

# Chapter 11

## Climate Change and Integrated Approach to Water Resource Management in the Murray-Darling Basin

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**Abstract** Provision of water resources is one of the most major elements to secure sustainable development for agriculture, industry, energy, and society. Climate change has raised concerns about the threat to water resources and increased international awareness of the importance of cross-border water resource management to confront such borderless problems. Integrated approach to water resource management for climate change is still a new field of study to develop an effective management framework even in the developed countries. This chapter presents one case study from the Murray-Darling Basin of Australia, which has recently engaged to apply the Basin Plan. The Basin Plan is the first case to introduce the integrated approach to water resource management in the Basin region. One of the major purposes of the Basin Plan is to restore long-term sustainable water quality and environmental development. The main objectives of this chapter are (1) to analyze mechanism of the integrated approach to the water resource management in the region of the Murray-Darling Basin under the federal political system and (2) to examine how this federal political system affects the process of negotiation within the Basin Plan. This chapter also raises several questions in order to provide some lessons from the case study and suggest applicable implications to other situation of the transboundary river management.

**Keywords** Transboundary rivers • Negotiation • Decision-making • Top-down approach

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## 11.1 Introduction

Climate change is extensively recognized as one of the largest obstacles to attain sustainable development which the global society faces in the twenty-first century. A wide range of scientific research into climate change has carried out and provided an understanding of key elements and scenarios of possible projected outcomes. Researchers raise important questions that climate change considerably affects the Earth's weather and living life but also causes degradation of global climate cycle.

Water resource has been considered a hot topic of climate change issues and is significantly subjected to influence the problems raised by climate change. Responding to the problems, many different projects and programs have been undertaken not only at the regional and national level but also at the cross-border level of the governance. Transboundary rivers including international and domestic river basins are now faced with a difficulty of advancing integrated water resource management with different roles of stakeholders. The current situation does not achieve a satisfactory level of management even in the transboundary rivers in a developed country. This chapter highlights "transboundary rivers" as the key element and argues with a problematic situation of water resource management in Australia.

This chapter proposes one case study from the Murray-Darling Basin in Australia as a major topic of the analysis. Recently, Australia is at the center of the water reform to evaluate water allocation and restore adequate supply and demand balance of water for sustainable river development by implementing the Basin Plan. The nation has encountered a difficult situation on whether or not to adopt this Plan. Firstly, the chapter reviews the aspect of climate change and examines historical context of water reforms. Secondly, the chapter analyzes the case of the Basin Plan and addresses several research questions. Did the Commonwealth government promote the right direction for implementing the Basin Plan? Are there any preferable alternatives to the process of decision-making? What if the Murray-Darling Basin Authority (MDBA) proposed less quantity of water than 3000–4000 GL at the first attempt of the Plan? How about 2000 GL? What is the main reason of low transparency and accountability between the basin states? The chapter lastly provides some useful lessons and guidance to the future integrated water resource management.

## 11.2 Background

There has been a wide range of researchers studying and tackling the climate change issues over the past few decades. There is unquestionable evidence that increased emission of greenhouse gas due to human activity causes global warming as well as climate change. According to the Intergovernmental Panel on Climate Change (IPCC), the scientific-based research showed that climate change is occurring across the world, rising air and ocean temperature, melting of snow and ice, and increasing average sea level. The IPCC analyzed that global surface temperature has been increased at 0.74 °C (0.56–0.92 °C) since the last 100 years (1906–2005). By

comparing to the trend (1901–2000) of 0.6 °C (0.4–0.8 °C) reported in the Third Assessment Report (TAR) (Fig. 11.1), the increase of global temperature has become greater and significant. In addition, the IPCC Special Report provided possible future scenarios of global climate change. According to the survey (IPCC 2007):

