

# The Murray-Darling River Basin

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# 1. Introduction

This paper analyses the governance in the Murray-Darling River Basin in Australia. The Murray-Darling River Basin has an important function for Australian economy through its large share in national agriculture, and supports numerous high-valued ecosystems as well. However, natural factors such as salinity and the cycle of droughts and floods pose a challenge for human management and these factors are usually aggravated by human impacts. The Murray-Darling River Basin is not the only river basin in which these issues play; other river basins in dry areas, like the Colorado, Nile, Rio Grande, and Euphrates-Tigris, struggle with similar issues. Since the Murray-Darling River Basin lies in a developed country unlike most other dry river basins, the research and management done in this river basin has a frontrunner role in solving these kinds of issues.

For our analysis of the governmental functioning of the basin, we use an assessment method of water governance as designed by Brouwer et al. (2012). This method poses an integrated way of looking at the water system and its governance by using concepts of the disciplines water system analysis, economics, law and public administration. We address each of the nine building blocks of the governance assessment as shown in figure 1 in separate chapters, after which we will draw a conclusion and put up issues for discussion.



Figure 1. The building blocks of the assessment method

## 1. Water system knowledge

The Murray-Darling River Basin is the largest river basin in Australia: its 1,059,000 km<sup>2</sup> cover one-seventh of the land area and extends to over four States and one Territory. It is one of the flattest catchments in the world, on average 200 meters above sea level. These flat, low-lying plains receive little rainfall. Along the east border of the Basin the Australian highlands (the Great Dividing Range) provide most of the precipitation; this can be recognized in the large amount of rivers that spring from that area (figure 2). These mountains form a rain shadow that causes the low precipitation rates in the rest of the Basin (Murray-Darling Basin Authority, 2013).

Precipitation averages 530,620 gigalitres annually. Of this, over 90% is lost to natural processes such as evaporation and transpiration. The remaining water runs off into the rivers and lakes or ends up as groundwater. Since the precipitation is highly variable from year to year, so are the river flows: they vary between 6,700 - 118,000 gigalitres per year. Floods and droughts are an integral part of the system.

The Basin comprises 26 major rivers, the Darling in the north and the Murray in the south being the largest. Many of the rivers are long, meandering, and slow-flowing. During droughts, the rivers naturally dry up into a chain of ponds. During very wet periods, water spreads from the river channels out onto wide, flat floodplains. The floods provide water to the floodplain ecosystems and flush out the system (e.g. removal of salt).

However, nowadays the Basin is the most heavily regulated river basin in Australia, with 24 of its 26 major rivers regulated by dams, locks and weirs. There are four main reservoirs in the Basin, along with 14 locks and weirs. These structures reduce the impact of floods and droughts by storing water and regulating the downstream flow, to ensure that the Basin rivers contain water year-round. This alteration of the natural patterns of flow has impact on the floodplain ecosystems.

These floodplains include over 30,000 wetlands, amongst which one World Heritage site and 16 wetlands listed as Ramsar sites. The Basin is home to numerous endangered species of fish, birds and mammals. Wetlands provide important functions in the landscape: next to providing breeding grounds for wildlife, and improving water quality by trapping sediment and absorbing nutrients, they mitigate the impact of droughts and floods. During wet periods, they spread flood peaks and store floodwaters, releasing them gradually and reducing the effects of flooding. During drought, they provide refuges for wildlife and grazing for stock. Their health relies on the alternation between floods and droughts, which is compromised by the existence of the man-made infrastructure.

The main challenges which face the Basin are caused by human impacts. These challenges include soil erosion by livestock grazing in wetland areas; natural occurring salinity aggravated by extensive logging; declining water quality (such as

algal blooms); acid sulphate soils that release their acidity when the normally waterlogged soils dry up; and climate change, which is projected to cause a 10% reduction on average surface water availability across the entire Basin for 2030, especially in the southern part of the Basin.

These challenges receive ample attention and extensive research and monitoring schemes are set up. One governmental national water assessment programme included developing monthly and annual estimates of evapotranspiration and other hydrological variables, and with forecasting water availability over periods of days to decades (Glenn, et al., 2011).

With the available knowledge and extensive research conducted on the Murray-Darling water system, we can safely assume that the knowledge is sufficient in order to deliver the required service level of societal functions, and to assess the impact on the water system because of changes in environment and societal functions.



