INITIATIVES POUR L'AVENIR DES GRANDS FLEUVES
INITIATIVES FOR THE FUTURE OF GREAT RIVERS

Synopsis sheets

Rivers of the World

THE MURRAY-DARLING BASIN

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The Murray-Darling Basin

Australia is the driest inhabited continent on the planet: deserts make up more than two thirds of the country. 90% of the population is concentrated in the southeast, around the Murray-Darling basin and on the coast. This basin is the country's largest hydrographic network, with a surface area of 1,059,000 km² (14% of the Australian territory), stretching from the Australian Alps to the Indian Ocean. Although it harbours 70% of Australia's irrigated land and 40% of its agricultural production, it is not spared from water shortages that now affect the rest of the country due to climate change and a lifestyle and economy that consume considerable volumes of water.

A laboratory for adapting to water stress

The origins

The River Murray, called *"Millewa"* by the Aboriginal traditional owners, has been central to human livelihoods for over 40000 years. Its exploitation was then accelerated in the 19th century, first as a navigable waterway and as a means for trading by European and other settlers. Development of the river basin quickly led to the degradation of an already fragile ecosystem. In addition to droughts, massive use of the rivers' waters, firstly for irrigation, and the transformation of the land through grazing and deforestation contributed to the salinisation ot the land and waters. The basin has always seen great variability: severe droughts and floods, that are being accentuated with climate change. 2013, 2014, 2015, 2017 and 2018 have seen some areas in the basin with the hottest temperatures ever recorded.

Through the Millennium drought, the Australian government launched a radical reorganisation of water governance in the Basin to limit the resulting environmental, health and economic impacts over over-exploitation of the Basin.

Action by the public authorities, with the support of scientists and communities, and the snowball affect it had on private actors, has led to making Australia a laboratory for reforms and innovations aimed at rationalising water use.

Technical details

Average discharge (Murray)	450 m^3/s (Wentworth) – 0.89 m^3/s (river mouth)
Total length	3,370 km (inc. 2,530 km for the Murray)
Watershed	1,072,000 km²
States crossed	New South Wales, Queensland, South Australia, Victoria and the Australian Capital Territory (Canberra)
Rivers and main tributaries	Murray, Darling, Lachlan, Murrumbidgee River

Characteristics

Australia is characterised by low altitudes. The Murray-Darling basin, limited in the east by the mountains of the Great Dividing Range, is mostly composed of plains, with varying climates. The low-lying topography of the Basin, warm to hot semi-arid conditions in most regions, and the meandering and slow-flowing nature of the creeks and rivers, all combine to make an environment characterised by high evaporation. The discharge of the Murray, known for its extreme variability, is practically zero at its mouth.

The regime of the Murray: of pluvial type, with a gradual reduction of rainfall between the source and the mouth.
Low water in winter; high water in summer.

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Multiple uses

As early as the 1870s, conflicts arose between riparian states over the joint management of the Murray. They became aware of the need to make the river a corridor better adapted for transporting goods, and to resolve the issues of a lack of water availability and control that was damaging farm production.

The Federation drought that hit the country at the turn of the 20th century and the subsequent farmers' revolts in the rural areas of the Murray valley (mostly composed of arid and sterile land) led the authorities to launch a large water management programme based on the construction of dams and water supply infrastructure. Ten dams and associated locks were built as a result between 1922 and 1935.

Navigation: a low use

In spite of the low flow and the uneven course of the river, flat bottomed steamboats designed to transport gold and wool enabled certain States such as Victoria to develop via trade as early as the end of the 19th century. River traffic then gradually decreased, in part due to extension of railways to the towns along the river.

The mouth of the Murray, at Goolwa, is now poorly adapted for navigation due to the low discharge and the characteristics of the estuary including barrages and coastal lakes. The river is still used for pleasure boating, nautical activities and angling.

Coastal lakes and barrages at the Murray mouth

Source: www.environment.gov.au

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Multiple uses

Agriculture: an important activity in the Basin

The construction of pumping stations for irrigation started in the 1870s and intensified with the signature of the River Murray Waters Agreement in 1915 between the States of New South Wales, Victoria, and South Australia.