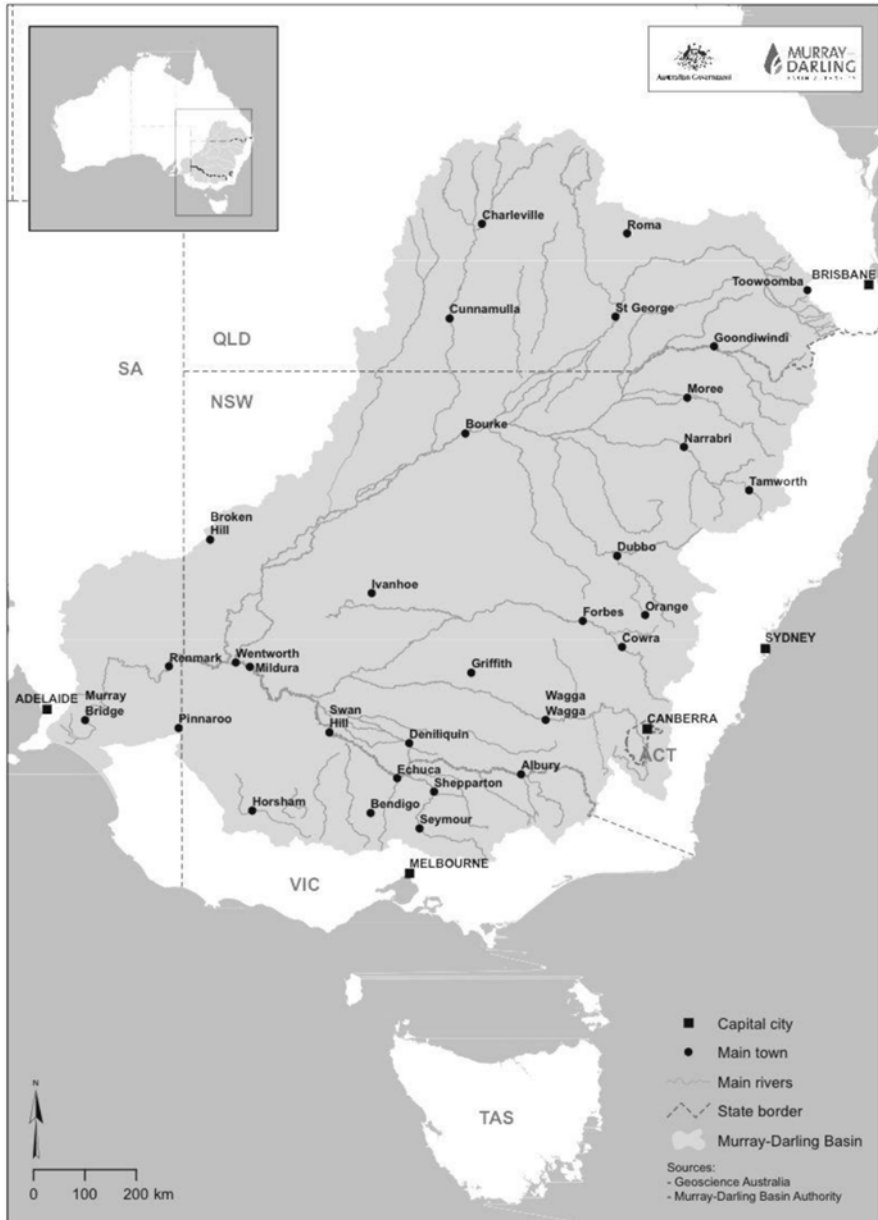


Fig. 11.1 Murray-Darling Basin boundary (Source: [http://www.mdba.gov.au/sites/default/files/images/8\\_Murray-Darling\\_Basin\\_Boundary.jpg](http://www.mdba.gov.au/sites/default/files/images/8_Murray-Darling_Basin_Boundary.jpg))

Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.

Global warming could change the whole climate system such as atmosphere, land surface, water, environment, fauna and flora, and human activities. Weather-related disasters would also increase.

### **11.3 International Movement for Water Management**

Climate change is one of the factors that cause water scarcity. According to the United Nations Department of Economic and Social Affairs (UNDESA), under the existing scenario of climate change, about 50 % of the population will live in the area of “high water stress” by 2030, and the demand for water will increase all over the world (UNDESA 2013).

