

An aerial photograph of a vast agricultural landscape. The terrain is a patchwork of various shades of green, brown, and tan, representing different crops and soil types. Several large, circular irrigation patterns are visible, particularly in the upper left and center. The overall impression is one of a well-managed but arid environment.

WaterGuide

Setting a path to improved water
management and use under scarcity

About the Author

Aither is an Australian advisory firm specialising in water policy, economics and management, working with leaders in the government, business and NGO sectors to improve water-related decision making. Declining water availability, growing populations, rising food demands and urbanisation are all contributing to the emergence of water management as one of the 21st century's grand challenges. Aither works with Australian and international partners to develop, communicate, implement and evaluate diverse approaches to overcoming this challenge.

Aither's dynamic interdisciplinary team specialises in four areas of water policy and management: water resources, water risks, water infrastructure, and water markets. The team's capabilities include the full range of quantitative and qualitative economic analysis and decision support services, public policy development and evaluation services, and performance improvement and evaluation services. Together, Aither and its clients are working to improve the way the world's water resources are managed, in accordance with global best practice and available evidence. For more information, visit www.aither.com.au

A I T H E R

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Cover photo: Murrumbidgee River and agricultural land in southwestern New South Wales (NASA Earth Observatory image by Joshua Stevens and Jesse Allen using EO-1 ALI data (<http://eo1.usgs.gov>)).

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Abbreviations

ADB	Asian Development Bank
AWP	Australian Water Partnership
GIWP	General Institute of Water Resources and Hydropower Planning [China]
IAP2	International Association for Public Participation
IWA	International Water Association
IWRM	Integrated Water Resources Management
MDB	Murray-Darling Basin
NGO	non-government organisation
NWI	National Water Initiative [Australia]
OECD	Organisation for Economic Co-operation and Development
SDG	Sustainable Development Goal
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
WWF	World Wide Fund for Nature

Foreword to the second edition

WaterGuide is an organising framework for improved water management and use in response to scarcity. The first edition of *WaterGuide* was published by the Australian Water Partnership in March 2017 as an Australian contribution to the work of the High Level Panel on Water. One year on, the High Level Panel is delivering its final outcomes statement, concluding two years of advocacy and activity. Australia has made several contributions to the Panel's work. Although the Panel is disbanding, the important work of water reform is not finished. Responding to water scarcity and drought, and achieving the water-related Sustainable Development Goals by 2030, requires consistent and concerted effort. We hope that *WaterGuide* will continue to help countries to launch and coordinate their efforts to improve water management in years to come.

Though the report is only one year old, an update to *WaterGuide* was deemed necessary. Australia has already used WaterGuide as the foundation for water policy dialogues with Jordan, Mexico, Senegal and Iran. These in-country applications have allowed us to reflect on the strengths of the WaterGuide framework. Chief among these is its versatility – the framework has been well-received as a tool for policy dialogue and strategic planning in countries on three continents – and its simplicity. But recent dialogues have also highlighted potential improvements for consideration. In this edition, changes to the central organising framework – the 'six elements' – reflect those improvements. For example, the importance of sustainable financing for water infrastructure and services has been emphasised. This second edition also provides more information about how WaterGuide can be, and has been, used to promote action in diverse contexts.

Despite these changes, *WaterGuide* continues to offer the same message for decision makers facing water scarcity and drought challenges: the costs of inaction are high, but more efficient water management and use can improve the lives and livelihoods of millions. The task is urgent, so learning the lessons of the past is essential to success. Australia's path to improved water management has been long and difficult; as in all other countries, the work is not yet complete, but we have deep expertise and experience to share. WaterGuide is an Australian contribution to improved water management and use globally. It frames Australian learnings in a way that is of immediate assistance to decision makers outside Australia, and helps present and organise the skills, tools and experience of the Australian water sector. While every country's context is unique, the process of deploying WaterGuide around the world has demonstrated that there are many common challenges. WaterGuide offers a promising new framework for meeting those challenges together.

Executive Summary

Water scarcity is threatening the viability of societies, economies and ecosystems across large areas of the planet. More than 50 per cent of the world's cities and 75 per cent of all irrigated farms are experiencing water shortages on a recurring basis, jeopardising future global food supplies, economic growth, environmental sustainability, and the viability of human settlements.

Australia is very familiar with the impacts of water scarcity and drought, which, globally, are now high on the agenda of many government and business leaders. Through its membership of the High Level Panel on Water, Australia has been able to share its experiences with the global community, including through the development and application of this guide.

Efficient water management and use lies at the heart of the global development challenge and is fundamental to achievement of the Sustainable Development Goals. As population grows, urbanisation continues, food demands increase and climate change intensifies, we must learn to do more and better with less. We must learn to invest efficiently, optimise across competing demands, and reallocate available water to meet basic human needs and support economic development. The costs of inaction will be revealed through reductions in human wellbeing and loss of life, stunted economies and decimated water dependent ecosystems.

Despite the challenges that lie ahead, significant benefits stand to be gained. There is a clear opportunity to increase the total value of water, in economic, human and environmental terms. For over half of the world's population, predicted large negative effects of water scarcity on economic growth could be comprehensively reversed through the adoption of efficient water policies. In some countries, the net effect could be equivalent to more than a ten per cent boost in GDP growth over the next three decades (World Bank, 2016). The benefits of improved water management will be increased resilience, economic prosperity and quality of life.

WaterGuide, depicted in Figure 1, is an organising framework for improved water management and use in response to scarcity. It is intended to be used primarily by national or local governments in countries where water scarcity is a present or future threat to human health and wellbeing, economic development and/or environmental sustainability.

WaterGuide can be used by decision makers responsible for water policy and management to:

- engage stakeholders and set a vision for outcomes from water management
- diagnose strengths, weaknesses and gaps in current water planning, allocation and use arrangements
- design a road map for improved water policy and management
- identify the portfolio and sequence of policy interventions, management arrangements and infrastructure investments that are most likely to deliver desired outcomes, and
- understand and communicate the benefits of water reforms.

WaterGuide provides multiple entry points for decision makers seeking to adapt proven water governance and management arrangements (including policy, regulation, incentives and institutions) to their own country or sub-national context. Many tools for managing water scarcity already exist and can be adopted or applied at a cost to national or provincial/state budgets that is significantly less than the value of the resulting benefits for people, economies and environments.

This report steps through each of WaterGuide's six elements. Each represents a fundamental practical element of improved water management:

1. Confirm a vision for water management and the value of water
2. Understand changing water availability and demand over time
3. Allocate water between different uses
4. Ensure effective water policies and institutions
5. Develop resilient water infrastructure and services
6. Pursue increasingly efficient water management and use

Improving approaches to water management, consistent with WaterGuide, will provide greater certainty about the nature of the water resource, the diverse demands on that resource, and the dynamic balance between water availability and demand. Most importantly, it enables the valuing of water for multiple uses and promotes decisions that enhance the efficient, equitable and sustainable management of water.

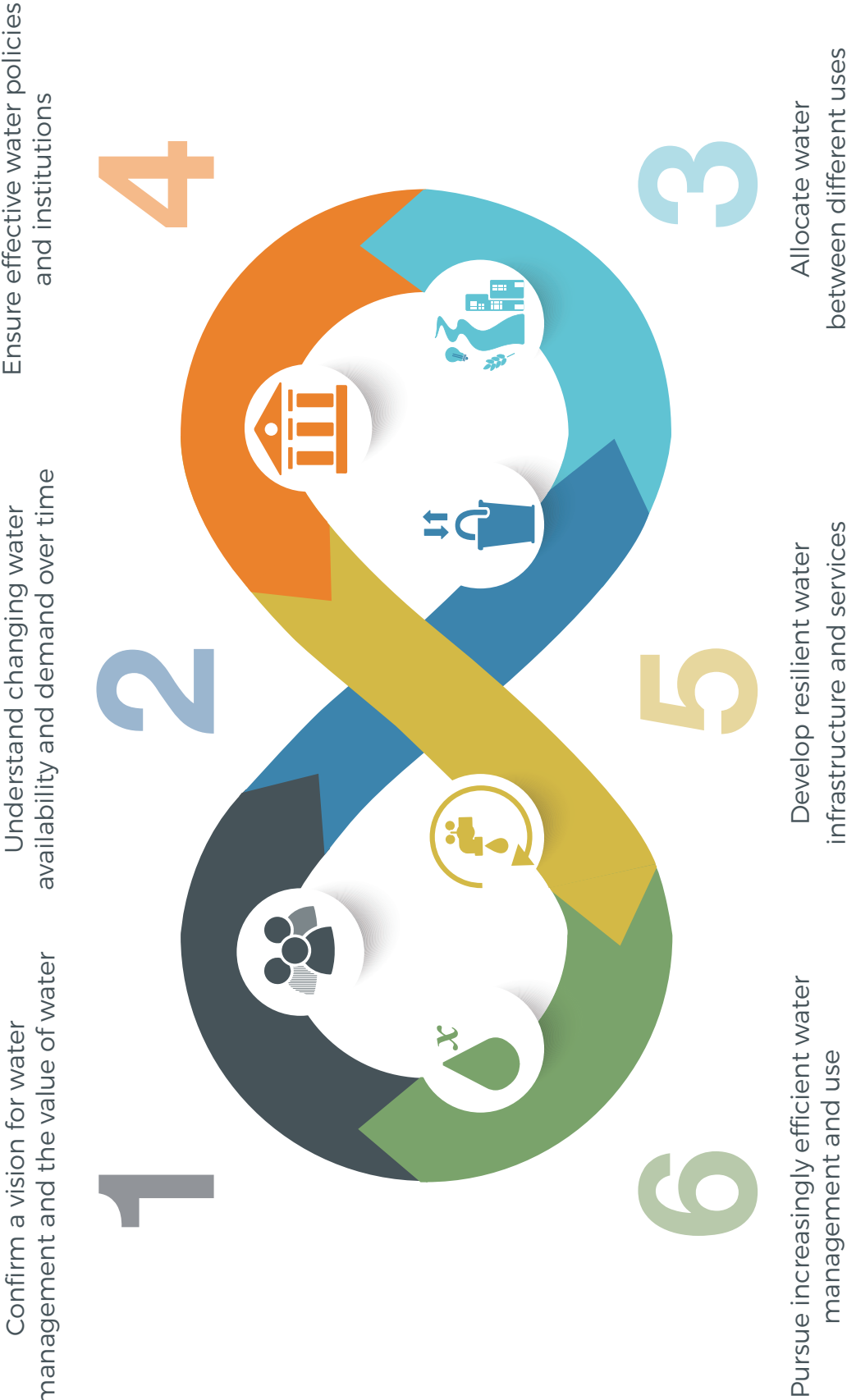
Water management is not a linear process and different countries possess different strengths and weaknesses in relation to each of WaterGuide's six elements. Each country is necessarily starting with the situation that they find themselves in, and so there are no genuine greenfield sites for good water management. Different countries face different challenges relating to water management and use; different problems demand different solutions. While there are important dependencies between the six elements, most countries will benefit from applying their efforts within a subset of areas where improvement is most needed.

While it enables government decision makers to chart a path toward improved water policy and management, WaterGuide also facilitates local implementation of small-scale interventions. Policy instruments associated with individual WaterGuide elements can help to close gaps in existing water management arrangements in the chosen country, region or basin. These solutions can be applied at the ground level and do not necessarily require the support of a national reform agenda or platform for change. Furthermore, they can be designed to be scalable and encourage leapfrogging. Where successful, such solutions will help to demonstrate the benefits of improved water management and use to multiple stakeholders.

Since its release in March 2017, WaterGuide has been used in the design and initiation of bilateral water policy dialogues between Australia and Jordan, Mexico, Senegal and Iran. Three of these countries are fellow High Level Panel on Water members. This second edition of the report includes several revisions informed by the experiences and learnings from those practical in-country applications. These revisions have strengthened WaterGuide and increased its versatility for different situations.

Water scarcity is a profound global challenge, and is worsening in many areas owing to population increases, resource development and climate change. WaterGuide offers a pathway toward identifying effective strategies for improving water management and use to realise economic, social and environmental objectives. The Australian Government welcomes the opportunity to work with water policy and management decision makers to improve outcomes from the management and use of scarce water resources globally.

Figure 1 WaterGuide



Introduction

About this report

The Australian Government, Australian Water Partnership (AWP) and Aither, a specialist water policy advisory firm, have partnered to develop a framework to assist governments to improve water management and use within their jurisdiction, in response to the threats presented by water scarcity. We call the framework 'WaterGuide'.

WaterGuide has been developed by drawing on the Australian experience of improving water management and use in the face of severe water scarcity. It leverages fundamental lessons from Australia's water reform journey but is not a history of that journey. While Australia has benefited from improved water management, the complexity of our institutional and governance arrangements, and the time and resources required to establish these, limit the direct applicability of Australia's experience elsewhere.

Panel members, as a group of world leaders, have come to believe that whether the world is talking about economic or social development, peace and security, or protecting the planet and adapting to climate change, water needs to be at the heart of the conversation.

High-Level Panel on Water, 2016

Most countries facing severe and worsening water scarcity do not have the luxury of spending 30 or more years developing a response. Urgent action is required. WaterGuide is a framework designed to assist water resource decision makers in accelerating progress towards improved water management and use.

This report is part of Australia's contribution to the work of the High Level Panel on Water (HLPW), on which the Australian Prime Minister sat as a Panel member from 2016 to 2018.

The HLPW was established to accelerate the implementation of Sustainable Development Goal (SDG) 6 and 'provide the leadership required

to champion a comprehensive, inclusive and collaborative way of developing and managing water resources, and improving water and sanitation related services' (High Level Panel on Water, 2016, 3).

Australia has worked with partners in other countries, including other HLPW member states, to make a practical contribution to the HLPW through piloting of the WaterGuide framework. This second edition of *WaterGuide* presents some of the outcomes of these collaborations among HLPW members.

Sustainable Development Goals

The efforts of the HLPW have been directed toward achievement of the SDGs. Introduced as part of the 2030 Agenda for Sustainable Development, the SDGs succeeded the Millennium Development Goals in 2015, establishing 17 goals, and 169 associated targets, for eradicating poverty, protecting the planet, and ensuring prosperity for all (UNGA, 2015). WaterGuide aims to address SDG 6 – 'Ensure availability and sustainable management of water and sanitation for all' – by providing a framework for considering possible improvements to water management. As a contribution to the HLPW's water-use efficiency theme, there is a strong focus on Target 6.4 – 'By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity'.

Targets within Goal 6 are closely related, so improvements to water management aligned with WaterGuide are likely to contribute to progress across several Goal 6 targets, not just Target 6.4. Likewise, many of the 17 SDGs are interconnected and interdependent: good water management can have positive implications for hunger relief (SDG 2), human health and wellbeing (SDG 3), gender equality and the empowerment of women and girls (SDG 5), supply of affordable and clean energy (SDG 7), the sustainability of cities and communities (SDG 11), and climate change adaptation efforts (SDG 13).

Structure

The body of this report is structured as follows:

- A global overview of water scarcity, focusing on its current and possible future impact on economies, societies and ecosystems, and describing the potential gains from improved water management in water-scarce regions.
- A closer look at the WaterGuide framework, its objectives and the process of its development.
- Detailed description of the milestones, importance and activities associated with each of the six elements that make up the WaterGuide framework.
- An overview of how WaterGuide can be used in practice to set a path to improved water management and use, through policy dialogue, diagnosis and action, including with reference to WaterGuide activities that have already been undertaken in four countries.
- A concluding statement.

Appendix 1 provides a summary of milestones and activities, and the case for action, for each of WaterGuide's six elements. Appendix 2 presents an account of the Australian response to water scarcity resulting from drought, focusing on reforms to water management and use in the Murray-Darling Basin (Australia's largest and most intensive water-using region), and the outcomes of those reforms.