Figure 2: Murray-Darling River Basin (Murray-Darling Basin Authority, 2013)

## 2. Values, principles and policy discourses

### *Values and principles*

Recognition of human rights, equity, the availability of sufficient water for agricultural use and drinking water and a healthy river system are seen as important values within Australia as a whole and within the Murray-Darling River Basin (Blomquist et al., 2005).

These values are further outlined in a number of principles within the River Basin management.

The principle of river basin management itself is in use in Australia since 1992, replacing an agreement dating from 1915 which concerned only the water within the river itself, and an amendment of this agreement dating from 1987. The Basin Agreement was given full legal status in 1993, but only in 1996 and 1998 the last two states of Australia in which part of the Basin lies signed the agreement and became partners of the so-called Murray-Darling Basin Agreement (Millington, 2006). This agreement led to the Murray-Darling Basin Authority which leads the planning and the management of the river basin and coordinates with the states, territories, national government and stakeholders.

### *Institutional principles*

The participation of all of the states is necessary to come to good results: within the Basin the partnerships are equal, without one state or territory or the national state dictating outcomes. This is particularly important due to the principle of subsidiarity that is in use within Australia. Almost all of the domestic policy power rests in the hands of the states, not of the national government (Blomquist et al., 2005).

### *Good governance, proportionality and public participation*

An important principle within the Basin is the principle of the user pays, or as the Australians call it: "ring fencing", the principle that costs of a publicly provided service for which fees can be collected should completely pay for itself. This is closely connected to the principle of privatization which was often applied in the 1980s, leading to a number of privatized water management organizations but also to an integrated approach of water management issues at ministries and departments (Millington, 2006). Public participation is done by committee made up of stakeholders, not by direct involvement of all stakeholders (Water Act, 2007).

### *Environmental principles*

Within the River Basin consumption-based pricing is in use when applicable. A portion of the financing of the river basin management, however, also comes from income taxation in the whole of Australia. The precautionary principle is also in use in the River Basin. When a modification of the current situation is planned, the expected changes to the system are mapped and weighted against expected

(financial) gains. The environment is seen as a legitimate user of water within the Murray-Darling management plan and is thus allocated water for its own use.

### *Technical principles*

The water infrastructure within the Murray-Darling River Basin is continuously being upgraded to comply with (possible) future changes and demands on the system. For the same reason a more comprehensive monitoring system is being installed. The current system does not undergo large-scale changes; the focus lies on small adjustments of the current design of the infrastructure.

### *Narratives*

Several discourses exist in the Murray-Darling River Basin. These discourses will be described below.

#### Discourse 1

Maintenance of agricultural practices, rural identity and livelihood within the Basin is seen as important. Agriculture is the traditional cornerstone of the Australian identity and economy. Limiting its ability to produce goods for foreign and domestic markets should not be within the power of nature protectors.

#### Discourse 2

Agriculture will have to be adjusted to the arid Australian climate and that this will necessitate a move away from current water use practices. Rivers and their related ecosystems are legitimate water users which should also be allocated a portion of the water. This will require a lowering of the current Cap on agricultural use to free up this portion for nature.

#### Discourse 3

Aboriginals see the water in a more spiritual way than the other stakeholders. It can best be described by the following quote from the Water Act (2007):

“Indigenous use includes for cultural, social, environmental, spiritual and economic purposes. Many Indigenous people view water spiritually—people, land and rivers are inextricably connected. Indigenous economic interests include trading, hunting, gathering food and other items for use that alleviate the need to purchase similar items and the use of water to support businesses in industries such as pastoralism and horticulture. The environmental and cultural health of the Murray-Darling Basin is of paramount importance in serving these interests”.

In the Murray-Darling River Basin there is sufficient knowledge of the values, viewpoints and principles that are common in the area. Most values and principles are shared and are not in conflict, but viewpoints may differ, especially between the different groups of stakeholders. These differences in viewpoints will have to be taken into account when facing water management issues.

### 3. Stakeholder involvement

The management of the Murray-Darling River Basin is overseen by a River Basin Organization. The decisions on strategy and policy are taken by a ministerial council which delegates power to other bodies. This ministerial council is directly advised by a Community Advisory Committee, which also advises the Authority of the MDBA, the Murray-Darling Basin Authority (Murray-Darling Basin Authority, 2013). The Community Advisory Committee represents local communities and stakeholder groups within the Basin. It has the right to advise the ministerial committee and the Authority, but its advices do not carry legal weight. Since the Community Advisory Committee has direct access to the ministerial committee its input and participation is not controlled or directed by the River Basin Organization itself (World Bank, 2006). The River Basin Authority is represented on the Committee by one of three part-time members on a rotational basis.