Climate change is undoubtedly recognized as one of the primary issues on which the world needs to work together in order to avoid and reduce the future threats to water resources. The idea of the integrated approach for water resource management has been well known since the United Nations Conference on Environment Development (UNCED), also called the “Earth Summit.” The World Water Forum is widely recognized as the largest international event in the field of water resource management. Recently, the 6th World Water Forum was held in Marseille in 2012. One hundred forty-five representative countries and more than 35,000 participants gathered to raise issues and find solutions (World Water Forum 2013). “Respond to climate and global changes in an urbanising world” is one of the priorities of the Forum (World Water Forum 2013).

### **11.4 The Basin Plan**

In October 2010, the Murray-Darling Basin Authority published the *Guide to the Proposed Basin Plan* in order to “assist all interested parties in understanding the basis of the proposed Basin Plan before the formal, legislated consultation process begins” (MDBA 2010). The release also provided opportunity for the public to present their opinions and interests and then to give appropriate feedback to the MDBA. After the release of the Basin Plan, the news were widely broadcasted (Wahlquist 2011). It has become a controversial issue that a large number of people living in Australia have a strong view against this Plan.

## 11.5 Objectives

The main objective of this chapter is twofold: (1) analyze mechanism of the integrated approach of the water resource management in the region of the Murray-Darling Basin under the federal system and (2) examine the negotiation process to implicate preferable framework of the Basin Plan.

## 11.6 Methodology

Literature review is the main research methodology of this chapter. Interviews with officers of the Murray-Darling Basin Authority (MDBA) and professors from the Australian National University were also arranged in September 2012 in Canberra, Australia.

## 11.7 Climate Change in Murray-Darling Basin of Australia

This section illustrates critical aspects of climate change in Australia and analyzes historical movement of the water reforms in the region of the Murray-Darling Basin.

Climate in Australia represents unique factors. In other words, climate varies from region to region in the country. The land contains many different climate zones: The northern part of the land is wet tropics, with dry region in inland part and alpine climates in the southeast (Bureau of Meteorology 2012a). The average annual amount of rainfall for 2012 was 476 mm contrasting with 2011 annual amount of 699 mm (Bureau of Meteorology 2012b). Based on the IPCC's report (IPCC 2007), climate change will affect the future Australian society in a variety of ways:

- Degradation of biodiversity is projected to occur by 2020.
- In southern and eastern Australia, water security problems are projected by 2030.
- Southern and eastern Australia is projected to have a decrease in agricultural production by 2030.

Climate change will have an impact on demand for agricultural water and change global agricultural distribution (FAO 2012). In Australia, agriculture is one of the most important industries.

The Murray-Darling Basin is a catchment for the Murray, Darling, and Murrumbidgee rivers. One of the biggest river basins in southeastern Australia, it covers over 1,059,000 km<sup>2</sup> and represents 14 % of the total area of the land (ABS 2013). The Murray-Darling Basin is a transboundary river system which includes four states, Queensland, South Australia, New South Wales, and Victoria, and ACT

(the Australian Capital Territory). A major part of the Basin is located in New South Wales (56 %) and Queensland (24 %). The Basin is significant for agricultural production. Within the Murray-Darling Basin, 84 % of the land use is related to agriculture (MDBA 2013a).

Approximately two million people are living in the Murray-Darling Basin which is 10 % of the national population. A large number of people lives in New South Wales (39 %) and Victoria (29 %). About 10 % of the population works as a farmer or in agricultural-related work, compared to 3 % at the national level.

## 11.8 Major Actors and Water Reforms

Australia has a long history of water reforms since the foundation of the nation. Throughout the history, large amounts of water have been used for agriculture. Since Australia introduced federal political system, state governments uniquely possess a solid independent legal power. Consequently, power balance between Commonwealth and states has become complex and controversial even in the field of water resource management. In other words, relationships between Commonwealth and each basin state government are critically complicated with consequent problems.

The complicated and ambiguous features of governance in the Murray-Darling Basin are a critical point of this discussion. The following gives an overview of major actors involved in the management of the Murray-Darling Basin.