The scale of the water scarcity crisis

Consequences of water scarcity

Water scarcity is a result of water demand for human activities exceeding the renewable, affordable supply of water in that region. Water resources in the world's river basins and aquifers are increasingly fully or overallocated (see Box 1). According to The Nature Conservancy, more than 50 per cent of the world's cities and 75 per cent of all irrigated farms are experiencing water shortages on a recurring basis (Richter, 2016). Of the 4,800 basins in the world where renewable water flows are being heavily depleted (i.e. more than 75 per cent of the renewable replenishment is consumptively used), approximately one third are chronically depleted and two thirds are episodically depleted (Richter, 2016).¹ By and large, this is not a reflection of changing 'natural' conditions, but of rising demand for water for agricultural, industrial and domestic uses in contexts where water policy settings and management practices are not adequate to ensure the long-term sustainability of the resource.

In many water-scarce regions, conditions are likely to worsen under climate change. According to the World Bank, '[i]f current water management policies persist, and climate models prove correct, water scarcity will proliferate to regions where it currently does not exist, and will greatly worsen in regions where water is already scarce' (World Bank, 2016, 1). Reduced water availability and increased competition between users could reduce water availability in cities by as much as two thirds by 2050, compared to 2015 levels (World Bank, 2016).

Water scarcity affects people, economies and environments in ways that are often interconnected and mutually reinforcing.

People

As more water users compete for available water resources, the likelihood of social conflict increases. The World Economic Forum has named 'water crises' as one of the top five global risks in terms of impact every year since 2012 (World Economic Forum, 2017). At its most severe, water scarcity can contribute to mass migration and civil unrest. Water shortages in discrete industries and sectors are already causing considerable economic losses and social conflicts in communities on every continent (see Box 1).

The global impacts of water scarcity are uneven. Often, the poor and women and girls are most disadvantaged by water policy and management that is not fit for purpose. Where water is not supplied to the house, the burden of collecting water traditionally falls to women and girls. In sub-Saharan Africa, 29 per cent of the population have to travel 30 minutes or more to access improved drinking water sources (UNICEF, 2016). This can reduce time available for education and other productive activities.

The alternative of persisting with inadequate water management policies puts a large section of the world with the greatest proportion of the poor at huge risk of greater economic decline with its accompanying problems of instability

Doolan, 2016b

¹ Chronic depletion occurs when more than 75 per cent of the renewable water replenishment is consumptively used on either an annual or seasonal basis. Episodic depletion occurs when consumptive use exceeds 75 per cent of the renewable water replenishment only during drier years or droughts

Economies

Where water scarcity exists, more than 90 per cent of water consumption on average goes to irrigated agriculture (Richter, 2016). With global population growth projected to continue until at least the middle of this century, and food demands increasing and evolving as diets change, water requirements for agriculture will continue to grow. Meanwhile, the world's cities are rapidly expanding in population and number, further increasing the demand for water in urban centres and affecting the movement of water through catchments and aquifers. Population growth and economic development are also increasing water demand for industry and energy production systems.

Together, these changes will demand new water allocation strategies, significant improvements in water-use efficiency and substantial augmentations to water supply. Making such changes is complex and costly, but without them, economic growth rates will almost certainly decline. The World Bank (2016) estimates that GDP growth rates in some regions could decline by more than 6 percentage points by 2050 as a result of water-related losses in agriculture, health, income and property. The cost of investing in improved water management is generally likely to be far less than the cost of inaction.

Environments

The consequences of water scarcity for ecosystems have already been dramatic, and are aggravated by pollution of rivers and lakes. WWF's *Living Planet Report 2016* estimates that the global population of freshwater species declined by 81 per cent between 1970 and 2012 (WWF, 2016). In many cases, the loss of the water dependent ecosystem services and natural infrastructure provided by the environment has led to, among multiple overlapping impacts, increased requirements for expensive water treatment, heightened exposure to flood risk, and aggravated riverbank erosion. A healthy environment is the cornerstone of a healthy society and economy. Failing to manage water in a way that sustains ecosystem health can be detrimental to all users and ultimately contribute to the terminal decline of the rivers, wetlands and aquifers that support a wide range of benefits for all (Aither, 2018).

Box 1: Water scarcity affects every continent

Across more than one third of all river basins, communities and economies are experiencing dry year, seasonal or chronic depletion of renewable, affordable water supplies (Richter, 2016). Inefficient, sub-optimal water allocation is a major contributor to the problem, and the benefits of improving water management and allocation could be significant for many countries. The following examples of the impacts of water scarcity show that the problem now affects every inhabited continent on the planet.

Africa

Recent drought conditions in southern Africa have contributed to significant livestock losses, reduced crop production and high animal feed prices, as well as severe urban water restrictions in Cape Town. South Africa's reliance on water transfers from neighbouring Lesotho means that both countries have suffered the impacts of drought.

Asia

Per capita water availability in India is just over a quarter of the global average, and the majority of the country is presently facing water scarcity. Much of India's land cover is irrigated and rainfed cropland, and 90 per cent of fresh water withdrawals are applied in agriculture. Some Indian croplands are among the most water-stressed in the world; the Northwest India Aquifer is being depleted at record rates.

Europe

Water-scarce northern and eastern Spain has faced numerous drought crises. In 2008, water reserves to supply Barcelona were so severely reduced that fresh water was shipped by tanker from other Spanish cities, prompting political tensions over which drought-affected regions should receive emergency supplies.

North America

The recent drought in California contributed to several large cities seeking alternative sources of fresh water, including through inter-basin transfers and water recycling. At the same time, a first-in-use water rights regime meant that relatively low-value and water-intensive crops continued to be grown for export.

South America

A recent two-year drought in São Paulo, the most populous city in Brazil, saw key reservoirs run dry and severe water restrictions enacted. Industrial output was curtailed due to a lack of reliable water supply, and some water users in industry have turned to private wells to enhance reliability of supply.

Oceania

The Millennium Drought in Australia's Murray-Darling Basin contributed to record low water availability across many key agricultural regions. The existence of policy and management mechanisms for the reallocation of available water to higher-value uses meant that the economic losses associated with the drought were not as severe as they otherwise may have been.



Photo: Australian sheep farm during drought, Ballarat. (Nils Versemann).

What we stand to gain by taking action

The critical challenge for the future is to improve our approach to understanding, valuing, allocating, using and sustaining water resources so that we can better balance the needs of water users.

Many countries, states, provinces and cities must urgently address this challenge. The World Bank calculates that the negative effects of water scarcity on the economies of East, South and Central Asia in 2050 could be comprehensively reversed through the adoption of efficient water policies (World Bank, 2016). Figure 2 shows that in Asia alone, home to over half of the world's population, the large negative effects of water scarcity on economic growth could be entirely reversed under efficient water policy regimes. In some countries, the net effect could be equivalent to more than a ten per cent boost in GDP growth over the next three decades.

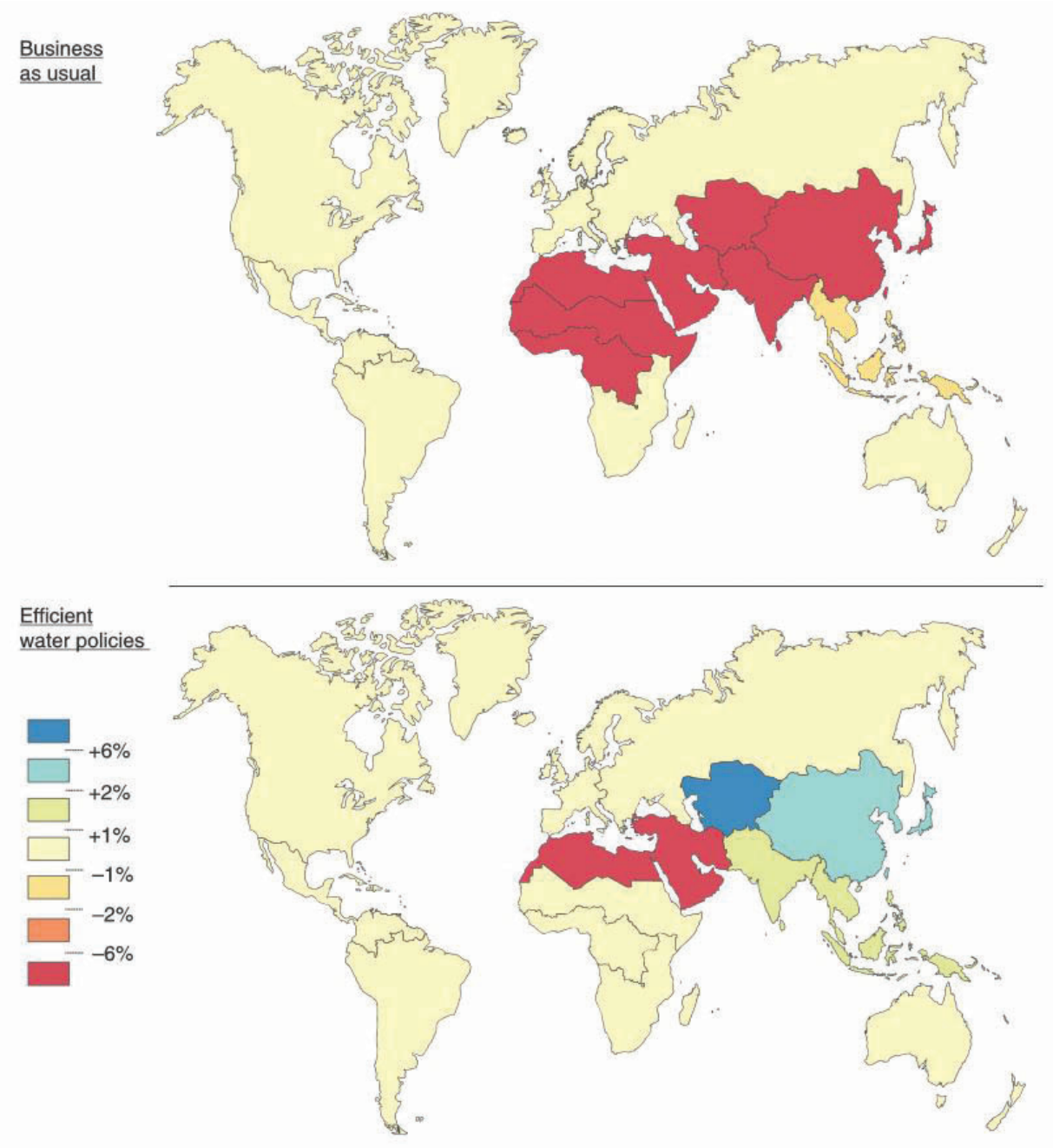
More efficient water policy settings and management regimes are not out of reach. Many of the tools for managing water scarcity already exist and can be adopted or applied at a cost to national or provincial/state budgets that is significantly less than the value of the resulting benefits for people, economies and environments. In many instances, current inefficiencies in water allocation and use are so profound that major water and financial savings could be realised with the implementation of relatively simple changes. Even where countries do not presently experience water scarcity, there are good opportunities to improve water management in this way.

Clearly, there is much to be gained from taking action. Action to address water scarcity is fully aligned with a commitment to respect, protect and fulfil the formally recognised human right to water and sanitation. Where there is not enough water to meet all needs, the risk that marginalised people miss out on affordable access to clean drinking water is increased. Progressive sustainable water management policies that help overcome the challenge of water scarcity are required to deliver on the human right to water and sanitation, and to reduce inequalities in access to water relating to gender and disability, in more parts of the world.

In an era of accelerating anthropogenic climate change, the warning that 'water is to adaptation what energy is to mitigation' (World Bank, 2016, 2) only serves to strengthen the case for targeted investments in water management and infrastructure. We need to change the way we interact with and use water to protect ourselves and future generations from the worst effects of climate change and improve the resilience of our cities, farms and industries.

Improving our approach to water management, consistent with WaterGuide, will provide us with greater certainty about the nature of the water resource, the diverse demands on that resource, and the dynamic balance between supply and demand. Most importantly, it enables us to value water for multiple uses and make decisions that enhance the efficient, equitable and sustainable management of water resources. Improving outcomes will require targeted resourcing, consistent monitoring and enforcement, and progressive strengthening of water institutions.

Figure 2 The estimated effects of water scarcity on GDP growth rates in 2050, under two policy regimes



Source: World Bank, 2016, Map ES.1.

Links to water quality

Water scarcity is by definition a problem of water quantity, a mismatch between supply and demand. As such, many of the policy instruments described in this report are targeted at changing the way water is allocated and used in order to reduce the severity of, or eliminate, that mismatch. These instruments act either on the supply side of the equation or on the demand side. Where basins are 'closed' (i.e. all the runoff in the basin is already allocated and utilised), it is often practically impossible to meet increasing demand by building new infrastructure and increasing supply. Instead, the focus of water managers must shift toward optimising allocation and re-allocation on the demand side (Molle, 2003).

Focusing on water quantity, and specifically on demand, should not mean that we disregard water quality. The two are closely linked. Poor water quality can be a principal contributor to water scarcity, as water that becomes unsafe to drink or even to water crops with can be considered as a reduction in total water supply for those uses. Likewise, over-abstraction and reduced water availability can contribute to poor water quality. Reducing stream flows can lead to warmer water temperatures and subsequent reductions in dissolved oxygen, which can ultimately make rivers and lakes unsuitable for sustaining aquatic life (Department of Sustainability, Environment, Water, Population and Communities, 2013). Understanding, and acting on, the link between quantity and quality is fundamental to good water resource management, especially where freshwater resources are scarce.

WaterGuide

Objectives of WaterGuide

WaterGuide is an organising framework for improved water management and use in response to scarcity. WaterGuide can be used by decision makers responsible for water policy and management to:

- engage stakeholders and set a vision for outcomes from water management
- diagnose strengths, weaknesses and gaps in current water planning, allocation and use arrangements
- design a road map for improved water policy and management
- identify the portfolio and sequence of policy interventions, management arrangements and infrastructure investments that are most likely to deliver desired outcomes, and
- understand and communicate the benefits of water reforms.

WaterGuide is a high-level framework, consisting of six elements that describe the fundamentals of the management of scarce water resources, from understanding the water resource and the demand for water, to allocation and infrastructure, and ultimately to improved efficiency in water management and use.

WaterGuide is intended to:

- be used primarily by national or local governments where water scarcity is a present or future threat to economic development, environmental sustainability and/or human health and wellbeing
- provide insights into water policy development and reform in a way that highlights critical elements leading to more efficient allocation and use of scarce water resources
- provide multiple entry points for decision makers seeking to adapt proven water governance and management arrangements (including policy, regulation, incentives and institutions) to their own country or sub-national context, enabling both a broad-brush approach to mapping required improvements and a ‘deep dive’ into one or more specific priority policy areas
- provide a lens through which to identify strengths, weaknesses and gaps in current water planning, allocation and use arrangements in diverse jurisdictions, and enable the prioritisation of interventions, and
- enable decision makers to access the benefits of the multi-billion-dollar investment made by Australia in its water governance and management reform journey over the past three decades (which has contributed to a reform journey of over one hundred years) by better directing financial and technical resources toward the interventions that are likely to deliver the best outcomes.

Water management is not a linear process, so the elements described in WaterGuide are not intended as a strict sequence of steps. Furthermore, different countries possess different strengths and weaknesses in relation to each of WaterGuide’s six elements, so it is not essential to accord the same depth of consideration to all six elements. Each country is necessarily starting with the situation that they find themselves in, and so there are no genuine greenfield sites for good water management. Different countries face different challenges relating to water management and use; different problems demand different solutions. While there are important dependencies between the six elements, most countries will benefit from applying their efforts within a subset of areas where improvement is most needed. The intention is that WaterGuide will be used in a targeted manner that responds directly to water management pressure points in each unique case, while recognising some common features that constitute the fundamentals of good water management. As such, WaterGuide is not intended as a prescription that should be followed at all cost, but rather as a catalyst for dialogue and partnership, built on Australia’s deep experience in responding to water scarcity and drought.