On the local scale the public consultation is organized along the same lines: public participation and an advisory task to the local water government organizations, from the irrigation companies to the catchment level structures (Blomquist et al., 2005).

The manner of selection of the committee members differs for the different states involved with the management of the River Basin. In New South Wales and Queensland a representational approach is used, wherein the members of the Community Advisory Committee are chosen to represent the different stakeholder bodies. In Victoria and South Australia, on the other hand, the members are chosen based on their expertise.

According to Blomquist et al. (2007) the level of economic development within the Basin and within Australia as a whole has made it possible for the stakeholders to invest time and money in stakeholder meetings, knowledge generation and other actions related to the implementation of institutions for river basin management.

The current structure of the public participation has its problems. Many of the members of the committees are government appointees. Local industries and companies are not well represented within the community advisory committees. This means that not all stakeholders can have the same influence on the advice of these committees, which possibly leads to advice that does not take all of the issues for all stakeholders into account. Urban interests, women, and Aboriginals are equally underrepresented in the community advisory committees (World Bank, 2006). Aboriginal stakeholders are not only underrepresented in the Community Advisory Committees themselves, but the use of representatives itself is not the way their own governance is structured, leading to a further underrepresentation (Bellamy et al., 2002)

Not all stakeholders are sufficiently represented in the public participation process in the Murray-Darling River Basin. This leads to an underrepresentation of their

interests in the management of the River Basin during the problem analysis, solution search process and decision-making.

## 4. Trade-offs between social objectives: service level agreements

### *Allocation*

Water allocation in the Murray-Darling River Basin developed around the idea of economic development, based on navigation of the major rivers and farming (Grafton & Horne, 2014). The original water allocations were based on a system of statutory water rights, where water licences were bundled with the land. They had no limit on water withdrawals, but restricted the land area that could be irrigated. Around the 1960s, these licences were gradually transformed into volumetric entitlements, typically equivalent to three megalitres (ML) per hectare.

Prohibition of granting of additional licences ('capping') took place between 1969 and 1977 across the states, after increasing concerns about over-allocation. However, this capping had as a result that diversions increased, since statutory water rights which had not been exercised yet were increasingly utilized. Close to 40% of the water volumes assigned to licences had never been exercised by 1992-1993.

Water trading was gradually permitted by the states, starting in 1983, after a drought and concerns about water availability. However, inter-valley and inter-district entitlement trading was not permissible at first, out of concerns about the social and economic effects on communities.

In 1995, a Cap was imposed on surface water diversions, restraining further increase in water diversions above the 1993-94 level. This was done to halt over-extraction of water which was causing environmental degradation, and to limit the downgrading of reliability of existing entitlements.

Management of free-flowing river water is done on a case-by-case basis by the Basin Authority: "For example, to maintain a weirpool at a level suitable for a ski race, it might be necessary to temporarily reduce releases from the weir making the river downstream unsuitable for boating. Alternatively, releasing water from a reservoir to meet irrigation deliveries could reduce recreational access to the reservoir" (Murray-Darling Basin Authority, 2012).

### *Allocation mechanisms*

Water rights were originally bundled with the land. After removing this connection in the 1960s, more recently water rights have been even more separated, to facilitate water trading and its transfer to higher value consumptive uses. Water rights are now divided into three parts; water access entitlements, water allocations and water use licences. Of these, only the first two are tradable.

Water access entitlements are an ongoing exclusive right to a share of water from a specified resource as defined in the relevant water resource plan. They do not require the holder to utilize the water to maintain the entitlement.

Water allocation is the volume of water allocated to water access entitlements in a given season by State governments. For example, if entitlement holders are allocated 80% of their water entitlement, a person owning a 10 ML water share would be able to use 8 ML of water that year (Murray-Darling Basin Authority, 2012).

Lastly, to be able to utilise the water allocation assigned to a water entitlement, a water use licence is required. Such a licence may impose conditions or obligations on the user. Water use licences are bundled to the land where the obligations on use are imposed and are therefore not tradable with the water entitlement or water allocation.