Irrigated agriculture in the Murray–Darling Basin makes an important contribution to the Australian economy and regional economies. In 2014–15 the Basin accounted for 66 per cent of Australia's total area irrigated and 40 per cent of the nation's irrigating agricultural businesses.

Approximately 42% of total surface water runoff is diverted from the river systems. A long-term average of almost 11,000 GL of water per year is diverted for household, urban or agricultural use. An additional 2,700 GL is intercepted by on-farm storages and forestry plantations.

Agriculture in Australia

The agricultural sector employs about 3% of the active population in the country. Its exports represented about AU$ 36 billion, i.e. more than 2% of GDP, and more than 15% of the country's exports (60% of Australian agricultural production is intended for export, mainly to Asia).

The total surface area devoted to irrigated agriculture amounts to 2 million hectares and the total water consumption by agriculture was 7,350 gigalitres in 2012.

Although irrigated agriculture only represents 0.5% of the country's farmland, the value of this production represents 25% of the gross value of total agricultural production. Over 60% of Australian irrigated land is in the Murray-Darling basin.

The main crops of the MDB are pasture; cereal crops including wheat and barley, and to a lesser extent oats, rye and buckwheat, rice and cotton; grapes; fruit and nuts; and vegetables. Australia is also one of the largest meat producers in the world.

The agricultural sector and its very water hungry production are under constant pressure to adapt to international competition standards and the lack of water resources. Improving water management in rural areas has thus been earmarked as a national priority.

Water supplies

Almost 90% of Australia's population lives in urban areas.

Even beyond the limits of the MDB with its 2 million inhabitants, cities like Adelaide and the steelmaking area of Port Augusta, and a large share of the rural regions of South Australia, depend on the basin's water. For example, Adelaide, with a population of 1.1 million and the country's 4th largest city, depends on the Murray for up to 80% of its water which is supplied by several pipelines.

Faced with the reduction in supply of their water reserves from climate change, the large Australian cities have adopted new supply systems and impose restrictions on consumption when required in severe droughts that vary as a function of the level of alert. Source diversification has occurred by experimenting with new solutions (e.g. managed aquifer recharge, rainwater collection, water recycling and desalinisation).

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Multiple uses

Hydroelectricity production

From 1949 to 1974, the Snowy Mountains Development Plan led to the construction of 16 dams, 7 hydropower plants and 145 km of tunnels in the State of New South Wales for hydroelectricity production and irrigation.

The reduction of available water resources is a major hurdle for hydroelectricity production in the country. The opportunities for growth for this energy rely more on the construction of very small hydropower plants that are installed either as run-of-the-river plants, without dams or reservoirs, or developed on existing dams designed to supply water, control water levels and irrigate land.

In Queensland, the gold mine of Kidston, which was once the largest in the country, will be converted into a hydropower plant. The works are scheduled for completion in 2018.

From now to 2030, the share of hydroelectricity in Australia's total electricity production may fall to 3.5% (versus 5% today) unless large-scale pumped hydro is developed across Northern and Southern Australia.

Energy in Australia

Australia's energy mix remains largely dominated by fossil fuels and Australia is the first exporter of coal in the world. It exports about 68% of the energy it produces.

Fossil fuels

The country primarily produces energy from coal and gas. Australia holds 33% of the world's uranium resources which are exported (but the country doesn't have nuclear plant), 10% of its coal (second reserve after China), and nearly 2% of global conventional gas resources. The mining sector represents 10% of Australia's GDP, and 60.5% of its income generated from exports. It is responsible for 248,000 direct jobs and continues to attract many investors.

Every year, the exploitation of the country's mineral resources consumes 4% of its available water (about 600 gigalitres). As most of the sites are located in arid and remote areas, securing water supplies is a crucial challenge for the country.

Renewable energies

Under the Paris Agreement, Australia committed to reduce its greenhouse gas emissions by 26% to 28% by 2030 compared to the level in 2005. The closure of former coal-fired power plants and the development of renewable energies are two main steps in the Australian energy transition, but the electricity mix is very different between Australian states and territories.

Renewable energies now account for 7% of the energy mix (mainly hydroelectricity, wind and solar power). About one hundred hydropower plants produce two-thirds of its renewable production.