Box 2: ‘Valuing water’ is critical to success

One of WaterGuide’s basic principles is that good water management decisions are hard to make when we do not understand the consequences of those decisions. To fully understand the consequences of our decisions, we must understand the value of water to diverse users.

The value of water is the benefit that people receive from water. This includes all people and all alternative uses, and is not limited to commercial benefits. It also includes the benefits provided by water dependent ecosystems and the existence of zones of high biodiversity. The value of water covers the benefits that people will receive in the future, even people who are yet to be born. The purpose of valuation is to facilitate comparisons between options, including priorities for allocation of water, where resources are scarce and decisions must be made; the benefits are usually expressed in monetary terms to provide a common metric and to enable comparison with the costs of, for example, investing in provision of water-related services.

Water is implicitly valued in many daily decisions. We make a value judgment about the benefits of fresh water when we pay to have water piped to our homes. And when we turn off the tap to conserve that water and reduce our water bills. Better understanding value helps us understand demand for scarce water resources.

In this report, ‘valuing water’ means making explicit the implicit value judgments that governments, water managers and water users make every time they allocate and use water, or choose not to. Regardless of who is making the decision, without the application of valuation techniques, you get poorly informed, less objective water management and use decisions. The result is that investment in and allocation of water is rarely transparent and does not always consider all possible uses and users of water.



Photo: Farmer working in rice plantation (sakhorn38 – Fotolia).

Explicit valuation of competing uses for water provides a more objective means for decision makers to holistically manage water resources and optimise across multiple benefits. There are many points in time when water valuation can inform improved investment, management and allocation, including when:

- Allocating water between users: by better understanding the benefits that different groups of users and stakeholders obtain from water, governments can make more informed decisions about how they allocate available water resources between these groups. Best-practice water valuation enables governments to estimate the value of water to the environment and to recreational and other non-consumptive ‘users’ or stakeholders, not just to consumptive users.
- Directing investments in water-related services and infrastructure: water valuation enables a clearer understanding of the benefits of providing improved services and infrastructure. These can then be considered alongside associated costs to inform investment decisions. By basing investment decisions on objective valuations, governments and other investors enhance their ability to transparently communicate the reasoning behind these decisions to all stakeholders.
- Putting a price on water pollution: just as they enable improved understanding of the benefits of water, water valuation techniques also allow decision makers to quantify the costs of degradation and water pollution. Valuation of clean water sources can be used to inform appropriate policy responses, such as administrative permitting regimes and markets for wastewater discharge.

The Australian Government’s framing paper for the High Level Panel on Water, *Valuing Water*, provides an introduction to multiple methods for valuing water (Aither, 2016).

How WaterGuide was developed

WaterGuide was initially developed through a collaboration of the Australian Government, AWP and Aither. Multiple rounds of feedback were sought from Australian water sector professionals, including current and former government decision makers. Versions of WaterGuide were presented at the 2016 IWA World Water Congress, the 2016 Budapest Water Summit, and The Nature Conservancy’s 2016 Global Water Summit. The framework was discussed with senior water management experts at the United Nations, World Bank, IWA, Organisation for Economic Co-operation and Development (OECD), International Water Management Institute, and International WaterCentre. Feedback from these conference presentations, workshops and discussions was actively incorporated in the development of WaterGuide. The framework has since been widely promoted, including at the 2017 Stockholm World Water Week and 2017 Asia International Water Week.

WaterGuide draws on, and combines, practice and theory. The ‘practice’ refers principally to the Australian experience of reforming water policy and management over the past century or more, with a dominant focus on experiences from the past three decades, when water scarcity became an acute problem. This experience is augmented by, contrasted with and compared to the experiences of numerous other countries with diverse hydrologies, climates, economies, demographics, cultures, governance arrangements and political systems. Maintaining the diverse needs and operating contexts of decision makers at the heart of WaterGuide ensures its broad relevance and applicability.

‘Theory’ refers to the range of principles, frameworks and processes developed by academics, practitioners, multilateral development banks and other members of the international water policy community to describe improved water management and provide guidance on how to achieve it. WaterGuide reflects elements of these previous efforts and does not seek to replicate them. For example, WaterGuide’s six elements are not dissimilar to the core principles of integrated water resources management (IWRM) (International Conference on Water and the Environment, 1992). In addition to IWRM, other theories referenced in the development of WaterGuide include:

- Saleth and Dinar’s ‘water institution’ (Saleth and Dinar, 2004, 2005)
- OECD Principles on Water Governance and ‘health check’ for water resources allocation (Akhmouch and Correia, 2016; OECD, 2015a, 2015b), and
- ADB/GIWP/UNESCO/WWF-UK ‘water allocation planning process’ (Speed et al., 2013).

Unlike these other theories and frameworks, WaterGuide has a specific focus on water scarcity and is based explicitly on the Australian experience of water reform.

Since its initial publication in 2017, WaterGuide has been used to inform water policy dialogues in Jordan, Mexico, Senegal and Iran. These in-country applications of the framework have enabled the updating of this report to make WaterGuide more flexible and relevant to situations where cultural, political, economic, legal and institutional arrangements differ markedly from those in Australia. In this edition of the report, changes to the framework reflect improvements identified through the piloting process, which is described in the final chapter.

Element 1 – Confirm a vision for water management and the value of water

Importance

- Reveals the benefits that water provides to different stakeholders
- Understanding the values that stakeholders want water resources to sustain helps establish overarching priorities to work towards
- Builds community and political support for action

Milestones

- Commonalities between the visions and objectives for water management expressed by relevant stakeholders are identified
- The value of water is understood in economic, environmental, and social terms
- A compelling ‘water narrative’ is projected to the broader community

Activities

- Identify the key stakeholders and the different benefits water resources provide to them
- Understand what stakeholders want from water resources over different temporal and spatial scales
- Quantify and articulate the different values of stakeholders, identifying divergence, conflict and commonality
- Determine the threats and opportunities water reform presents to each stakeholder group
- Reflect on, and adaptively respond to, the lessons of the past and changing norms and attitudes
- Identify ‘champions’ to argue the merits of the proposed water reforms

The case for action

Improved water management requires the assent and cooperation of a critical number of those who have a vested interest in the resource base, from farmers to urban residents, recreational and industrial users, and environmentalists. Creating consensus across the relevant and varied stakeholders in a water resource is therefore critical to the implementation of water reform. As such, stakeholder engagement to identify commonalities between the visions and objectives for water management, among diverse groups, forms the foundation of the WaterGuide framework.

In most hydrological systems, irrigated farms, prominent industries and big cities account for the majority of water use, and it is the leaders of these interests who should be engaged early in any policy development or reform process. This includes leaders of representative social organisations such as farmers’ associations, environmental groups and industry peak bodies. Understanding the values that different stakeholders want to sustain through their interactions with water helps to establish overarching priorities to work towards. It will never be the case that every stakeholder group is fully satisfied at the same time, but a transparent process of vision and objective setting allows compromise positions to be identified, agreed and communicated.

Proactive and deliberate participation of women and gender-discriminated peoples at all stages is needed

- Grant *et al.*, 2016

Stakeholder engagement allows water users to reflect on the value that water provides for each of them. It also invites the participation of marginalised groups, giving them a voice that is otherwise unavailable to them. In particular, good stakeholder engagement presents the opportunity for improved gender mainstreaming in water governance. Women remain underrepresented in water governance fora. Women and gender experts should be involved in program design and delivery, and stakeholder groups representing gender-discriminated people should be actively engaged (Grant et al., 2016).

By engaging a broad range of water users relevant to the scale at which decisions are being made (nation, state/province, basin, etc.), policymakers can increase the degree of stakeholder acceptance of the agreed reform process and enhance trust in, and ownership over, its outcomes, while also improving economic efficiency, social cohesion and capacity development over the long term (OECD, 2015c). Decision makers need to understand what stakeholders want and expect from water management so that these needs and values can be effectively balanced. Without an understanding of stakeholders' desired outcomes, it will be impossible to identify an approach to water management that delivers on even some of those outcomes, and building the requisite consensus for change will be extremely challenging. At the heart of water management is the need to reach sufficient agreement as to how to share the available resource.

Historically, winning and maintaining stakeholder support for water policy development and reform has not been easy. Water allocation regimes tend to be 'strongly conditioned by historical preferences and usage patterns, tracing their roots to previous decades or even centuries. They have often evolved in a piecemeal fashion over time and exhibit a high degree of path dependency' (OECD, 2015a). In Australia's Murray-Darling Basin, water reforms have been hotly contested by local communities. Images of copies of the draft Guide to the Murray-Darling Basin Plan, published in 2010, being burnt by residents of one Basin town became a potent symbol for the difficulties involved in building consensus for basin-wide water allocation and management reforms (Arup and Jopson, 2010).

Adaptive, participatory water management is more likely to provide lasting improvements to outcomes for a wide range of stakeholders. The implementation of adaptive management can provide a water management regime with the flexibility necessary to respond to a wide range of future events, including seasonal or other variations in water availability and demand, climate change impacts, abrupt changes to the characteristics of the water resource through pollution events, and advances in water technologies. It also helps groups with differing perspectives to reach agreement on water reform principles under conditions of information uncertainty.

How to make progress

Water policy and management decision makers will benefit by fostering enduring coalitions of key stakeholders, and supporting these coalitions to pursue and promote improved water management. There is a need to: establish a sense of urgency to act; bring stakeholders together; define and communicate a vision for water management and use (and specific objectives related to this); empower individuals to take action; and build on initial wins to establish momentum for long-term sustainable change.

The first step in any long-term planning process should be to identify key stakeholders and develop an appropriate forum through which to engage with them and understand the benefits that they derive, or wish to derive, from water management and use. Understanding what stakeholders want from, or expect from, water (and how this may be changing over time) is a critical first step in establishing a vision for water management and use that satisfies at least some of the needs of most people. To allow meaningful compromises to be negotiated, some consistent quantification or articulation of the different values provided by water to different stakeholder groups is useful. Where these values diverge or conflict is where the hard work of compromise must take place, especially in contexts where water

demand exceeds availability. Understanding the threats and opportunities water reform presents to each stakeholder group will allow facilitators and decision makers to identify points of conflict and focus their energies there.

The critical elements of effective stakeholder engagement processes will vary depending on context. This context includes the specific drivers for making improvements to water management. Water scarcity will rarely stand alone as a reason for changing the way water is managed; other possible drivers include financial crises, food security pressures, environmental degradation, parallel economic and/or political reforms, and external pressure from multilateral donors (Saleth and Dinar, 2005). In all cases, effective stakeholder engagement is likely to include the following elements (Australian Department of Prime Minister and Cabinet, 2013):

- determining who will coordinate the stakeholder engagement process and how
- determining which stakeholders need to be involved
- developing a fit-for-purpose approach that is tailored to deliver desired outcomes
- managing stakeholder expectations in relation to the purpose of the engagement and the intended roles of the participants, and
- actively using the information collected and generated to shape decision making and subsequent communication of those decisions.

There are many models to refer to in designing stakeholder engagement processes. In Canada, between 2012 and 2014, the South Saskatchewan River Basin Adaptation to Climate Variability Project oversaw the completion of collaborative modelling processes, involving government and regulator representatives, civil society, business, research institutions and farmers (OECD, 2015c). Based on the resulting shared understanding of the scientific modelling process, stakeholder groups have been able to use the same model to discuss a series of flood mitigation options and the consequences of those alternatives for all stakeholders. Opening up datasets and engaging stakeholders in understanding and employing scientific techniques are good examples of resource-intensive but rewarding participatory management and decision making tools. There are several established international frameworks for participatory engagement and management, such as those promoted by the International Association for Public Participation (IAP2), which provide guidance relevant to many different fields, including water management.

In many countries, one of the key stakeholder groups whose interests should be reflected in water management improvements is indigenous peoples. For instance, Australian water policy experts agree that their national water policy should be strengthened in the area of Aboriginal stakeholder engagement: ‘Indigenous actors can and do remain disenfranchised in decision-making, in particular if they have limited resources, organisation or legal rights’ (Carmody et al., 2016, 134).

As only a limited number of people can be involved in the stakeholder engagement process, it is important to identify trusted and articulate spokespeople who can champion the proposed water reforms among the wider community. These champions may be popular political leaders, celebrated social activists or successful business people, or anyone that is well known, articulate and respected in the community.

Also vital is the development of a compelling water narrative that these champions can relay to the broader community. Experience shows that citizens respond most positively to simple and authentic stories that convey a sense of urgency and noble purpose. A compelling water narrative should have four basic ingredients. The first is the ‘burning platform’ or imperative to change. The second is a realistic ‘vision’ of the outcomes being sought by the reforms. The third is the ‘call to action’, summarising the various interventions required to reach the outcomes envisioned. The fourth is the ‘benefit statement’ explaining how the reforms will deliver a net benefit for the community.

Acknowledging that the agreed reforms necessitated compromise, and that this was achieved in good faith, is a critical ingredient for engendering broader community support. It is essential that those involved in the stakeholder engagement process support the designated ‘champions’ and the agreed ‘water narrative’, projecting a single voice to the wider community.

While this first element of WaterGuide is focused on establishing a vision and objectives for water management and use, stakeholder engagement and participatory management lie at the heart of the entire WaterGuide process. Specific opportunities to meaningfully engage key stakeholders at different points in the water management process include:

- gathering and assuring the quality of water supply and use data (Element 2)
- identifying and selecting preferred policy instruments for responding to issues (Element 4), and
- evaluating the outcomes from policy development or reforms (Element 6).

Because water availability and demand drivers change over time, because attitudes toward water management shift, and because technological advancement continues, the work of water reform is never finished. Decision makers should reflect on, and adaptively respond to, these drivers of change, including through consistent stakeholder engagement processes (see Box 3). Opportunities for stakeholder engagement exist in relation to every element of WaterGuide, and these are identified through text boxes at the end of each subsequent chapter in this report.

Box 3: Participatory water management planning in the Rhine River Basin

The Rhine River Basin incorporates territory in nine European countries. The river is used for navigation, recreation, hydropower generation, and domestic, agricultural and industrial water supply. The basin is at risk from climate change-induced flood and drought, as well as pollution. In the Kromme Rijn region in the Netherlands, a water management plan has been established to reconcile a wide range of conflicting interests and objectives, including those of various stakeholders with a particular stake in environmental and financial outcomes from water management. Stakeholders were engaged throughout the process, which has resulted in a shared water management plan for the region. The experience of the Kromme Rijn region demonstrates how an appropriate participatory management process can help reconcile conflicting interests to establish a vision for water management in a single basin.



Source: Timmerman et al., 2010. Photo: Rhine River, Germany (Sheri – Wikimedia Commons).

Element 2 – Understand changing water availability and demand over time

Importance

- Understanding the dynamic characteristics of the water resource provides the foundation for informed stakeholders and decisions
- Stakeholders who understand the criticality of reform are more likely to be engaged in supporting and delivering that reform

Milestones

- The resource is defined in terms of water availability and quality
- The water requirements of all current water users are understood
- Risks to future water supply and demand are understood

Activities

- Clearly define the unit of management, along with what surface water and groundwater is available and the level of demand
- Clarify the supply-demand situation for the unit of management, including risks and trends over time
- Ensure that good water information underpins supply-demand estimates and future projections
- Employ hydrologic models capable of representing complex water sharing agreements, when necessary
- Promulgate key insights from water resource assessments in the ‘water narrative’ communicated to stakeholders

The case for action²

Understanding the nature of the water resource, and how much surface water and groundwater is available over time, is essential to the establishment of an effective water management system. Without an understanding of water availability at the catchment or groundwater system scale, and the way this can change over time, it is impossible to establish the water balances needed to sustainably manage water resources for the full range of current and future needs.