People who want to use more water than is allocated to them for agricultural, industrial or residential use, can buy it from other people who have no use for it. Water allocations are sold for single years. Water entitlements are sold permanently.

Water allocation prices are highly volatile and depend on the climatic conditions of that year. During the Millennium Drought, many medium reliability water entitlements received zero water allocations, and high reliability entitlements received historically low allocations. This induced a run on water allocations, especially by irrigators with high value crops such as perennial crops. At the end of the Millennium Drought, in 2010-11, allocation prices fell sharply as water availability greatly increased.

Water entitlement prices on the other hand are much more stable. Entitlements can have different levels of reliability and this influences their price. The reliability is determined by the probability that the entitlement holder will receive the nominal volume of water specified on the entitlement, ranging from 90% on high security entitlements to 80% for medium security to as low as 25% on some low reliability entitlements. In the first quarter of 2014, water entitlements per ML of water exchanged hands for on average 1000 AU\$ up to 2000 AU\$ (Psi Delta, 2014). It takes 2 ML to fill an Olympic swimming pool. Some 15% of surveyed irrigators in 2010-2011 had traded water entitlements in the previous three years.

### *Reallocation*

Some recent changes in water allocation had impact on the water trade. One of them is the requirement that water entitlements retain their source characteristics, including their level of reliability, when traded across state boundaries, impacts trade. The decision by the Australian government in 2008 to purchase water entitlements to increase environmental flows has also had a major effect on volumes for the entitlement trade. In 2013, New South Wales imposed a 10-year 3% trade

cap on water entitlements for environmental purchases. This effectively stopped any purchases by the Australian government.

As part of the Basin Plan, the Cap, which has been in place since 1995, will be replaced by sustainable diversion limits (SDL) from 1st of July 2014 (Murray-Darling Basin Authority, 2012). However, because transitional water plans which are now in place override the Basin Plan, the new SDLs will only be in full effect across the Basin by 2019. The Basin Plan has this long-term implementation because of lower total water access for users, since a large amount of ML are given back to environmental flow (Grafton & Horne, 2014).

The Basin Plan also incorporates new trading rules that help ensure that water trade is free from restrictions except those for environmental reasons, and that sufficient market information is available. There are no restrictions on the volume of water that can be traded or on the purpose of use of water entitlements.

The mechanisms of water entitlements with subsequent yearly water allocations which are freely tradable ensure an equitable distribution of costs and benefits across the different users in the Basin.

## 5. Responsibility, authority and means

### *Property rights*

The rights of water users in the Murray-Darling River Basin are based on rights granted by the state. The states and territories administer the access to and use of water as governed by statutory water rights (National Water Market, 2011). Use conditions of the water are determined by the states and territories. Water rights can be allocated to a user independent of riparian access status (Grafton and Horne, 2014). These rights can in general be described as state (public) property, but there are exceptions.

The water allocation and water entitlement systems in the Darling-Murray River Basin have been described in chapter 4, but there are several other mechanisms not covered under this system. These include riparian right, stock and domestic right, water delivery right, irrigation right and Native Title. These rights will be described based on the website of the National Water Market (2011).

Riparian right is the right of a landowner with property next to a water body to part of the water contained therein for on-farm reasonable use. The water can be used for drinking, domestic use and fishing. These rights are not tradable without the land. In some cases riparian right is not tradable with the land; right may be extinguished when land is sold, depending on the local jurisdiction (National Water Market, 2011).

Stock and domestic right describes rights of landowners that are sold with the land. These rights are not tradable without land, but rights may be extinguished when land is sold. It describes a right of rural landowners to water for domestic, on-farm purposes. It excludes rights for intensive or commercial use.

Water delivery right is the right of a landowner to water delivered by an Irrigation Infrastructure Operator through their network. This right is tradable within delivery systems.

Irrigation right is the right to receive water from an Irrigation Infrastructure Operator. In this case the Irrigation Infrastructure Operator holds the right to receive water for a group of consumers. These consumers have a contract with the Irrigation Infrastructure Operator that gives them the right to a portion of the water. These contracts can be tradable within the irrigation district, depending on the jurisdiction. An irrigation right can be transformed in a water access entitlement (see chapter 4 for more information).