Founded in December 2008, the Murray-Darling Basin Authority aims to manage water resource in the Basin in order to reflect the national interest. It is the first “single agency” that is legally responsible for providing integrated management to this region. The Water Act 2007 requires the MDBA to prepare the Basin Plan as their main objective. About 300 staff who are specialized in various fields of the study work at the office. Before the establishment of the MDBA, Murray-Darling Basin Commission (MDBC) was in charge of the management. The Ministerial Council and the Basin Officials Committee also take their roles in providing advice and making decision to the MDBA (2013b).

Although the basin states have been faced with continual struggles for more than 100 years, the main actor of water resource management tends to be the hand of state governments. Water resource management has always been one of the main objectives in this country. However, people’s interest toward water was quite low until the late 1980s, and the idea of the integrated approach of water resource management was barely considered under the federal and state governments (Kondo 2006). Aggregated damage from drought in the 2000s and excessive use of water and water rights by the basin states have since become a serious problem. As a result, the improvement of traditional frameworks for water resource management was required. Table 11.1 shows recent movement of the water reforms.

**Table 11.1** Recent movement of water reforms in Australia

Year, month	Name of water reforms
2004, June	Intergovernmental Agreement on a National Water Initiative
2004, July	Australian Government Water Fund
2007, Jan	A National Plan for Water Security
2007, April	National Climate Change Adaptation Framework
2007, November	Water Act 2007
2008, August	Establishment of the Murray-Darling Basin Authority (MDBA)
2010, October	Proposed Basin Plan

## 11.9 Findings and Discussions

The Basin Plan has been recently accepted as a law by the Federal Water Minister Tony Burke in November 2012 after long stymied discussion. It has just entered a new stage and been asked to look closely to see consequences and result of the implementation.

This chapter closely traces the recent movements of the Murray-Darling Basin and analyzes how the integrated water reform is managed in Australia. In addition to literature survey, several interviews with the officers of the MDBA and professors of the Australian National University (ANU) were carried out in Canberra in September 2012. The purpose of the interviews was to find out the ongoing process of the Basin Plan.

The first part of the chapter questions are as follows: Did the Commonwealth government promote the right direction for implementing the Basin Plan? Are there any preferable alternative processes of decision-making?

### 11.9.1 *Problems of Traditional Governance Framework*

The Basin Plan made under the Commonwealth Water Act 2007 is the first case to introduce the integrated approach to water resource management in the Basin region (Connell 2011a). A choice as to whether to implement the Basin Plan will change a direction of the future of the nation. As a matter of fact, Australia is now at the turning point of the history of water resource management. Looking into the past, a traditional approach of decision-making method required “unanimous agreement” among all governments. Consequently, this method was often unable to function and caused difficulties to have a consensus of all governments. In addition, it resulted in delays in discussion and implementation (Connell 2011a). By recognizing a need for improvement in the traditional framework of the governance, the Basin Plan is developed under the Water Act 2007.

Australia has now reached the “third wave” of major water reform since the 1990s (Alexandra 2012). The earlier two waves were the Council of Australian

Governments (CoAG) water reforms known as the National Water Initiative (NWI) in 1994 and 2004. The CoAG program required all governments' agreement to improve environmental sustainability in the Murray-Darling Basin and implemented water trading across the basin state borders to boost water markets. In contrast, the Water Act 2007 is the most recent attempt (Connell 2011a). As the third wave, it put emphasis on the improvement of environment and sustainable use of water resources. It is obvious that the characteristic of water reforms has shifted from market-based framework to concerning environmentally friendly and sustainable development of the Murray-Darling Basin. In other words, the third wave of the water reform has tried to rebalance water resources, reflecting changes on Australia's national interest.

Additionally, across the Murray-Darling Basin, Australian government has challenged a wide range of other water reforms. Examples of the reform are listed below:

- Salinity and Drainage Strategy in 1989
- The Natural Resources Management Strategy in 1990
- The 1994 Council of Australian Governments (CoAG) Water Reform Framework
- The Cap in 1995
- The Integrated Catchment Management (ICM) Policy Statement in 2000
- The Living Murray First Step during 2003–2004
- The National Water Initiative (NWI) in 2004

The latest attempt of the water reform is called the Water Act 2007. Key elements of the Act are (Australian Government 2013):