But water availability is challenging to assess. Water may be on the surface, underground, in soil moisture, or in the form of liquid, vapour, snow or

Data is required to build a shared understanding of water challenges at local, national and regional levels – in particular the key vulnerabilities, interdependencies, and opportunities associated with water

- High Level Panel on Water, 2016

² This chapter draws extensively on material developed by the World Bank and others in support of the High Level Panel on Water’s ‘World Water Data Initiative’, including the Good Practice Guidelines for Water Data Management Policy (BOM, 2017). For a more detailed theoretical analysis of the importance of accurately and transparently valuing water for multiple uses, see Aither (2016). Portions of this section are adapted from that publication

ice. And water availability is constantly changing in space and time. Connectivity between surface water and groundwater also complicates efforts to understand the nature of the resource. In many countries, hydrologic measurement and water data management procedures are variable and often fragmented. The High Level Panel on Water has recognised a need for meaningful, multi-dimensional, accurate and timely information on water availability that is accessible by governments, businesses, communities, and water professionals (High Level Panel on Water, 2016). The Australian Government led the work of the Panel on this ‘World Water Data Initiative’.

As the threat of water scarcity increases, so does the need for reliable hydrological data; at the same time, the growing aggregate value of assets and services at risk means that a case can be mounted for greater capital expenditure on establishing requisite data systems: ‘[i]n countries with severe risk of water scarcity and high economic value at stake, broad-based coalitions should come together and invest in better information systems in the water sector’ (2030 Water Resources Group, 2009, 120). In turn, accurate and accessible water data can help stakeholders to appreciate the criticality of reform and increase the likelihood that they are supportive of, and help to deliver, that reform.

Understanding the demand for, or value of, water (see Box 2) is also an important aspect of managing scarce water resources for multiple economic, environmental, social and cultural objectives. Although water may be equally scarce for all users in a single region, it is not equally valued. As such, it is important to estimate the value of water for multiple uses and users. This can facilitate decision making that reflects those values and encourages efficiency in water allocation and use, while also enabling governments to pursue policy goals such as environmental sustainability and social equity.

Understanding demands for water, and how these change over time, can help decision makers to better allocate water between geographical regions, types of water use, and individual users. This is achieved by building knowledge of the total and marginal economic value of water use for various users under various scenarios. Understanding water demand supports more transparent and better informed decision making in the allocation and use of a resource that often possesses ‘common-pool’ characteristics (i.e. is rivalrous and non-excludable) and suffers from related issues of overuse and pollution (Ostrom, 1990).

Valuing water is central to estimating the benefits and costs of different water management options and how they are distributed across communities. This evidence-based approach ensures that the preferences of all people, including the poor and disadvantaged, are considered in decision making. It also enables explicit consideration of the value placed on water by women, and the value of women’s time and labour. This is an important step toward ensuring that water allocation schemes consider existing inequalities and help to transform, rather than entrench, them (Grant et al., 2016). Valuing water is helpful in considering how to pursue all water-related elements of the SDGs.

Establishing a firm evidence base that faithfully characterises past, present and projected future water supply-demand balances is a vital prerequisite for the formulation of the ‘compelling water narrative’ referred to in Element 1 of WaterGuide. The crux of most water scarcity problems is the over-abstraction of water beyond sustainable limits, wastage of the water that is abstracted, and deficient water sharing arrangements. Reliable water resource assessments are crucial for drawing attention to these problems and their possible solutions.

How to make progress

Water availability

There are two critical steps that must be taken to understand water availability:

1. Water data must be collected, either directly or indirectly (see Box 4).
2. That data must then be converted into some form of catchment- or groundwater system-scale resource assessment that provides measures of water availability, now and in the future.

Together, these steps encourage improved decision making on the basis of a more accurate understanding of the water resource at the catchment or groundwater system scale. Water resource assessments generated through analysis of hydrologic data are a necessary foundation for determining consistent water allocation rules. These need to be responsive to the dynamic nature of water availability and grounded in knowledge of the way water moves through surface water and groundwater systems under different conditions.

It is critical that reliability of supply is understood under all climate change scenarios, and that decisions are made that will continue to be effective under a drier and more variable climate

- Doolan, 2016b

[W]e should not understate how rare transparent and precise data is for supply... and for actual withdrawals from industrial, municipal and agricultural users

- 2030 Water Resources Group, 2009

These rules and management decisions should be further strengthened through assessments of risks to future water availability, from drought and climate change to water source pollution and changes in transboundary water sharing agreements or assumptions. Contamination and degradation of water sources should be regarded as a risk to water availability, as this can limit the types of uses that water is suitable for and effectively reduce availability for some uses. Technological change can also change the risk profile for future water availability by allowing access to new alternative sources of water. For instance, treated wastewater and desalinated seawater are increasingly regarded as viable new water sources in

many countries, and these should be considered in future scenarios where relevant.

As with any risk assessment, decision makers should adopt methods for assessing the impact and likelihood of different water-related events over the short, medium and long term. Understandings of both impact and likelihood can be facilitated through the use of hydrological models, which generate future projections for water availability across space and through time. Different models are associated with different levels of uncertainty and a clear understanding of the utility of model outputs in different decision making processes is required to maximise the benefit of these models for improved water management. Climate models are an important tool in water resource assessments, revealing potentially significant negative impacts on future water availability in some parts of the world. These models can also be used to project the impacts of introducing new alternative sources of supply or of a change in water sharing agreements, including changes to transboundary water sharing arrangements (see Box 5).

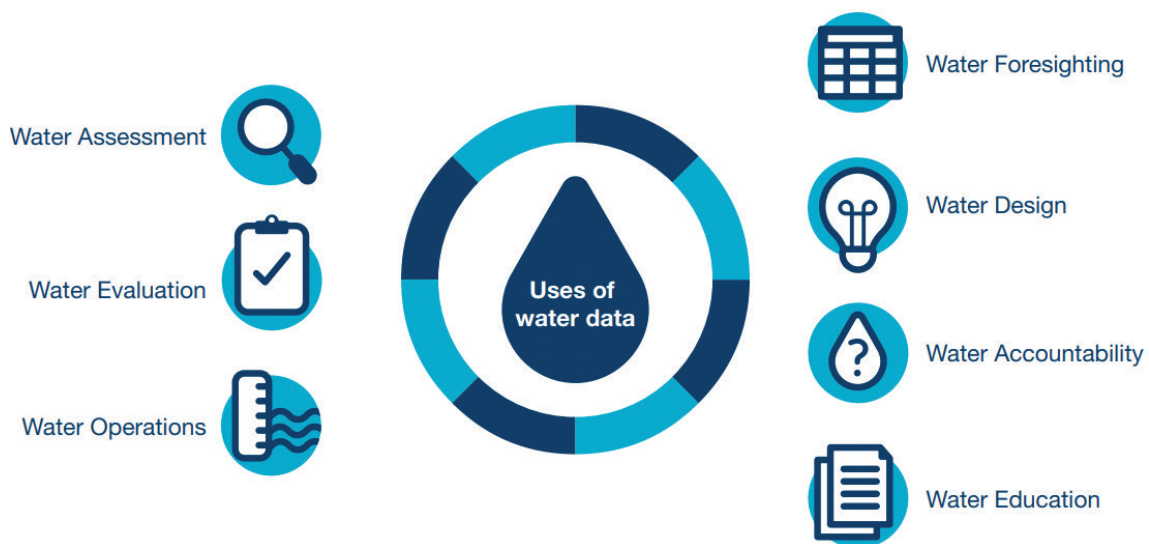
Having identified useful tools for improving understanding of water availability, water managers must set standards for data sharing, accounting and analysis. Several countries have implemented different standards and techniques for collecting and analysing data on water availability. Efforts are now underway to standardise approaches to water resource assessment internationally. The Australian Government

has contributed to these efforts through preparation of the Good Practice Guidelines for Water Data Management Policy on behalf of the World Meteorological Organization (BOM, 2017). The Good Practice Guidelines identify the following seven elements of good practice in water data management (BOM, 2017, 1):

1. Identifying the priority water management objectives (see WaterGuide Element 1)
2. Strengthening water data institutions
3. Establishing sustainable water data monitoring systems
4. Adopting water data standards
5. Embracing an open data approach to water data access and licensing
6. Implementing effective water data information systems, and
7. Employing water data quality management processes.

In general, water use data should be available at an appropriate time step to enable analysis of shifting water demand within a single agricultural season or year. A risk-based approach mandates that data collection and analysis efforts should be focused where the risks of water scarcity and drought are greatest. Sex-disaggregated data will also be required to better understand the particular costs and benefits of various water management systems and approaches. The trend toward open access data and software, and the use of modern technologies such as telemetry and satellites is rapidly improving the utility value of water data. Rapid changes in technology and the maturation of water data management systems affords the opportunity for less developed countries to leapfrog developed nations in transforming their water data arrangements. The basic uses of water data are shown in Figure 3.

Figure 3 The basic uses of water data



Source: BOM, 2017, Figure 2.1.

Box 4: How is water data collected?

Data on water availability is collected in two main ways:

- **Directly**, through the operation of hydrometeorological instruments or by collection of information from water users. Direct measurements tend to be more accurate than other forms of measurement, but are local in scale so need to be evenly spread across river basins and groundwater systems to provide accurate representative information.
- **Indirectly**, through remote sensing or earth observation. The accuracy and accessibility of indirect measurement techniques is improving, but local capacity for data processing and analysis varies greatly around the world. Indirect measurement techniques have been successfully used to monitor large changes in groundwater availability and local amounts of evapotranspiration.

Water demand

Stakeholder engagement and water use metering are critical to understanding the water requirements of current water users. By assessing current water use patterns, decision makers can gain insights into how much water is being used by different types of users (e.g. agricultural, industrial, domestic, etc.) and how much is being lost as non-revenue water, either through leakage, theft or administrative losses. Surveys and analyses of different sectors of the economy can also shed light on how the requirements of different users have changed over time.

Water demand, however, is not necessarily accurately reflected in current water use patterns. Some users may use water relatively inefficiently – if they have access to more than they need, for example – while others may have to limit their use of water, and hence their production, due to a lack of supply. For non-consumptive users of water, such as recreational fishers or indigenous peoples, estimating demand (or value) requires the application of economic valuation methods. The demands of the hydrological system as a whole – the quantity and quality of water required at various times to maintain system health – are also critically important to understand. If the basic requirements for system health are not met, all other water-related values are placed in peril.

The three main categories of economic valuation technique for understanding the demands of current water users are:

1. **Revealed preference approaches** – market prices; production function approaches; surrogate market approaches
2. **Cost-based approaches** – replacement cost; mitigative or avertive expenditures; damage cost avoided
3. **Stated preference approaches** – contingent valuation surveys; conjoint analysis; choice experiments; willingness to pay and willingness to accept

Of the methods listed above, revealed and stated preference approaches tend to be most useful for assessing water demand. Where water markets exist, market prices for water provide insights into how water demand shifts over time as climatic and other conditions change. Where markets do not exist, or where stakeholders are using water non-consumptively, contingent valuation surveys can be used to elicit the value different people place on water resources. These surveys involve asking people directly how highly they value water, either through questions about their willingness to pay for more of it or their willingness to accept having less of it. In some cases, benefits transfer methods can also be used to estimate the benefits of water use based on revealed or stated preference studies completed under similar circumstances in other locations.

Estimating the value of water for all users also means mainstreaming gender considerations, and the value of water to indigenous people. A greater range of investments in water service provision will be shown to be worthwhile when women's time and labour is appropriately valued; globally, it is estimated that women and girls spend up to 200 million hours each day collecting water, many times more than men (Unilever et al., 2015). For indigenous groups, efforts should be made to understand value in terms of the special spiritual and cultural significance of water and its uses for those groups.

Finally, to improve outcomes from water planning, there is a need to understand likely future demand. Demand forecasting should account for population growth, human migration, lifestyle change, industrial and agricultural change, and climate change impacts. As water demands increase, the complexity of water sharing arrangements increases also. In situations where many diverse demands are made on basin water resources and supply is variable, it is necessary to employ hydrologic models that can simulate the impacts of complex water sharing regimes. The Australian model *Source* (see Box 5) is an example of such a model.

Box 5: Using eWater Source for improved water management decision making in Australia

eWater *Source* – Australia's National Hydrological Modelling Platform – is designed to simulate all aspects of water resource systems to support integrated planning, operations and governance from urban, catchment to river basin scales including human and ecological influences. *Source* accommodates diverse climatic, geographic, water policy and governance settings for both Australian and international climatic conditions.

Source provides a consistent hydrological and water quality modelling and reporting framework to support transparent urban, catchment and river management decisions. A free public version of *Source* has been developed for transboundary IWRM studies and research.

eWater and its Australian government and industry partners have completed more than 100 *Source* applications. *Source* has been used around the world, with a significant user base emerging in South and East Asia.



Source: eWater, 2014.

Box 6: Engaging stakeholders

Non-government stakeholders, in most contexts, are the major users of water resources, and so an understanding of their demand for water is essential to effective water planning, allocation and regulation. Where stated preference valuation approaches are adopted, stakeholders must be directly approached and invited to participate in relevant surveys and studies. Stakeholders could be asked to support an understanding of the water resource by, for example:

- participating in a determination of the boundaries of the resource (i.e. the unit of management)
- participating in the selection of methods for measuring water availability and other characteristics of the resource, and/or
- contributing their own historical data (e.g. flood heights, bore records, and water usage) to strengthen existing datasets or fill gaps in the available data.

Within governments, water data collection and management require collaboration between central and sub-national governments and often between individual agencies at each level of government. Data user groups can be helpful in bringing these government stakeholders together and ensuring alignment in the way data is collected and used.

Finally, these stakeholders and data users need sufficient capacity development support to make best use of available technical resources. Determining current and future water availability and demand, with a focus on regions and resources at risk, relies on the existence of local capacity for data collection and analysis, environmental and resource economics, and valuation methods. Capacity development in these areas should be supported by broader water literacy and awareness programs in the general community.

Element 3 – Allocate water between different uses

Importance

- Determines sharing of water between uses, in support of vision and values, with consideration for necessary trade-offs, and with clear communication of the reasons for the decisions made
- Accounts for current and future limitations to availability and demand

Milestones

- Water is effectively allocated between different uses at the appropriate scale, taking into account resource characteristics, the value of water, and vision and objectives
- Stakeholder acceptance of, and confidence in, water management decisions is promoted

Activities

- Consider the requirements of all water users, including the environment, with respect to quantity and quality
- Determine who gains access to water, and who makes these decisions
- Clarify the allocation process, the temporal and spatial scales that apply, and how changes to supply and demand parameters are dealt with
- Ensure the process is transparent, accepted and adhered to, legally enforceable, and enforced through metering and monitoring
- Ensure stakeholders understand their rights and obligations in the allocation of water

The case for action

Many regions of the world face worsening water scarcity. In these places, water resources are increasingly overallocated, with climate change and population growth likely to compound the crisis. Improving the way governments allocate water to agriculture, industry, cities, ecosystems and other uses is the only way to sustainably manage the resource. Where water use or demand exceeds water availability, or is soon likely to, suboptimal water allocation can contribute to environmental degradation, social tensions and conflict, and reduced rates of economic growth. In these contexts, allocation decisions are always trade-offs, and there is a need to clearly communicate how and why certain allocation decisions and outcomes are considered preferable to others.

Building climate-resilient economies that can develop and grow in a warming world will require better ways of allocating scarce water resources across sectors to higher-value uses

- World Bank, 2016

The challenge for governments, water managers and all water users facing water scarcity is to do as much – often more – with less. This means addressing overallocation so that users' needs can continue to be satisfied and economies can continue to grow even as total water use is capped. An important part of achieving this objective is allocating water so that the value of that water is maximised, while ensuring the basic needs of individuals and communities are met. If one type of user gains a greater value from using an available volume of water than another type of user, there is a strong argument for structuring water allocations to reflect this. This applies equally to those using water for economic gain and to environmental and cultural uses of water, as value is a broader concept than profit or price.

Even if decisions do not entail an allocation of water to higher-value uses, it is imperative that the consequences of allocation decisions are well understood.