Native Title is the right of Aboriginal inhabitants of Australia to take water for personal, domestic and non-commercial reasons. It can be granted to individuals or to groups, and is applied for a certain location or locations. Native Title cannot be traded.

### *Allocating authority and responsibilities*

The Murray-Darling River Basin is governed by the Murray-Darling Basin Authority (MDBA) which holds responsibility for the planning and management of ground-

and surface water in the entire Basin. It holds a certain authority at the central level, but its decisions have to be ratified by all participating states and territories.

The MDBA has one of its four Authority members assigned to the Basin Community Committee, which advises both the MDBA and the Ministerial Council on issues linked to stakeholder interests (Water Act, 2007). This method safeguards an influence of stakeholders in the creation of Basin management plans, which allows for higher support of these plans.

*Means: Financing water management*

The Murray-Darling Basin Plan is funded by the governments of the states and the territories within the River Basin. Additional costs for these governments and territories that are due to the Basin Plan are covered by the Australian Government for the first eight years (Government of South Australia: Department of Environment, Water and Natural Resources, 2014).

Joint management programs of the Murray-Darling River Basin are funded by the governments of the states and territories within the Murray-Darling River Basin. These governments can unilaterally cut funding of the joint programs and several have done so in 2011-12 and 2012-13. As a reaction several key programs, such as an independent health check of the river system and the joint management of the water entitlements by the MDBA, have come under attack (Horne, 2013). Attempts have been made to increase income by shifting responsibilities for these issues to the Australian government, which pays for actions undertaken under the Basin Plan. The shifting of responsibilities or axing of programs will negatively affect the outcome of the Basin Plan.

*Means: participative capacity*

Due to the system of subsidiarity in place in Australia communities and stakeholders have the opportunity to provide input on the management of the River Basin in all states and territories that are part of the Murray-Darling River Basin. The opinion of stakeholders is also taken into account on the river basin level, as described in chapter 4.

## 6. Regulations and agreements

### *Appropriateness*

The governmental organisation of the Murray-Darling River Basin has a river basin approach and most of the policy power lies on the level of the states and territories. They determine water allocations, water use conditions, and can cut funding of joint programs. The water planning and management is in hands of the Murray-Darling Basin Authority, but its decisions have to be ratified by the states and territories. This way of organisation is consistent with the principle of subsidiarity. The Basin has very unequally distributed precipitation patterns, so a lower main level of organisation than the states and territories would not be appropriate.

Stakeholders are not directly involved, but are represented by a committee. Not all stakeholders are sufficiently represented in this process, so underrepresentation can occur, which is not in line with principles of equity.

Non-urban and urban water meters and water trade markets are mechanisms which ensure that the user pays and costs of provision are covered. The environment is seen as a separate user too, with its own water allocations, paid for by the Australian government.

### *Legitimacy*

The organisation of the governance of the River Basin is in conformity with the rule of law. Stakeholders have legal certainty with regard to rights, duties and accountability. The decision making is held at the lowest level possible, on a river basin or state and territory scale. The government system is transparent and information is freely available.

There are vulnerable groups such as Aboriginals, women, and urban interests, which are underrepresented. Especially the interests of Aboriginals, which have a different governance structure which does not necessarily match with the one needed for representation, are not taken into account sufficiently. Irrigators' direct interests are not served by the Cap on water use and governmental purchases of water entitlements to increase environmental flow. However, the measures are met without much resistance since good river health facilitates well-functioning ecosystem services from which irrigators benefit as well.

The governance includes both public and private (most importantly Irrigation Infrastructure Operators) actors. The highly variant spatial distribution of water in the Basin calls for mainly public governance, to conquer issues of scale and avoid conflict over spatial distribution. However, the exact distribution of powers and responsibilities over the different government layers is not without question. Most policy power lies with the states and territories and they exercised this power by unilaterally cutting funding on joint projects, and shifting the responsibilities for these projects to the Australian government.

*Legal certainty and adaptiveness*

The adaptiveness of the system is ensured by water entitlements which provide legal certainty of water rights to users, combined with yearly water allocations, which provide an opportunity for the authorities to adapt to the highly variable yearly precipitation regime. The more informal water rights (riparian rights, stock and domestic right, water delivery right, irrigation right and Native Titles) do not have fixed norms, but an assumed principle of fair use.