- Establishment of the MDBA with the power of enforcement
- Preparation of the Basin Plan
- Establishment of the Commonwealth Environmental Water Holder
- Implementation of the Australian Competition and Consumer Commission (ACCC) with enforcement of “water charge and water market rules”
- Monitoring of water-related information by the Bureau of Meteorology

### ***11.9.2 Conflict in Water Resource Management***

From a historical perspective, during the time of pre-federation, management of the River Murray was under the problematic situation between the colonies of New South Wales, Victoria, and South Australia. Conflict was caused by the boundary between states, and the use of water for irrigation was a controversial issue. The River Murray Waters Agreement was enacted in 1915 by the Australian governments, New South Wales, Victoria, and South Australia (MDBC 2013). In response to the Agreement, the Murray-Darling Basin was managed until the early 1980s under the control of River Murray Commission (MDBC). The River Murray Waters Agreement was in operation over 90 years. In spite of the changes provided by the Agreement and expanding the power of the MDBC, there were increased



difficulties in the management of the Basin. Water resource management by “individual agencies within the separate states” was confronted with a new type of problems such as environmental degradation and increased salinization in the early 1980s (MDBC 2013). It was gradually noted as a serious problem that the “identical legislation” adopted between the Commonwealth, New South Wales, Victoria, South Australia, Queensland, and the Australian Capital Territory no longer provided effective development for the Basin (Connell 2011a).

Under the judicial arrangement in the Water Act 2007, the Commonwealth government enforces Commonwealth constitutional powers. In this background, state governments failed to engage effective water policy and control over-allocations of irrigation water as they agreed to follow the rules of the NWI 1994 and 2004 (Byron 2011). In the end, the Commonwealth government set a top-down approach to water resource management. However, problems still remain that this single legislation system within a top-down approach is also complex and complicated. And the question is how the Commonwealth top-down approach helps to solve the recent situation of the Basin.

### ***11.9.3 Integrated Approach and Climate Change***

Arrangement of the Basin Plan creates a new framework of the integrated approach to manage water resource and to tackle with climate change in the Murray-Darling Basin. First of all, the meaning of the term “integrated approach” remains obscure and might cause misunderstanding of its implications. Hence, by clearly representing the meaning of the integrated approach in the case of the Basin Plan, it expected the integrated water resource management within the bound of Commonwealth government’s top-down strategy to overcome the difficulties and restore sustainable water in the Murray-Darling Basin. The role and responsibility of the Commonwealth government are important because coordination for facing with broader issues such as threat of environmental degradation and water security is necessary.

### ***11.9.4 Federal System in Water Resource Management***

The introduction of the Basin Plan eventually changed the power balance of the Commonwealth government and state governments in terms of water resource management. Ever since the foundation of the nation, Australia is under the federal political system: State governments are not subordinated bodies but have independent rights. The question is how the change in balance of power would affect the Basin Plan and what is the benefit from the change. On the first sight, the top-down approach somehow seems to be a disadvantage for the state government and local communities. Yet, it is also an advantage for them to have opportunities to provide local knowledge to improve “environmental, cultural, and socioeconomic values”

and to encounter climate change impacts (Hatton et al. 2011). In other words, each state government has had a close relationship with their local communities such as farmers and irrigators. In addition, taking advantage of conducting a large number of programs and projects throughout the basin state history, it is clearly proved that there is an advantage for the state governments in terms of water resource management. As a proof of this, from the interviews with the officers of the MDBA, they were aware of their lack of knowledge and ability to conduct technical skills. Regarding the water resource management, transboundary rivers including the Murray-Darling are often face problems such as lack of the process of decision-making, low transparency and accountability, high transaction cost, and conflict between different stakeholders (Connell 2011b). Once the integrated approach is adopted, there is a need to have a “good balance” of relations between states and the Commonwealth government. Yet, the questions is, what is the main reason of low transparency and accountability?

### ***11.9.5 Information Sharing***

Information sharing is another key factor of the discussion and one of the complicated problems. As discussed before, under the federal system, the power of state governments tends to be sovereign and independent. Each state has their local relationships with their local farmers and irrigators. As a result, there has been a localized network within the basin states as if it is the hereditary system of information sharing. On the one hand, local network is an advantage of the state governments. On the other hand, it also creates difficulties to manage equal and cooperative information sharing with other basin states and the Commonwealth government. To tackle with the borderless problem such as climate change, there is a need for comprehensive and integrated system for information sharing.