Failing to adequately reflect the value of water in administrative allocation may undermine the economic potential of some sectors and could lead to the loss of water-related ecosystem services. This includes through the underallocation of water to the river or aquifer system that supports all other water-related values. Suboptimal allocation of water resources could also contribute to countries falling short on national, state and/or local development objectives where water is a key input to development (e.g. for agricultural expansion or hydropower development) (OECD, 2015d). This ties back to the vision and objectives for water management and use in Element 1 – sharing of water between uses should be aligned with these objectives, whatever they might be in a particular country context.

Wherever the process of allocation planning is pursued, it provides several important benefits. When done effectively, allocation planning:

- provides a consistent, transparent process for licensing water abstractions
- ensures water dependent values can be maintained
- brings certainty for water users and other stakeholders
- provides water availability information that is needed for urban, agricultural, industrial and other development, and
- helps increase the value of water resources by facilitating improved water allocation and use.

How to make progress³

Water allocation planning is an important tool for water management. At their most basic, allocation plans set out what water is available from a defined resource or area and what water needs to be left in the system to maintain system health. Allocation plans describe how licences for abstracting water are to be provided to, or purchased by, water users (including where these are transferred between users), and how plans will be implemented, evaluated and modified over time. The stakeholder engagement processes described in Element 1 of WaterGuide and the water supply-demand assessments described in Element 2 are important prerequisites for effective water allocation planning.

The fundamental steps that should be taken to improve water allocation planning are:

1. **Establishing allocation limits** at the catchment or groundwater system scale to ensure that the water resource is sustainably managed for the benefit of future generations. One of the key steps taken in the case of Australia's Murray-Darling Basin was the setting of 'sustainable diversion limits' for each surface water catchment and groundwater system in the basin, based on a 'triple bottom line' assessment of the water required to meet defined economic, social and environmental objectives. Such limits on water abstractions must be supported by effective governance and regulatory arrangements; in some cases, it may be advantageous for a basin-scale management authority to be created to support water management at the appropriate scale.
2. **Defining an approach for allocating available water resources** between uses (e.g. agriculture, industry, cities, hydropower etc.) at the catchment or groundwater system scale. Assuming that water use for ecosystem health is excluded from the total allocation that has already been established, the remaining available water should then be allocated between geographic regions and groups of users, on the basis of agreed rules that explicitly account for variability in water availability within and

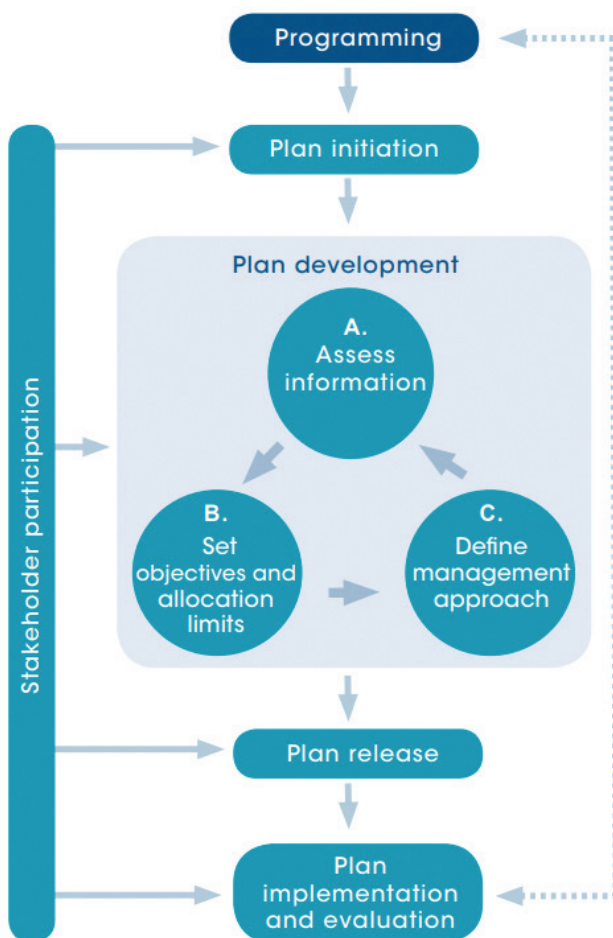
³ This section draws extensively on a guide to water allocation planning published by the Government of Western Australia (Department of Water, 2011).

between individual years. This allocation is easier to administer and regulate where users are all part of a single operating system. The approach should establish an access regime, based on clearly defined rights, which might involve formalising existing informal arrangements. It should also describe how this regime is to be administered, including by defining who may apply for the right to access water and the method for determining priority among applicants – priority may be determined according to who applies first, a preference for certain categories of use (e.g. domestic water), or some other principle. Where volumetric rights to access water exceed the water that is actually available, a fair and transparent process to reduce total water allocations is required. Licensing policies should be developed with stakeholder input, and applied transparently and consistently, to build confidence in, and acceptance of, allocation principles and subsequent decisions. Users who benefit from water that is left in rivers, lakes, wetlands and aquifers, such as hydropower generators and aquaculturists, should also have their requirements considered.

3. **Monitoring, evaluating and reporting outcomes** from water allocation. Allocation decisions should be monitored with reference to specific indicators developed in light of the objectives for water management and use in that context. Planners should be clear about the frequency, content and distribution method for public reporting during the term of any allocation plan. Enforcement of allocation decisions is essential, and requires a commitment to funding and capacity development.

A basic water allocation planning model is shown in Figure 4.

Figure 4 A basic water allocation planning model



Source: Department of Water, 2011, Figure 1.

Where river basins span more than one country or province/state, high-level allocation decisions, including decisions to reduce total water abstractions, should be agreed by all governments (see Box 7). Transparent rules should be established in a collaborative manner to reduce the likelihood of conflict and tension between basin governments, including rules to determine how those governments share water during times of reduced availability. Policy coherence across sectors that affect allocation is also important – regulations for energy, agriculture and industry should support good water management and the system should be managed as a whole (OECD, 2015b).

It is important to note that allocation planning rests on the authority of those making the decisions. The key enabler for improved allocation of water resources is the legal authority for governments to control how water is stored and allowed to flow, and determine who has access to those flows and when. In Australia, the constitutional reform to provide Australian state governments with this authority was completed over a century ago, and remains the foundation for ongoing

refinements to allocation regimes. A national or provincial government that lacks this authority to control how and when water is used cannot implement an effective water management regime. In countries where governments do not possess this authority and assign unfettered riparian rights to withdraw water, it is extremely difficult for basins and aquifers to be managed sustainably. One example of a challenge in this area is to modify the widespread belief that groundwater belongs to the overlying land owner and, instead, to build an understanding that groundwater is a collective good.

Box 7: Interstate water sharing in Brazil

In 2006, Brazil's National Water Resources Council approved the National Water Resources Plan; since then, state water resource plans have been completed in most of Brazil's 27 states, and nine interstate river basin water resource plans have been finalised. Major developments in data collection and water resource mapping, including through the establishment of a National Registry of Water Resources Users, have contributed to more than 7,000 new water permits being issued in federal river basins, and over 200,000 permits issued nationally.

Brazil has developed water sharing compacts in at least eight river basins – these limit total withdrawals of water and establish rules for water sharing during periods of scarcity. In the São Marcos River basin, a compact determines the allocation of a basin-wide cap on water consumption among basin states through limits on irrigated agriculture. With the emergence of hydropower as a major new user of water, however, and parts of Brazil having recently faced record drought conditions, there is an ongoing risk of conflict between irrigators and hydropower developers. In this context, it is important to ensure that water allocation planning continues to serve the objectives for water management and use identified by a wide range of stakeholders.



Source: OECD, 2015d. Photo: Itaipu Dam, Brazil–Paraguay Border (Leandro's World Tour).

Box 8: Engaging stakeholders

Where governments have the authority to control water use, it is important that allocation decisions are made in a collaborative and transparent manner, in support of agreed objectives for water management and use, to build confidence in water management decisions. Processes should be developed with stakeholder input, be accepted and adhered to, and be enforced through monitoring and metering of water use, disaggregated where possible at the user level. WaterGuide Elements 4 and 6 support this.

Altering water allocations between uses and reducing total allocations can be politically contentious and can significantly impact upon individuals or groups who rely on water for their livelihoods. As such, effective stakeholder engagement is essential to build the consensus required and arrive at useful compromises – between governments, between governments and groups, and between groups – to build a sustainable allocation regime that is likely to be supported by a majority of stakeholders. Transparently communicating decision making processes and rationales to affected parties is also critical – if stakeholders can understand the reasoning behind decisions, and particularly if these decisions are based on sound valuation of water resources, it is easier for decision makers to clearly and consistently defend their position. Such communication is an important part of the ‘compelling water narrative’ described in Element 1 of WaterGuide.

Element 4 – Ensure effective water policies and institutions

Importance

- Good governance and policy is a prerequisite for sustainable water management

Milestones

- A regulatory and planning framework is developed that supports agreed objectives, engenders buy-in, and acknowledges stakeholder groups
- Institutions and processes are sufficiently resourced, including through capacity development
- Increased confidence in water policy and management is established

Activities

- Develop and champion a compelling reform narrative that engenders stakeholder buy-in and can be widely understood
- Develop a clear policy framework articulating the objectives and a road map for water policy and reform
- Invest in capacity, leadership and effective coordination
- Align legal frameworks and incentives and avoid overlapping institutional responsibilities, including by ensuring coherence between government departments and between different levels of government

The case for action

Effective regulatory and planning frameworks, supported by competent people throughout the water sector, are fundamental to improved water management, especially where there is competition for scarce resources. Good water policies create confidence among stakeholders and reduce the chance of conflict between water users. A clearly defined and secure right to use water, for instance, encourages long-term investment in water savings measures by individual farmers as a pathway to increased productivity.

As noted earlier, water is a critical input for agriculture, energy production and industry; operations cease without it. Knowing that water will be available in specific volumes, depending on prevailing conditions, enables farmers to invest in equipment, factory operators to guarantee production, and all users to assess the potential benefits of improvements to the efficiency with which they use water. Knowing that a water resource is being managed in a way that protects ecosystem health is just as important, and so sustainable management and use ultimately supports confidence and certainty for water users and investors.

As highlighted elsewhere in this report, the benefits from improved water policy settings are potentially significant. The World Bank calculates that the negative effects of water scarcity on the economies of East, South and Central Asia in 2050 could be comprehensively reversed through the adoption of efficient water policies (World Bank, 2016).

How to make progress

There are many different water policy instruments that have been effectively deployed to govern water management and use in diverse jurisdictions. Some, such as restrictions on discharge of wastewater into rivers and lakes, are coercive, while others, such as payments for ecosystem services, offer incentives for certain behaviours. Some, such as water rights for individual users, are designed to require or encourage different types of individual conduct, while others, such as basin-scale management authorities, are designed to reshape the environment in which everybody's water management decisions play out. WaterGuide does not attempt to list every type of water policy instrument that has been, or might be, implemented in a given context – that task is beyond the scope of this document. Instead, this chapter offers some guidance on how to ensure policy makers, their institutional environments, and the policies that they create and implement, are equipped for success.

Water policy framework

A water policy 'blueprint' can be a powerful motivator for coordinated action. Australia's National Water Initiative (NWI), agreed by all state and federal governments in 2004, provided a national blueprint for water reform and was critically important in guiding a necessary acceleration in reform during the years of the Millennium Drought (Council of Australian Governments, 2004). An effective water policy clearly articulates the objectives for water management and use (see Element 1) and provides a road map for water policy reform. The policy should be prescriptive enough to commit governments to action. In the case of Australia's NWI, state and federal governments committed to:

- prepare comprehensive water plans for all major water supply systems
- reduce water allocations to sustainable levels in stressed water systems
- introduce registers of water rights and standards for water accounting
- expand trade in water rights
- implement cost-reflective pricing for water storage and delivery, and
- better manage urban water demands.

Each of these commitments entailed the introduction of new water policy instruments or the modification of existing settings at the State government level. In each case, the NWI provided a stable blueprint, with agreed roles and accountabilities, against which to measure the progress of reform and through which to ensure efforts were aligned. Formal review processes were set in place to assess progress and, in some instances, some federal funding to states was contingent on agreed reform targets being met. Any such framework should clarify institutional responsibilities to avoid overlap or tensions between organisations and their mandates.

Capacity, leadership and coordination

Water policy frameworks must be implemented, monitored and improved over time. The ability to do this depends on the quality and depth of capacity, leadership and coordination. The OECD Principles on Water Governance (see Box 9) highlight the importance of adapting the level of capacity of responsible authorities to the complexity of the water challenges to be met, and to the set of competencies required to carry out their duties. One of the most challenging tasks for leaders in water reform, including for the

Technical solutions are often known but the challenge is translating that into “who does what, at which level, and how”

- High Level Panel on Water, 2016

responsible Minister(s), is to make and enforce decisions that require trade-offs between different water uses and users. Great political will is required to act against vested interests where inertia is sustaining allocation regimes that are no longer fit for purpose. For example, in Australia's Murray-Darling Basin, the decision to recover rights to water previously held by consumptive users for the maintenance and improvement of ecosystem health was vigorously contested by irrigators. Government Ministers needed to manage a lot of criticism and anger from affected rural communities in defending water policy reforms that were aimed at the broader public good.

Water policy reform, by definition, builds upon prior policy foundations so there is a need to acknowledge the water sharing and use norms and any informal or formal systems that already exist or have previously existed. Any pre-existing water rights or water use practices should be incorporated into or appropriately acknowledged by a modern planning and policy regime. This process can be among the most politically contentious in establishing a new water rights system. As always, stakeholder engagement and strong leadership are critical.

Compliance and enforcement

One of the behaviours sometimes observed in water-scarce regions is the illegal withdrawal of water from the water resource system. Hence, effective water regulations and policy settings must be backed by an adequately resourced compliance and enforcement regime that provides water management authorities with real powers. Enforcement provides stakeholders with confidence that all water users are abstracting water in accordance with their relevant rights and allocations. If rights holders are withdrawing more water than is allocated to them, the long-term sustainability of the water resource and the ability of others to access their allocated share of that resource can be negatively impacted.

The establishment of a public register of water rights can contribute to the transparent monitoring of rights holders and their water use activities. Clear and accurate water accounting is critical to maintaining water balances at different scales, from the water user association to the basin as a whole. In Victoria, one of the five Australian states and territories with a claim on the surface waters and groundwaters of the Murray-Darling Basin, a water register has been established to (Victorian Water Register, 2016):

- hold records of rights to take and use surface water and groundwater
- record water allocations that are available in the current season (these vary according to extant climate conditions and the amount of water held in storage), and
- track and reconcile volumes of water rights by water system and trading zone.

Another important aspect of enforcing appropriate water use is metering. This may be done at the individual water user level or at the district level where the aggregate water use of several users is monitored. A targeted approach to metering – only major users or those with the greatest incentives to overuse water are metered – is likely to deliver the highest value for water managers with the least expenditure of time and resources.

Efforts should also be directed toward enforcement of water quality and other standards and requirements. In the Murray-Darling Basin, extensive state-based, federal and collaborative monitoring of environmental outcomes from water management focuses on river flows and connectivity, native water dependent vegetation and birds, and native fish, recognising that these are the most critical indicators of river basin health in the context of the Murray-Darling Basin (Murray-Darling Basin Authority, 2014).

Under different water management regimes, ensuring compliance may be as simple as ensuring that a given average flow rate out of an upstream reservoir is maintained. In the Colorado River basin, for example, the key requirements of the Colorado River Compact will be met so long as the agreed

average minimum flow is released from Hoover Dam. In China's Yellow River basin, the centralisation of operational responsibility for major water infrastructure within a basin management authority ensures that trans-provincial flow requirements are always met and no compliance effort is required (Speed et al., 2013).

Box 9: OECD Principles on Water Governance

The OECD Principles on Water Governance provide a framework for governments to consider when designing and implementing water policies. The 12 principles were introduced in 2015 and seek to guide the development of effective, efficient and inclusive water policies. The 12 principles are as follows:

1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.
2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.
3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.
4. Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.
5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.
6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.
7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.
8. Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders.
9. Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making.
10. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation.
11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.
12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.