The governance of the Basin has a sufficient level of appropriateness and certainty combined with flexibility. The legitimacy can be improved by incorporating the interests of vulnerable groups to a larger extent and by solve the irregularities concerning project funding responsibilities within the first eight years that the Australian government supports the Basin Plan.

## 7. Engineering and Monitoring

### *Improving water infrastructure*

The Basin Plan facilitates the inter-region and inter-basin trade. There are continuously projects underway which improve infrastructure and ensure service level agreements are met. For example, a project in South Australia which finished in 2009 focussed on providing infrastructure to integrate storm water, groundwater, wastewater and drinking water systems in the Northern Adelaide Plains region. The project integrally improved all of these, by reducing communities' dependency on drinking water by reusing storm water, and improving aquifer and river health (The Department of the Environment, 2009).

Another, cross-regional project which was carried out in the Murray-Darling River Basin was the Irrigation Modernisation Plan, between 2007 and 2012. Irrigators were helped to develop modernisation plans for their districts, and to assess options to adapt to a future with less water (The Department of the Environment, 2009). The specifics of the Plan were different for every region, but included goals like upgrading, replacing or reconfiguring existing irrigation infrastructure, and improvements to metering to increase knowledge of water use.

In the same line, the National Framework for Non-Urban Water Metering has been established, which has as goal to provide comprehensive metering system across the Basin. The two basic requirements are that any meter installed after 2010 must comply with the national metering standards, and that any meter installed before that date must be replaced at the earliest opportunity by a compliant meter, before 2020 (The Department of the Environment, 2011).

### *Monitoring*

The installation of modern meters across the Basin greatly improves monitoring capabilities. Completed in 2011, a monitoring project under the name of Central Irrigation Trust Remote Reading of Irrigation Water Meters opened up information on consumption and flow data from 2334 electronic water meters on irrigation farms every 15 minutes. Farmers can use this information to improve irrigation schedules to improve water use efficiency, but this information is also useful for water planners to analyse how water is supplied and improve performance, and to fine tune water delivery to meet critical demands (The Department of the Environment, 2009).

The existing infrastructure across the Basin is continuously being redesigned and upgraded to ensure future water availability and effective water management. Monitoring is mainly carried out on a project basis. There are beginnings of a more comprehensive monitoring system, but there is room for improvement, to provide the whole Basin and its users and managers with monitoring information.

## 8. Enforcement

### *Enforcement as breach block of the policy process*

The water allocation within the Murray-Darling River Basin and the Cap on the total use require enforcement of the rules of allocation. Unlimited access of users without the necessary entitlements would erode the support for the system and the value of tradable water rights and the system would lose its legitimacy.

The implementation of the use of the Cap on water use is monitored by the Independent Audit Group, an entity which reports the results of their audit to the Murray-Darling Basin Ministerial Council (Garrick et al., 2009). This audit focuses on financial aspects, water targets and environmental response (Murray-Darling Basin Authority, 2010).

When this audit concludes that a state uses more water than agreed on, the state in question has to address this problem.

Territories, states and irrigation companies monitor the water use within their area. When individuals or groups of users use more water than they are allowed according to their entitlement, the relevant authority has the power to issue fines (Garrick et al., 2009). Bought entitlements are usually easily monitored because the water flows through regulated storage comparable to normal irrigation. Local, small-scale projects involving pumping are tracked in the same manner, but unregulated water use is more difficult to monitor. There does not appear to be a mechanism for overuse of riparian rights, stock and domestic right, water delivery right, irrigation right and Native Titles; if there are they are not discussed within the literature.

The regulations and agreements within the Murray-Darling River Basin are enforceable. Fines for persons and organizations and accountability for governments are the response to overuse of entitlements and allocation. Local-level low-use of water, however, is more difficult to monitor and regulate. This use of water, however, is likely only a small portion of the total water use and the lack of enforcement on this level does not constitute a large problem.

## 9. Conflict prevention and resolution

### *Conflict prevention*

Since the Murray-Darling River Basin flows through a large number of jurisdictions the division and use of the water has a potential for causing conflict. The introduction of the trade of water allocation and entitlement has gone a long way towards resolving this issue. Exchange rates cause the involved parties to think about the value of the water and serve to prevent conflict (Etchells et al., 2004). In general water markets lead to an increase of economic efficiency (Turrall et al., 2005). The value of the water, as determined by the trade of water rights, serves to reallocate water to high-value usage. Furthermore activities are moved to areas where they have a lower negative impact on water quality and quantity (Turrall et al., 2005).