### ***11.9.6 Process of Preparing the Basin Plan***

Since the MDBA released the *Guide to the Proposed Basin Plan* in October 2010, it has become a controversial issue and was broadcasted widely across the states. Under the Water Act 2007, it clearly states that consultation process is required with the basin states, Basin Officials Committee, and Basin Community Committee in order to arrange the Plan. According to the interviews with the MDBA’s officers, MDBA held several meetings with farmers before releasing the *Guide to the Proposed Basin Plan*. However, until the release of the proposed Plan, it seems that the public hardly enabled to catch the information of the Plan due to the fact that MDBA seemed to remain silent until the release (Wahlquist 2011). From the aspect of the journalist, the proposed plan was suddenly appeared to the public. Journalist Margaret Simons stated that (Wahlquist 2011):

The plan, two years in the making, is the result of the first exercise ever in asking the vital question: what is sustainable use of this nation's major river system?... And we knew, or should have known, that the answer would be 'something very different to what we are doing now.'

The Commonwealth government and the MDBA failed to engage with the public and communities in the early stage of preparation for the Plan. It is important to provide clear and accurate information to the public and encourage participation of communities and people in the process of preparation. When the proposed Basin Plan was firstly released, the media and opponents mainly criticized and pointed out the matter of reduction of water use in the Murray-Darling Basin. However, one of the main purposes of the Basin Plan is to restore healthy river environment and to adopt sustainable water resource management to tackle with future threat of water. The first step would be the hardest but most important process for the Basin Plan. If the keyword "environment" was in the front page of the *Guide to the Proposed Basin Plan*, it would not be impossible to have smoother situation of the process.

### 11.9.7 Process of Negotiation

As soon as the *Guide to the Proposed Basin Plan* was issued, the Commonwealth and state governments put effort into managing negotiations. The MDBA provided consultation meetings with basin communities including Basin Community Committee, national peak bodies, some scientists and technical experts, indigenous representatives, and local government representatives. In response to this consequence, MDBA revised the proposed Basin Plan (MDBA 2013c). Table 11.2 outlines timeline related to the Basin Plan.

**Table 11.2** Timelines related to the Murray-Darling Basin Plan

August 2007	Establishment of the MDBA was introduced by the Howard government and taking control over water rights (used to be controlled by the states)
March 2008	Enforcement of the Water Act
October 2010	The release of the guide to the proposed Basin Plan with arguing cuts of 4,000 GL water allocation from the Basin, raising a great number of protests by rural communities
October 2011	The release of the revised draft plan with proposing cuts of 2,750 GL and starting 20-week public consultation
May 2012	The release of the third version of the Basin Plan taking into consideration the comment and suggestions from the public
November 2012	Passing the law, after receiving all individual views

Sara Phillips, 'Murray-Darling Basin reflect the failure of the government', *ABC Environment*, 31 May 2012, viewed 23 January 2013, <http://www.abc.net.au/environment/articles/2012/05/31/3514567.htm>

In November 2012, the Basin Plan was passed into a law after longstanding difficulties and controversies with the basin states. Until the very late moment of time, basin states and related stakeholders, including farmers and irrigators, opposed the Plan. The question is how and why basin states turned their opinions and accepted the propose.

One of the significant purposes of the Basin Plan under the Water Act 2007 is to guarantee environmentally sustainable use of water in the Murray-Darling Basin. This draft plan required cutting 3000–4000 billion liters (GL) of water allocation. Based on the “hydrological indicator site method,” the percentage of water reduction was around 27–37 %. In response to the voices of stakeholders including opponents, the MDBA revised the Plan and new version required 2750 GL cut of water. Under the negotiations, the MDBA compromised the amount of water cut, since one of the opponents, the Wentworth Group of Concerned Scientists, proposed 2800 GL. The question is, what if the MDBA proposed less quantity of water than 3000–4000 GL at the first draft Plan? How about 2000 GL?