Source: OECD, 2015b.

Box 10: Engaging stakeholders

It is important to work with water user groups when attempting to make policy improvements that directly affect the livelihoods of communities. For instance, even where there is no existing water rights system in place, there will be norms and informal rules for the sharing of water resources. These can be firmly entrenched and difficult to set aside through the introduction of formalised legal and regulatory systems for water management and use. Careful negotiation is vital in such cases. The Australian experience attests to the importance of maintaining close and collaborative relationships not just with stakeholders outside government, but between different groups within government that have some responsibility for implementing reforms. For instance, the agriculture, industry and environment portfolios within government may have quite different perspectives on the merits of particular water policy propositions. These differences should be identified, discussed and moderated to garner broad-based support for water policy reforms.

Element 5 – Develop resilient water infrastructure and services

Importance

- Appropriate investment in water infrastructure and delivery of water services sustains economic growth, human health and sanitation, social amenity, and environmental protection

Milestones

- Affordable, accessible and reliable water infrastructure and services are delivered
- Cost-effective water infrastructure projects are identified and implemented
- Capital and operating expenses are appropriately funded and financed

Activities

- Document infrastructure needs for rural and urban water, in relation to water supply and wastewater, on the basis of desired levels of service, and determine whether they are being met
- Clarify water services provided and levels of service, and how the provision and operation of infrastructure and services is organised, funded and financed
- Ensure investment in, and use of, water infrastructure is well directed and designed to provide value for money and be resilient in the face of uncertainty
- Introduce an independent economic or utility regulator to oversee cost recovery
- Transparently account for all water infrastructure costs, including capital, operating and maintenance and administrative costs
- Appropriately allocate costs between customers and government
- Implement appropriate standards for operation and maintenance of critical water and wastewater infrastructure, and monitor and report on compliance with these standards

The case for action

Achievement of the SDGs requires significant new investments in water infrastructure and services. Globally, the annual investment in water infrastructure required by 2025 has been estimated at USD 1.04 trillion (World Water Council and OECD, 2015). Governments, international financial institutions, donors, and institutional and other lenders are working together to meet financing needs in the water sector.

While governments increasingly recognise the critical connection between water security and economic growth, they often struggle when it comes to the delivery of affordable, accessible and reliable water infrastructure and services. For example, the prevalence of high rates of non-revenue water in many large cities highlights the massive room for improvement. It has recently been estimated that 32 billion cubic metres of treated water is lost from urban systems around the world each year through leaks in the pipes (Damania et al., 2017). Large efficiency gains can potentially be made through improved funding and financing, contracting and regulation, and operations and maintenance.

Financially sustainable water infrastructure and services promote public and business confidence in water management and policy settings. The link to water allocation (Element 3) is critical: utilities that are unable to reliably deliver the water that has been allocated to different users will lose the trust of

those users and fail to meet agreed objectives for water management and use. In turn, water users become less inclined to pay for services that are unreliable or to make investments in water dependent businesses, farms or other assets. In cities, this is manifested in a ‘vicious cycle’ of poor piped water service – often plagued by leaks, variable pressure and aging parts – contributing to low cost recovery, which leaves utilities short on revenue to finance billing and debt collection and general improvements to the system. Surveys reveal that, in 2004, 89 per cent of utilities in low-income countries and 37 per cent of utilities in lower-middle-income countries charged tariffs that were too low to cover basic operation and maintenance costs (Damania et al., 2017).

Pricing that allows water service providers to recover the full costs of service delivery allows water service providers to fund future investment in new infrastructure and an appropriate level of investment in renewals and maintenance of existing infrastructure (Aither, 2017). Future investment drivers including ageing assets, population growth and balancing supply and demand in the face of climate variability and change mean that full cost recovery is critical to ensure that water service providers can fund investments to meet these challenges (Aither, 2017).

How to make progress

In many instances, new water and wastewater infrastructure and services will be required. However, we also need to make better use of what infrastructure is already in place, including to promote resilience in an increasingly uncertain future. Regardless of where a country or city finds itself in its infrastructure investment cycle, there is a need to invest in improved regulation, appropriate pricing of water services, and efficient operations of water and wastewater utilities. This section provides guidance for decision makers seeking to promote action, whatever their context.

New infrastructure and services, and making better use of what we have

From dams to urban wastewater networks, all countries have an ongoing need to refurbish and build new water and wastewater infrastructure. Such interventions are not always timely, and in some cases a crisis point is being reached where critical infrastructure urgently requires replacement or rehabilitation. While the types of water infrastructure available to meet our diverse needs has increased dramatically in recent decades, traditional supply-side investments in assets such as dams, pipes and treatment trains remain necessary. Taking the example of dams, a new era of dam construction and inter-basin transfer is now underway. The number of dams in the world is expected to rise 16 per cent by 2030, with storage volume increasing by approximately 40 per cent (Damania et al., 2017). As the remaining suitable sites for new dams are developed, however, alternative sources of water are becoming more popular and cost-effective. Desalination, for instance, is increasingly considered an affordable and reliable source of supply for some water-scarce regions.

In considering investments in new infrastructure and services, desired levels of service and water quality requirements should be taken into account, as they can differ from user to user. Likewise, infrastructure that supports reliable water supply, such as hydrologic monitoring systems, should not be neglected. Critically, the dynamic nature of water availability and demand (see Element 2) requires multi-purpose climate-resilient infrastructure that is able to respond to potentially significant changes in circumstances over the course of its useful life, which could easily extend beyond three or four decades. Many cities and countries are now actively pursuing a strategy of diversification in their water supply portfolio. For instance, the city of Perth in south-western Australia has recently deployed desalination plants and water recycling facilities, introduced managed aquifer recharge schemes, and increased groundwater abstractions to balance reduced streamflows into water storages caused by declining rainfall (NCCARF, 2016). Perth’s Water Corporation is now implementing a ten-year plan to ‘drought-proof’ the city and achieve climate resilience through investment in a portfolio of water production options

(Water Corporation, 2011). This is a posture that other cities affected by extreme water scarcity and the impacts of climate change may increasingly need to adopt.

Where continual assessment of water demand indicates the need to make decisions about building or not building new water infrastructure (e.g. dams), these decisions should be made with reference to the value of additional water to different users. A cost-benefit tool or similar should be used to logically and transparently assess the value created by the new infrastructure, including through comparison with viable alternative solutions. Decisions that reflect the value of water, including for environmental and non-consumptive uses, are more likely to deliver positive social, environmental and economic outcomes.

While natural capital solutions may not entirely match the storage capacity of large dams, they offer the potential to address some water scarcity issues without large financial outlays or environmental damage

- Damania et al., 2017

Decision makers should consider how to complement investments in built infrastructure with improved use of 'natural infrastructure' and the ecosystem services it provides. For example, wetlands (including artificial wetlands) provide important water storage, water filtration and flooding prevention benefits. By adopting a value lens that accounts for wide range of financial and non-financial benefits, it can often become clear that negligible investments in protecting or restoring such natural infrastructure can yield considerable rates of return. Activities to be considered include catchment protection, limits on floodplain development, wetland restoration and riverbank revegetation.

WaterGuide's central argument is that decision makers should pursue improvements in the efficiency of water allocation and use to maximise the value of water in water-scarce environments. These improvements should be based on an understanding of the consequences of current and alternative water policy settings and use practices. One area in which efficiency gains can be readily pursued is the operation and maintenance of existing infrastructure. Reductions in non-revenue water (see Box 11) are an important part of the equation but there is more that can be done. There is wide scope to make better and more integrated use of existing storage infrastructure (e.g. dams and aquifers) and new sources of supply. Managed aquifer recharge is one solution that is being considered with increasing seriousness around the world. Demand management (see Element 6) should also be considered as a means of making better use of what we have.

Regulation, pricing and corporatisation

Water infrastructure and services cannot be appropriately planned, financed or sustained without a competent regulatory framework and institutional structure to support the outcomes sought by stakeholders.

As an essential service and natural monopoly, water supply requires economic regulation. Regardless of the ownership and institutional structure of water and wastewater utilities in a given country or city (i.e. municipal, corporatised or private), independent economic regulation to oversee cost recovery is advisable. There are several different approaches to price setting and economic regulation that have been used in different parts of the world with varying degrees of success. The success of these approaches in achieving the desired objectives will largely be based on the effectiveness of the governance and implementation of the regulatory arrangements. One of the important insights from the literature is that performance can be significantly improved by focusing regulatory efforts on the aspects of each specific water services market that present the largest barriers to financially sustainable provision of those services (Damania et al., 2017, 67). Key activities to improve water pricing include:

- transparently accounting for all water infrastructure costs, including capital, operating and maintenance and administrative costs
- determining appropriate cost sharing arrangements to allocate costs between customers and government, and
- defining appropriate cost recovery mechanisms (e.g. fixed and variable tariffs to recover the share of costs allocated to customers).⁴

In addition to economic regulation and its impacts on water pricing, the organisational structures of utilities should also be assessed, as greater efficiencies are sought in all aspects of water management. There is a general trend toward corporatisation (rather than full privatisation) of public water utilities. This involves a change in the status of the utility from an entity within a government department (or similar) to a separate legal entity with a skills-based board, increased independence in financial and staffing matters, and managerial autonomy. With this independence comes new responsibilities for reporting and transparent handling of information, and (in some cases) the application of private law to the actions of the utility.

Box 11: Metering to support good water management in Phnom Penh

Ek Sonn Chan took responsibility in 1993 for a Phnom Penh water supply system from which 70 per cent of water was lost to leakage and theft. The city's water agency was collecting fees from only half of its users. By forcibly closing illegal connections to the water system and installing thousands of new water meters, the municipal utility was able to increase tariff collection rates (to 99 per cent by 2003) and attract international funding assistance to finance subsidised water for the city's poorest inhabitants and improve the overall performance and sustainability of the system. Without a political commitment to water use metering, improved infrastructure financing and maintenance, and enforcing laws against theft of water, the reforms initiated by Ek Sonn Chan in Phnom Penh would never have been implemented as rapidly or successfully as they ultimately were.



Source: Brennan, 2012. Photo: Water purification facility, Phnom Penh (PPWSA).

⁴ Considerations of capacity to pay can be taken into account as part of this activity.

Box 12: Engaging stakeholders

Everybody has a stake in water infrastructure and services, but few realise the expense and complexity in maintaining essential water supply and wastewater services for domestic and other uses. Improving people's understanding of how water is delivered to them, or what might be required to enable it to be delivered where it is not already, will increase support for important reforms, including to pricing for cost recovery.

Stakeholders can be involved right from the identification of what improvements to infrastructure and services are required, through to the monitoring of infrastructure and service performance. Essential infrastructure is often the most 'real' point of contact between citizens and the broader water management and policy framework that sits behind the infrastructure; as such, there are opportunities to use that point of engagement to improve alignment between stakeholder attitudes and the overarching vision for water management and use outcomes.

Element 6 – Pursue increasingly efficient water management and use

Importance

- Ensuring progress towards improved water management requires ongoing commitment to optimising the value of scarce water resources

Milestones

- Changes to water resources, information and values are appropriately managed, as the vision and objectives continue to be pursued
- Mechanisms and processes to refine and optimise water management and use are introduced

Activities

- Introduce settings to facilitate an improved water management system, such as adaptive management and planning arrangements
- Introduce mechanisms and incentives for more efficient and effective water allocation, investment and use, such as water pricing and markets
- Invest in monitoring, evaluation and reporting

The case for action

More efficient water management and use enables the value of scarce water resources, and thus the economic, social, environmental and cultural benefits of water, to be maximised. Where water scarcity is negatively impacting on those benefits, there is a clear incentive to be more efficient in the allocation and use of water. In other words, there is an incentive to do more with less.

Enhancing the efficiency of water management and use will not only improve the economic return on every unit of water that is used for consumptive purposes, but will also allow water resources to be managed more sustainably for the benefit of future generations, even as economies and communities continue to grow. By more optimally allocating available water between users, increasing productive efficiency, and allowing water to be reallocated more flexibly in accordance with the changing value of the resource to different users, countries can significantly overcome the constraints of water scarcity and variability.

By adopting the recommendations of this report, decision makers have the opportunity to encourage water use practices that deliver a wide range of benefits for diverse stakeholders in a way that does not threaten the long-term viability of the hydrological system.

How to make progress

There are many ways in which governments can enhance the allocative, productive and dynamic efficiency (see Box 13) of water use. In general, techniques can be classified into either centralised administrative approaches or incentive-based approaches that encourage individual involvement in decision making. Australia's experience is that those instruments that increase individual participation in decisions relating to the allocation and use of water lead to significantly greater allocative, productive and dynamic efficiency. Regardless of the specific approach to increasing the efficiency of water management and use, there is a need to invest in and commit to appropriate monitoring, evaluation and reporting, including through capacity development as required.

Box 13: Three types of water efficiency

The three types of water efficiency referred to in WaterGuide are:

Allocative – optimal allocation of water between different users and uses (see Element 3)

Productive – maximised output of production per unit of water consumed (in irrigated agriculture, ‘crop per drop’) (driven across multiple WaterGuide elements)

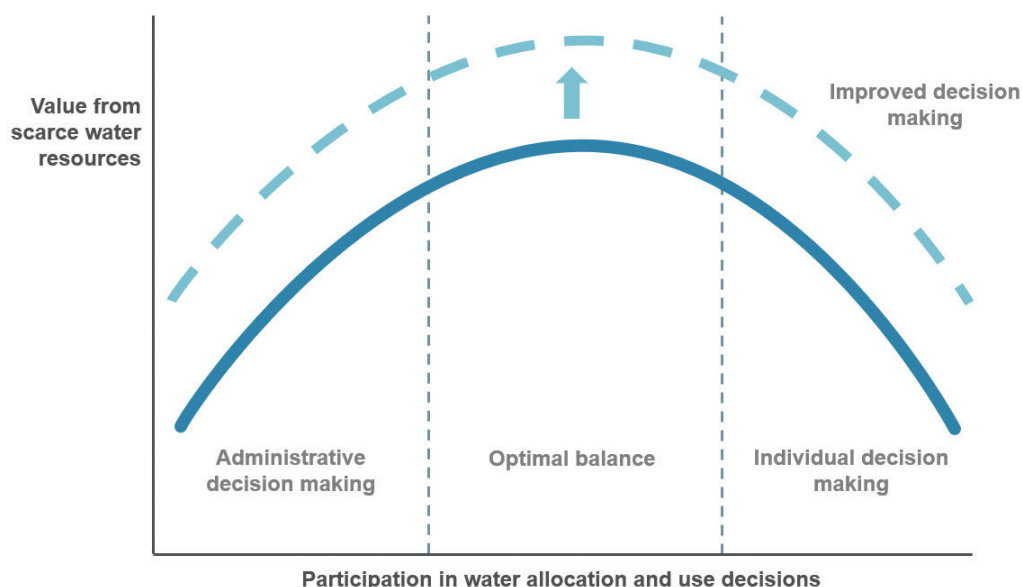
Dynamic – improved water allocation and use across time and space (see Element 6)

When considering options for improving water-use efficiency, many people think only of productive efficiency. While important, improvements to productive efficiency do not redress inefficient allocations of water across sectors or assist in shifting water from lower-value to higher-value uses.

Optimising the total value obtained from scarce water resources can be understood as a process of finding the ideal balance of administrative and individual involvement in water allocation and use. This is illustrated by the solid curve in Figure 5. Toward the left end of the horizontal axis, highly centralised decision making is poorly equipped to achieve the optimal allocation of water between individual users who may each attach a different value to water use, including in different locations and at different points in time, reducing the overall value obtained from water use. Toward the right end, unfettered access and unregulated decision making by individuals threatens the long-term sustainability of the water resource and rewards those with political and/or financial power at the expense of better planned and regulated water management.

