frequent heavy rainfall events. The Basin Plan is designed to adjust to climate variation, with irrigation allocations
varying substantially, but changes to long term inflows will have impacts on production and the environment.

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