It seems that the quantity of water reduced from rivers is not the main point of this controversial discussion. As long as the Commonwealth government decides to limit the use of water, no matter how hard they attempt to deal with the issue, the situation would remain the same as before or end up with deadlocked negotiation unless they find out an alternative way to solve the situation.

### ***11.9.8 Sustainable Environment and Use of Water***

There is an alternative. Since new version of the Basin Plan emphasizes a threat of climate change and requires recovery of sustainable water resource, the environment has been taken into a serious consideration throughout the assessment to recover healthy rivers. The following table shows major points of the changes applied to the final Basin Plan (MDBA 2013d):

- The Sustainable Diversion Limit (SDL) adjustment mechanism
- Apportionment
- Climate change
- Groundwater
- Water trading

In the end, the Basin Plan proposed 2750 GL as the baseline target for the water reduction in order to recover the Murray-Darling environment. The first point of “SDL adjustment mechanism” means that the establishment of 2750 GL would be changeable. It would be possible to reduce the target of 2750 GL by a contribution of effective use of water resource for the environment. On the other hand, it would also be possible to increase the limit to 3230 GL.

Until the last moment, there was no agreement between the basin states due to the fact that how to share and be responsible for the 971 GL of downstream

components shared among the basin states. Right after signing the agreement, the Federal Water Minister Tony Burke stated that (Vidot 2012):

The environment, when it turned up to the negotiating table, turned out to be more ruthless and less compromising than any of the states; the environment turned up at the negotiating table and said, ‘if you’re going to manage the rivers this way then none of you can have the water’...

It is considered to be a strategic approach of the Commonwealth government and the MDBA to reinforce the importance of the “environment” in the Murray-Darling Basin to stimulate people’s incentive to have a consensus and conclude the negotiation.

## 11.10 Conclusion and Implications

It is generally assumed that informed decision-making on water issues can enhance local development practices and is linked to larger water policy issues of the country. Sustainable development of a country may be realized through efforts of this sort in various sectors and regions within the country.

Some conclusions and implications can be drawn from the discussion of the Basin Plan in the Murray-Darling Basin. It is suggested that the right procedure to attain sustainable development may not be attained automatically even in a developed country.

It was witnessed that the Basin Plan adopted a strategy of the top-down approach to manage the Murray-Darling Basin. Although state governments are not subordinated bodies but have independent rights, the Commonwealth government leads all involved stakeholders into achieving the nation’s goal under the Water Act 2007. Yet, the Commonwealth government and the MDBA still have a trouble with conducting local communities. Implications observed in this context include:

- Take an advantage and cooperate with state governments in order to improve regionally specific information and values to encounter climate change impacts
- Create comprehensive water resource network to share the information and fill a gap between different stakeholders

The MDBA also needs to improve the first attempt at releasing the *Guide to the Proposed Basin Plan*. It should:

- Engage with the public and communities in the early stage of preparation
- Provide clear and accurate information to the public and encourage participation of communities and people in the process of preparation
- Highlight priorities of the Plan, in this case, environment and sustainable water resource management

Under the process of the negotiation, the MDBA and the Commonwealth government experienced a hard time to reach agreement. The concerns of opponents

were not the amount of the water to reduce but something else. The negotiation could have been completed, by discussing what is the best reasonable option and stimulating incentive to have a consensus.

The following lessons are also learned from the case study in this chapter: Under the leadership of the Commonwealth government, it is necessary to take an advantage and cooperate with state governments in order to improve regionally specific information and values to encounter climate change impacts under the comprehensive networks among all basin states and stakeholders. It is also very important to engage with the public and communities in the early stage of preparation and provide clear and accurate information to the public and encourage participation of communities and people in the process of preparation. Highlighting priorities of the Plan, in this case, environment and sustainable water resource management, is also another key aspect. To avoid deadlocked negotiation, discussing what is the best reasonable option is a crucial point to stimulate incentive to have a consensus and end the negotiation.