Australia is rapidly developing energy storage options to balance intermittent renewable supplies in the grid with home and community scale storage batteries and pumped hydroelectricity schemes.

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Multiple uses

Hydroelectricity production: plant capacity

In 2013, Australia had 124 hydropower plants generating 18.27 TWh. They are mainly located in the State of New South Wales (55%) and Tasmania (29%). The country's largest hydropower project is the Snowy Mountains scheme.

Installed capacity of the largest hydropower plants and production for 2008-2012:

Figure 1 Top five largest hydro plants in Australia – by capacity (MW)
Source: Clean Energy Australia Report, 2011

HYDRO PLANT	OWNER	STATE	INSTALLED CAPACITY
Tumut 3	Snowy Hydro	NSW	1500 MW
Murray 1	Snowy Hydro	NSW	950 MW
Murray 2	Snowy Hydro	NSW	550 MW
Wivenhoe	Tarong Energy	QLD	500 MW
Gordon	Hydro Tasmania	TAS	432 MW

Figure 2 Top five largest hydro plants in Australia (2008-2012) – by generation (GWh)
Source: Intelligent Energy Systems (IES)

HYDRO PLANT	OWNER	STATE	GENERATION GWh
Murray	Snowy Hydro	NSW	8103.678 GWh
Upper Tumut	Snowy Hydro	NSW	4235.144 GWh
Poatina 101 & 220	Hydro Tasmania	TAS	3982.959 GWh
Reece 1 & 2	Hydro Tasmania	TAS	3827.56 GWh
Tarraleah	Hydro Tasmania	TAS	2269.203 GWh

Example: Snowy Mountains Scheme

From 1949 to 1974, the Snowy Mountains Scheme in the State of New South Wales, led to the construction of 16 dams, 7 hydropower plants (including two underground plants), a pumping station and 145 km of tunnel for hydroelectricity production and irrigation.

Several rivers were diverted to convey the water to the cities of the southeast and irrigate the interior of the country.

The installations are now managed by **Snowy Hydro Limited.**

List of dams

Talbingo Reservoir - 1970
Lac Eucumbene - 1958
Blowering Dam - 1968
Geehi - 1966
Tumut Pond Reservoir - 1959
Lac Jindabyne - 1967
Tooma Reservoir - 1961
Island Bend - 1965
Tumut 2 - 1961
Tantangara Dam - 1960
Jounama - 1968
Murray 2 - 1968
Guthega Dam - 1955
Happy Jacks Pondage - 1959
Deep Creek - 1961
Khancoban - 1966

List of hydropower plants

Guthega (60MW) - 1955
Tumut 1 (330MW) - 1958
Tumut 2 (286MW) - 1961
Blowering (80MW) - 1967
Murray 1 (950MW) - 1967
Murray 2 (550MW) - 1969
Tumut 3 (1500MW) - 1974

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Governance

Water governance in Australia

The reform of the water sector has been based on partnerships between governments, service companies, communities and the private sector.

The National Water Initiative: setting up a market for trading water

In the 1990s the Australian government forged new frameworks to implement innovations and reforms. The **National Water Initiative (NWI)** was adopted **in 2004**. Endowed with an investment fund of €1.5 billion, it aimed to reorganise the procedures involved in managing water resources and in favouring investments in water infrastructure and new technologies.

The programme was initially implemented by the **National Water Commission** until it was abolished in 2014**.**

The NWI programme comprises several sections, including:

- water access entitlements and planning framework
- water markets and trading
- best practice water pricing
- integrated water management for environmental and other public benefit outcomes
- water resource accounting
- urban water reform
- knowledge and capacity building
- community partnerships and adjustment.

An evaluation report is published every two years.

The NWI's main goal is to fully redefine water management by setting up a market based on a system for regulating and planning the management of surface and ground waters. Irrigation structures, environmental managers and public water services can all participate and buy and sell according to their needs and economic situations. Entitlements and allocations to water can be traded temporarily or permanently.

The Water Act and the creation of the MDBA

In 2007, the Water Act led to the creation of a single Federal body: **the Murray-Darling Basin Authority (MDBA**) to replace the previous Murray-Darling Basin Committee.