At any point along this curve, there is the potential to increase the value derived from the allocation and use of scarce water resources by improving decision making processes, without altering the degree of individual participation in the allocation of water. For example, more accurate data on water availability and demand is likely to improve outcomes from water management under any decision making structure. This relationship is indicated by the arrow and dashed curve in Figure 5. Any improvements made under other elements of the WaterGuide framework will contribute to an upward shift of the value curve.

Figure 5 Enhancing value from scarce water resources



Centralised administrative approaches

All of the reforms to water management, policy and institutions already discussed in earlier chapters, when designed and implemented appropriately, can contribute to more efficient water management and use. To encourage increasing efficiencies, these reforms should be developed within an adaptive management and planning framework. One of the major barriers to improved water management and use in many contexts is the difficulty in changing water sharing and tariff regimes and other processes that have been in place often for decades at a time without substantive change. The costs of inaction are particularly high where uncertainty and change – climatic, demographic, political or otherwise – are most prevalent. In these contexts, flexibility and resilience in responding to change is of the utmost importance.

Administrative approaches – including planning rules and regulations – can be particularly useful in enforcing or achieving minimum standards, while more flexible individual approaches are required to realise optimal returns. Decision makers should consider possibilities to improve productive efficiency by promoting or mandating the uptake of more efficient water technologies at the scale of the individual farm (e.g. drip irrigation systems), factory/business (e.g. water reuse systems) or home (e.g. more efficient appliances). Although these may require considerable upfront expense, savings on water bills can often repay the cost over time. By some accounts, the annual investment in water infrastructure required to achieve sustainable universal access to clean water and adequate sanitation by 2030 could be met entirely through savings from greater efficiencies in the operation of existing water, transport, power, and telecommunications infrastructure (World Water Council and OECD, 2015).

Demand management can be a particularly useful tool in urban settings. Decision makers should consider the appropriateness of improved and real-time consumption information, water use restrictions, and water efficiency labelling schemes. Enabling direct comparison of daily, weekly or monthly water consumption against the water use habits of neighbours or city residents in similar settings through billing has been used extensively in Australia to encourage household users to ‘do better’ than their fellow residents. Restrictions on certain types of behaviour during periods of water scarcity, such as watering gardens or washing cars, have been adopted by many countries. Australia was a pioneer in the establishment of a Water Efficiency Labelling Scheme, which provides consumers with information on the physical efficiency of washing machines, dishwashers, shower heads and other household products, encouraging purchasers to directly consider their water bill and environmental footprint when buying the devices that account for much of household water consumption. These behaviour change policies rely on active education campaigns, to raise awareness of the existence of the relevant incentives, to enhance understandings of the benefits of efficient water use behaviour and to increase the likelihood of compliance with any associated regulatory measures (Gardner et al., 2009).

Administrative interventions should establish incentives for individuals and groups to use water more wisely, including by adopting some of the technical solutions highlighted above. The most efficient technology can only contribute to optimised water access and use up to a given technical threshold. Encouraging efficient water use behaviour ensures that the value of that infrastructure is maximised.

Incentive-based approaches

Recognising that laws, regulations and administrative decisions will always be necessary to ensure an effective water policy and management operating environment, establishing incentive-based mechanisms for optimising water allocation and use can make an important contribution to increasingly efficient water management and use. Cost-reflective water pricing and regulated water markets are two examples of approaches to encouraging more efficient water use at the individual level. Each approach requires concerted action by governments, but is designed to elicit behavioural responses, over which government has no direct control, at the individual level.

Cost-reflective water pricing encourages more efficient water use based on revealing the ‘true cost’ of the provision of water-related services and infrastructure. In practice, very few municipalities have established fully cost-reflective pricing and urban water services are generally subsidised to some extent, especially in developing countries. This is a valid government policy decision; understanding the value of water does not mean such decisions cannot be taken, it merely enables a full appreciation of the trade-offs involved when coming to these decisions. Effective cost-reflective pricing should be backed by monitoring and enforcement of tariff collection, to send a clear price signal to water users. If implemented effectively, cost-reflective pricing can generate the revenue required to ensure affordable universal access and fund technological improvements for enhanced productive efficiency and reduced water losses (see Box 14).

The gains from addressing scarcity through markets, prices, or other economic instruments would be immediate

- World Bank, 2016

Box 14: Introducing water tariffs in Manila

In the Philippines, a public-private partnership based on a build-operate-transfer relationship, extensive corporatisation and price restructuring enabled Manila Water to reduce non-revenue water, improve maintenance practices and ultimately supply water continuously. For the poor, largely reliant on bottled water and informal markets set up by households with illegal water connections, connection to the municipal supply system reduced water payments (per cubic metre) by up to 95 per cent. ‘Base-of-the-pyramid’ beneficiaries have accounted for more than half of the increase in Manila Water’s customer base since the beginning of the reform process.



Source: Rivera, 2014. Photo: Manila Water’s East Zone pipelaying project, Philippines (Manila Water).

Water markets open up pathways for entities wanting to access more water to do so in a highly cost-effective manner that is far less environmentally damaging than building new infrastructure

- Richter, 2016

When supported by cost-reflective pricing of water-related services and infrastructure, regulated water markets reveal the value of water at any given time, as determined by individual buyers and sellers. This provides water users with the means to weigh the value they place on water use against the market price, and buy or sell water accordingly. Water markets enable the value of scarce water resources to be maximised, and promote allocative, productive and dynamic efficiency, by both revealing the opportunity cost of water use and enabling the reallocation of scarce water resources among alternative uses (Freebairn, 2003). Effective water markets could play a critical role in the global effort to feed a growing population, ensure water

for cities, and return water to water dependent ecosystems. The potential of water markets has been recognised by a large number of water sector institutions, including major environmental NGOs like The Nature Conservancy (Richter, 2016).

With water scarcity increasing in severity in dozens of countries, and more than 90 per cent of water consumption in water-scarce regions going to irrigated agriculture, water markets offer a path toward increasing the value that can be obtained from limited water resources (Richter, 2016). The key capability that water markets offer is a means to move water away from low-value agriculture toward high-value agriculture, urban and industrial uses, and the environment.

Markets must be established on firm institutional and regulatory foundations to avoid market failures and maximise the benefits of dynamic reallocation. Typical pre-conditions for effective water markets include: a cap on total water abstractions at the basin scale; clearly defined, enforceable and enforced water rights and allocations; and the legal and administrative means by which to reallocate water among uses. Appropriate regulation is critical. The Australian water market is

judiciously constrained by a series of trade rules. These are enforced by government, to protect market participants and the environment, reduce third party impacts, ensure deliverability of traded water, protect the public interest, and reflect hydrologic realities.

Because of their relative institutional complexity, establishing and maintaining water markets is more likely to provide a return on investment in those geographical areas where the potential human, environmental and financial costs of water scarcity are highest. This aligns with a risk-based view of water management. For example, governments may wish to pursue administrative recovery of water rights where these are deemed to be overallocated in advance of, or instead of, establishing a market, depending on their particular short- and long-term policy objectives.⁵ Decision makers may also wish to consider options for phasing water markets in through limited trials in defined areas.

There is ample evidence from across the world – from Mexico and Chile to Australia and Spain – that countries with different levels of development and institutional capacity can, when pressed by fiscal or resource constraints, design market mechanisms that achieve a more effective management of water resources

- 2030 Water Resources Group, 2009

⁵ It is worth noting that the introduction of markets in Australia provided state governments with a mechanism to recover water for the environment, with the administrative alternative deemed politically unacceptable and economically inefficient.

Box 15: Engaging stakeholders

Decisions makers can encourage increasingly efficient water management and use by helping stakeholders to appreciate the benefits of efficiency measures. If stakeholders can see the value of improved water policies and management arrangements, they are much more likely to support them. Where measures to improve water-use efficiency include the introduction of, or increases in, water prices, stakeholders should be alerted to the increase and encouraged to understand how it will affect them and the rationale for the decision. Establishing water markets requires significant stakeholder engagement and education: information asymmetry can produce suboptimal outcomes in market settings, and there is a need for individuals to fully understand the benefits they can expect to receive as a result of their informed participation in that market.

Using WaterGuide to set a path to improved water management

WaterGuide is an organising framework for thinking about pathways toward improved water management in countries facing water scarcity. It is deliberately non-prescriptive because water management is context-specific and each country will face their own particular challenges.

WaterGuide does, however, present a view of the fundamental policy options and considerations that national and sub-national governments should take into account in working toward improved outcomes from water planning, allocation, management and use. WaterGuide provides the basis for multiple partners in water management, including outside experts where relevant, to work together to identify priority pathways and make progress toward improving outcomes and tackling water scarcity.

How WaterGuide has been applied

Since its initial publication in 2017, WaterGuide has been used to initiate and structure water policy dialogues in Jordan, Mexico, Senegal and Iran, supported by the Australian Water Partnership. These in-country applications of the framework have highlighted its strengths and also its limitations. In this second edition of WaterGuide, changes to the framework reflect improvements identified through its implementation to date.

In each jurisdiction where WaterGuide has been applied, there are striking similarities in the way that water scarcity is impacting national and local economies, communities and environments. Each WaterGuide policy dialogue has revealed challenges and priorities related to:

- surface and groundwater being utilised at an unsustainable rate, and the exacerbation of this situation due to the impacts of drought and climate change
- the vast majority of available water currently being committed to and used by agriculture
- cities, towns and industries facing the real risk of being unable to access secure water supplies in the future, if this is not already the case
- significant (including globally significant) environmental assets, such as wetlands, being at risk or in terminal decline
- a lack of clarity about the real extent and nature of the water management and use problem, due to gaps in information, data and reporting
- limitations in capacity to finance solutions, due in part to inadequate recovery of the costs of providing water infrastructure and services
- the need for flexible reallocation of water within and between sectors, in ways that are politically feasible, socially acceptable, environmentally sustainable, and economically efficient
- the lack of a compelling narrative for reform, articulating the challenges and priorities for change in a way that is effective in mobilising change, and
- solutions being available, and their implementation being widely acknowledged as necessary, but decision makers feeling hampered by political and/or institutional constraints.

These are typical of the challenges faced by those dealing with water scarcity and drought. They are likely to intensify in regions already affected, and to spread to more and more parts of the world as supply- and demand-side drivers put pressure on existing water management systems. The similarities encountered in Jordan, Mexico, Senegal and Iran emphasise the widespread nature of the water scarcity and drought challenge, and also the merit in sharing experiences to accelerate practical responses to that challenge.

In an era in which a wide array of technical, regulatory, administrative and incentive-based responses to water scarcity have been tested and proven in diverse contexts, including in Australia, there is a need to consider how sharing of experiences can move beyond simple technology transfer. There is a desire to tackle the political and institutional constraints mentioned above, as these are often seen to be the main brakes on progress. Key issues to be considered include:

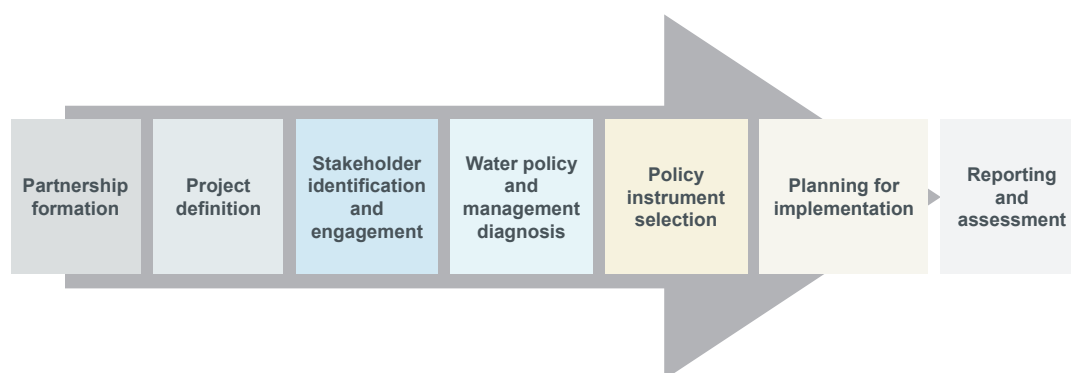
- how to engage with the full spectrum of water management stakeholders in a meaningful way that drives progress
- how to encourage water users to think about the value of water, including to inform understanding about trade-offs and the consequences of different decisions
- how to build and maintain political will and support for action
- how to collect useful water information and use it to identify where reforms are required, and
- how to develop a compelling narrative in support of water reform.

In applying WaterGuide, Australian and international water management experts have observed universal interest in adopting means to reallocate water within and away from lower-value agriculture, to higher-value agricultural, urban and industrial uses.

An approach for the future

Recognising that every application of WaterGuide offers unique opportunities and challenges, and each country faces its own pressures relating to water management, a basic scope and approach for a single application of WaterGuide has been developed. This provides the foundation for interactions to date in Jordan, Mexico, Senegal and Iran. The approach is shown as a series of seven stages in Figure 6.

Figure 6 An approach for applying WaterGuide



The approach leverages the WaterGuide framework as an entry point for partnership and discussion. It provides an opportunity for engagement with a diverse bunch of stakeholders, invites discussion of challenges, weaknesses and priorities in water management, and enables sharing of experiences between Australian, host country, and other international water management practitioners and experts. Through a process of discussing and diagnosing water policy and management issues, decision makers (some of whom may represent different ministries or departments, and so rarely have the opportunity to collaborate closely in this manner) can collaborate to explore possible priority responses. In each of the four countries where WaterGuide has been applied to date, this exploration of priority responses has led to fruitful conversations about possibilities for ongoing collaboration between Australia and the country in question to further scope these responses for implementation.

Through the completion of WaterGuide policy dialogues in Jordan, Mexico, Senegal and Iran, key decision makers in each of those countries have been able to progress the scoping of priority practical projects, including in a way that can be discussed with multiple funders, where relevant, in the context of overarching priorities and activities for the country in question and for related funders. Though no WaterGuide pilot application process is yet complete, at least one has progressed to the point of planning for implementation (the second last stage in Figure 6), based on a shortlist of agreed priorities developed by national government and other stakeholders. In that instance, it was felt that the agreed priorities represented areas where: a) assistance was required to improve water policy settings, and b) Australian experience and expertise could readily be brought to bear.

Conclusion

WaterGuide offers a way forward in the global effort to tackle water scarcity across diverse hydrological and political settings. It serves as an organising framework for the establishment of national, basin-scale and sub-national water management policies and plans.

WaterGuide can be used by decision makers responsible for water policy and management to:

- engage stakeholders and set a vision for outcomes from water management
- diagnose strengths, weaknesses and gaps in current water planning, allocation and use arrangements
- design a road map for improved water policy and management
- identify the portfolio and sequence of policy interventions, management arrangements and infrastructure investments that are most likely to deliver desired outcomes, and
- understand and communicate the benefits of water reforms.

WaterGuide enables decision makers to design and implement improvements and interventions across each of its six elements:

1. Confirm a vision for water management and the value of water
2. Understand changing water availability and demand over time
3. Allocate water between different uses
4. Ensure effective water policies and institutions
5. Develop resilient water infrastructure and services
6. Pursue increasingly efficient water management and use

The challenge for the international water community is to establish pathways for achieving improved outcomes from water management in a wide range of countries facing diverse pressures on surface and groundwater resources. The urgency of the challenge – water scarcity is already severe in many basins and aquifers and rapidly increasing in severity in many others – demands leapfrogging and development and piloting of solutions.

The Australian Government is committed to making a contribution to that solution development and piloting process, including by working with key government actors to apply WaterGuide in their specific situations. WaterGuide has already yielded positive outcomes by helping to catalyse productive water policy dialogues between Australian water experts and decision makers in Jordan, Mexico, Senegal and Iran. These dialogues have validated the utility of the framework and demonstrated its value in guiding structured consideration of water policy and management, generating new insights, and identifying specific priorities for international collaboration. Australia is able to share these insights in greater detail, and work with others to accelerate practical action in response to the challenges of water scarcity and drought.