The water trade system and the Cap on the total water use have led to a system that is transparent and comprehensible for the layman. This, combined with the transparency of information, serves to prevent conflicts about water in the River Basin.

Several states and territories within the Murray-Darling River Basin, however, have currently set limits on interstate trade and/or trade out of irrigation zones. Furthermore, there are artificial limits set by the regional authorities on the amount of water that can be bought by the Australian government for the use of nature. These limitations undermine the efficiency of the water trade system in the Murray-Darling River Basin. A reduction of the current restrictions would serve to improve reallocation of water to high-value usage (Turrall et al., 2005).

### *Conflict resolution*

The water trade system (chapter 4) and enforcement (chapter 8) currently in place in the Murray-Darling River Basin go a long way towards preventing and resolving water governance and management issues, but some conflicts remain.

The national government of Australia has assumed a coordinating role within the Murray-Darling River Basin. However, the consent of the participating states and territories is required for all policy and management of the River Basin, effectively creating a veto right for these participating governments (Millington, 2006). When a conflict of interests arises the issue needs to be negotiated until a mutually satisfactory decision is reached. With a large number of participating governments this can be a difficult and long-lasting process.

When a conflict cannot be resolved this way, the Murray-Darling Basin Authority can take the lead to resolve the conflict. It will first attempt to mediate between the participants involved with the conflict and when this falls it can take a final decision if this action is proportional to the raised issue. It is only allowed to do this as a last resort (Murray-Darling Basin Plan Implementation Agreement, 2012).

There are sufficient conflict prevention mechanisms in place in the Murray-Darling River Basin. The use of water trade to prevent and resolve conflicts, as was the intention when implementing the system, functions well. The involved states and territories could improve on this system to ameliorate the situation.

Conflict resolution, which falls under the authority of the Murray-Darling Basin Authority, functions slowly but it does function well, partially due to the authority of the Australian government.

## 10. Conclusion

The process of public participation in the Murray-Darling is not optimal due to the underrepresentation of minorities and less powerful stakeholders in the stakeholder process. This also leads to an underrepresentation of the Aboriginal discourse within the Murray-Darling River Basin management plan.

There does not appear to be a mechanism for overuse of riparian rights, stock and domestic right, water delivery right, irrigation right and Native Titles in the river basin. Misuse and abuse of these rights cannot be limited within the current structures of enforcement.

Australian states and territories have attempted to decrease their costs by shifting responsibilities for issues that fall under their responsibility to the Australian government, which pays for additional actions undertaken under the Murray-Darling Basin Plan. The shifting of state responsibilities or axing of state programs will negatively affect the outcome of the Basin Plan.

Despite efforts to equitably divide the available water between different users, the problem remains that there is on average (especially in the recent Millennium Drought) not enough water available for all projected uses. The Basin is home to the large majority of Australia's most water-intensive crops such as cotton and rice, whose cultivation puts enormous strain on the available water resources. In line with the first discussed discourse in Chapter 2, the agricultural lobby is very strong in ensuring that these practices can continue, to detriment of other water users such as the environment.

Although not adequately addressed in this analysis (for more information see Discussion), other serious issues not connected to water availability are at play in the Basin: these are natural processes which are aggravated by human impacts, such as soil erosion caused by livestock grazing, salinity aggravated by extensive logging, and acid sulphate soils that release their acidity when the normally waterlogged soils dry up.

## **11. Discussion**

The transition to a new Basin Plan in the Murray-Darling River Basin means that some of the research done up to now could be inaccurate or outdated. It is not always clear on which Basin Plan more recent papers are based. The conclusions based on information from this research could thus be (partially) inaccurate as well. Changes to the water allocation and entitlement trade structure will lead to further changes in the governance structure, now and in the future.

These changes to the river basin management will also lead to new research opportunities. The new management can be compared to the old methods of management to see whether there has been a significant result in both the approach and the results.

The framework on which this research was based mainly focuses on water quantity and its management. However, in the Murray-Darling River Basin, water quality issues also play a major role; most importantly the issue of salinity aggravated by extensive logging for clearing land, which renders large stretches of agricultural land unusable. Issues like these and their management are not adequately addressed in Brouwer et al.'s (2012) framework and thus this paper.

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