The passage of the Water Act represented several changes:

- **The States deferred some of their water powers to the Federal Government**
- The number of irrigation permits was reduced
- **A market was set up for trading water entitlements.**

According to the OECD, this policy has reduced water consumption by 50% at constant production.

The Australian government's **Water for the Future plan** completes these different schemes in view to securing the supply of water for different uses. With a fixed term of 10 years and AU$12.9 billion, it includes a series of programmes and policies intended to supply funds for purchasing water, irrigation, modernisation, desalinisation, recycling, and collecting rainwater.

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Governance

The MDBA

The Murray-Darling Basin Authority (MDBA) was instigated by the Water Act in 2007. It is reponsible for:

- Preparing and implementing an integrated plan for the sustainable use of the basins's water;
- Exploiting the hydraulic system and supplying water to users on behalf of the States of the basin;
- Measuring, evaluating and recording the quality and quantity of the water;
- Supporting, encouraging and carrying out research;
- Advising the Australian Ministry of Water Resources on accrediting water resource plans issued by the government.
- Supplying information on the water credit trading system on the scale of the basin;
- Educating the Australian people regarding the basin's water resources.

The Murray-Darling Agreement stipulates that the MDBA supervises the management of the assets of the MDB system (Dartmouth and Hume dams, Lake Victoria, Lower Lake dams, locks and spillways).

The MDBA is an independent institution that reports to the Ministry of Agriculture and Water Resources. Its board of governance comprises the Minister of Agriculture and Water Resources, 6 members of the MDBA, the Ministerial Council, the Basin Officials Committee and the Basin Community Committee.

The MDBA is managed jointly by the Australian Government and the Governments of the basin States.

The Basin Plan

In 2012, the MDBA approved the Basin Plan, intended to set the limits on the quantity of water that can be withdrawn from the basin's resources, determine water quality and salinity standards, develop provisions for trading water across the basin, and improve water security for all the users.

Main provisions include:

- Withdrawal thresholds at water abstraction points and at the scale of the basin;
- Planning and coordination frameworks intended to ensure that the volume, period and nature of the flows are beneficial for the environment;
- Objectives at the scale of the basin to ensure that the water is suitable for irrigation and leisure activities, for maintaining aquatic ecosystems and for domestic uses;
- Trading rules in relation with the NWI;
- 10 year water management plans;
- Evaluation and regular updating of objectives.

The National Water Account

Every year **the Bureau of Meteorology** (BOM) prepares a **National Water Account,** responsible for quantifying the water available and recording the volumes traded and used, and the users.

The lessons of this system of resource accounting are examples that may be copied elsewhere in other countries.

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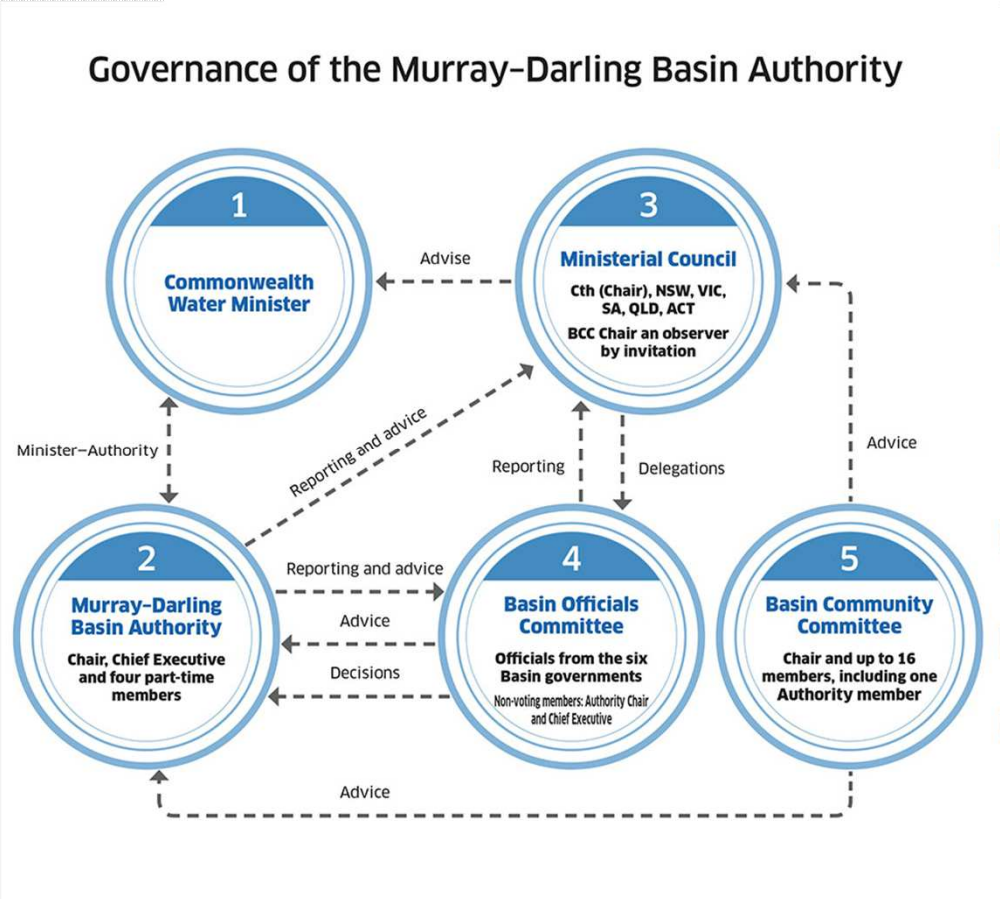
Governance