Australia welcomes the opportunity to work with water policy and management decision makers to apply WaterGuide in more countries and, in so doing, contribute to the global response to water scarcity and drought and achievement of the Sustainable Development Goals.

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A1. Summary of importance, milestones and activities for WaterGuide's six elements

Table 1 provides a summary of the importance, milestones and activities for each of WaterGuide's six elements, collating material presented in the body of this report.

Table 1 WaterGuide's six elements – importance, milestones and activities

Importance	Milestones	Activities
Element 1 – Confirm a vision for water management and the value of water		
<ul style="list-style-type: none"> Reveals the benefits that water provides to different stakeholders Understanding the values that stakeholders want water resources to sustain helps establish overarching priorities to work towards Builds community and political support for action 	<ul style="list-style-type: none"> Commonalities between the visions and objectives for water management expressed by relevant stakeholders are identified The value of water is understood in economic, environmental, and social terms A compelling 'water narrative' is projected to the broader community 	<ul style="list-style-type: none"> Identify the key stakeholders and the different benefits water resources provide to them Understand what stakeholders want from water resources over different temporal and spatial scales Quantify and articulate the different values of stakeholders, identifying divergence, conflict and commonality Determine the threats and opportunities water reform presents to each stakeholder group Reflect on, and adaptively respond to, the lessons of the past and changing norms and attitudes Identify 'champions' to argue the merits of the proposed water reforms
Element 2 – Understand changing water availability and demand over time		
<ul style="list-style-type: none"> Understanding the dynamic characteristics of the water resource provides the foundation for informed stakeholders and decisions Stakeholders who understand the criticality of reform are more likely to be engaged in supporting and delivering that reform 	<ul style="list-style-type: none"> The resource is defined in terms of water availability and quality The water requirements of all current water users are understood Risks to future water supply and demand are understood 	<ul style="list-style-type: none"> Clearly define the unit of management, along with what surface water and groundwater is available and the level of demand Clarify the supply-demand situation for the unit of management, including risks and trends over time

Importance	Milestones	Activities
		<ul style="list-style-type: none"> • Ensure that good water information underpins supply-demand estimates and future projections • Employ hydrologic models capable of representing complex water sharing agreements, when necessary • Promulgate key insights from water resource assessments in the 'water narrative' communicated to stakeholders
Element 3 – Allocate water between different uses		
<ul style="list-style-type: none"> • Determines sharing of water between uses, in support of vision and values, with consideration for necessary trade-offs, and with clear communication of the reasons for the decisions made • Accounts for current and future limitations to availability and demand 	<ul style="list-style-type: none"> • Water is effectively allocated between different uses at the appropriate scale, taking into account resource characteristics, the value of water, and vision and objectives • Stakeholder acceptance of, and confidence in, water management decisions is promoted 	<ul style="list-style-type: none"> • Consider the requirements of all water users, including the environment, with respect to quantity and quality • Determine who gains access to water, and who makes these decisions • Clarify the allocation process, the temporal and spatial scales that apply, and how changes to supply and demand parameters are dealt with • Ensure the process is transparent, accepted and adhered to, legally enforceable, and enforced through metering and monitoring • Ensure stakeholders understand their rights and obligations in the allocation of water

Importance	Milestones	Activities
Element 4 – Ensure effective water policies and institutions		
<ul style="list-style-type: none"> • Good governance and policy is a prerequisite for sustainable water management 	<ul style="list-style-type: none"> • A regulatory and planning framework is developed that supports agreed objectives, engenders buy-in, and acknowledges stakeholder groups • Institutions and processes are sufficiently resourced, including through capacity development • Increased confidence in water policy and management is established 	<ul style="list-style-type: none"> • Develop and champion a compelling reform narrative that engenders stakeholder buy-in and can be widely understood • Develop a clear policy framework articulating the objectives and a road map for water policy and reform • Invest in capacity, leadership and effective coordination • Align legal frameworks and incentives and avoid overlapping institutional responsibilities, including by ensuring coherence between government departments and between different levels of government
Element 5 – Develop resilient water infrastructure and services		
<ul style="list-style-type: none"> • Appropriate investment in water infrastructure and delivery of water services sustains economic growth, human health and sanitation, social amenity, and environmental protection 	<ul style="list-style-type: none"> • Affordable, accessible and reliable water infrastructure and services are delivered • Cost-effective water infrastructure projects are identified and implemented • Capital and operating expenses are appropriately funded and financed 	<ul style="list-style-type: none"> • Document infrastructure needs for rural and urban water, in relation to water supply and wastewater, on the basis of desired levels of service, and determine whether they are being met • Clarify water services provided and levels of service, and how the provision and operation of infrastructure and services is organised, funded and financed • Ensure investment in, and use of, water infrastructure is well directed and designed to provide value for money and be resilient in the face of uncertainty

Importance	Milestones	Activities
		<ul style="list-style-type: none"> • Introduce an independent economic or utility regulator to oversee cost recovery • Transparently account for all water infrastructure costs, including capital, operating and maintenance and administrative costs • Appropriately allocate costs between customers and government • Implement appropriate standards for operation and maintenance of critical water and wastewater infrastructure, and monitor and report on compliance with these standards
Element 6 – Pursue increasingly efficient water management and use		
<ul style="list-style-type: none"> • Ensuring progress towards improved water management requires ongoing commitment to optimising the value of scarce water resources 	<ul style="list-style-type: none"> • Changes to water resources, information and values are appropriately managed, as the vision and objectives continue to be pursued • Mechanisms and processes to refine and optimise water management and use are introduced 	<ul style="list-style-type: none"> • Introduce settings to facilitate an improved water management system, such as adaptive management and planning arrangements • Introduce mechanisms and incentives for more efficient and effective water allocation, investment and use, such as water pricing and markets • Invest in monitoring, evaluation and reporting

A2. Australia's response to water scarcity

The staged development of Australia's water sector reform shows an example of a path forward

- 2030 Water Resources Group, 2009

Substantive reform of water management policies and planning processes in Australia's Murray-Darling Basin (MDB) has occurred over a period of more than 100 years and continues to this day. The Australian Water Partnership has already published a thorough account of the Australian reform process (Doolan, 2016) and this report will not repeat in detail the historical facts collated in that and other publications. The purpose of revisiting the Australian

water reform story here is to present that journey, and particularly its last 30 years, as a disaggregated sequence of steps, as these significantly informed the development of WaterGuide and are likely to be of interest to water policymakers in developing countries as they seek to improve water management and use in their national and regional contexts over coming years and decades.

Objectives of Australian water policy reform

Australia's MDB encompasses 23 rivers and their catchments, including Australia's three longest rivers: the Murray, Murrumbidgee and Darling rivers. The MDB covers a land area of over one million square kilometres and supports a significant proportion of Australia's irrigated agricultural output. Though the volume of water flowing along the rivers of the MDB is significant by Australian standards, average Murray-Darling flows are among the lowest of any major river system in the world.

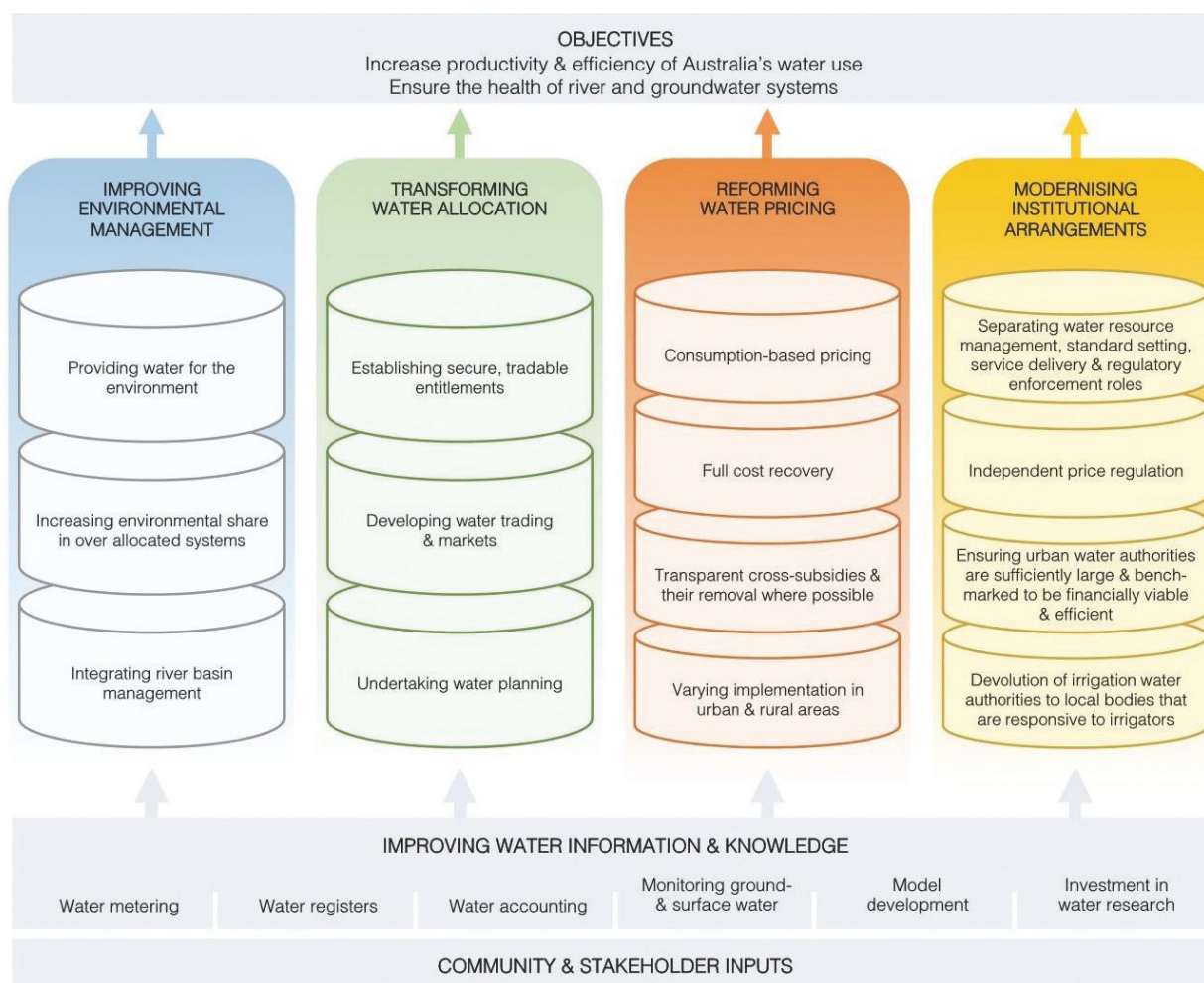
As the push for regional economic growth in the MDB gathered speed across the course of the twentieth century, water use for farms, homes and industries increased too. It became apparent toward the end of the century that all water users would need to cooperate with the federal government and the state governments of Victoria, New South Wales, Queensland, South Australia and the Australian Capital Territory to ensure that future water use did not routinely exceed renewable water supply. Simply put, the MDB was faced with the challenge of severe water scarcity. This challenge became most urgent during the Millennium Drought, which reached its peak in the early 2000s and led to huge reductions in water availability across the MDB.

Prior to the 1980s, the dominant water management philosophy in the MDB was grounded in supply augmentation and little discipline was applied in allocating new irrigation licences, ultimately leading to a serious overallocation problem. This approach significantly undervalued water resources, and resulted in a legacy of debt, under-pricing of water, service delivery challenges and widespread environmental degradation. Combined with the increasingly evident negative impacts of water scarcity, these increasingly acute problems became the drivers for national water reform. In 1994, the Council of Australian Governments, representing all state governments and the federal government, agreed to implement a strategic framework for the efficient and sustainable reform of the water industry. By 2004, this framework was extended and became known as the National Water Initiative (Doolan, 2016; National Water Commission, 2011).

The underlying aims of the Australian water reform agenda were to increase the productivity and efficiency of Australia's water use and ensure the health of river and groundwater systems while servicing rural and urban communities. The objectives in implementing the long-term agenda were to provide greater certainty for investment and the environment and ensure that Australia's water management could deal with change responsively and fairly. These aims and objectives fed into the overall vision – to achieve a market, regulatory and planning based system of managing water resources for rural and urban use that optimised economic, social and environmental outcomes and that was delivered by an efficient and sustainable water industry (Council of Australian Governments, 2004).

The major objectives and elements of water reform in Australia over the past 30 years are presented in Figure 7.

Figure 7 Objectives and elements of water reform in Australia over the past 30 years



Source: Doolan, 2016, Figure 1.

What did Australia do to respond to water scarcity in the Murray-Darling Basin?

As illustrated in Figure 7, Australian governments, irrigators and other stakeholders cooperated to improve water information and knowledge, improve environmental management, transform water allocation, reform water pricing, and modernise institutional arrangements.

Multi-government decision making for water management in the MDB was formally structured for the first time in 1914, when the basin states of Victoria, New South Wales and South Australia signed the River Murray Waters Agreement. In the more than one hundred years that have elapsed since that landmark agreement was signed, many individual policies have been agreed and put in place. This report is mainly concerned with those policies established since the 1914 Agreement was amended in 1987 as the Murray-Darling Basin Agreement, bringing Queensland, an upstream state, into the decision making process for the first time. The three decades since 1987 were marked by high levels of policy and management activity in the MDB and spawned numerous policy developments and reforms that will be of interest to policymakers in developing countries.

The sequencing of major water policy and management reforms that have affected water resource use in the MDB over the past 30 years is presented in Box A2-1. In other political contexts, an emphasis on different policy instruments, or limited combinations of those described below, may be justified. While the Australian experience has significantly been one of reforming water management and use in the agricultural sector, this should not limit the utility of that experience in countries where there is a need to focus heavily on municipal or industrial water systems.

Box A2-1: 30 years of water management reforms in the Murray-Darling Basin

Critical water policy and management reforms undertaken in the MDB since the mid-1980s include:

- Improving stakeholder knowledge of the water resource through hydrologic monitoring and modelling and water use metering
- Strengthening basin-scale management and monitoring (through the Murray-Darling Basin Commission, now Authority)
- Strengthening legislation to govern the use of water resources (e.g. through the *Water Act 2007*)
- Improving standards of cost recovery for water-related infrastructure and services
- Guaranteeing water for the environment, based on a scientific determination of sustainable diversion limits
- Recognising the cultural and spiritual value of water to Indigenous Australians
- Developing water markets to enable water to move between uses, according to shifting demands
- Improving and harmonising standards for water planning

This list is not exhaustive. For a comprehensive overview of the history of water reform in Australia, interested readers should seek out the texts cited throughout this report.



Photo: Murray River in Mannum, South Australia (Shane Strudwick - Discover Murray River).

Results of reforms

Water policy and management reforms in the MDB have led to positive outcomes for people, economies and environments.

People

The process of recognising and valuing cultural uses of water for Indigenous Australians has been commenced as part of the MDB water management reform journey of the past three decades. Likewise, comprehensive water planning now means that the value of water for recreation and other non-consumptive uses is actively considered and accounted for. Economic benefits from reforms have enabled Australians living in rural and regional Australians to better plan for the future.

Economies

Water management reforms have contributed to improved efficiencies in water use and a more resilient agricultural economy in the MDB. Water markets have given individual irrigators an additional tool to manage water availability risk and have increased flexibility in their water and production decisions (National Water Commission, 2011). This and other reforms have helped MDB water users to better respond to drought, changes in input prices, fluctuations in commodity prices and other external factors.

Environments

Reforms in the MDB have guaranteed minimum environmental flows to maintain ecosystems and protect the services that they provide. The establishment of a water market has also allowed governments and other traders acting on behalf of the environment to secure water for environmental uses. Improved monitoring and modelling of water flows means that the water requirements of ecosystems, and the wide-ranging benefits of each additional megalitre of water used for environmental uses, are better understood.



Australia

water partners for development

The Australian Water Partnership is an Australian Government aid initiative bringing together public and private organisations from the Australian water sector with international development partners.