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## References

- ABS (2013) Water and the Murray-Darling Basin – a statistical profile, 2000-01 to 2005-06. <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0.55.007>. Accessed 22 Jan 2013
- Alexandra J (2012) Australia's landscapes in a changing climate – caution, hope, inspiration, and transformation. *Crop Pasture Sci* 63:227
- Australian Government (2013) Australian Government, Department of Sustainability, Environment, Water, Population and Communities, 'Water legislation'. <http://www.environment.gov.au/water/australia/water-act/index.html#water-act>. Accessed 23 Jan 2013
- Bureau of Meteorology (2012a) Rainfall deficiencies. <http://www.bom.gov.au/climate/drought/>. Accessed 22 Jan 2013
- Bureau of Meteorology (2012b) Twelve-monthly rainfall totals for Australia. <http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=totals&period=12month&area=na>. Accessed 22 Jan 2013
- Byron N (2011) What can the Murray-Darling Basin plan achieve? Will it be enough? In: Connell D, Quentin Grafton R (eds) Basin future water reform in the Murray-Darling Basin. ANU E Press, Canberra, p 389
- Connell D (2011a) The role of the commonwealth environmental water holder. In: Connell D, Quentin Grafton R (eds) Basin future water reform in the Murray-Darling Basin. ANU E Press, Canberra
- Connell D (2011b) Water reform and the federal system in the Murray-Darling Basin. *Water Resour Manag* 25:3998
- FAO (2012) FAO water report, coping with water scarcity, an action framework for agriculture and food security, p 15
- IPCC (2007) Climate change 2007: synthesis report, summary for policymakers. [http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf). Accessed 21 Jan 2013
- Kondo M (2006) Water reform in Australia: its general overview. Research Center for Sustainability and Environment, Shiga University, Research Paper, 2006, vol 3, p 52

- Macdonald DH, Bark R, Garrick D, Banerjee O, Connor J, Morrison M (2011) Multiple benefits through the life cycle of the Basin Plan. In: Connell D, Quentin Grafton R (eds) Basin future water reform in the Murray-Darling Basin. ANU E Press, Canberra, p 269
- MDBA (2010) Guide to the proposed Basin Plan technical background. <http://download.mdba.gov.au/Guide-to-proposed-BP-vol2-0-12.pdf>. Accessed 22 Jan 2013
- MDBA (2013a) Quick facts. <http://www.mdba.gov.au/explore-the-basin/about-the-basin>. Accessed 8 Jan 2013
- MDBA (2013b) Governance of the Murray-Darling Basin Authority. [http://www.mdba.gov.au/about/governance/ministerial\\_council](http://www.mdba.gov.au/about/governance/ministerial_council). Accessed 22 Jan 2013
- MDBA (2013c) Process for the proposed Basin Plan. <http://www.mdba.gov.au/have-your-say/whats-next/process-for-PBP>. Accessed 23 Jan 2013
- MDBA (2013d) Change to the Basin Plan. <http://www.mdba.gov.au/basin-plan/changes-to-the-basin-plan>. Accessed 23 Jan 2013
- MDBC (2013) A brief history of the Murray-Darling Basin agreement, [http://www2.mdbc.gov.au/about/history\\_mdbc.html](http://www2.mdbc.gov.au/about/history_mdbc.html). Accessed viewed 23 Jan 2013
- UNDESA (2013) Water scarcity, International Decade for Action 'Water for Live 2005–2015'. <https://www.un.org/waterforlifedecade/scarcity.shtml>. Accessed 21 Jan 2013
- Vidot A (2012) Murray-Darling Basin Plan signed into law at last. ABC Rural, 22 November 2012. <http://www.abc.net.au/rural/news/content/201211/s3638832.htm>. Accessed 23 Jan 2013
- Wahlquist A (2011) The media and the guide to the Basin Plan'. In: Connell D, Grafton RQ (eds) Basin futures water reform in the Murray Darling Basin. ANU E Press, Canberra, pp 115–134
- World Water Forum (2013) Contribute to 'time for Solutions' and share your solutions with the world. [http://www.worldwaterforum6.org/fileadmin/user\\_upload/pdf/Thematic\\_targets\\_EN.pdf](http://www.worldwaterforum6.org/fileadmin/user_upload/pdf/Thematic_targets_EN.pdf). Accessed 21 Jan 2013