CORE FUNCTIONS

1. The decision maker on the Basin Plan and chairs Ministerial Council
2. Responsible for implementing and monitoring the Basin Plan

   Planning and management of Basin water resources in collaboration with partner governments and the community

   Manages the River Murray system on behalf of joint governments
3. Policy and decision-making roles on state water shares and funding of joint programs
4. Makes decisions consistent with the delegations from the Ministerial Council
5. Provides advice to the Authority and Ministerial Council on Basin community issues

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What river for tomorrow?

The resources of the Murray-Darling basin are still largely used for irrigation in four States and to supply water to some of the country's main cities. The impacts of drought and overexploitation of the river's resources are obvious:

- The reduced discharge of the rivers speeds up the silting of the estuary, despite permanent dredging done to maintain a minimum flow to the sea and the Coorong lagoon.

- The irrigation and deforestation associated with the development of agriculture have led to the salinisation of the country's arable land. This is carefully managed in the MDB but also affects the State of Western Australia, where between 1 and 2 million hectares of arid land are now affected, and between 2 and 4 million additional hectares are threatened.

When rainfall infiltrates into the groundwater it mobilises the salt present in the soils and seeps into the rivers: 500,000 tons of salt are withdrawn from the MDB every year.

Technological development

Australia has one of the most advanced measurement and forecasting systems dedicated to groundwater. It is also a pioneer in managing aquifer recharging systems ("water banking"), which limit losses linked to evaporation. This system has been implemented experimentally in the Bowen and Namoi basins for agriculture, and in cities like Adelaide and Perth (for horticulture and urban irrigation).

Many infrastructure research and construction projects (desalinisation, pipelines, wastewater recycling) have also emerged.

The mining sector is also seeking to adapt by developing more water thrifty systems (e.g., the Cloudbreak mine).

Controversial political choices

The country is one of the leading polluters per capita in the world, in particular due to its dependence on coal. It is also the 3rd largest consumer of water per capita, even if much of this water is exported embedded in agricultural and mining products.

During the COP21, Australia undertook to reduce its greenhouse gas emissions by as much as 26 to 28% by 2030 from the 2005 figure. This contribution was deemed highly inadequate to meet the objective of keeping the increase in climate warming to 2°C by 2100.

Despite the loss in value of coal and the many ecological impacts linked to its production, the country chose to reassert in December 2015 its controversial projects such a expanding the coal port of Abbot Point, next the Great Barrier Reef.

Furthermore, the MDBA's Basin Plan is subject to considerable tension, with suspicions of mismanagement and corruption raised by some political parties. Reviews have since led to the development of sophisticated remote-sensing and additional systems for improving compliance monitoring.